

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**Department of Computer Science and Engineering (CSE)**

**MID SEMESTER EXAMINATION**

**WINTER SEMESTER, 2021-2022**

**DURATION: 1 HOUR 30 MINUTES**

**FULL MARKS: 75**

**CSE 4105: Computing for Engineers**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Logic programming is not only used in computers but also in other devices. Give one specific example (with programming details) where programming enables the functionality of the device. 4  
CO1  
PO1
- b) A novice user used the commands `ls` and `cd` as shown in Figure 1 and got a message: 'Error: not a directory'. 6  
CO1  
PO1

```
# ls
user          bin          etc          home
dev          var          myfileDirDev
# cd myfileDirDev
Error: not a directory
```

Figure 1: Code Snippet for Question 1(b)

Identify the mistakes. What actions does the user need to perform to investigate the contents of `myfileDirDev`?

- c) Definition and realization of a *Pixel* is the fundamental issue in any display technology. How is a *Pixel* defined in CRT, LCD and LED technologies? 6  
CO1  
PO1
- d) Briefly describe the components of a computer system. 4  
CO1  
PO1
- e) Briefly answer the following questions: 5  
CO1  
PO1
- i. How does 'Cache' memory help in Memory Hierarchy?
  - ii. Why is the 'location' itself called an information instead of data?
  - iii. How do information get converted to knowledge?
  - iv. How is a bit represented in Hard Disc and in Network Cable?
  - v. Differentiate between a Virus and a Malware.

2. a) Briefly discuss the 'Computing Paradigm' shifts in the history of computing. 4  
CO1  
PO1
- b) Write an algorithm to convert a decimal number *D* to a base *B* number system. 5  
CO1  
PO1

- c) Perform the following 2's complement arithmetic assuming 4-bit computer system. Also indicate whether the arithmetic is correct or not. 6  
CO1  
PO1
    - i.  $6 - 3$
    - ii.  $-4 - 5$
    - iii.  $-4 - 4$
  - d) Describe Keyboard and Optical Mouse technology in brief. 5
  - e) Briefly answer **any one** of the followings: 5
    - i. List the features that must be included in an automated admission system based on your own experience. CO1  
PO1
  - OR**
  - ii. Write the essential and exciting features that should be included in a Learning Management System (LMS).
3. a) How a URL is resolved when it is typed in the browsers address bar? 5  
CO1  
PO1
- b) How does a computing device connect to the internet now-a-days? You can describe your internet connection mechanism at IUT or at your home with end-to-end technology details. 5  
CO1  
PO1
- c) HTTP is a request-response protocol and is stateless. Briefly describe the protocol by explaining the two terminologies mentioned. 5  
CO1  
PO1
- d) A file has a permission 0755 (111 101 101)<sub>2</sub> set by its owner. What does it imply? Which types of files have this sort of permission? 5  
CO1  
PO1
- e) Briefly answer the following questions: 5
  - i. Name three essential components of an OS kernel. CO1
  - ii. How does H/W virtualization help in cloud computing? PO1
  - iii. Mention the role of IDE and a compiler in writing a program in high level language.
  - iv. How many bits make a kilo byte?
  - v. Name two devices that perform both input and output.

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MID SEMESTER EXAMINATION  
DURATION: 1 HOUR 30 MINUTES

WINTER SEMESTER, 2021-2022  
FULL MARKS: 75

**CSE 4107: Structured Programming I**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 1. a) The double factorial of a number n, denoted by n!!, is the product of all the integers from 1 up to n that have the same parity (odd or even) as n. 15  
(CO3)  
(PO2)  
For example:  
Double factorial of 5!! = 5 × 3 × 1 = 15  
Double factorial of 6!! = 6 × 4 × 2 = 48  
Solve the problem of finding the double factorial of a number n, by writing a C program.
- b) Modify the following lines of codes given in the Table 1 by rearranging them, so that it produces the expected output. 10  
(CO3)  
(PO2)

Table 1: Sample program and expected output

Given Code	Expected Output
<pre>#include&lt;stdio.h&gt; int main(){ int i, j; j = (i/10); for(; i &gt; 0; i--) for(i=100; i&gt;=0; i-=10){ for(i=j; i&lt;5;i++) if(j%2) printf("%d ",j); printf("%d ",2*i-1); printf("%d ",9-2*i); printf("\n"); printf("\n"); return 0; } }</pre>	<pre>9 7 5 3 1 9 7 5 3 1 9 7 5 3 1</pre>

[NB: You may only rearrange the statements, do not add, remove, or modify any lines of the given code]

- 2 a) Write the output for each of the code segments provided below: 7.5  
(CO1)  
(PO1)
  - i. `printf("\\\\//\\//\n\\\\//\\//\n");`
  - ii. `printf("%%d%c%d=%c%\n",3,'+',2,'?');`
  - iii. `int a=4, b=1;`  
`printf("%d %d\n", a++, ++b);`
  - iv. `int i=37;`  
`printf("%d\n", (i%10)*10 + (i/10));`
  - v. `char ch='A';`  
`printf("%c %d %d\n", ch+1, ch+1, ch= 'A');`

- b) Find whether the following conditions are true or false. Also find the updated values of the variable after evaluating the expression. 7.5  
(CO1)

- i. `if( a++ && --b || --c)` (PO1)
- ii. `if( ++a && b-- || --c)`
- iii. `if( c-- || ++a && b--)`
- iv. `if( --c || ++a && b--)`
- v. `if(a = 0 || (b=10) && (c=12))`

For each of the case, consider the variables are initialized as below:  
`int a = 0, b = 1, c = 1;`

[NB: 50% marks will be deducted for each wrong answer]

- c) Answer the following questions: 10  
(CO1)  
(PO1)
- i. Why is it important for the `scanf` function to know the address of the variable, but not for the `printf` function?
  - ii. Why is it necessary to allocate consecutive memories for the elements of an array?
  - iii. Write short notes on typecasting with an example.
  - iv. Can you find a value of the variable 'x', so that the condition  $(30 < x < 40)$  becomes false? If your answer is yes, find the value. If your answer is no, explain why.
  - v. Write down the basic data types and their size in the memory.

3. a) Suppose you want design an application, that asks the user to enter a string as an input and prints the occurrence of the last character in the string. Solve the problem by writing C program. 12  
(CO3)  
(PO2)

For example:

If user provides "programming" as an input, the program should print 2 as an output, as the last character 'g' appears twice in the string.

- b) Examine the following program and expected output provided in the Table 2. Due to logical errors, the program was not producing the expected output. 5+8  
(CO2)  
(PO1)  
(CO3)  
(PO2)

Table 2: Sample program and expected output

Program	Expected Output
<pre>#include&lt;stdio.h&gt; int main(){     int num=12345678, sum, rem;     while(num &gt; 0){         num /= 10;         rem = num%10;         if(rem%2){             printf("%d + ", rem);             sum += rem;         }     }     printf("0 = %d", sum);     return 0; }</pre>	<p>8 + 6 + 4 + 2 + 0 = 20</p>

Answer the following questions:

- i. Find the output of the given program.
- ii. Modify the program with minimum changes so that it produces the expected output.

[NB: Any unnecessary changes will cause penalty]

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**Phy 4141: Physics I**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) Discuss Michelson-Morley's experiment. Write down the postulates of Einstein's Special Theory of Relativity. What are inertial and non-inertial frame of reference? 7  
(CO1)
  - b) Derive Lorentz Transformation equations. Write down the inverse transformed form of these equations. Apply Lorentz transformation to muon decay. 10  
(CO2)
  - c) A spacecraft is moving in the x-direction at a velocity  $0.8c$  with respect to a rest frame and fires a missile which moves at a velocity  $0.7c$  with respect to the moving space craft. 8  
(CO2)
  
  2. a) Discuss charge and matter in electrostatics. With the help of a suitable example show that electric charge is quantized. Define electric and magnetic flux? Write down Gauss's law for (i) **Electrostatics** (ii) **Magnetism** (iii) **Gravitation**. 7  
(CO1)
  - b) Derive an expression for the electric field  $E$  for the section of an infinite line of charge having a constant linear charge density  $\lambda$ . (do not apply Gauss's law). Write down the similar expression for the magnetic field  $B$  created due to a *current*  $i$  flowing through the conductor. 10  
(CO2)
  - c) The electric field between the plates of a cathode-ray oscilloscope is  $1.2 \times 10^4$  nt/coul. What deflection will an electron experience if it enters at right angles to the field with a kinetic energy of 2000 eV ( $=3.2 \times 10^{-16}$  joule), a typical value. The deflecting assembly is 1.5 cm long. 8  
(CO3)

OR

3. a) Discuss Gauss's law and Coulomb's law in electrostatics. Show with an example that an excess charge put on a metallic conductor will move onto the outer surface of the conductor. 7  
(CO1)
- b) Apply Gauss's law to find the electric field  $E$  for the following cases 10  
(CO2)
  - i.  $E$  at a distance  $y$  from a line of charge having a linear charge density  $\lambda$ .
  - ii.  $E$  for an infinite sheet of charge having surface charge density  $\sigma$
  - iii.  $E$  for points a short distance above the surface of a charged insulated conductor having surface charge density  $\sigma$ .
- c) A point charge of  $1.0 \times 10^{-6}$  coul is at the center of a cubical Gaussian surface 0.50 meter on edge. Calculate electric flux ( $\Phi_E$ ) for the surface. 8  
(CO2)

4. a) Discuss wave-particle duality of light. Discuss the nature of a photon and an electron according to the Quantum Theory as confirmed through the photoelectric effect. 7 (CO1)
- b) Discuss Einstein's photo-electric effect with the help of a circuit diagram and the relevant equation. Define (i) photo-current (ii) retarding potential, and (iii) work-function. Plot photo-current ( $I$ ) and retarding potential ( $V_s$ ) as a function of frequency of incident light ( $\nu$ ). Graphically how would you calculate the work function ( $W$ ) of a metal? 10 (CO2)
- c) The threshold wavelength for photoelectric emission in tungsten is 230 nm. What wavelength of light must be used in order for electrons with a maximum energy of 1.5 eV to be ejected? (Work-function of Tungsten = 4.50eV, 1 eV =  $1.67 \times 10^{-19}$  joule) 8 (CO2)

**Program:** BSc CSE & SWE 1<sup>st</sup> Semester  
**Semester:** Winter semester

**Date:** September 29, 2022 (Thursday)  
**Time:** 2:30 pm to 4:00 pm

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
 ORGANISATION OF ISLAMIC COOPERATION (OIC)  
 DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

**Exam:** Mid Semester Examination  
**Course Number:** Hum 4145  
**Course Title:** Islamiyat

**Academic Year:** 2021 - 2022  
**Full Marks:** 50  
**Duration:** 90 minutes

There are 4 (Four) questions. Answer the question no.1 and any two from the rest. The symbols have their usual meaning.

- |    |   |    |     |         |
|----|---|----|-----|---------|
| 1. | a. Explain briefly "Tawheed ur Rububiyah" and "Tawheed ul Uluhiyyah" briefly.   | 08 | CO1 | PO11    |
|    | b. "Seeking Engineering knowledge is an Ibadah", explain it in the light of Quran, Hadith and Dr. Martin Luther king's saying- "Intelligence plus Character- that is the Goal of true Education". | 10 | CO2 | PO8/PO9 |
| 2. | a. What is the basis of Eemaan? Explain.  | 06 | CO1 | PO8/PO9 |
|    | b. "Working Is Ibadah" –Explain the Comprehensiveness of the Concept of Ibadah in Islam with reference.   | 10 | CO2 | PO8/PO9 |
| 3. | a. Write down the Qualities of Allah's servants you see in yourself with Reference to the holy Quran.   | 04 | CO3 | PO11    |
|    | b. What is trinity? Write down one Popular Nullifier of Eeman existing in the society.  | 06 | CO1 | PO8     |
|    | c. Explain the etiquettes with respect to Intention, Oneself and Al-Qur'an.   | 06 | CO2 | PO8/PO9 |
| 4. | Write short notes on the following:   | 16 | CO3 | PO11    |
|    | (i) Salaf   |    | CO2 | PO8/PO9 |
|    | (ii) Nafs Khabisah, Nafs Lawwamah, Nafs Mutmainnah.   |    | CO1 | PO8     |
|    | (iii) Hijrah, Muhajir, Ansar.   |    | CO3 | PO11    |
|    | (iv) Al-Qadaa' Wal Qadar.   |    |     |         |

**May Almighty Give You Tawfeeq.**

Program: B.Sc. CSE 1<sup>st</sup> Sem & B.Sc. SWE 1<sup>st</sup> Sem  
Semester: Winter semester

Date: October 4, 2022 (Tuesday)  
Time: 02:30 pm – 04:00pm

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)**

Exam: Mid Semester Examination  
Course Number: Hum 4147  
Course Title: Technology, Environment, and Society

Academic Year: 2021 - 2022  
Full Marks: 75  
Duration: 90 minutes

There are 4 (four) questions. Answer any 3 (three) questions.

- |    |   |      |     |     |
|----|---|------|-----|-----|
| 1. | a) Define the Earth system. Mention the component of the earth system.  | (05) | CO1 | PO1 |
|    | b) Uncontrolled population growth is an environmental concern. What is your opinion? Explain with logical reasoning.                                  | (10) | CO2 | PO1 |
|    | c) Explain the term Sustainable Development. Describe measures of sustainable development.  | (10) | CO3 | PO7 |
| 2. | a) Why "Photochemical smog" is considered a secondary pollutant?  | (05) | CO3 | PO7 |
|    | b) Differentiate between Weather and Climate. Explain the seven theories of climate change.   | (10) | CO2 | PO1 |
|    | c) Explain the process of ozone layer depletion with chemical reactions and mention the impacts of ozone layer depletion on human health and ecology. | (10) | CO2 | PO7 |
| 3. | a) What do you understand by Environment? Explain the relationship between the environment, society, and technology.                                  | (10) | CO1 | PO1 |
|    | b) Describe the Hydrological cycle and name five major pollutants of air.   | (10) | CO3 | PO7 |
|    | c) What are Greenhouse Gases? Name them.  | (05) | CO3 | PO7 |
| 4. | a) What is meant by environmental stewardship? Explain the principles of environmental stewardship.   | (10) | CO3 | PO7 |
|    | b) Discuss the benefits of implementing an Environmental Stewardship.   | (10) |     |     |
|    | c) Define environmental justice with examples.  | (05) |     |     |



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**MID SEMESTER EXAMINATION**

**WINTER SEMESTER, 2021-2022**

**DURATION: 1 HOUR 30 MINUTES**

**FULL MARKS: 75**

**CSE 4301: Object Oriented Programming**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) LFR group is manufacturing toy car for children. Each car has a *model name*, *batch number* (production batch), and *color*. They want to give a serial number (e.g. first car will get serial number 1, second one will get 2 and so on) to each car in order to track them. After quality checking of a car, the company may reject it from selling, if found faulty. (CO2)  
 Your task is to create a "Car" class, which includes the above-mentioned attributes and following behaviors: (PO2)
- At the time of creation, the Car object should be initialized.
  - One can set or change only model name, batch number and color using a Car object.
  - One can return the value of above-mentioned attributes as well as serial number using a Car object.
  - There should be a method that returns the total number of car objects currently present.
- In `main()`, create 5 Car objects using dynamic memory allocation and delete any 2 objects. 13
- b) In C++, you can use reference variable while passing value to and returning from a user defined function. Generally, to pass an object to a function, pass by reference method is preferred over pass by value method. Do you agree with this statement? Justify your answer with example. (CO1)  
 (PO1)
- c) In Question 1. (a), the value of the attribute "color" can only be Red, Green, or Blue. Choose a data type to accommodate this restriction. Justify your choice comparing with other data type(s). 5  
 (CO1)  
 (PO1)
2. a) Rational numbers can be expressed as a fraction  $p/q$  where  $p$  (numerator) and  $q$  (denominator) are each whole numbers and  $q$  does not equal to 0. Create a class named "RationalNumber". 13  
 Your implementation must maintain the following properties: (CO2)  
 (PO2)
- A new object should be initialized with decimal value zero (0).
  - It should have a *set (int numerator, int denominator)* function.
  - The *get ()* function should return the decimal value of the fraction. Individual numerator and denominator getter function is not public or absent.
  - Member variables must be private
- Overload the addition (+), subtraction (-), multiplication ( $\times$ ), and division (/) operators. These overloading functions should return a RationalNumber object. Both operands can be of RationalNumber type or one of the operands (first or second) can be of `int` data type.
- b) Create a class named "Account" that represents a bank account. You need to store the information about the *account number*, *account title* and *balance*. Now add *deposit(double)* and *withdraw(double)* public member functions. The balance should be checked at the time of withdrawal. 7  
 (CO2)  
 (PO2)
- Create a class named "StudentAccount" that has similar attributes and behaviors of Account. In addition to that, it needs to store the information of *GuardianName*. It should be noted that with an object of StudentAccount class, you cannot call *deposit()*, or *withdraw()*.

- c) Object Oriented Programming is popular in developing medium to large scale software. On the other hand, Procedural Paradigm is normally used in small scale software and developing system level software. 5  
(CO1)  
(PO1)

Identify drawbacks of Procedural Paradigm for which Object-Oriented Programming offers some solutions.

