

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

SEMESTER FINAL EXAMINATION
DURATION: 2 HOURS

WINTER SEMESTER, 2023-2024
FULL MARKS: 120

CSE 4105: Computing for Engineers

Programmable calculators are not allowed. Do not write anything on the question paper.
Answer all **4 (four)** questions. Marks of each question are written in the right margin with brackets.

1. a) Can you explain the followings in terms of OS working mechanism: 3 × 5
- i. A computer program like 'word.exe' does not take any CPU time when the projector is showing the graphics output, whereas a program for calculating n-th Fibonacci number is hungry for CPU.
 - ii. When a computer is running many programs, it often happens that text input to the 'word.exe' program experiences a delayed output.
 - iii. It is observed that a folder/directory, X, when moved to another directory, Y, in the same physical drive (D:\), does not take much time in the 'move' operation; whereas when the files inside the folder, X, are 'cut' and 'pasted' in directory Y, it takes much more time when number of files are many (e.g. 5000 files).
- b) A novice user used the commands **ls** and **cd** as shown in the following Code Snippet 1 and got a message: 'Error: not a directory'.

```

1 # pwd
2 /
3 #ls
4 user          bin          etc          home          dev
      var          myfileDirDev
5 # cd myfileDirDev
6 Error: not a directory

```

Code Snippet 1: A Bash script for question Question 1.b

- i. What is the cause of such error? What actions need to be performed to investigate the contents of **myfileDirDev**? 2
 - ii. What will be the output of the **ls -l** when typed in the command prompt? (two line sample output will be enough for the demonstration) 3
 - iii. Write a program that will take the output of **ls -l** as input and will just print the number of files and directories. Write a simple **algorithm** for the purpose. (you can assume any algorithmic artefact as needed without implementation, for example **getLine()**, etc) 5
 - c) When OS transfers the control of the CPU to any program, how does it regain control of the CPU? 5
2. a) What do you understand by 'Man-month'? Can you always increase software project's productivity by hiring more people? Explain. 5
- b) What are the cloud services commonly referred to as '-aaS'? Which is the cloud service that reaches the end users? 6 + 4
- c) Suppose you have a matrix: 2 × 5

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

- i. How do you create a two-dimensional array in python using the above data named as, myarray.
 - ii. What will be the output of the operation, myarray[:,1]?
 - iii. What will be the output of the operation myarray[2,:]?
 - iv. What will be the output of the operation myarray[1:3,1:3]?
 - v. What will be the output of the operation myarray[1:3,-1]?
 - d) Write few lines of code to demonstrate that Python is an interpreted language.
3.
 - a) Sections in a PE has the four information in the section header: ['SizeOfRawData', 'PointerToRawData', 'VirtualSize', 'VirtualAddress']. How does the loader use these information?
 - b) FileAlignment is an Optional Header entry in PE that may help virus to creep into an executable. Explain by language or graphics.
 - c) How does virus do obscuration and/or polymorphism to disguise itself?
 - d) IAT viruses are hard to detect-why?
 - e) Briefly explain XSS, SQL Injection attack on web applications.
 4.
 - a) Briefly discuss on HIPAA and FISMA. How much are they enacted in USA?
 - b) Briefly describe the task of miner in a block chain.
 - c) How does block chain invalidate double spending?
 - d) How is PoW byzantine fault tolerant?
 - e) How is the Merkle Tree used in Block chain?

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SEMESTER FINAL EXAMINATION
DURATION: 2 HOURS

WINTER SEMESTER, 2023-2024
FULL MARKS: 120

CSE 4107: Structured Programming I

Programmable calculators are not allowed. Do not write anything on the question paper.
Answer all 4 (four) questions. Figures in the right margin indicate full marks of questions with corresponding COs and POs in parentheses.

1. a) For IUT admission, the information of applicants is stored in a CSV (Comma Separated Values) file named "applicants.csv". 20
(CO3)
(PO2)
- Each row in the file contains the following fields: (ApplicantID,Score,Name).
 - Students name does not contain any spaces and at most 100 characters long.
 - ApplicantID is a unique positive integer less than 9001.
 - There are at most 9000 applicants, and the input file is not sorted.

Write a C program to perform the following tasks:

- Read applicant information from the file "applicants.csv".
- Filter out only the eligible applicants (those with a score of 93.5 or more).
- Sort the eligible applicants based on ApplicantID in ascending order.
- Write the eligible applicants to a new CSV file named "eligible.csv", maintaining the same format

A sample input-output file is given in Table 1.

Table 1: Sample input-output for Question 1.a)

applicants.csv	eligible.csv
850,94.0,Alice	101,96.2,Charlie
1450,89.5,Bob	850,94.0,Alice
101,96.2,Charlie	
205,65.3,Eve	

- b) A magic square is a square grid of numbers in which the sum of each row, each column, and the main diagonals is the same. A sample 3×3 magic square is provided in Table 2, where the row-wise, column-wise and diagonal sum is 15. 10
(CO3)
(PO2)

Table 2: A 3×3 magic square

8	1	6
3	5	7
4	9	2

Write a user-defined function that takes a square matrix (as a 2D array) and its dimension as parameters and the function should return 1 if the matrix is magic square, and 0 otherwise.

2. a) A bus company operates two types of buses: Premium and Economy.

- In a Premium bus, each row contains 3 seats.
- In an Economy bus, each row contains 4 seats.
- Each seat is labeled using a combination of the row letter (A, B, C, ...) and a column number (starting from 1).

10
(C03)
(P02)

For example: The seat numbers of the first row of an economy bus will be A1, A2, A3, and A4, and the seat numbers for the third row of a premium bus will be C1, C2, and C3.

Write a C program that reads the total number of seats and the type of bus and prints the seat layout. The program should print an error message if total seats can not be divided evenly among all the rows. A sample input output is given in Table 3

Table 3: Sample input-output for Question 2.a)

Input	Output
Total number of seats: 12	A1 A2 A3 B1 B2 B3 C1 C2 C3 D1 D2 D3
Type of bus (1: Economoy, 2: Premium): 2	
Total number of seats: 11	Invalid input
Type of bus (1: Economoy, 2: Premium): 2	

- b) You are planning to print a message on a poster. The printing company charges only for printing uppercase letters, and the cost for each letter varies. The cost of printing each letter is provided in an integer array of size 26 (where the first element is the cost for 'A', the second for 'B', etc.).

20
(C03)
(P02)

- Write a user-defined function called *calculateCost* that takes a string and the cost array as arguments and returns an integer indicating the total cost (i.e., the sum of the costs of all the letters in each string).
- Write a C program that reads some strings (each maximum 50 characters) from the user, calculates the cost of each string using the function *calculateCost*, and then prints the string along with its cost, sorted based on the total cost in ascending order.

Input: The first line of the input contains 26 numbers indicating the cost of each letter, next line contains a single integer N, indicating the number of strings. Each of the next N line contains a string.

A sample input-output file is given in Table 4

Table 4: Sample input-output for Question 2.b)

Input	Output
3 7 1 5 9 6 4 2 8 3 7 5 1 6 2 9 4 8 7 3 5 2 1 6 9 4 2 IS IT EASY? IT IS NOT.	IT IS NOT. 37 IS IT EASY? 54

3. a) You are tasked with designing a detailed result processing system for a university. The system needs to manage academic information for multiple students across multiple semesters. The following data must be stored: 5 + 10
(CO3)
(PO2)

Information for each subject:

- Subject Code: Alphanumeric (e.g. "CSE 4107")
- Subject Title: Alphanumeric (e.g. "Data Structures")
- Credit: Floating-point value (e.g. 3.0)
- Obtained Marks: Floating-point value (e.g. 92.50)

Information for each semester:

- Semester Number: Integer (1 to 8)
- Number of Subjects: Integer (maximum of 10)
- Credit: Floating-point value (e.g. 3.0)
- Subjects: Array of subject structures (maximum size 10)

Information for each student:

- Student ID: Integer (e.g. 230041215)
- Student Name: String (alphanumeric)
- Semester Information: Array of 8 semester structures (fixed for 8 semesters)
- Current CGPA: Floating-point value

Complete the following tasks:

- Define the necessary struct types to represent the above information and declare an array to store data for 100 students.
- Write a function *findAPlusSubjects(Student student, int semesterNumber)*, which receives a student object and semester number as arguments and prints the subject code for all subjects where the student obtained an A+ grade for the specified semester. A student is considered to have received an A+ in a subject if $(\text{obtained marks} / \text{credit}) \geq 80$.

- b) Explain the concepts of unions and bit-fields in C. Write a C program that uses a union containing a char variable, and a structure with bit-fields representing the individual bits of a byte. The program should take a character as input and print the binary representation of its ASCII value by accessing each bit through the bit-field structure. 5 + 10
(CO1)
(PO1)

4. a) You have access to a folder in the Student Information System (SIS), where each student's photo is stored. The type of each image file is "jpg" and the student ID is used as the file name (example: 230041119.jpg). 20
(CO3)
(PO2)

Your are planning to replace the pictures of the next 10 students (based on ID numbers) with your own picture.