3. a) An approach can be syntax error free but have bad design. Update the following code according to the good design approach of OOP. 13  
(CO3)  
(PO2)

```
#include <iostream.h>
int totalNoOfCars = 0; // Initially total no of car is 0
class RacingCar{
    ///Constant Acceleration
    void accelerate(double amount, double t){
        distance += speed*t + 0.5*amount*t*t;
        speed += amount * t;
    }
    ///Constant deceleration
    void decelerate(double amount, double t){
        distance -= speed*t - 0.5*amount*t*t;
        speed -= amount * t;
    }
    ///Constant Speed
    void advance(double t){
        distance+=speed*t;
    }
    double getCurrentSpeed(){
        return speed;
    }
    double getCurrentDistance(){
        return distance;
    }
protected:
    double distance;
    double speed;
};

int main(){
    RacingCar r1;
    cout<<"Speed: "<<r1.getCurrentSpeed()<<endl;
    cout<<"Distance: "<<r1.getCurrentDistance()<<endl;
    r1.accelerate(5,10); /// 5 meter/sec for 10 sec
    cout<<"Speed: "<<r1.getCurrentSpeed()<<endl;
    cout<<"Distance: "<<r1.getCurrentDistance()<<endl;
    r1.advance(20);
    cout<<"Speed: "<<r1.getCurrentSpeed()<<endl;
    cout<<"Distance: "<<r1.getCurrentDistance()<<endl;
    r1.decelerate(5,8);
    cout<<"Speed: "<<r1.getCurrentSpeed()<<endl;
    cout<<"Distance: "<<r1.getCurrentDistance()<<endl;
}
```

Figure 1: Code snippet for Question 3. (a)

Use const and static modifier where it is necessary. Correct any logical error found.

- b) Explain the *diamond shape inheritance* problem with a detailed example and show its relationship with multi-level and multiple inheritance. 7  
(CO1)  
(PO1)
- c) C++ has some useful features like encapsulation, data access restriction, etc. that restricts the developers from making mistakes. In some cases, these normal features lead to restricting the programmer from writing intended code. Therefore, some features (like friend function) are also offered to help the programmer to avoid this kind of situation. 5  
(CO1)  
(PO1)
- Explain the friend function with an example.

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**MID-SEMESTER EXAMINATION**  
**DURATION: 1 HOUR 30 MINUTES**

**WINTER SEMESTER, 2021-2022**  
**FULL MARKS: 75**

**CSE 4307: Database Management Systems**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) "In a traditional file processing system it is hard to provide user access to some, but not all, data." **10**  
Explain using suitable example. (CO1) (PO1)
- b) Is there any difference between schema and instance in relational database area? Explain. **4 + 6**  
Consider the following records: (CO1) (PO1)

**Table 1:** Employees data for Question No. 1.(b)

Name	Address	DOB
m	a	1-1-87
n	b	2-4-82
q	a	1-12-80
r	f	3-4-79

Now, deduce its super keys, candidate keys, and primary key for the given records. Present suitable arguments for finalizing the primary key.

- c) What is domain of attribute? How can you ensure it in implementation phase? Explain with example. **5**  
(CO1) (PO1)
2. a) Consider the following SQL statement to list all employees name, address and their total salary where total salary is calculated as the sum of his/her basic and bonus amount (if any): **5**  
(CO1) (PO1)
- ```
select Name, address, (salary+bonus) Total
from emp;
```

It was observed that the values for total salary for a number of employees were displayed as 0 but each of employees monthly salary has been found correct.

Your task is to identify and explain the most probable cause of the above result. At the same time, provide a suitable solution to get rid of such error.

- b) Consider the following entities (note: here pk means primary key, fk[x] means foreign key referencing entity x): **2 x 5**  
(CO1) (PO1)
- Depts (Name (pk) , Location, Budget)
  - Students (SID (pk) , Name, CGPA, Dept (fk [Depts]))
  - Teachers (TID (pk) , Name, Designation, Dept (fk [Depts]) )
  - Supervisors (TID (fk [Teachers]) , SID (fk [Students]) , ProjectName)

Write SQL statements for the following queries:

- List of departments name, location, and total number teachers for each department.
- List of the students with ID, name, their dept name, and dept location only for those departments that are located at "Academic Building 2".

- iii) List of teachers with their name, designation, and the total number of students they are supervising.
- iv) List of teachers with their name and designation who are supervising at least 5 students.
- v) List of top 3 department name, location and the total number of students (ranking is based on total number of students)

c) What is the basic purpose of a materialized view? Consider the following 2 view definitions:

5  
(CO2)  
(PO2)

```
create or replace view empV
as select id,name, salary/12 as monthlySalary
from emp;
```

```
create or replace view studentV
as select id,name,dob,cgpa
from students;
```

Is it allowed to insert data through these views? Justify your choice. (assume the tables emp and student exist with the mentioned attributes in the view definitions)

3. Read the following user requirement in the context of automation of Bangladesh NID, driving license and treatment history:

*National ID (NID) is an integrated collection of citizens' information such as Name, Date of Birth, Occupation, Blood Group. Each citizen has his/her own NID. In order to investigate the population density, the country has been divided into divisions. Each division has its name, size (in square kilometer) and a brief description. Again each division has a number of districts with similar attributes. Citizen information must be connected to its corresponding division and district.*

*Each citizen may have exactly one driving license where information such as type of license, issue date, and expiration date are maintained. Whenever any accident occurs, it is logged in the central system. The system stores relevant information such as date and time of accident, location of accident, and the number of deaths (if any).*

*There are a number of hospitals in the country having names and contact information. Each hospital may have more than one contact number. Citizens may avail treatment in any hospitals they prefer. Whenever any patient (i.e. citizen) is admitted, the system keeps the record of his/her date of admission, a brief description, and release date.*

a) Draw the Entity Relationship Diagram (ER-D) using conventional method.

10  
(CO3)  
(PO3)

b) Write appropriate DDL statements to implement above ER-D.

10  
(CO1)  
(PO1)

c) Write standard SQL for the followings:

5 × 2  
(CO1)  
(PO1)

- i Find the list of Districts along with its total population.
- ii Find the list of Districts having at least 20000 people living there.
- iii Find the number of accidents occurred (if any) by a citizen whose NID is 210.
- iv Find the list of top 5 hospitals based on the number of patients admitted so far.
- v Find the list of Divisions along with its total number of Districts for each Division.

B.Sc. Engg. (CSE), 3<sup>rd</sup> Sem.

Date: October 3, 2022  
Time: 2.30 pm-4.00 pm

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination  
Course Number: EEE 4383  
Course Title: Electronic Devices and Circuits

Winter Semester: 2021 - 2022  
Full Marks: 75  
Time: 90 Minutes

There are **03 (three)** questions. Answer all **03 (three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in brackets.

1. (a) Illustrate the effect of lower values of  $V_{CC}$  on the load line and the Q point in output characteristics curve of BJT. (05)  
(CO1)  
(PO1)
- (b) Analyze the circuit using small signal  $r_e$  model for the common emitter transistor configuration given in Fig. 1(b) and find the following parameters. (20)  
(CO2)  
(PO2)
- Determine  $r_e$ .
  - Calculate  $Z_i$  and  $Z_o$ .
  - Find  $A_v$ .
  - Repeat parts (ii) and (iii) with  $r_o = 25 \text{ k}$ .

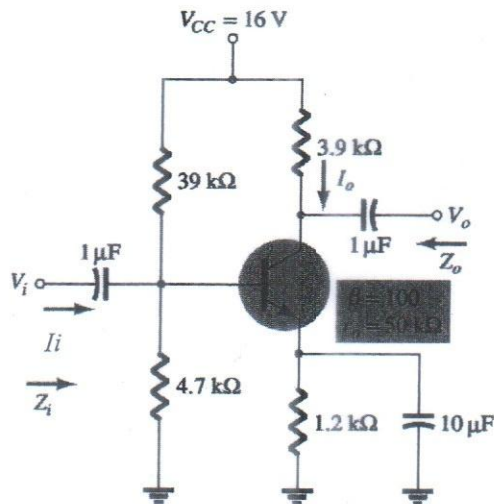


Fig. 1(b)

2. (a) The transistor in the circuit shown in Fig. 2(a) has  $\beta=100$  and exhibits a  $V_{BE}$  of 0.7 at  $i_c=1$  mA. Design the circuit so that a current of 2 mA flows through the collector and a voltage of +5 V appears at the collector. (15) (CO3) (PO3)

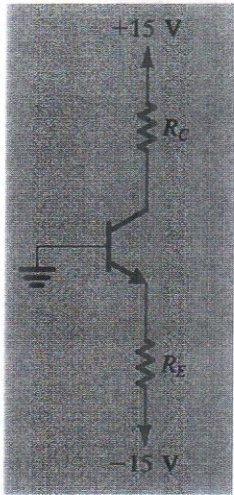


Fig. 2(a)

- (b) Write down the working principle of BJT for Common emitter configuration. (10) (CO1) (PO1)

3. (a) Sketch Output Voltage ( $V_o$ ) for the given network shown in the Fig. 3(a2). Also, show the necessary calculation. (15) (CO1) (PO1)

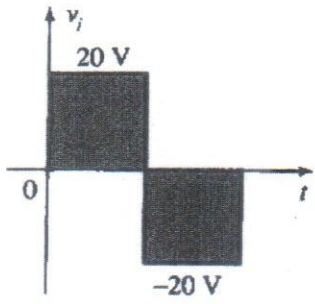


Fig. 3(a1)

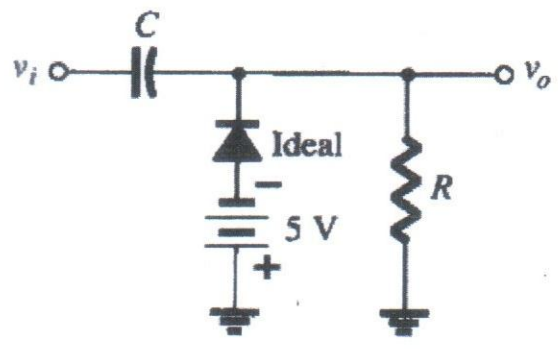


Fig. 3(a2)

- (b) Explain three types of equivalent circuits of diode and sketch their corresponding characteristics. (10) (CO1) (PO1)

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4501: Operating Systems**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Consider that you are a software developer at a renowned software development company. One of the products requires client-server communication for proper functioning. The product also exchanges certain status messages with the server. However, the development is not completely object oriented and hence, has dedicated functions for certain features. The company has requested your expertise to optimize the product in terms of leveraging various communication protocol(s), where they have presented to you the following questions: (CO2) (PO2)
- i. What are the differences between RMI and RPC? Can a mixture of these two communication protocols be utilized in this scenario? 7
  - ii. Between Web-Sockets and RPC, which protocol will you prefer for allowing the exchange of the status messages? Justify your preference through a comparative analysis of the downsides of each of these protocols. 10
  - iii. If you choose to implement RMI, how will you ensure exchange of the parameters that are *local* to the client and those which are *remote*? 3
- b) Justify the sentence - "*Although a single processor system has separate special purpose microprocessors, they are not considered as multiprocessor systems.*" 5 (CO1) (PO1)
2. a) "*All Orphan processes are Zombie processes but all Zombie processes are not Orphan processes.*"- Explain with appropriate scenario and process timeline diagram. 5 (CO1) (PO1)
- b) Suppose you have a list of 12 numbers (considering there are no zeros in the list) and your workstation has 4 processing cores. Now, consider the following three scenarios: (CO1) (PO2)
- Scenario I:  
You divide the list of numbers in 3 parts. For the first part, you have to find their summation and for those in the second, you have to find their product. For the third part, you must divide the first half by the second half. Finally, you have to find the difference between the summation and the product and divide the result by the quotient of the third part.
- Scenario II:  
You have to find the difference between the summation and the product of all the numbers in the list.
- Scenario III:  
Consider that the scenario I is repeated for a different list of numbers. However, the number of cores in your workstation reduced to 2 due to malfunctioning in one of the 4 cores. 6
- Now answer the following questions: 6
- i. How will you utilize all the processing cores in scenarios I and II? Explain separately. 8
  - ii. What is meant by *task parallelism* and *data parallelism*? What type of parallelism will you implement in scenarios I and II? Elaborate on your answer with suitable diagrams.
  - iii. Considering Scenario III, what will be the reduction in the computation speed compared to Scenario I? Explain mathematically using Amdahl's law.

3. Consider the following code snippet in Figure 1:

```
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>
#include <sys/wait.h>
#include <stdlib.h>

int main(int argc, char *argv[])
{
    printf("I am: %d\n", (int) getpid());

    pid_t pid = fork();
    printf("fork returned: %d\n", (int) pid);

    if (pid < 0) {
        perror("Fork failed");
    }

    if (pid == 0) {
        printf("Hello from the other side (number: %d)\n", (int) getpid());
        printf("Child process is exiting\n");
        exit(0);
    }

    printf("I am the parent waiting for the child process to end\n");
    wait(NULL);

    printf("parent ess is exiting\n");

    return(0);
}
```

Figure 1: Code Snippet for Question 3.(a)

- a) Determine the output of the program in Figure 1. 5  
(CO1)  
(PO1)
- b) What are CPU bound and I/O bound processes? "Mixing these two types of process is necessary" – justify the statement. What type of scheduler ensures a good mix of processes? Explain its working mechanism with diagram. 2 + 4  
+ 6  
(CO1)  
(PO1)
- c) Write brief notes on the following: 2×4  
(CO1)  
(PO1)
- i. Cascading Termination
  - ii. Marshalling and Unmarshalling
  - iii. Asynchronous and Deferred Cancellation
  - iv. Asymmetric and Symmetric Multiprocessor Systems



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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4503: Microprocessors and Assembly Language**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets. Any Other Statements if necessary.

1. a) Briefly explain the functionalities of the following control pins of 8086 microprocessor: 12  
(CO2)  
(PO1)
- |                                       |                                     |
|---------------------------------------|-------------------------------------|
| i. ALE                                | ii. $\overline{\text{BHE}}$         |
| iii. $\overline{\text{MN}}/\text{MX}$ | iv. $\overline{\text{DT}}/\text{R}$ |
- b) Identify the mistakes of the following assembly language program and re-write to correct. 10  
(CO4)  
(PO2)
- ```

ORG 0100h
.DATA
X DB 10000001
Y DW FEH
Z DB 512
S DB ??

.CODE
MAIN PROC
    MOV BL, Y
    MOV AX, BL
    MOV DL, 5
    DIV AL, DL
    MOV CL, Z
    MUL BL, CL
    MOV S, Z

    MAIN ENDP
END MAIN
RET

```
- c) Write a short note on Implied Addressing. 03  
(CO1)  
(PO1)
2. a) What is an assembler? Using an appropriate example, briefly explain the concept of fetching an instruction/data from the memory. 10  
(CO1)  
(PO1)
- b) Derive the contents of the Flag (CF, PF, ZF, SF, OF, AF) register of 8086 microprocessor upon executing the following instructions: 12  
(CO1)  
(PO1)
- |   |
|---|
| i. CMP AL, ABh ; Assume AL initially contains FFh.      |
| ii. SUB AX, FFFFh ; Assume AX initially contains 8FFFh. |
- c) Differentiate between SUB and CMP instructions with example. 03  
(CO1)  
(PO2)

- 3. a) Differentiate between the operation of stack memories and use of stack pointers of 8085 and 8086 microprocessors. 10  
(CO2)  
(PO2)
- b) Derive the machine codes of the following instructions using their instruction/coding template/format and also show how the machine codes of the instructions are to be stored in memory: 3×4=12  
(CO1)  
(PO1)
  - i. IN AL, 1234H
  - ii. MOV SS:[BX+DI+A1B2H], DX
  - iii. MOV BX, 01010101B
- c) How can a 20-bit address of a primary memory be addressed by 16-bit register(s)? 03  
(CO2)  
(PO2)

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MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4511: Computer Networks**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 1. a) By applying a suitable probabilistic model, determine the maximum achievable throughput of a slotted ALOHA network. Derive a formula to calculate the average transfer delay of a slotted ALOHA network. 5+6  
(CO1)  
(PO1)
- b) What is the slot time in CSMA/CD? Explain how the slot time is related to the maximum network length. 6  
(CO1)  
(PO1)
- c) What are the significances of *To DS* and *From DS* flags of an IEEE 802.11 frame? How does the D (Duration) field relate to NAV? Distinguish between the Distributed Coordination Function (DCF) and the Point Coordination Function (PCF) as a MAC sublayer for *IEEE 802.11*. 8  
(CO1)  
(PO1)

OR

Briefly explain the access method (baseband layer) of Bluetooth. Mention the effective length of a one-slot frame and a three-slot frame of Bluetooth. In a Bluetooth frame, why does the 54-bit header portion contain three identical 18-bit sections? 8  
(CO1)  
(PO1)

- 2. a) How does a bridge differ from a repeater? Demonstrate the learning procedure of a transparent bridge with a suitable example. Consider a system of four LANs ( $L_1$  to  $L_4$ ) interconnected by five bridges ( $B_1$  to  $B_5$ ). The bridges connect the LANs as follows: 7+4  
(CO1)  
(PO1)
  - i.  $B_1$  connects  $L_1$  and  $L_2$
  - ii.  $B_2$  connects  $L_1$  and  $L_3$
  - iii.  $B_3$  connects  $L_1, L_3,$  and  $L_4$
  - iv.  $B_4$  connects  $L_3$  and  $L_4$
  - v.  $B_5$  connects  $L_1, L_2,$  and  $L_4$

Assume  $B_4$  as the root bridge. Show the forwarding and the blocking ports after applying the spanning tree protocol (STP).
- b) In an IPv4 datagram, the M-bit is 0, the value of HLEN is 5, the value of total length is 200, and the fragment offset value is 200. What are the number of the first byte and the number of the last byte in this datagram? Is this the last fragment, the first fragment, or a middle fragment? 5  
(CO2)  
(PO1)
- c) Which fields of the IPv4 header are mutable (the value changes from router to router)? Name the fields in the IPv4 header that are necessary to handle the fragmentation of packets. Briefly explain the source route option of IPv4. 2+2+5  
(CO2)  
(PO1)

3. a) What are the major motivations for summarization (route aggregation)? What might be a potential problem of summarization if the subnets are not geographically close to each other? What is the solution to the problem? (Your answer should include network diagrams using classless addressing.) 10 (CO2) (PO2)

OR

What is VLSM in IPv4? Considering a class C network explain the VLSM technique with the necessary diagrams. (Your answer should include the optimized VLSM worksheet.) 10 (CO2) (PO2)

b) What are the subnet address and broadcast address of the host 192.168.10.244/29? A router receives a packet on an interface with a destination address of 192.168.10.174/28. What will the router do with the packet? 4 (CO2) (PO1)

c) Suppose you are working in a reputed ISP. You are given a class B network address 172.16.0.0 and you are asked to create subnets from the given network using the subnet mask 255.255.255.192 (which equivalent is to /26 in CIDR). Now, as a network expert answer the following questions: 11 (CO2) (PO1)

- i. How many subnets can be there?
- ii. How many hosts per subnet?
- iii. What are the valid first and last five subnets?
- iv. What are the broadcast addresses for the first and last five subnets?
- v. What are the valid hosts in the first and last five subnets?