For example: If your ID is 230041119, you will overwrite the pictures of the following students: 230041120.jpg, 230041121.jpg, ..., 230041129.jpg. Each of these files will be replaced with a copy of your own picture. [You may assume there will be always at least 10 students after your student ID.]

Write a C program that will do this job for you.

b) A sample C code snippet is shown in Code Snippet 1.

```
1 #include<stdio.h>
2 void f1(char *str){
3     if(*str) {
4         //Location #1
5         printf("%c", *str);
6         //Location #2
7     }
8 }
9 int main(){
10     f1("ABC");
11 }
```

Code Snippet 1: A recursive C program for Question 4.b

Determine the output of this code if you add this recursive call $f1(str+1)$:

- Only in location #1
- Only in location #2
- In both location #1 and #2

Program: B.Sc.C.S.E. 1st Sem. & B.Sc.S.W.E. 1st sem.
Semester: Winter

Date: April 10, 2025 (Thursday)
Time: 10:00 am – 12:00 pm

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

Exam: Semester Final Examination
Course Number: Hum 4145
Course Title: Islamiyat.

Academic Year: 2023 - 2024
Full Marks: 80
Time: 2.00 Hours

There are 4 (Four) questions. Answer all of them. The symbols have their usual meaning.

- | | | | |
|--|----|-----|--------------|
| 1. a) If you give zakah, your wealth will decrease, but interestingly, Zakah lexically means to increase, Why and How? Explain based on the Sura Saba, verse No. 39. | 10 | CO3 | PO11/
PO6 |
| b) Compare ‘Ibn Khaldun’ and his book ‘ <i>Muqaddimah</i> ’ (the prolegomena) with ‘Adam Smith’ and his book ‘ <i>The Wealth of Nations</i> ’. | 10 | CO1 | |
| 2. a) Explain the Physical Benefits of Fasting in the Light of “Autophagy” concepts with its philosophical basis. | 10 | CO2 | PO8/
PO6 |
| b) “If one does not abandon falsehood and other actions like it, God has no need that one should abandon one's food and drink” (Bukhari), How to apply the Concept of Fasting in your Daily Life according to this Hadith. | 10 | CO3 | PO11 |
| 3. a) “Performing the Hajj maintaining some different activities, including Tawaf, Say’ee, throwing stones, etc. without question, whether these made sense or not”, as Prophet’s (PBUH) order”- Explain the Specialty of Hajj as a pillar of Islam. | 10 | CO2 | PO8/
PO6 |
| b) Discuss the Types of Hajj with the Pillars (Arkan) of Hajj and the Wajib (Obligatory) acts of Hajj. | 10 | CO1 | |
| 4. a) Illustrate the concept of environmental stewardship (<i>khalifah</i>) with references from the Quran and Sunnah. Provide examples of how this responsibility (<i>khalifah</i>) applies to modern environmental challenges. | 10 | CO2 | PO8/
PO11 |
| b) “Man is free and has free will to choose”- How to apply the ‘Concept of Reward, Crime & Punishment’ in your life according to Quran and Sunnah. | 10 | CO3 | |

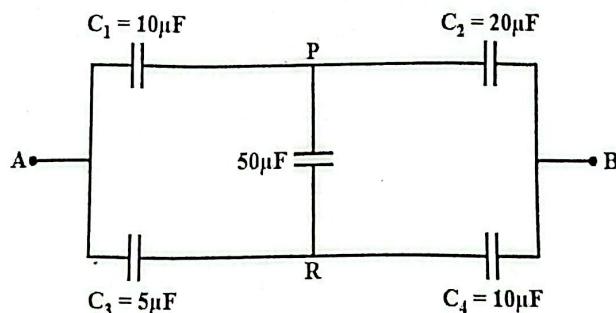
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF NATURAL SCIENCES (NSc)

Semester Final Examination
 Course Number: PHY 4141
 Course Title: Physics I

Winter Semester: 2023-2024
 Full Marks: 120
 Time: 2 Hours

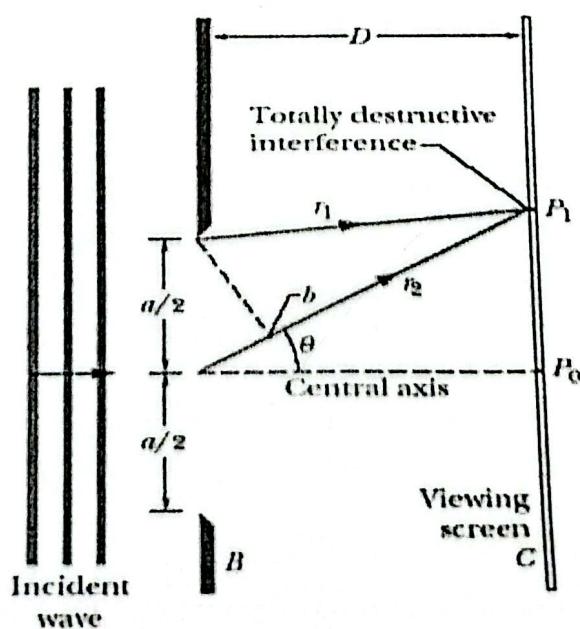
Answer all **4 (Four)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses