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4513: Software Engineering and Object-Oriented Design**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Why does an iterative process make it easier to manage changes? How does product backlog differ from sprint backlog? 2+3  
(CO1)  
(PO1)
- b) Assume that the velocity of your team is 50 Story points. You have 20 user stories (US1-US20) in your project backlog. You have estimated the user stories to have a difficulty/complexity expressed in story points as follows: 5+4+1  
(CO1)  
(PO1)
- Each of US1 to US5 equals 3 story points
  - Each of US6 to US10 equals 5 story points
  - Each of US11 to US15 equals 8 story points
  - Each of US16 to US20 equals 13 story points
- i. If you have a team of 4 developers and weekly sprints (1 week = 5 days = 40 hours), which user stories would you be able to implement in the next sprint and achieve the highest possible value without violating your capacity (effort) constraint?
- ii. How would your result change if the following needs to be implemented with highest priority?
- US3 must be implemented together with US11
  - US7 must be implemented together with US16
  - US17 must be implemented together with US18
- iii. What is the minimum number of sprints required to complete the project?
- c) *Pair programming is an agile software development technique in which two programmers work together at one workstation. One types in code while the other reviews each line of code as it is typed in. The person typing is called the driver. The person reviewing the code is called the observer. The two programmers switch roles frequently (possibly every 30 minutes or less).* 5+5  
(CO1)  
(PO1)
- Suppose that you are asked to build a system that allows Remote Pair Programming. That is, the system should allow the driver and the observer to be in remote locations, but both can view a single desktop in real-time. The driver should be able to edit code and the observer should be able to "point" to objects on the driver's desktop. In addition, there should be a video chat facility to allow the programmers to communicate. The system should allow the programmers to easily swap roles and record rationale in the form of video chats. In addition, the driver should be able to issue the system to backup old work.

From the description above, figure out five functional and five non-functional requirements?

- 2. a) Prepare a class diagram for the remote pair programming system described in question 1.(c). 10  
(CO2)  
(PO2)
- b) Walton recently started manufacturing a security light system which has a switch and a motion sensor attached. It can be either armed or unarmed. If the switch is in the off position, the light is off and the system is unarmed. When the switch is turned on, the light stays off, but the system is armed. If the system is armed and the motion sensor detects movement, the light comes on. If no movement is detected for 5 seconds, the light goes off. 8  
(CO2)  
(PO2)

Draw the state diagram for the above-mentioned security light system.

- c) In ABC Hospital, the front desk officer enters the patient's name, address, date of birth and emergency contact details into the system. If the patient has only Government health insurance, the Medical Assistant enters the patient's insurance ID, and the system verifies this with government health database. If the patient also has private health insurance, then the Medical Assistant also enters the patient's private health insurance details, and the system verifies these details with the private health insurance system. When these details are verified as correct, the system saves the patient's details and confirms the registration for further processing. 7  
(CO2)  
(PO2)

Draw a UML sequence diagram for the scenario where the front desk officer registers a patient who only has a government health insurance.

- 3. a) Discuss the tradeoffs involved in the choice between inheritance and composition. 5
- b) A burndown chart is essential for any agile team. Mention the information listed in a burndown chart. 5
- c) What are the main reasons of software upgrade? What is velocity in Agile? 3+2
- d) *"Software entities (classes, modules, functions, etc.) should be open for extension, but closed for modification"* 10  
Do you agree with the statement above? Justify your answer with suitable example.

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**MID SEMESTER EXAMINATION  
DURATION: 1 HOUR 30 MINUTES**

**WINTER SEMESTER, 2021-2022  
FULL MARKS: 75**

**CSE 4531: E-Commerce and Web Security**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) Amazon.com, Inc. is an American multinational technology company which focuses on e-commerce. It sells a wide range of products. Users and different businesses can sell their products on Amazon as well. Amazon has their services spread out to multiple countries around the world. Identify and explain the unique features of E-commerce technology in the case of Amazon. 8  
(CO1)  
(PO2)
- b) Bill Gates has an e-commerce cross platform application where he sells computer and accessories. He also provides repair services. Bill sometimes resells the repaired parts to the customers as brand new. He knows this is wrong. But not doing so would reduce his profit, resulting in laying off of his employees. Bill also ensures that the parts he sells are totally functional and he provides sufficient warranty so that the customers are not harmed. 9  
(CO5)  
(PO8)
- In this case of Bill's ethical dilemma, explain what should be done considering the Candidate Ethical Principles.
- c) UffTasty is a website for restaurant reviews. People can give their reviews and also find recommendations for restaurants according to their taste buds, locations and other preferences for free. People can also buy subscription for UffTasty that allows them to get lucrative discounts and packages in some restaurants during dine-in. Even though UffTasty is the first-mover of this sort of service, they do have some competitors like the home-delivery services that also offer discounts and vouchers of their own. Customers like to visit UffTasty as their reviews are authentic and many of them are also buying their subscription to get dine-in discounts. 8  
(CO1)  
(PO2)
- Analyse UffTasty's business model and describe the key elements of it.
2. a) Fred and George Weasley are incurring huge losses in their online store "All Things Magic". Their competitor, Voldemort is offering Buy-One-Get-One in his shop for everyone who has a buyer's license. They still have some loyal customers. They have some unique products which can drive more customers if proper marketing is done. Fred and George cannot reduce their prices. Their online store is known to all but the only reason they are losing is Voldemort's popularity and his BIG1 strategy.
- i. Perform using SWOT analysis of All Things Magic. 5  
(CO2)  
(PO2)
- ii. Using the Mass Market-Personalization Continuum, identify (with proper logic) a marketing strategy and a marketing attribute that will help the store earn more profit. 5  
(CO3)  
(PO12)

- b) Demonstrate the Website System Development Life Cycle for an E-commerce website. 5  
(CO2)  
(PO1)
  
- c) Kylie Jenner, a young entrepreneur is going to launch her own e-commerce website. But to get success in her e-commerce business, she needs to examine different security measures that she must implement in order to completely protect her website. 10  
(CO4)  
(PO2)  
On behalf of Kylie, identify the different directions of security measures that she needs to ensure with proper justification.
  
- 3. a) FoodThanda is an online food-delivery application. People can choose their favorite food from a variety of restaurants and cuisines. The food will be delivered at their doorstep within an hour. 5+5  
(CO3)  
(PO12)  
Evaluate the consumer decision process and supporting communication in the case of FoodThanda. Also compare the points with that of any food court which has many physical restaurants at one place.
  
- b) Compare the three main types of intellectual property protection with one example for each type. 3  
(CO5)  
(PO8)
  
- c) Rabindranath Tagore sells his art and music online. He uses a technique where he stores user activity on his website so that he can make better recommendations to the users in the future. 2+6  
(CO2)  
(PO2)  
Identify the core communication protocol used by Rabindranath. Also diagnose the mechanism of his aforementioned technique.
  
- d) Would you say that Amazon and eBay are direct or indirect competitors? Compare. Are they B2B, B2C or C2C? 2+2  
(CO1)  
(PO2)



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MID SEMESTER EXAMINATION  
DURATION: 1 HOUR 30 MINUTES

WINTER SEMESTER, 2021-2022  
FULL MARKS: 75

**CSE 4539: Web Programming**

Programmable calculators are not allowed. Do not write anything on the question paper.  
Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Consider the following two modules given in Figure-1 and answer the subsequent questions.

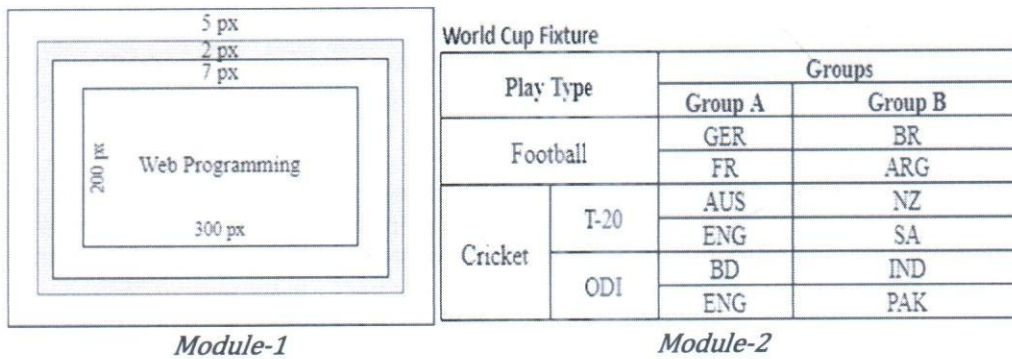


Figure-1: Modules for question-1

- a) What are **tag** and **attribute** in HTML? Give an example. 5  
(CO1)  
(PO1)
- b) Explain **Module-1** in details and write the corresponding CSS code. If the border is changed to 4px, what will be the total area (in px<sup>2</sup>) of **Module-1** excluding the padding portion? 10  
(CO2)  
(PO1)
- c) Analyze **Module-2** and write the corresponding HTML code. Also, if we want to present it to a multilevel list, what will be the structure of the HTML code? 10  
(CO2)  
(PO2)

2. Consider the following HTML form shown in Figure-2 and answer the subsequent questions.

Name:

Email:

Gender:  Male  Female

Program:

Figure-2: Student form for question 2

- a) In form submission, we use either GET or POST request. Differentiate between a GET and POST request? Explain with examples. 5  
(CO1)  
(PO1)

- b) Design the form using HTML having the following requirements and show the proper messages if an error occurs. 10  
(CO2)  
(PO1)
  - i. Name: required field.
  - ii. Email: must be a valid email address. Required field.
  - iii. Gender: Either Male or Female. Required field.
  - iv. Program: give select options (CSE, SWE, BTM). By default, program: CSE.
  - v. Submit and reset button: When a user clicks the reset button, value of every field will be erased.
  
- c) Add a single action listener for the submit button with the following functions and implement the following JavaScript functions. If all the functions return true, the form will be submitted, otherwise it will be returned to the user with proper error messages (use JavaScript). 10  
(CO2)  
(PO1)
  - i. FetchUserData(): Collect user data from the form.
  - ii. isValidName(): The length of the name will be between 5 and 10. It contains only letters (A-Z, a-z) and numbers(0-9).
  - iii. isValidEmail(): Valid email address.
  - iv. isFilledGender(): Check whether two combo box (male and female) are checked or not.
  - v. isValidProgram(): Check whether the program is valid or not. It should only support CSE, SWE and BTM.
  
- 3. Rokomari (<https://www.rokomari.com>) is one of the online book stores where different types of books are available. Suppose, a book has three unique properties such as name, author and genre. Two users visit this site and buy a set of books which are stored in two different object arrays such as cart1 and cart2.
  - a) When the user typed “<https://www.rokomari.com>” into a web browser, how does the Domain Name System (DNS) resolve the request? 5  
(CO1)  
(PO1)
  - b) In JavaScript, an object can be defined in different ways. Define the Book object in different ways with their pros and cons. Also, implement a function *getDetails()* inside that object that returns all the information related to the book. 10  
(CO1)  
(PO1)
  - c) Write a function *isAnagram(cart1, cart2)* that takes two inputs and checks whether the given two carts are Anagram or not. Note: An Anagram is a word or phrase formed by rearranging the letters of a different word or phrase, typically using all the original letters exactly once. 10  
(CO2)  
(PO1)

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WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**Math 4541: Multivariable Calculus and Complex Variables**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Define analytic function. Show that the function  $f(z) = u + iv$  is continuous but not analytic, where  $f(z) = x + i(x + y)$ . 8  
(CO1)  
(PO1)
- b) Show that the function  $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$  is harmonic and find the harmonic conjugate. Find the corresponding analytic function. 10  
(CO1)  
(PO1)
- c) Explain the Laurent theorem. Expand  $f(z) = \frac{z}{(z+1)(z+2)}$  in a Laurent series for the region  $1 < |z| < 2$ . 7  
(CO1)  
(PO1)
2. a) State and prove the Cauchy's theorem. 8  
(CO1)  
(PO1)
- b) Evaluate  $\oint_c \frac{dz}{z-a}$ , where  $c$  is any simple closed curve and  $z = a$  is:  
i. outside  $c$ . 7  
(CO1)  
(PO1)  
ii. inside  $c$ .
- c) Assume that  $f(z)$  is analytic in a region  $R$  bounded by two concentric circles  $C_1$  and  $C_2$ , and also it is on the boundary. Prove that if  $a$  is any point in  $R$ , then 10  
(CO1)  
(PO1)
- $$\frac{1}{2\pi i} \oint_{c_1} \frac{f(z)}{z-a} dz = \frac{1}{2\pi i} \oint_{c_2} \frac{f(z)}{z-a} dz.$$
3. a) State the Cauchy's residue theorem. Find the residue,  $f(z) = \frac{z^2}{(z-1)^3(z-2)}$ . 8  
(CO1)  
(PO1)
- b) Describe the general Argument theorem. Evaluate  $\frac{1}{2\pi i} \oint \frac{\cos \pi z}{z^2 - 1} dz$  around a rectangle with vertices  $(2 \pm i, -2 \pm i)$ . 7  
(CO1)  
(PO1)
- c) State Cauchy's Integral Formula and Morera's theorem. Find the pole and zeros of the function  $f(z) = \frac{z^2 + 5}{(z-1)(z-3)^4(z-4)}$ . Evaluate the value  $\oint_c \frac{f'(z)}{f(z)} dz$ , where  $|z| = 4$ . 10  
(CO1)  
(PO1)

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4547: Parallel and Distributed Systems**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Write down the steps for executing the following set of instructions using the scoreboard scheduling method: 12  
(CO2)  
(PO2)

```
LD    F2, 0(R1)
ADD   F6, F2, F4
MUL   F8, F6, F0
LD    F10, -8(R1)
ADD   F12, F10, F4
MUL   F14, F12, F0
```

Figure 1: Instruction Set for Question 1.(a)

The latency of the Integer unit is 1 cycle, Floating-Point Adder is 2 cycles, and Floating-Point Multiplier is 10 cycles.

- b) Show how to add 0100100011 to 1001000010 where both numbers are in floating point binary format using 6 bits for the mantissa and 4 bits for the exponent. Show how this operation can be divided into different stages when running in a parallel architecture. 8  
(CO2)  
(PO2)
- c) Consider the execution of a program having 15000 instructions by a linear pipeline processor with a clock rate on 25 MHz. Assume that the instruction pipeline has five stages and considering the ideal condition. 2+3  
(CO1)  
(PO1)
- i. Calculate the speedup factor in using this pipeline
- ii. What are the efficiency and throughput of this pipelined processor?

2. a) Write down the steps for executing the following set of instructions using the scoreboard scheduling method: 15  
(CO2)  
(PO2)

```
LD    F6, 256(R1)
LD    F2, 260(R2)
MUL   F0, F2, F4
SUB   F8, F6, F2
DIV   F10, F0, F6
ADD   F6, F8, F2
```

Figure 2: Instruction Set for Question 2.(a)

The latency of the Integer unit is 2 cycle, Floating-Point Adder is 2 cycles, Floating-Point Multiplier is 10 cycles, Floating Point Subtract is 2 clock cycles, and Floating-Point Divide is 40 clock cycles

- b) Explain the Flynn's Classification method for classifying different parallel architecture. 5  
(CO1)  
(PO1)
- c) Give examples of the different types of data hazard that can occur while designing a parallel pipeline. 5  
(CO1)  
(PO1)

- 3. a) Differentiate between scaling up and scaling out a distributed system. Describe three (3) different scaling techniques that can be applied to scale out a distributed system. 9  
(CO1)  
(PO1)
- b) Illustrate the architecture of a grid computing system and describe how the different components work with each other to ensure the functionality of the system. 8  
(CO1)  
(PO1)
- c) A system can be the combination of multiple types of distributed systems. 8  
With brief explanation, identify the type of distributed system present in each of the following examples: (CO3)  
(PO2)
  - i. A hospital management system that connects the patients with the doctors.
  - ii. A distributed system between multiple research institutes that allows them to share their sophisticated devices among them.
  - iii. A supercomputer consisting of multiple off-the-shelf computers that is used in a research institute.
  - iv. A network of sensors that coordinate with each other to maintain the optimum temperature with a vegetable warehouse and periodically check the inventory level within the warehouse. If the system detects that the inventory level is less than the threshold, it can automatically order new vegetables.

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4549: Simulation and Modeling**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Jobs arrive at a single-CPU computer facility with interarrival times that are IID exponential random variables with mean 1 minute. Each job specifies, upon its arrival, the maximum amount of processing time it requires, and the maximum times for successive jobs are IID exponential random variables with mean 1.1 minutes. However, if  $m$  is the specified maximum processing time for a particular job, the actual processing time is distributed uniformly between  $0.55m$  and  $1.05m$ . The CPU will never process a job for more than its specified maximum; a job whose required processing time exceeds its specified maximum is returned to the end of the queue and is allocated the CPU for the remaining time again. The system states are changed due to following three activities: (CO1)
- Arrival of a job,
  - Departure of a job after completing the service, and
  - Return of a job to the queue after processing the job for the specified maximum time.

You are asked to develop a simulation program to study the computer facility until 1000 jobs are returned to the queue for a second time processing. Assume that jobs in the queue are processed in a FIFO manner.

The system is studied to compute the average and maximum delay in queue of jobs, the proportion of jobs that are delayed in queue more than 5 minutes, and the average number of jobs in the queue.

- a) Identify the set of events for the simulation model and state how the events are changing the system states. Assume that the simulation is terminated by a terminating event. 3 (PO2)
- b) Write down the state equation(s) for the simulation model. 5 (PO2)
- c) Draw separate flow charts of the event routines (i.e., the event handler functions) for each of the events of the simulation model. 14 (PO3)
- d) Write down the pseudocode of the function that updates the necessary statistical variables. 8 (PO3)
2. a) Without actually computing any  $Z_i$ 's, determine whether the following mixed Linear Congruential Generator (LCG) has full period: 5 (CO2)  
 $Z_i = (Z_{i-1} + 12)(\text{mod } 13)$  (PO1)
- b) Determine whether the LCG shown below can achieve a maximum period. Also, state the restrictions on  $Z_0$  to obtain this period. 10 (CO2)  
 $a = 4951$  (PO1)  
 $c = 247$   
 $m = 2^{32}$

- 3. a) Use appropriate method to generate random variates with the following distribution function ( $\lambda \geq 0$ ): 10  
(CO2)  
(PO1)

$$f(x) = \begin{cases} \frac{\lambda}{2} e^{-\lambda|x|}, & -\infty < x < +\infty \\ 0, & \text{otherwise.} \end{cases}$$

Develop the mathematical formulation and write down the pseudocode. Generate 3 random values assuming necessary random numbers.

- b) A machine is taken out of production if it fails, or after 5 hours, whichever comes first. By running similar machines until failure, it has been found that time to failure,  $X$ , has the uniform continuous distribution with parameters  $a = 0$  and  $b = 10$  hours. Thus, the time until the machine is taken out production can be represented as  $Y = \min(X, 5)$ . Develop a step-by-step procedure for generating  $Y$ . 10  
(CO2)  
(PO1)

- c) Use the acceptance rejection method for generating random variates with the following probability distribution function: 10  
(CO2)  
(PO1)

$$f(x) = \begin{cases} 30(x^2 - 2x^3 + x^4) & 0 \leq x \leq 1 \\ 0, & \text{otherwise.} \end{cases}$$

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MID SEMESTER EXAMINATION  
DURATION: 1 HOUR 30 MINUTES

WINTER SEMESTER, 2021-2022  
FULL MARKS: 75

**CSE 4703: Theory of Computing**

Programmable calculators are not allowed. Do not write anything on the question paper.  
Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Explain if each of the following assertion is *correct* or *incorrect*. 2×4=8
- i. *Deterministic Finite Automata* (DFA) are strictly weaker classes of machines than *Non-deterministic Finite Automata* (NFA), i.e., there exists a language that is accepted by an NFA and not by any DFA. (CO1)  
(PO2)
  - ii.  $a^n b^m$  is a regular language, where the alphabet is  $a, b$  and  $n \geq 0, m \geq 0$ .
  - iii. The regular expressions  $(a^* b^*)^*$  and  $(a + b)^*$ , represent the same language, where  $\Sigma = \{a, b\}^*$
  - iv. Considering the languages  $L_1 = \emptyset$  and  $L_2 = \{1\}$ , the strings, are accepted by the language  $L_1 \circ L_2^* + L_1^*$  is  $\{\epsilon, 1\}$ .
- b) Prove that if  $L, M$  and  $N$  are any languages, then  $L(M + N) = LM + LN$ . 7  
(CO1)  
(PO1)
- c) Consider the following NFA shown in Figure 1. Convert this NFA into an equivalent DFA. Your answer should be the state diagram of a DFA. Your diagram should include only the states that are reachable from the *start* state. 10  
(CO1)  
(PO2)

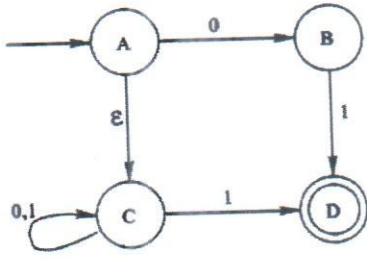


Figure 1: NFA for the question no. 1. (c)



2. a) Assume that the NFA,  $N_1$  recognizes language,  $L_1$ ; and  $N_2$  recognizes language,  $L_2$ . Construct the NFA  $N$  to recognize the language,  $L_1 \circ L_2$ . Use the *proof by construction* and also draw the *schematic diagram* for the new machine  $N$ . 9  
(CO1)  
(PO1)

b) Convert the given DFA in Figure 2 over  $\Sigma = \{a, b\}$  into regular expression. 8  
(CO1)  
(PO2)

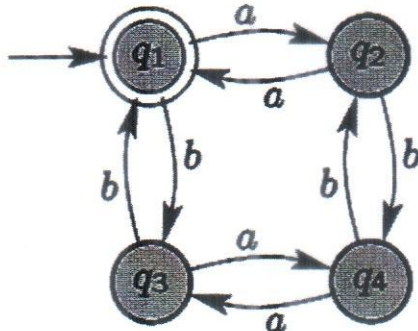


Figure 2: DFA for question 2. (b)

c) Design the DFA/NFA for the following regular expression  $R$  over  $\Sigma = \{a, b\}$ . 8  
(CO1)  
(PO2)  
 $R = (ab)^* + (a + ab)^*b^*(a + b)^*$

3. a) Design the regular expression for the following languages over the alphabet  $\Sigma = \{0, 1\}$ . 3\*3=9  
(CO1)  
(PO2)  
 i.  $L_1 = \{w \mid w \text{ consists of at least one '00' and '11' and not divisible by 2}\}$ .  
 ii.  $L_2 = \{w \mid w \text{ starts and ends with 1}\}$ .  
 iii.  $L_3 = \{w \mid \text{in } w, \text{ the number of '1' is exactly 3 and it must end with one or more '0's'}\}$ .

b) Design a *Finite Stat Machine* that accepts strings in which the number '1' is congruent to  $1 \pmod 3$  over the alphabet  $\Sigma = \{0, 1\}$ . 8  
(CO1)  
(PO2)

c) Apply the pumping lemma to prove that the language  $L$  over the alphabet  $\{a, b\}$  is not regular  $L = \{ww : w \in \{a, b\}^*\}$ . 8  
(CO1)  
(PO1)

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**MID-SEMESTER EXAMINATION**  
**DURATION: 1 HOUR 30 MINUTES**

**WINTER SEMESTER, 2021-2022**  
**FULL MARKS: 75**

**CSE 4711: Artificial Intelligence**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Consider the game of Pacman, where the main protagonist Pacman has to move through an  $M \times N$  grid eliminating ghosts. Pacman starts from an empty square and can choose one of the four following actions: left, right, up, and down to move to another square, if it does not contain a wall or go beyond the board. Pacman can eliminate a ghost by moving to the same square as the ghost. The goal is to eliminate all the  $G$  ghosts present on the board.

For simplicity, we assume that the ghosts are stationary and the cost of executing each action is 1.

- a) Determine the size of the minimal state space graph. 1  
(CO1)  
(PO1)
- b) With proper justification, determine whether each of the following heuristics is only admissible, only consistent, none of them, or both of them: 4 × 6  
(CO3)  
(PO2)
- i. The sum of the Manhattan Distance from Pacman to every ghost.
  - ii. The number of remaining ghosts.
  - iii. The minimum Manhattan Distance between Pacman and any of the ghosts.
  - iv. The number of remaining ghosts multiplied by the minimum Manhattan Distance between Pacman and any of the ghosts.
2. a) Four people, Ali ( $A$ ), Sristy ( $S$ ), Maliha ( $M$ ), and Rafid ( $R$ ) are looking to rent space in an apartment building. There are three floors in the building: 1, 2, and 3 (where 1 is the lowest and 3 is the highest). More than one person can live on a single floor, but each person must be assigned to some floor. The following constraints must be satisfied on assignment:
- $A$  and  $S$  must not live on the same floor.
  - If  $A$  and  $M$  live on the same floor, they must be on floor 2.
  - If  $A$  and  $M$  live on different floors, one of them must be on floor 3.
  - $R$  must not live on the same floor as anyone else.
  - $R$  must live on a higher floor than  $M$ .
- We formulate the scenario as Constraint Satisfaction Problem (CSP) considering each person as a variable and the floors as values in their domains.
- i. Sketch the constraint graph for the CSP. 5  
(CO2)  
(PO2)
  - ii. Apply arc consistency to determine the remaining values in the domain of each variable. 9  
(CO3)  
(PO2)
  - iii. Let's assume  $A$  chooses to live on floor 3. Solve the CSP to determine which person lives on which floor. 7  
(CO3)  
(PO1)
- b) Assume that we have a tree-structured CSP with 100 variables. Each variable can take 5 values. Compare the performances of Tree-CSP-solver with Naïve Backtracking on a computer that can process 10 million nodes/second. 4  
(CO1)  
(PO1)

3. a) "Artificial Intelligence (AI) is the science of making machines that act rationally" - Justify the statement by comparing it with other schools of thought on AI.
- b) In the state space graph shown in Figure 1, the values beside each arc denote the cost of executing the action for going to a successor state.

7  
(CO2)  
(PO2)  
3 × 6  
(CO1)  
(PO1)

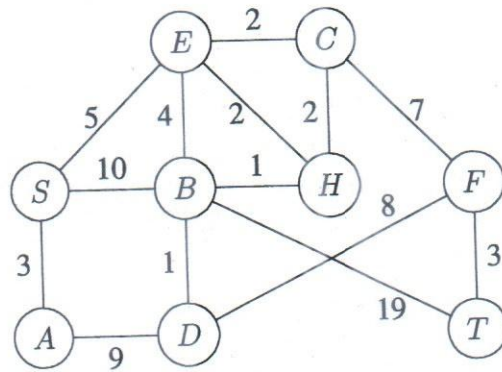


Figure 1: State Space Graph for Question 3(b).

Assume that *S* is the start state and *T* is the goal state. We will run graph search variants of different search algorithms to find a path from the *S* to *T*. When expanding the successors of a state, we will break ties in alphabetic order.

For each of the following search algorithms, determine the order in which the states are expanded, and the path returned:

- i. Depth-First Search
- ii. Breadth-First Search
- iii. Uniform Cost Search

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DURATION: 1 HOUR 30 MINUTES

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FULL MARKS: 75

**CSE 4733: Digital Image Processing**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) Suppose you have a gray-scale image of size 50×50 pixels. Your job is now to shrink this image to a size of 32×32 pixels. Apply a resizing operation with less amount of blocking effects? 8  
(CO1)  
(PO1)
  - b) Suppose that a flat area with center at  $(x_0, y_0)$  is illuminated by a light source with intensity distribution  $i(x, y) = Ke^{-[(x-x_0)^2 + (y-y_0)^2]}$ . Assume for simplicity that the reflectance of the area is constant and equal to 1.0, and let  $K=255$ . If the resulting image is digitized with  $k$  bits of intensity resolution (in 256 levels;  $k=8$ ), and the eye can detect an abrupt change of eight shades of intensity between adjacent pixels, what value of  $k$  will cause visible false contouring? 7  
(CO2)  
(PO2)
  - c) Interpret the statement – “Discrete histogram equalization technique does not, in general, yield a flat histogram”. 10  
(CO1)  
(PO1)
  
  2. a) In a given application an averaging mask is applied to input images to reduce noise, and then a Laplacian mask is applied to enhance small details. Would the result be the same if the order of these operations were reversed? Compare and explain your answer. 7  
(CO2)  
(PO2)
  - b) Show that applying a  $n \times n$  Box filter repeatedly on an image is equivalent to applying a Weighted Average filter of size  $m \times m$ , where  $m > n$ . Demonstrate with an example from 1-D image values. 10  
(CO1)  
(PO1)
  - c) Design a single mask with which if you perform spatial convolution once, the output will be equal to sharpening with High-Boost Filter (parameter  $k > 1$ ). 8  
(CO3)  
(PO3)
  
  3. a) How can you employ the Histogram Specification technique for color images? 7  
(CO1)  
(PO1)
  - b) Suppose the color values of your image are corrupted by separately adding Gaussian noise of zero mean and  $\sigma$  variance in each RGB color channels. Now if the same image is analyzed using Hue-Saturation Intensity (HSI) components, which channels will show more or less color degradation levels? Compare and explain the cause. 10  
(CO2)  
(PO2)
  - c) Consider the following 500×500 image in Figure 1, in which the squares are fully saturated red, green, and blue, and each of the colors is at maximum intensity [e.g., (1, 0, 0) for the red square]. An HSI image is generated from this image.

Green	Red
Blue	Green

Figure 1: Input for Question 3.(a)

- i. The *saturation* channel of the HSI image is smoothed using an averaging mask of size  $125 \times 125$ . Determine the appearance of the result (you may ignore image border effects in the filtering operation).
- ii. Repeat the same process for the *hue* channel.

4+4  
(CO2)  
(PO2)

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WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4739: Data Mining**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Consider the following transactions shown in of Table 1: 15

Table 1: A transaction database

<i>Transaction ID</i>	<i>List of items in the transaction</i>
T1	B, A, T
T2	A, C
T3	A, S
T4	B, A, C
T5	B, S
T6	A, S
T7	B, S
T8	B, A, S, T
T9	B, A, S

(CO3)  
(PO2)

Find out the frequent patterns including conditional pattern base and conditional FP-Tree using Frequent Pattern Growth (FP-Growth) algorithm.

Assume that the minimum support count is 2.

- b) Assume that you are using the Apriori algorithm for generating frequent itemsets from the transactions shown in Table 1. Analyze how a hash-based technique can be used to reduce the number of candidate 2-itemsets examined. 4  
(CO4)  
(PO2)
- c) List all the strong association rules (with support *s*, confidence *c*, and lift *l*) for the frequent itemsets generated from Table 1, matching the following metarule, where *X* is a variable representing customers, and item denotes variables representing items (e.g., "A," "B,"). Assume that the minimum confidence is 50%. 6  
(CO3)  
(PO1)

$$\forall x \in \text{transaction}, \text{buys}(X, \text{item}_1) \Rightarrow \text{buys}(X, \text{item}_2) \wedge \text{buys}(X, \text{item}_3) [s, c, l]$$

2. a) Differentiate between nominal attributes and ratio-scaled attributes using suitable examples. 3

(CO1)  
(PO2)

- b) Assume that you are working with a dataset with a single attribute *age*. The *age* values in ascending order are as follows: 2+2+3  
13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, (CO1)  
70 (PO2)

- i. With proper justification, find out if the distribution of *age* is symmetric, positively skewed, or negatively skewed.
- ii. Determine the mode of the data. Comment on the data's modality (i.e., bimodal, trimodal, etc.).
- iii. Sketch a boxplot for the distribution of *age* and give its five-number summary.

- c) Assume that you are working with the following two documents: 5+2

- "Tenz is one of the best professional Valorant players Sentinels has acquired." (CO2)
- "Although not good as Tenz, Shahzad is doing great as Sentinels IGL." (PO2)

- i. Calculate the cosine similarity between these two documents using their term frequency vectors and comment on their similarity.

- ii. Explain why a distance measure such as Euclidean Distance is not suitable for comparing the two documents.
- d) Consider the dataset shown in Table 2, described using the following attributes:
  - **ID:** Unique identifier for each franchise
  - **Offered\_Food\_Type:** The type of food offered by a franchise
  - **Customers\_Served:** Number of customers served by a franchise
  - **Average\_Rating:** Average rating of a franchise provided by customers

8  
(CO2)  
(PO2)

Table 2: A sample data table of different restaurant franchises

<i>ID</i>	<i>Offered_Food_Type</i>	<i>Customers_Served (in thousand)</i>	<i>Average_Rating</i>
1	Bengali	20	Excellent
2	Indian	25	Good
3	Mexican	27	Good
4	Mexican	22	Bad

Calculate the dissimilarity matrix of the dataset.

- 3. a) Assume that you are working with a dataset with a single attribute *salary*. The *salary* values (in 1000 BDT) in ascending order are as follows:
  - i. There are different normalization methods like min-max normalization, z-score normalization, etc. Depending on the given samples, which normalization method should you use to normalize these values? Justify your answer.
  - ii. Apply the normalization method you selected in 3(a)(i) to normalize the following *salary* values: 13, 35, 45, 150.
- b)
  - i. Sketch an equiwidth histogram of width 10 for the data in 3(a).
  - ii. Use *smoothing by bean means* to smooth the data in 3(a), using a bin depth of 3. Illustrate your steps. Comment on the effect of this technique for the given data.
- c) Consider the following contingency table shown in Table 3:

1+4  
(CO2)  
(PO2)  
  
5+5  
(CO2)  
(PO2)  
10  
(CO3)  
(PO1)

Table 3: Job placement by type of training (Observed Frequencies)

<b>Placed in a job?</b>	<b>Type of training</b>		<b>Total</b>
	<b>Vocational Education</b>	<b>Work Skills Training</b>	
Yes	175	125	300
No	25	125	150
<b>Total</b>	200	250	450

Present the null hypothesis and apply the Chi-Square test for statistical significance to hypothesize whether there exists a correlation between the type of training received and the rate of job placement for a probability of error level (alpha value),  $p = 0.05$ . You can find a partial list of critical values in Table 4.

Table 4: Chi-Square ( $\chi^2$ ) Distribution

Area to the Right of Critical Value

Degrees of Freedom	0.995	0.99	0.975	0.95	0.9	0.1	0.05	0.025	0.01	0.005
1	—	—	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.01	0.02	0.051	0.103	0.211	4.605	5.991	7.378	9.21	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.86
5	0.412	0.554	0.831	1.145	1.61	9.236	11.071	12.833	15.086	16.75
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.69	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.18	2.733	3.49	13.362	15.507	17.535	20.09	21.955
9	1.735	2.088	2.7	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.94	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.92	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.299
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.66	5.629	6.571	7.79	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.39	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.26	9.591	10.851	12.443	28.412	31.41	34.17	37.566	39.997
21	8.034	8.897	10.283	11.591	13.24	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.042	30.813	33.924	36.781	40.289	42.796
23	9.26	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.98	45.559
25	10.52	11.524	13.12	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.16	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.29
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.257	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.954	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.42	76.154	79.49



ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF BUSINESS AND TECHNOLOGY MANAGEMENT

Mid-Semester Examination

Winter Semester, A. Y. 2021-2022

Course No. : Hum 4741

Time : 1.5 hours

Course Title : Business Communication and Law

Full Marks : 50

Answer **all 2 (two)** questions. All questions carry equal marks. Marks in the margin indicates full marks.

1. a) What is communication? "Communication forms a part of your self-concept, and it helps you understand yourself and others, solve problems and learn new things, and build your career" – Explain 10
- b) What are the eight essential components of communication? Imagine two people talking. Describe their communication. See if you can find all eight components and provide an example for each one. 10
- (c) Explain the six ways in which language can be an obstacle or barrier to communication 05
2. (a) What assumptions are present in transactional model of communication? Find an example of a model of communication in your workplace or classroom, and provide an example for all components. 10
- (b) Discuss and provide several examples of each of the two main responsibilities of a business communicator. 05
- (c) Explain the differences between clichés, jargon, and slang. How does language change over time? Interview someone older than you and someone younger than you and identify words that have changed. Pay special attention to jargon and slang words. 10

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**Math 4741: Mathematical Analysis**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) i. With a brief explanation, illustrate the Josephus Problem with a diagram. 5  
(CO1)  
(PO1)
- ii. When sending messages over a network, there is a chance that the bits will be corrupted. A Hamming code allows for a 4 bit code to be encoded as 7 bits, with the advantage that if 0 or 1 bit(s) are corrupted, then the message can be perfectly reconstructed. 5  
(CO1)  
(PO1)
- You are working on the Voyager space mission and the probability of any bit being lost in space is 0.1. Determine the improvement in reliability when using a Hamming code with 7 bits instead of 4 bits.
- b) Suppose that an airplane engine will fail, when in flight, with probability  $(1 - p)$  independent of all engines. Again, the airplane will make a successful flight if at least 50 percent of its engines remain operative. Determine the value of  $p$  for which a four-engine plane preferable to a two-engine plane. 7  
(CO2)  
(PO2)
- c) Suppose that the amount of time that a light bulb works before burning itself out is exponentially distributed with a mean of 10 hours. Suppose, that Dobby enters a room in which a light bulb is burning. If he desires to work for 5 hours, find out the probability that he will be able to complete his work without the bulb burning out. 8  
(CO3)  
(PO2)
2. a) A box contains three coins: two regular coins with head on one side and tail on the other side and one fake coin with heads on both sides.
- i. You pick a coin at random and toss it. Find out the probability that it lands heads up. 2  
(CO1)  
(PO1)
- ii. You pick a coin at random and toss it, and get heads. Find out the probability that it is the two-headed coin. 2  
(CO1)  
(PO1)
- b) i. Assume that a rare disease infects 1 out of every 10000 people in a population. There is a good, but not perfect, test for this disease: if a person has the disease, the test comes back positive 98% of the time. However, 7% of uninfected people also test positive. Given that someone just tested positive, determine their chances of having this disease. 5  
(CO2)  
(PO2)
- ii. An individual uses the following gambling system in Las Vegas. He bets \$1 that the roulette wheel will come up red. If he wins, he quits. If he loses then he makes the same bet a second time only this time he bets \$2; and then regardless of the outcome, quits. Assuming that he has a probability of 0.5 of winning each bet, find out the probability that he goes home a winner. 5  
(CO3)  
(PO2)

- c) The traffic authority is facing low levels of traffic at GG Tower junction road. Late at night, at an average 5 automobiles per hour pass through the junction.
  - i. Find the probability that no one passes in a given minute. 3  
(CO3)  
(PO2)
  - ii. Determine the expected number passing in two minutes. 4  
(CO3)  
(PO2)
  - iii. Find the probability that this expected number actually passes through in a given two minute period. 4  
(CO3)  
(PO2)
  
- 3. a) In a certain species of rats, black dominates over brown. Suppose that a black rat with two black parents has a brown sibling.
  - i. Find out the probability that this rat is a pure black rat as opposed to being a hybrid with one black and one brown gene. 3  
(CO1)  
(PO1)
  - ii. Suppose that when the black rat is mated with a brown rat, all five of their offspring are black. Now, find out the probability that the rat is a pure black rat. 5  
(CO2)  
(PO2)
  
- b) In a sequence of independent flips of a biased coin (probability of a head is 0.65), let N denote the number of flips until there is a run of three consecutive heads. Find
  - i.  $P(N \leq 8)$  5  
(CO2)  
(PO2)
  - ii.  $P(N = 8)$  5  
(CO2)  
(PO2)
  
- c) Borsha tosses a coin repeatedly. The coin is unfair and  $P(H)=p$ . The game ends the first time that two consecutive heads (HH) or two consecutive tails (TT) are observed. She wins if HH is observed and loses if TT is observed. For example, if the outcome is HTHTT, she loses. On the other hand, if the outcome is THTHTHH, she wins. Find the probability that she wins 7  
(CO2)  
(PO2)

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4743: Cryptography and Network Security**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) Choose the technique (cryptography or steganography) and its subtypes that should be used in each of the following cases for confidentiality: 2×5  
(CO1)  
(PO2)
    - i. A student writes the answer to a test on a small piece of paper, rolls up the paper, and inserts it in a ball-point pen, and passes the pen to another student.
    - ii. To send a message, a spy replaces each character in the message with a symbol that was agreed upon in advance as the character's replacement.
    - iii. A company uses special ink on its checks to prevent forgeries.
    - iv. A graduate student uses watermark to protect her thesis, which is posted on her website.
    - v. Members of the secret 'Nuvos' family uses a digital lock when entering their meeting room.
  - b) Ayai and Irido are two friends studying in the same grade. Ayai sends a secret message, "DCTE GW TW TVC DKGVTE RCETKXUD" to Irido using Affine Cipher with keys,  $k_1 = 15$  and  $k_2 = 20$ . Deduce the original message. 10  
(CO2)  
(PO1)
  - c) Some archeologists found a new script written in an *unknown language*. The archeologists later found a small *tablet* at the same place that contains a sentence in the same language with the translation in Greek. Using the tablet, they were able to read the original *script*. Identify the type of cryptanalysis attack with proper justification the archeologists used. 5  
(CO2)  
(PO1)
  2. a) Alice often needs to encipher plaintext made of both letters (a to z) and digits (0 to 9). For each of the following scenarios, determine the key domain and the modules: 2×3  
(CO2)  
(PO1)
    - i. If she uses an additive cipher.
    - ii. If she uses a multiplication cipher.
    - iii. If she uses an affine cipher.
  - b) Determine the ciphertext for the message "cryptography is fun" each of the following ciphers. 6×2  
(CO2)  
(PO1)
    - i. Autokey Cipher with key = 12.
    - ii. Vigenere Cipher with key = "lucky"
  - c) Suppose you have a modern block cipher where the number of input bits,  $n = 64$  and the number of output bits,  $m = 64$ . If there are ten 1's in the ciphertext, determine the number of tests you need to conduct to recover the plaintext from the ciphertext for each of the following cases: 3.5×2  
(CO3)  
(PO1, PO2)
    - i. The cipher is designed as a *substitution* cipher
    - ii. The cipher is designed as a *transposition* cipher

- 3 a) The input/output relation in a  $2 \times 2$  S-box is shown in Table 1. Show the table for the inverse S-box that is used in decryption.

6  
(CO3)  
(PO1, PO2)

Table 1: Table for Question 3(a)

Input	0	1
0	01	11
1	10	00

- b) The final design of the Feistel Cipher is shown in Figure 1.

12  
(CO3)  
(PO1, PO2)

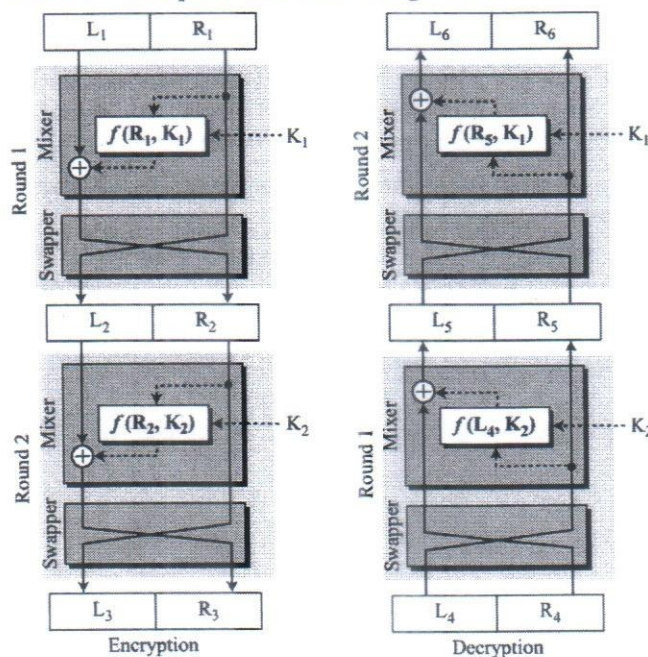


Figure 1: Figure for question 3(b)

Show appropriate mathematical calculations and reasoning to derive,  $L_6 = L_1$  and  $R_6 = R_1$ . Assess the differences between this design and its previous iterations.

- c) What is called the heart of Data Encryption Standard (DES)? Illustrate the working principle of S-Box in each round of DES.

7  
(CO3)  
(PO1, PO2)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
**Department of Computer Science and Engineering (CSE)**

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4749: Introduction to Cloud Computing**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
- 1. a) Compare the three cloud computing delivery models, SaaS, PaaS, and IaaS, from the application developers' and users' points of view. Discuss the security and reliability of each one of them. 7+4  
(CO1)  
(PO1)
  - b) Differentiate between the following: 3×3
    - i. Grid Computing and Cloud Computing. (CO1)
    - ii. Paravirtualization and Full virtualization. (PO1)
    - iii. Types of Hypervisors.
  - c) What is Service Oriented Architecture (SOA)? Explain how SOA is an enabling technology in cloud computing. 2+3  
(CO1)  
(PO1)
  
  - 2. a) An organization is debating whether to install a private cloud or to use a public cloud, e.g., the AWS, for its computational and storage needs, asks your advice. What information will you require to base your recommendation on, and how will you use each one of the following items: 10  
(CO3)  
(PO2)
    - i. The description of the algorithms and the type of applications the organization will run.
    - ii. The resources needed by each application.
    - iii. The size of the user population.
    - iv. The relative experience of the user population.
    - v. The costs involved.
  - b) You are given a host machine with 128 GB RAM and asked to use a VMM to create as many virtual machines as possible. Each of the virtual machines requires 6 GB RAM but only uses 4 GB RAM. How can you maximize the number of VMs your host machine can support? Calculate the amount of memory saved if you used memory overcommit. 5  
(CO2)  
(PO2)
  - c) Write short notes on the following: 10
    - i. Load Balancing. (CO1)
    - ii. Fault Tolerance in cloud computing. (PO1)
    - iii. Ballooning in memory reclamation.
    - iv. Static and Dynamic binary translation.
  
  - 3. a) Consider a Google File System (GFS) cluster with the following architecture assumptions and answer the following questions: 2+10+4  
(CO2)  
(PO2)
    - o There is one GFS Master and one shadow master. (PO2)
    - o There are 6 chunk servers in the cluster.
    - o The architecture uses a replica of (2) two.
    - o Each file is split into 3 chunks.

- i. What is Google File System (GFS)?
  - ii. With the help of a diagram, describe the process of a WRITE operation in a GFS cluster.
  - iii. What happens to the cluster if the chunk server with the primary replica fails?
- b) What is Dominant Resource Fairness (DRF) Scheduling? Consider a system with 9 CPUs, 18 GB RAM, and two users, where user A runs tasks with demand vector  $\langle 1 \text{ CPU}, 4 \text{ GB} \rangle$ , and user B runs tasks with demand vector  $\langle 3 \text{ CPUs}, 1 \text{ GB} \rangle$  each. Using DRF allocation, calculate the amount of CPU and RAM that will be assigned to each user.
- 2+7  
(CO1)  
(PO1)

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**  
**Department of Computer Science and Engineering (CSE)**

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4753: Bioinformatics**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) *Central Dogma* is a process of flowing genetic information from DNA to biological system. Describe in details how central dogma works. 10  
(CO1)  
(PO1)
- b) Compare *microarray* and *RNA-Seq* technology to measure gene expression. 8  
(CO2)  
(PO2)
- c) “*DNA length, gene count, or chromosome count* are not proportional to the complexity of a life form” – justify. 7  
(CO1)  
(PO2)
2. a) Two sequences are given as follows- 15  
(CO3)  
(PO2)  
 Sequence1: ATGCTAAC  
 Sequence2: CATGCTAC  
 And a substitution matrix is given in Table 1:

Table 1: Substitution Matrix for Question 2.a)

	A	T	G	C	-
A	1	-2	-2	-2	-1
T	-2	1	-2	-2	-1
G	-2	-2	1	-2	-1
C	-2	-2	-2	1	-1
-	-1	-1	-1	-1	

Find a global alignment for the sequences using *needleman-wunch* algorithm.

- b) Two sequences can be aligned in many different ways. How will you find the best alignment from a set of given alignments? – explain in detail. 10  
(CO3)  
(PO2)
3. a) Discuss how *multiple sequence alignment* can be achieved from *pairwise sequence alignment*. 5  
(CO3)  
(PO1)



- b) Distance matrix for sequences S1, S2, S3, S4, and S5 is shown in Table 2. Construct a guided tree for *ClustalW* method using *Neighbor Joining approach*.

15  
(CO3)  
(PO2)

Table 2: Distance matrix for Question 3.b)

	S1	S2	S3	S4	S5
S1	0				
S2	14	0			
S3	12	8	0		
S4	10	15	12	0	
S5	15	18	16	20	0

- c) Explain the necessary preprocessing techniques to train a *Logistic Regression* model for cancer classification on the data shown in Table 3.

5  
(CO3)  
(PO2)

Table 3: Gene expression data for cancer and non-cancer patients for Question 3.c)

	Gene1	Gene2	Gene3	-----	GeneK	Label
Person1	21733	0.1	50	-----	0	0
Person2	16444	0.7	50	-----	0	0
Person3	1520	2.2	0	-----	0	1
-----	700	0.9	50	-----	0	0
PersonN	2000	4.3	0	-----	0	1

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**

**Department of Electrical and Electronics Engineering (EEE)**

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 Hour 30 Minutes

FULL MARKS: 75

**CSE 6249: Data Mining**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question is written in the right margin.

1. (a) Consider the following dataset given in **Table 1**. 15

*Table 1: Dataset for question 1.*

TransactionID	Items
T1	{1, 2, 4, 6}
T2	{1, 2, 3, 4, 5}
T3	{1, 2, 3, 5}
T4	{1, 2, 4}

Considering the support threshold,  $s = 50\%$ , Find all frequent itemsets using the Apriori algorithm. Show the detail process of your answer, including candidate itemsets generation and pruning. Explain when necessary.

- (b) Based on the answer to Question 1. (a), List all of the strong association rules, along with their *support*, *confidence*, and *lift* values, which match the following metarule where X, Y, and Z are items. 10

$$\{X, Y\} \rightarrow \{Z\}$$

Please note that the support threshold,  $s = 50\%$ , and confidence threshold,  $c = 80\%$ .

2. (a) Consider the following dataset given in **Table 2**. 15

**Table 2:** Dataset for question 2.

TransactionID	Items
T1	{F, A, C, D, G, I, M, P}
T2	{A, B, C, F, L, M, O}
T3	{B, F, H, J, O, W}
T4	{B, C, K, S, P}
T5	{A, F, C, E, L, P, M, N}

Construct the *FP-Tree* for the dataset in **Table 2**. While constructing the tree, follow alphabetical order when two items have the same frequency.

- (b) Consider the same dataset given in **Table 2** and same support threshold as mentioned in **Question 1.(a)**. Apply the **PCY algorithm** to find frequent pairs with the following hash function. 10

$$h(X, Y) = (2 * X + Y) \% 11$$

List all the candidate pairs you obtained after the first pass of the PCY algorithm. Show the detail computation of your answer. Also, find the percentage of *False Positives* in this case.

3. (a) The Silhouette Coefficient or silhouette score is a metric used to calculate the goodness of a clustering technique. It can be calculated for each data point  $i$  according to the following formula.

$$s_i = \frac{b_i - a_i}{\max(b_i, a_i)}$$

where,  
 $b_i$  : is the inter-cluster distance defined as the average distance to the closest cluster of datapoint  $i$  except for that it's a part of

$$b_i = \min_{k \neq i} \frac{1}{|C_k|} \sum_{j \in C_k} d(i, j)$$

$a_i$  : is the intra-cluster distance defined as the average distance to all other points in the cluster to which it's a part of

$$a_i = \frac{1}{|C_i| - 1} \sum_{j \in C_i, i \neq j} d(i, j)$$

**Overall Silhouette score** for the complete dataset can be calculated as the mean of the silhouette score for all data points in the dataset.

Consider the two different clustering results (for  $k=2$  and  $k=3$ ) of the numbers 1 to 6 in the following Figure 1. Calculate the Overall Silhouette score of both clustering results and identify the best result.

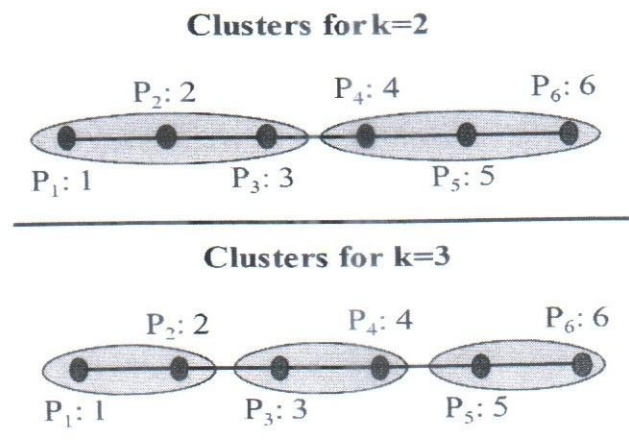


Figure 1: Clustering results for  $K = 2$  and  $K = 3$ .

(b) The following is a set of one-dimensional points: {6, 12, 18, 24, 30, 42, 48}. 10

**Find** the two clusters produced by both Single-Linkage and Complete-Linkage algorithms for Hierarchical Clustering. **Determine** the “more natural” cluster between these two sets of clusters. **Justify** your answer based on two concepts – *Cohesion* and *Separation*.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 6261: Advanced Probability and Stochastic Process**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Figures in the right margin indicate full marks.

1. a) A child is lost at Fantasy Kingdom in Dhaka. The father of the child believes that the probability of his being lost in the east side of the Fantasy Kingdom is 0.75 and in the west side is 0.25. The security department sends three officers to the east side and two to the west to look for the child. Suppose that an officer who is looking in the correct side (east or west) finds the child, independently of the others, with probability 0.4. Find the probability that the child is found in the east side, given that he has been found. 10
- b) A box contains 8 blue balls and 7 red balls. Suppose you randomly pick balls from the box one-after-another without replacement until you pick 3 blue balls and 2 red balls among the first five balls. If the first five balls that you pick are not exactly 3 blue balls and 2 red balls, then you return the balls in the box and start the process again. Let random variable  $X$  represent the number of attempts (in an attempt you pick five balls without replacement) you need to pick exactly 3 blue balls and 2 red balls. Find the PMF of  $X$ . 8
- c) The interarrival time  $T$  between "hits" on a certain web page is an exponential random variable with parameter  $\lambda = 0.5$  hits/minute. The average interarrival time is given by  $1/\lambda$ . Find the probability that the interarrival time between hits is greater than twice the average interarrival time. If it is given that the last hit occurred 1 minute before, find the probability that the next hit will occur after 3 minutes. 7
2. a) A fair die is tossed twice. The absolute difference of the outcomes is denoted by  $X$  and the largest value by  $Y$ . Calculate the joint probability mass function of  $X$  and  $Y$ . Find the marginal probability mass functions of  $X$  and  $Y$ . Find  $E[X]$ . 10
- b) An urn contains 100 chips of which 20 are blue, 30 are red, and 50 are green. Suppose that 20 chips are drawn at random and without replacement. Let  $B$ ,  $R$ , and  $G$  be the number of blue, red, and green chips, respectively. Calculate the joint probability mass function of  $B$ ,  $R$ , and  $G$ . 7
- c) At a certain college, 16% of the students of the probability course get A's, 34% B's, 34% C's, 14% D's, and 2% F's. Find the probability that, of 15 students of the probability course selected at random, five get B's, five C's, two D's, and at least two A's? 8
3. a) A prisoner is trapped in a cell containing three doors. The first door leads to a tunnel that returns him to his cell after two days of travel. The second leads to a tunnel that returns him to his cell after three days of travel. The third door leads immediately to freedom.
  - i. Assume that the prisoner will always select doors 1, 2, and 3 with probabilities 0.5, 0.3, 0.2, respectively. Find the expected number of days until he reaches freedom. 7
  - ii. Assume that the prisoner is always equally likely to choose among those doors that he has not used. Find the expected number of days until he reaches freedom. 8  
[If the prisoner initially tries door 1 (or door 2), then when he returns to the cell, he will now select only from door 2 (door 1) and door 3.]
- b) Random variables  $X$  and  $Y$  are independent and described by the probability density functions (PDFs) given Fig. 1.

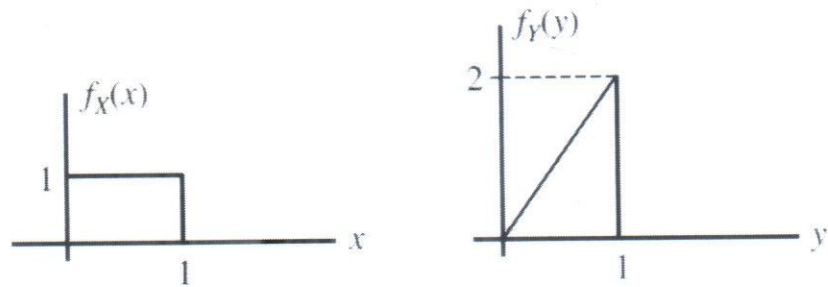


Fig. 1: PDFs of random variables X and Y for question 3 (b).

- i. Find the joint probability density function (JPDF)  $f_{XY}(x, y)$  of the random variables. Mention the range of values of X and Y for the JPDF and sketch the region. 5
- ii. Find the probability  $P[X \leq Y]$ . 5

Appendix A: PMF/PDF and the expected values of some Random Variables

Distribution	PMF/PDF	Expected value	Variance
Bernoulli	$P_X(x) = \begin{cases} 1-p & x=0 \\ p & x=1 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = p$	$Var[X] = p(1-p)$
Geometric	$P_X(x) = \begin{cases} p(1-p)^{x-1} & x \geq 1 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = 1/p$	$Var[X] = (1-p)/p^2$
Binomial	$P_X(x) = \begin{cases} \binom{n}{x} p^x (1-p)^{n-x} & x = 1, \dots, n \\ 0 & \text{otherwise} \end{cases}$	$E[X] = np$	$Var[X] = np(1-p)$
Pascal	$P_X(x) = \begin{cases} \binom{x-1}{k-1} p^k (1-p)^{x-k} & x = k, k+1, \dots \\ 0 & \text{otherwise} \end{cases}$	$E[X] = k/p$	$Var[X] = k(1-p)/p^2$
Poisson	$P_X(x) = \begin{cases} \frac{(\lambda T)^x e^{-\lambda T}}{x!} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = \alpha$ $\alpha = \lambda T$	$Var[X] = \alpha$
Uniform (discrete)	$P_X(x) = \begin{cases} \frac{1}{b-a+1}, & x = a, a+1, a+2, \dots, b \\ 0, & \text{otherwise} \end{cases}$	$E[X] = \frac{a+b}{2}$	$Var[X] = \frac{(b-a)(b-a+2)}{12}$
Exponential	$f_X(x) = \begin{cases} ae^{-ax} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = 1/a$	$Var[X] = 1/a^2$
Gaussian	$f_X(x) = \begin{cases} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}} & \sigma > 0 \\ 0 & \text{otherwise} \end{cases}$	$E[X] = \mu$	$Var[X] = \sigma^2$
Uniform (Continuous)	$f_X(x) = \begin{cases} \frac{1}{b-a}, & a \leq x < b \\ 0, & \text{otherwise} \end{cases}$	$E[X] = \frac{a+b}{2}$	$Var[X] = \frac{(b-a)^2}{12}$

Appendix B: Necessary formulas

Variance	$Var[X] = E[(X - \mu)^2] = E[X^2] - (E[X])^2$
Standardization of Normal Random Variable	$Z = \frac{X - \mu}{\sigma}$
Joint PDF of X and Y	$f_{XY}(x, y) = f_{X Y}(x y)f_Y(y)$
Joint PMF of X and Y	$P_{XY}(x, y) = P_{X Y}(x y)P_Y(y)$

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**MATH 4141: Differential Calculus and Geometry**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) Sketch the graph of the function: 10  

$$f(x) = \frac{x^2-9}{x^2-5x+6}$$
(CO1)  
 Discuss the continuity of the function. Also find the horizontal and vertical asymptotes, if any. (PO4)
- b) Find an equation for the tangent line to the trisectrix  $y^3 + yx^2 + x^2 - 3y^2 = 0$  at (0,3). At what point(s) in the first quadrant is the tangent line to the trisectrix vertical? 15  
(CO2)  
(PO2)
2. a) State Mean value Theorem. Expand  $f(x) = \log(x + h)$  in a finite series in powers of  $h$  and also find the remainder term. 8  
(CO3)  
(PO4)
- b) Suppose that liquid is to be cleared of sediment by allowing it to drain through a conical filter which is 18 cm high and has a radius of 5 cm at the top. Suppose that the liquid is forced out of the cone at a constant rate of 3 cm<sup>3</sup>/min. At what rate is the depth of the liquid in the filter changing when the liquid in the cone is 10 cm deep? 8  
(CO4)  
(PO1)
- c) If  $y = \sin(m \sin^{-1} x)$ , then find  $y_n(0)$ . 9  
(CO1)  
(PO4)
3. a) Transform the equation  $11x^2 + 24xy + 4y^2 - 20x - 40y - 5 = 0$  to rectangular axes through the point  $(-2,1)$  and inclined at an angle  $\tan^{-1}(\frac{4}{3})$  15  
(CO1)  
(PO2)
- b) Find the angle between two straight lines  $\alpha x^2 + 2\beta xy - \alpha y^2 = 0$ . Sketch the graph. 10  
(CO3)  
(PO3)

Name of the Program: B.Sc. in SWE  
Semester: 1<sup>st</sup>

Date: 03 October 2022  
Time: 02:30 pm – 04:00 pm

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination  
Course No.: Phy 4143  
Course Title: Physics II

Winter Semester: 2021 - 2022  
Full Marks: 75  
Time: 90 Minutes

There are **03 (three)** questions. Answer **03 (three)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets.

1. i. Find  $I$  in the circuit in Fig. 1 using superposition theorem.

5  
(CO2)  
(PO1, PO2)

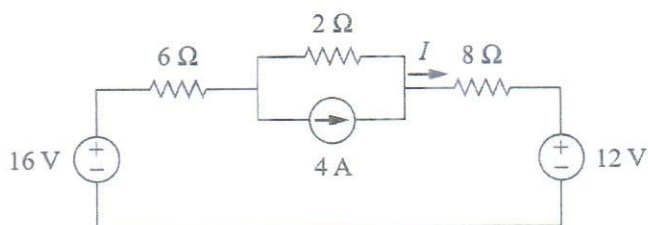


Fig. 1

- ii. Find  $i_0$  for the circuit in Fig. 2 using mesh analysis.

10  
(CO2)  
(PO1, PO2)

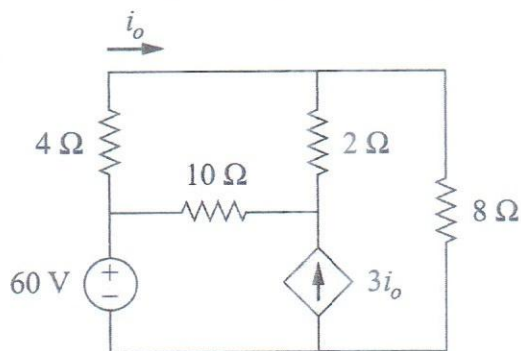


Fig. 2

- iii. For the circuit in Fig. 3, find the Thevenin equivalent circuit from the terminal a-b.

10  
(CO2)  
(PO1, PO2)

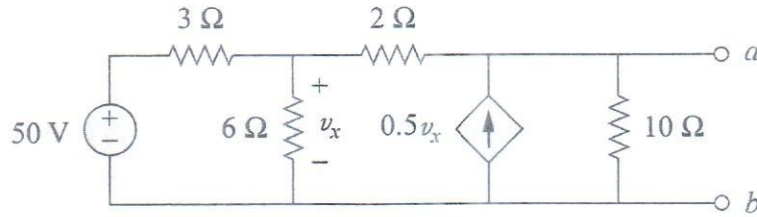


Fig. 3

2. i. For the circuit in Fig. 4, find  $i_1$  to  $i_5$ .

5  
(CO2)  
(PO1, PO2)

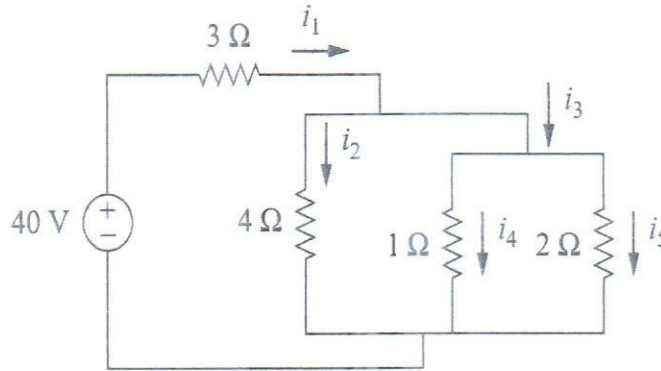


Fig. 4

ii. Determine equivalent resistance  $R_{ab}$  in the circuit in Fig. 5.

10  
(CO2)  
(PO1, PO2)

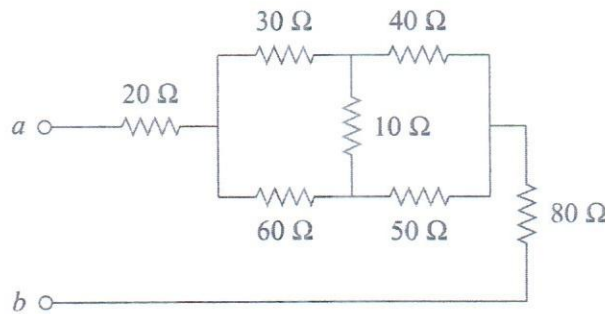
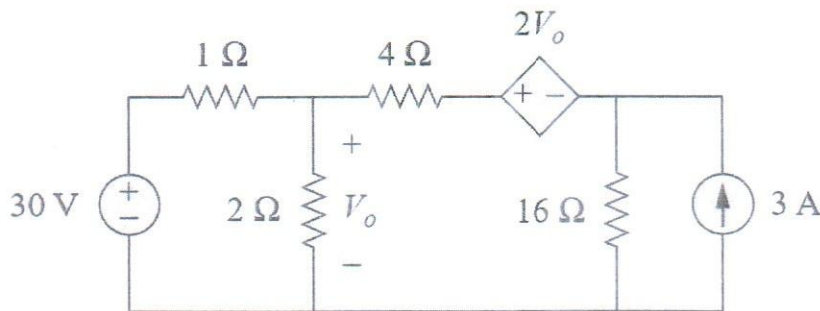


Fig. 5

iii. Find  $V_o$  in the following circuit in Fig. 6 using Nodal analysis.

10  
(CO2)  
(PO1, PO2)





3. i. For capacitors connected in parallel, why do you add the capacitances to obtain the equivalent capacitance, while in the case of resistors, you take the inverse of them? 5  
(CO1)  
(PO1)
- ii. Find  $i_0$  for the circuit in Fig. 7 using superposition theorem. 5  
(CO2)  
(PO1, PO2)

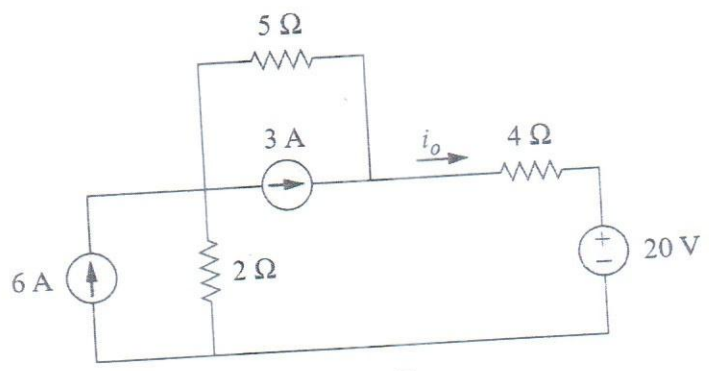


Fig. 7

- iii. Determine the current through a  $200\mu\text{F}$  capacitor whose voltage is shown in Fig. 8. 5  
(CO1)  
(PO1)

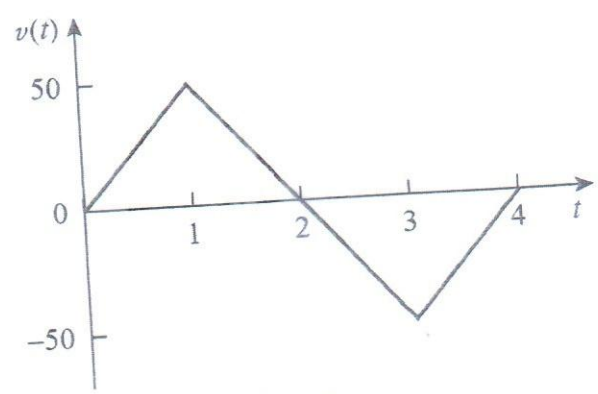


Fig. 8

- iv. For the circuit in Fig. 9, find the voltage across each capacitor. 10  
(CO2)  
(PO1, PO2)

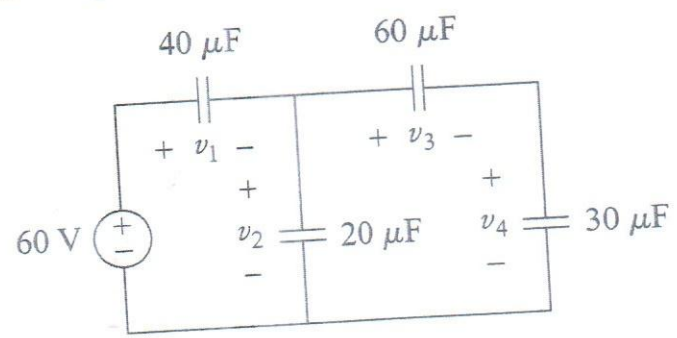


Fig. 9

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
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**Department of Computer Science and Engineering (CSE)**

**MID SEMESTER EXAMINATION**  
**DURATION: 1 HOUR 30 MINUTES**

**WINTER SEMESTER, 2021-2022**  
**FULL MARKS: 75**

**SWE 4301: Object Oriented Concepts-II**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. Consider, you are a software developer, who is working on a project. A code snippet of the project is given in Figure 1.

```

1 enum DegreeType {
2     RegularThesis, RegularNonThesis
3 }
4 public class MastersProgram {
5     private DegreeType dt;
6     private String major;
7     public MastersProgram(DegreeType type, String major){
8         this.dt = type;
9         this.major = major;
10    }
11    public boolean isEligible(float cgpa, String major){
12        if(dt == DegreeType.RegularThesis){
13            return this.major.equals(major) && cgpa >= 3.8;
14        } else {
15            return this.major.equals(major);
16        }
17    }
18    public int getMarks(int theoryM, int thesisM, int pm){
19        if(dt == DegreeType.RegularNonThesis){
20            return theoryM + pm/2;
21        } else {
22            return theoryM + thesisM;
23        }
24    }
25 }

```

**Figure 1:** Code Snippet for Question 1 and Question 2.a

- a) What is code smell? Detect at least 5 unique code smells and find at least 10 lines of code with smells. Mention the line number where a particular code smell is found. 12  
(CO2)  
(PO2)
- b) What is Refactoring? Why refactoring is useful in this context? Draw a class diagram or write a code that represents the expected code after refactoring. 3+10  
(CO4)  
(PO1)
2. a) A new type of degree named "Executive" is requested from the client for the project discussed in Question 1. To incorporate the change request, you analyzed the code base and identified that the existing code is not open for this extension. 3+4  
(CO2)  
(PO2)

- i. Find the locations of the code that require modification to implement the extension.
- ii. What are the benefits of the design you suggested in you answer to Question 1.b) has over the original design? Note that there is a lot more code in the project, the *MastersProgram* class is only a part of it.

b) Consider the *Car* class as shown in Figure 2, which uses an object of *Engine* class to operate. Both classes have other code that are not relevant for this question. 4+4  
(CO1)  
(PO1)

```

1 class Car {
2     Engine engine; // Engine class is declared somewhere
3     Car() {
4         engine = new Engine();
5     }
6 }

```

**Figure 2:** Code Snippet for Question 2.b

- i. From the design perspective, do you find any problem between the classes *Car* and *Engine*? Identify dependent class and dependee class?
- ii. Rewrite the code to demonstrate *Dependency Injection* for *Car* class.

c) State *Liskov Substitution Principle (LSP)*, and give a simple code example where *LSP* is violated and mention possible solution (without code). 10  
(CO2)  
(PO2)

3. a) A common phrase among the developer community is, "prefer composition over inheritance". How do you choose one over the another? Defend your preference with an example. 7  
(CO2)  
(PO2)

b) The *count* method of the class *Algorithm* as shown in Figure 3, only supports list elements of *Integer* type and checks whether an element of the list has a specific property or not (in this case, property is divisible by 3).

```

1 public class Algorithm {
2     public static int count(List<Integer> list) {
3         int count = 0;
4         for (Integer elem : list)
5             if (elem%3 == 0)
6                 ++count;
7         return count;
8     }
9 }

```

**Figure 3:** Code Snippet for Question 3.b

i. Rewrite a generic version of this method so that any type of list can be supported. Elements of the list may have a different property like even number, or palindrome string. 8  
(CO2)  
(PO2)

ii. Write 2 unit test cases to check the correctness of the program in Figure 3 4  
(CO3)  
(PO1)

c) What is Test Driven Development (TDD)? Write 3 differences between TDD and Unit Testing. 6  
(CO3)  
(PO1)

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4303: Data Structures**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer all **3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Suppose that we have inserted all the integers between 1 and 1000 (inclusive) in a Binary Search Tree (BST). When searching for an integer  $X$  in the BST, a sequence of numbers can be encountered. 12  
(CO2)  
(PO2)
- With proper justification, determine the validity of the following sequences when  $X = 363$ :
- i. 2, 252, 401, 398, 330, 344, 397, 363.
  - ii. 924, 220, 911, 244, 898, 258, 362, 363.
  - iii. 925, 202, 911, 240, 912, 245, 363.
  - iv. 2, 399, 387, 219, 266, 382, 381, 278, 363.
- b) Assume that you have an empty AVL tree. Now, sketch the resulting AVL trees after performing each of the following operations sequentially maintaining the necessary conditions of an AVL tree: 13  
(CO3)  
(PO2)
- Insert (2)
  - Insert (1)
  - Insert (4)
  - Insert (3)
  - Insert (6)
  - Insert (5)
  - Insert (8)
  - Insert (7)
  - Insert (10)
  - Insert (9)
  - Delete (2)
  - Delete (3)
  - Insert (11)
2. a) The central cafeteria of IUT has a single food counter. The students line up in front of the counter to take their lunch. On a Friday,  $2n$  students queued up to take lunch before the Jumma prayer. The people in charge of the cafeteria realized that the single counter will not suffice to serve all the  $2n$  students in time before the Jumma Prayer. So, they set up a second counter at the end of the line and offered to serve food to students at both ends of the line. But the other students protested: "The last student was last! This is not fair!" To resolve the issue, the people in charge decided to divide the students into two groups. The first  $n$  students of the line will remain in their original positions. The last  $n$  students will invert their order in such a way that the  $(n + 1)$ <sup>th</sup> student in the first line becomes the first customer at the second counter, and the final student in the first line becomes the last student in the second counter. 7+8  
(CO4)  
(PO2)

- i) Given a doubly linked list containing the names of the  $2n$  students, in order of the original line formed in front of the first counter (where the first node contains the name of the first student in line), propose an  $O(n)$  time algorithm to modify the linked list to reverse the order of the last half of the list. Your algorithm should not make any new linked list nodes or instantiate any new non-constant-sized data structures during its operation.
- ii) Other than the strategy that the people in charge came up with when a new counter was set up, propose any other strategy that can provide a fairer solution. Also propose a suitable algorithm to make necessary changes in the doubly linked list.

b) Apply heap sort to organize the following list of integers in ascending order: 10  
 $1, 89, -7, -A, 2, 10, 89, A, B, A \times B, -25, -2 \times B$  (CO1)  
(PO1)

Here,  
 $A = 1 + (\text{Student ID} \% 9)$   
 $B = \left\lfloor \frac{\text{Student ID}}{100} \right\rfloor \% 100$ , where  $\lfloor \rfloor$  = Floor Operation  
 You must show all the necessary steps.

3. a) The following expressions are written in Reverse Polish notation: 9
- i)  $1\ 2\ +\ *\ 4\ 5\ *\ 6\ +\ +$  (CO3)
  - ii)  $1\ 2\ 3\ +\ *\ 4\ 5\ *\ +\ +$  (PO2)
  - iii)  $1\ 2\ +\ 3\ *\ 4\ 5\ *\ 6\ +$

Evaluate the result of the expressions using stack.

- b) Determine the amortized cost of  $n$  pushback calls in a Dynamic Array. 6  
(CO3)  
(PO2)
- c) Given a stack  $S$  containing integers and an integer  $k$ , propose an algorithm that will re-order  $S$  so that the top value is swapped with the  $k^{\text{th}}$  value from the top. All other values in the stack should retain their positions. If  $k$  is greater than the number of values in the stack, there will be no change. 10  
(CO4)  
(PO2)

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**Department of Computer Science and Engineering (CSE)**

MID SEMESTER EXAMINATION  
 2022

WINTER SEMESTER, 2021-

DURATION: 1 HOUR 30 MINUTES

FULL MARKS:

75

**CSE 4309: Theory of Computing**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Define "*Finite Automaton*". Explain  $\delta$  for DFA, NFA and  $\epsilon$ -NFA. 4  
(CO1)  
(PO1)
- b) Design a DFA for the language accepting strings ending in either '01' or '10' over input alphabet,  $\Sigma = \{0, 1\}$ . 6  
(CO2)  
(PO2)
- c) Design an NFA to recognize *abc*, *abd*, and *aacd* over the alphabet  $\Sigma = \{a, b, c, d\}$ . 6  
(CO2)  
(PO2)
- d) The classic game Pac-Man requires the player to navigate through a maze, eating pellets and avoiding the ghosts who chase him through the maze. Occasionally, Pac-Man can turn the tables on his pursuers by eating a power pellet, which temporarily grants him the power to eat the ghosts. When this occurs, the ghosts' behavior changes, and instead of chasing Pac-Man, they try to avoid him. The ghosts in Pac-Man have four behaviors :
- Randomly wander the maze
  - Chase Pac-Man, when he is within line of sight
  - Flee Pac-Man, after Pac-Man has consumed a power pellet
  - Return to the central base to regenerate
- Draw the state diagrams of a Finite Automata that emulates the behaviors of the ghosts in Pac-Man. Show the states that the ghosts might be in at any given moment and also what inputs they take to make a transition from one state to another state.
2. a) State the differences between a DFA and an NFA. 3  
(CO1)  
(PO1)
- b) Compute the  $\epsilon$ -closure of each state and convert the following  $\epsilon$ -NFA shown in Table 1 to its equivalent DFA. 6  
(CO5)  
(PO2)

	$\epsilon$	a	b	c
$\rightarrow p$	$\emptyset$	{p}	{q}	{r}
q	{p}	{q}	{r}	$\emptyset$
* r	{q}	{r}	$\emptyset$	{p}

**Table 1:** Transition table of an  $\epsilon$ -NFA for Question 2(b)

- c) Consider the following NFA,  $N = (Q, \Sigma, \delta, q, F)$ , where  $Q = \{1, 2, 3\}$ ,  $\Sigma = \{a, b\}$ ,  $q = \{1\}$ ,  $F = \{2\}$ . Convert this NFA to an equivalent DFA. After that, minimize the DFA reducing the number of states which will accept the same language. (CO3) (PO2)

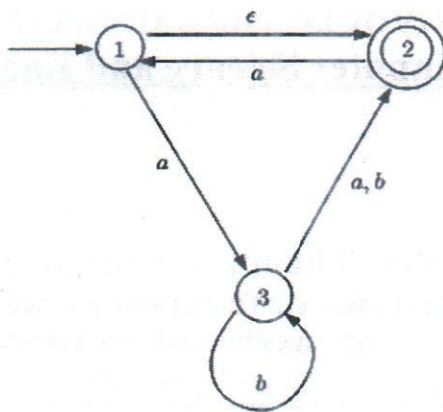


Figure 1: State Diagram of an NFA for Question 2(c)

- d) A vending machine is an automated machine that provides items such as snacks, beverages, lottery tickets to consumers after money, a credit card, or a specially designed card is inserted into the machine. Consider a very simple vending machine which provides pen at a cost of 10 BDT each. The machine takes 2 BDT, 5 BDT, and 10 BDT only, and does not return changes even if you pay more than the price of a pen. It accepts payment only if you pay at least or more than the rate for a pen, otherwise rejects. There is a reset button in the machine which someone can press anytime to start a new purchase. Design a DFA (state diagram) for this vending machine. (CO2) (PO2)
3. a) What is the order of precedence followed by the operators of Regular Expression? Write some applications of Regular Expression. (CO1) (PO1) 5
- b) Using pumping lemma of regular languages, show that the language,  $L = \{0^n 1^n \mid n \geq 0\}$  is not regular. (CO1) (PO1) 6
- c) Given an NFA,  $N_1 = (Q_1, \Sigma, \delta_1, q_1, F_1)$  that accepts language  $A$ , and an NFA,  $N_2 = (Q_2, \Sigma, \delta_2, q_2, F_2)$  that accepts language  $B$ . Show that there exists an NFA,  $N$  that recognizes the language  $A.B$ . Give a formal definition of the NFA,  $N$ . (CO1) (PO2) 6
- d) Convert the following Regular expression to an equivalent NFA. 2x4
- i.  $(0 \cup 10)^* 010 (0 \cup 1)^*$  (CO5)
  - ii.  $a (abb)^* \cup b$  (PO1)

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**Math 4341: Linear Algebra**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) Consider the following three matrices

18+2  
(CO1)  
(PO1)

$$A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \quad C = \begin{bmatrix} a & 1 & 1 \\ 0 & a & 1 \\ 0 & 0 & a \end{bmatrix}$$

- i. Determine if the matrices  $A$ ,  $B$  and  $C$  are invertible. If any of the matrices is invertible, find its inverse by Gauss-Jordan elimination. For matrix  $C$ , find the inverse in terms of  $a$ , if it exists.
- ii. For what values of  $a$  is  $D$  invertible? How does your formula for  $D^{-1}$  breakdown for values of  $a$  for which  $D$  is not invertible?

- b) Consider the following matrix  $A$ ,

5  
(CO1)  
(PO1)

$$A = \begin{bmatrix} a & 2 & 3 \\ a & a & 4 \\ a & a & a \end{bmatrix}$$

Find three values of  $a$ , for which the elimination process will fail to give three pivots for this matrix. In other words, for which three values of  $a$  is this matrix singular?

2. a) Assume that  $S$  and  $T$  are lines in  $\mathbb{R}^4$  (4-dimensional space) the pass through  $(0, 0, 0, 0)$ . So,  $S$  and  $T$  both can be considered as subspaces of  $\mathbb{R}^4$

2+3+3  
(CO3)  
(PO1)

- i. When is the union  $S \cup T$  of the two lines also a subspace?
- ii. If  $S \cup T$  is not a subspace, describe the smallest possible subspace that contains both lines  $S$  and  $T$ .
- iii. If  $S$  and  $T$  are ANY type of subspaces of  $\mathbb{R}^4$ , not necessarily lines, how would you construct the smallest subspace that contains both  $S$  and  $T$ ?

- b) Find the complete solution of the following:

10  
(CO2)  
(PO1)

$$\begin{bmatrix} 1 & 3 & 1 & 2 \\ 2 & 6 & 4 & 8 \\ 0 & 0 & 2 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ t \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix}$$

Show all necessary steps.

- c) Does there exist a matrix  $B$  whose column space is spanned by  $(1, 2, 3)$  and  $(1, 0, 1)$  and whose nullspace is spanned by  $(1, 2, 3, 6)$ ? If so, construct  $B$ . If not, explain why not.

7  
(CO3)  
(PO3)



3. a) Forward elimination changes  $Ax = b$  to a row-reduced form  $Rx = d$ , and the complete solution for  $Ax = b$  is:

10+10  
(CO2)  
(PO1)

$$x = \begin{bmatrix} 4 \\ 0 \\ 0 \end{bmatrix} + c \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix} + d \begin{bmatrix} 5 \\ 0 \\ 1 \end{bmatrix}$$

- i. What is the 3 by 3 reduced row echelon matrix  $R$ ? What is  $d$ ?
  - ii. If the process of elimination subtracted 3 times row 1 from row 2 and then 5 times row 1 from row 3, what matrix connects  $R$  and  $d$  to the original  $A$  and  $b$ ? Use this matrix to find  $A$  and  $b$ . Remember, no upward elimination was involved in the process.
- b) Suppose  $A$  and  $B$  are 3 by 3 matrices.
- i. If a vector  $v$  is in the column space of  $AB$ , why is  $v$  also in the column space of  $A$ ? [Hint:  $b$  is in the column space of  $A$  means there is some  $x$  for which  $Ax = b$  is true.]
  - ii. Give an example for both  $A$  and  $B$  so that  $C(AB)$  is smaller than  $C(A)$ .

2+3  
(CO3)  
(PO1)

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION  
DURATION: 1 HOUR 30 MINUTES

WINTER SEMESTER, 2021-2022  
FULL MARKS: 75

**CSE 4501: Operating Systems**

Programmable calculators are not allowed. Do not write anything on the question paper.  
Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) What is an Operating System? Describe from both the user's point of view and the system's point of view how an Operating System ensures ease of use and good performance of the Computer System through proper utilization of the resources. 2+8  
(CO1)  
(PO1)
  - b) Explain the concept of 'Cache' in Operating System (OS). What do you understand by 'Cache Coherency'? Discuss, with examples, how the problem of Cache Coherency is handled in a Single-Processor system. 2+2+4  
(CO2)  
(PO1)
  - c) The Government of Bangladesh has hired you to design a dedicated Weather Forecasting System just for Bangladesh. The Bangladesh Meteorological Department operates four (4) sub-stations across the nation. Local forecasting is the responsibility of each sub-station. 7  
(CO1)  
(PO2)  
Now, as an operating system designer, which of the Single Processor System, Multi-Processor System, and Clustered System should you select to ensure better and more accurate weather forecasting? Explain your answer.
  2. a) What are System Calls? Write the sequence of System Calls executed by the Operating System (OS) when a user wants to copy the content of a file (e.g., *file1.txt*) to another file (e.g., *file2.txt*). OS should show the notification if any one of the files does not exist. OS should also check the *read* and *write* permission of the files. 2+8  
(CO1)  
(PO1,  
PO2)
  - b) Explain different structures of Operating Systems with their advantages and disadvantages. It is sometimes difficult to achieve a layered approach if two components of the Operating Systems are dependent on each other. Identify a scenario in which it is unclear how to layer two system components that require tight coupling of their functionalities. 5+5  
(CO1)  
(PO1,  
PO2)
  - c) Describe the relationship between an API, the System-Call interface and the Operating System. 5  
(CO1)  
(PO1)
  3. a) What do you understand by Context Switch? What is the relation between Context Switch and Process Control Block (PCB)? Explain in detail with a diagram how the processor executes interruption with the help of the concept of Context Switch when a lower priority process, P1, is interrupted by a higher priority process, P2. 2+2+5  
(CO1)  
(PO1)

- b) What will be the output at lines A, B, C and D? (Assume that the process, executing the following lines of code with process ID 1900, creates a child process with process ID 1901.)

8  
(CO2)  
(PO2)

```
#include<sys/types.h>
#include<stdio.h>
#include<unistd.h>
#include<sys/wait.h>

int main()
{
    pid_t pid, pid1;
    /* fork a child process */
    pid = fork();
    if (pid < 0) { /* error occurred */
        fprintf(stderr, "Fork Failed");
        return 1;
    }
    else if (pid == 0) { /* child process */
        pid1 = getppid();
        printf("child: pid = %d",pid); /* A */
        printf("child: pid1 = %d",pid1); /* B */
    }
    else { /* parent process */
        pid1 = getpid();
        printf("parent: pid = %d",pid); /* C */
        printf("parent: pid1 = %d",pid1); /* D */
        wait(NULL);
    }
    return 0;
}
```

- c) Make a note on how Local Procedure Call (LPC) is different from the Standard Remote Procedure Call (RPC) and also point out similarities between them. Is it possible to use standard RPC instead of LPC to get similar performance in windows? Explain your answer.

4+4  
(CO2)  
(PO2)

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 50

**SWE 4501: Design pattern**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

- 
1. a) What are the main components of OOP? Explain the statement “classes should be open for extension and closed to modification” with proper example. 1+3  
(CO1)  
(PO1)
  - b) Consider the following scenarios and write down the name of the design pattern or principle that would be the most appropriate for each of them. 3  
(CO4)  
(PO2)
    - i. You are building a system that relies on a complex algorithm, and that algorithm may be changed often due to marketing pressures.
    - ii. A pizza factory produces pizzas with various toppings. There are 20 different toppings and a customer may order any combination of toppings. Assume that each of pizza bread and each topping will be represented by a different class.
    - iii. We are building a cricket app that notifies viewers about the information such as *current score*, *run rate* etc. Suppose we have made two display elements **CurrentScoreDisplay** and **AverageScoreDisplay**. **CricketData** has all the data (runs, bowls etc.) and whenever data changes the display elements are notified with new data and they display the latest data accordingly.
  - c) Explain a scenario where the Adapter Pattern can be used. Write the corresponding code for that scenario. Also, draw the UML diagram for that scenario. 8  
(CO4)  
(PO2)
  2. a) Briefly, explain the purpose of the “Decorator Pattern”. List three distinct advantages of factory methods over constructor. 3  
(CO3)  
(PO1)
  - b) Identify a pattern which can define a one-to-many dependency between objects so that when one object changes its state, all of its dependents are notified and updated automatically. Briefly explain that pattern. Also discuss the advantages and disadvantages of that pattern. 5  
(CO3)  
(PO1)
  - c) Draw a UML diagram for the Mediator Pattern between web services and web clients. Consider the web services Ebay auction house and Amazon, plan functions to search for an item with a textual description, and to buy an item from the service that gives you the best price. 2+5  
(CO4)  
(PO2)
  3. a) Explain a pattern satisfying the statement (program to an interface, not to an implementation) with real world scenario. 7  
(CO4)  
(PO2)
  - b) Which design pattern uses composition to extend the capabilities of an object at runtime? Explain a scenario satisfying that pattern. Draw an UML diagram for that scenario. 2+5+5  
(CO4)  
(PO2)
  - c) Differentiate between: 3
    - i. Method Overloading and Overriding (CO3)
    - ii. Prototype and Singleton (PO1)
    - iii. Coupling and Cohesion

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**Math 4543: Numerical Methods**

Programmable calculators are not allowed. Do not write anything on the question paper

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin.

1. a) Suppose you have a spherical oil tank that is 6 ft in diameter. After using up some oil from your tank, you want to know how much oil is left in the tank. One way of getting this information is to design such a ruler that you can dip inside the tank and based on the height of the ruler that becomes wet with oil, you can find the volume of oil left in the tank.

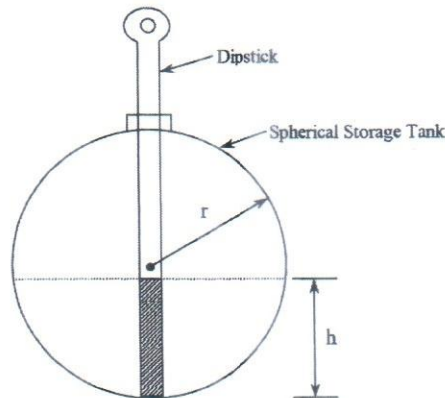


Figure 1: Oil in a spherical storage tank

Suppose you found that the relationship between the volume of oil and the height of the ruler that will be marked with oil is given as:

$$V = \frac{\pi h^2(3r - h)}{3}$$

where  $r$  is the radius of the spherical tank.

For marking the different heights of the ruler, you would have to solve the above nonlinear equation for different volumes. Suppose you wanted to use a bracketing method like Regula Falsi, otherwise known as the False Position Method.

- |      |  |                       |
|------|--|-----------------------|
| i.   | Formulate the given scenario as a nonlinear equation problem that can be solved using the False Position Method.   | 4<br>(CO1)<br>(PO2)   |
| ii.  | Apply the False Position method and perform at least 4 iterations to find the height at which you would mark the scale for measuring 4 ft <sup>3</sup> of oil. | 10<br>(CO2)<br>(PO1)  |
| iii. | Analyze your results to see if you are converging towards the solution by checking the absolute relative approximate error at each iteration.                  | 3<br>(CO3)<br>(PO2)   |
| b)   | Differentiate between Round Off Error and Truncation Error? What are the different ways Truncation error may be introduced?                                    | 5+3<br>(CO3)<br>(PO2) |

- 2. a) i. The Maclaurin series is a special case of Taylor series. Find the Maclaurin series for  $\cos(x)$  starting from the general definition of Taylor Series. 4  
(CO1)  
(PO2)
- ii. Estimate the bounds of the truncation error in the representation of  $\cos 2$  using the Remainder Theorem, given that only the first 3 terms of the Maclaurin series are used. 6  
(CO3)  
(PO2)

b) The upward velocity of a rocket is given as a function of time in Table 1:  
**Table 1: Velocity as function of time for Question 2.(b)**

T (s)	V (ms <sup>-1</sup> )
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

Solve the following problems using the spline interpolation method with linear splines:

- i. What is the velocity of the rocket at  $t = 14$ ? 6  
(CO2)  
(PO1)
  - ii. What is the acceleration of the rocket at  $t = 21$ ? 4  
(CO2)  
(PO1)
  - iii. What is the distance travelled by the rocket from  $t = 14$  to  $t = 21$ ? 5  
(CO2)  
(PO1)
- 3. a) Find the Quadratic form of Newton's Divided Difference polynomial and using its pattern, find the Cubic form of Newton's Divided Difference polynomial. 9+3  
(CO1)  
(PO2)
  - b) Compute  $f(6)$ ,  $f'(6)$  and  $f''(6)$  given that  $f(5) = -30$ ,  $f'(5) = 10$ ,  $f''(5) = 16$  and  $f'''(5) = 6$  and all higher derivatives of  $f(x)$  at  $x = 5$  are zero. 5+4+4  
(CO2)  
(PO1)

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MID SEMESTER EXAMINATION

WINTER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 75

**CSE 4553: Machine Learning**

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.

1. a) For a color detection application, suppose you want to display the name of the color and the approximated color intensity values of red, green, and blue color in a test image. Whenever you click in any area of the image, the output will be the color name and the corresponding intensity values of red, green, and blue. The system has color datafile containing color intensity values of 864 different colors with their names. You have calculated distance measures between the test color and the datafile colors. The output color name and the approximated intensity value are determined based on the closest distance of intensities obtained from the test color and the datafile colors' difference. Is it a machine learning problem? Justify your explanation. 7  
(CO1)  
(PO2)
- b) Consider a dataset consisting of two Boolean variables  $X_1, X_2 \in \{0,1\}$  and label,  $Y \in \{0,1\}$ . In figure 1, there are three positive examples ('+' for  $Y = 1$ ) and one negative example ('-' for  $Y = 0$ ). 8  
(CO1)  
(PO1)

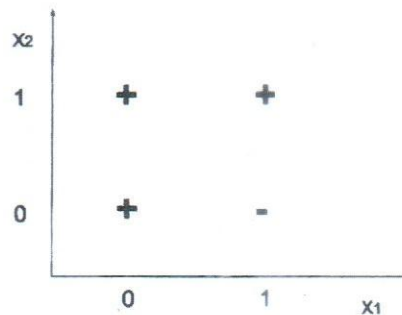


Figure 1: An example dataset

Explain which regression model is better for predicting the samples, linear regression model or logistic regression model.

- c) Write the steps of developing a machine learning application with a real-life example. 10  
(CO1)  
(PO1)
2. a) In case of univariate feature for linear regression, the weight update equations of batch gradient descent algorithm is given below: 8+5  
(CO1)  
(PO1)
- $$\text{Repeat until convergence } \{$$
- $$\theta_0 := \theta_0 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^i) - y^i)$$
- $$\theta_1 := \theta_1 - \alpha \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x^i) - y^i) x^i$$
- $$\}$$

Consider the learning rate,  $\alpha = 0.001$  and initial weight values are,  $\theta_0 = 0$  and  $\theta_1 = 0$ . For the work- experience-salary dataset given in Table 1,

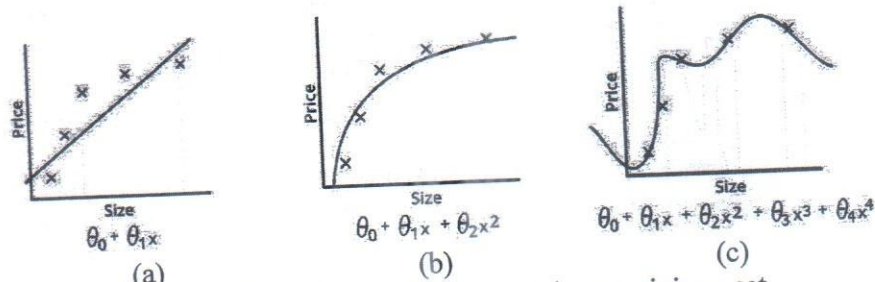
Table 1: Work-experience-salary dataset

Experience (X) in years	Salary (Y), in millions (BDT)
2	3
6	5
5	4
7	6

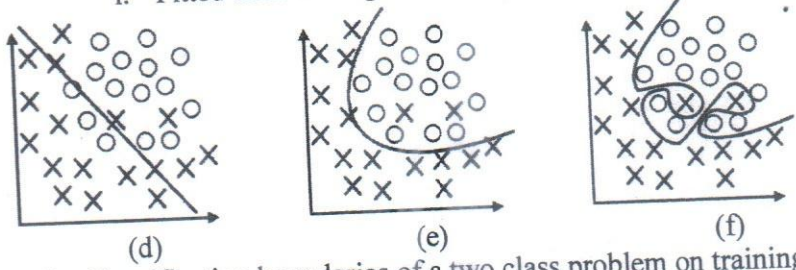
Now, answer the following questions:

- i. Perform two iterations to find out the updated weights and predicted outputs by the hypothesis function for each iteration.
  - ii. In each iteration, find the output of the cost function using sum squared error (SSE). How do you understand that the algorithm is converging?
- b) Consider the graphs given in Figure 2.

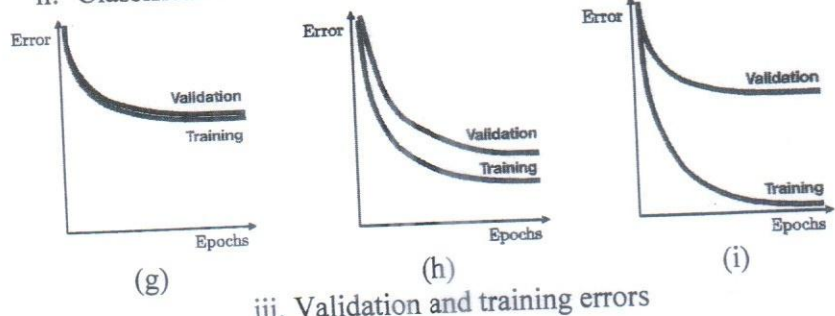
12  
(CO2)  
(PO2)



i. Fitted lines for regression models on training set



ii. Classification boundaries of a two class problem on training set



iii. Validation and training errors

Figure 2: Example graphs for (i) regression models, (ii) classification models, (iii) error vs epoch of classification models

Now, answer the following questions:

- i. Briefly explain which models are underfitted or overfitted or just rightly fitted in terms of bias and variance for each of the graphs in Figure 2(i), Figure 2(ii), and Figure 2(iii).
- ii. Write the remedies for underfitting and overfitting.



- 3. a) What do you mean by probabilistic generative classification model? How is the Bayes theorem applied in Naïve Bayes classification model? 8  
(CO1)  
(PO2)
- b) In the dataset shown in Figure 1, apply Naïve Bayes classifier to determine the prior probabilities  $P(Y)$ , and conditional probabilities  $P(X_i|Y = 1)$ , and  $P(X_i|Y = 0)$ . 5  
(CO1)  
(PO1)
- c) Consider the following dataset in Table 2 to learn a decision tree that predicts if people pass machine learning course (Yes or No), based on their previous GPA (High, Medium, or Low) and whether or not they studied. 12  
(CO1,  
CO3)  
(PO3)

Table 2: Dataset for Decision Tree

GPA	Studied	Passed
L	F	F
L	T	T
M	F	F
M	T	T
H	F	T
H	T	T

Now, answer the following questions:

- i. What is the Entropy,  $H(Passed)$ ?
- ii. What is the Entropy,  $H(Passed | GPA)$ ?
- iii. What is the Entropy,  $H(Passed | Study)$ ?
- iv. Draw the full decision tree that would be learned for this dataset.

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**MID SEMESTER EXAMINATION  
DURATION: 1 HOUR 30 MINUTES**

**WINTER SEMESTER, 2021-2022  
FULL MARKS: 75**

**CSE 4559: Introduction to Cloud Computing**

**Programmable calculators are not allowed. Do not write anything on the question paper.**

**Answer all 3 (three) questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets.**

- 
- |       |   |                          |
|-------|---|--------------------------|
| 1. a) | Compare the three cloud computing delivery models, SaaS, PaaS, and IaaS, from the application developers' and users' points of view. Discuss the security and reliability of each one of them.  | 7+4<br>(CO1)<br>(PO1)    |
| b)    | Differentiate between the following:<br>i. Grid Computing and Cloud Computing.<br>ii. Paravirtualization and Full virtualization.<br>iii. Types of Hypervisors.   | 3×3<br>(CO1)<br>(PO1)    |
| c)    | What is Service Oriented Architecture (SOA)? Explain how SOA is an enabling technology in cloud computing.  | 2+3<br>(CO1)<br>(PO1)    |
| 2. a) | An organization is debating whether to install a private cloud or to use a public cloud, e.g., the AWS, for its computational and storage needs, asks your advice. What information will you require to base your recommendation on, and how will you use each one of the following items:<br>i. The description of the algorithms and the type of applications the organization will run.<br>ii. The resources needed by each application.<br>iii. The size of the user population.<br>iv. The relative experience of the user population.<br>v. The costs involved. | 10<br>(CO3)<br>(PO2)     |
| b)    | You are given a host machine with 128 GB RAM and asked to use a VMM to create as many virtual machines as possible. Each of the virtual machines requires 6 GB RAM but only uses 4 GB RAM. How can you maximize the number of VMs your host machine can support? Calculate the amount of memory saved if you used memory overcommit.  | 5<br>(CO2)<br>(PO2)      |
| c)    | Write short notes on the following:<br>i. Load Balancing.<br>ii. Fault Tolerance in cloud computing.<br>iii. Ballooning in memory reclamation.<br>iv. Static and Dynamic binary translation.  | 10<br>(CO1)<br>(PO1)     |
| 3. a) | Consider a Google File System (GFS) cluster with the following architecture assumptions and answer the following questions:<br>o There is one GFS Master and one shadow master.<br>o There are 6 chunk servers in the cluster.<br>o The architecture uses a replica of (2) two.<br>o Each file is split into 3 chunks.  | 2+10+4<br>(CO2)<br>(PO2) |

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- i. What is Google File System (GFS)?
  - ii. With the help of a diagram, describe the process of a WRITE operation in a GFS cluster.
  - iii. What happens to the cluster if the chunk server with the primary replica fails?
- b) What is Dominant Resource Fairness (DRF) Scheduling? Consider a system with 9 CPUs, 18 GB RAM, and two users, where user A runs tasks with demand vector  $\langle 1 \text{ CPU}, 4 \text{ GB} \rangle$ , and user B runs tasks with demand vector  $\langle 3 \text{ CPUs}, 1 \text{ GB} \rangle$  each. Using DRF allocation, calculate the amount of CPU and RAM that will be assigned to each user.
- 2+7  
(CO1)  
(PO1)