1. (a) Define equipotential surface. Describe the characteristics of equipotential surfaces. (2 + 4)
 (CO1)
 (PO1)
- (b) Capacitor can be of any shape, although the capacitance will be different for different geometries. A spherical capacitor consisting of two concentric, conducting spheres of radius a (inner sphere) and b (outer radius). We envision that we apply a voltage V to the inner conductor, as a result of which the inner conductor becomes charged with total charge q , and the outer conductor becomes charged with total charge $-q$. (i) Find an expression for the capacitance of the spherical capacitor. Then if we have a spherical capacitor (nested spheres) where the inner sphere has a radius of 2 cm and the outer sphere has a radius of 4 cm. (ii) Find the capacitance and the charge stored by this capacitor when 10 V is applied? (12 + 3 + 3)
 (CO2)
 (PO2)
- (c) Calculate the equivalent capacitance between the points A and B in the circuit below. If a battery of 10 V is connected across A and B, calculate the charge drawn from the battery by the circuit. (3 + 3)
 (CO3)
 (PO2)



2. (a) Biot-Savart law is one of the major physical laws that govern the behavior of magnetic field due to a moving charge. State Biot-Savart's law and explain briefly with the aid of a sketch. (5)
 (CO1)
 (PO1)
- (b) A circular loop with radius a carrying current I . (i) Find the magnitude of the magnetic field at a point along the axis of the coil and at a distance x from the center of the loop using Biot-Savart Law.
 (ii) Find the magnetic field at the center of a circular loop.
 (iii) Along the axis, at what distance from the center of the coil is the field magnitude $\frac{1}{8}$ as great as it is at the center? (12 + 3 + 4)
 (CO2)
 (PO2)
- (c) In the Bohr model of the hydrogen atom the electron circulates around the nucleus in a path of radius 5.1×10^{-11} meter at a frequency of 6.8×10^{18} rev/sec. (3 + 3)
 (CO3)
 (i) Find the value of B which will set up at the center of the orbit?
 (ii) Find the equivalent magnetic dipole moment?

3. (a) Define interference of light? Describe the fundamental conditions for light waves to interfere. (3 + 3)
 (CO1)
 (PO1)
- (b) (i) Two light waves with amplitudes A_1 and A_2 interfere with a phase difference ϕ , estimate that the intensity at any point in the interference pattern can be expressed as $I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$, where the I_1 and I_2 are the intensities of the two sources and ϕ is the phase difference. (12 + 3 + 3)
 (CO2)
 (PO2)
- (ii) Find the resultant intensity if the amplitudes are nearly equal?
 (iii) Explain, what is fringe visibility and relate that is expressed by, $V = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$.
- (c) In Young's double slit experiment, the positions of the dark and bright fringes depend on the separation between the slits (d), the distance from the slits to the screen (D), and the wavelength (λ). (3 + 3)
 (CO3)
 (PO2)
- (i) Sketch the experiment labelling D , d and y .
 (ii) How far do the slits need to be from the screen for the first dark fringe to be at $y = 1.7 \text{ cm}$ if the slits are 0.023 mm apart and the wavelength is 560 nm ? (iii) Using the same slits and the distance found in part (ii), Solve for the position of 4^{th} bright fringe in case of 640 nm light source.
4. (a) Explain briefly the diffraction of light. Describe what do you understand by Fresnel and Fraunhofer diffraction of light. (3 + 3)
 (CO1)
 (PO1)
- (b) (i) Show that the intensity pattern for the diffraction of light with a wavelength λ through a single slit of width a can be expressed as $I = I_0 \frac{\sin^2 \beta}{\beta^2}$, where $\beta = \frac{\pi a \sin \theta}{\lambda}$ and θ is the angle of the light rays from the slit to a point on a distant screen. (10 + 2)
 (CO2)
 (PO1)
- (ii) For light of wavelength 480 nm falling on a slit of width $3.5 \mu\text{m}$, find the value of β when $\theta = 19^\circ$.
- (c) In the single-slit diffraction experiment of the figure, let the wavelength of the light be 516 nm , the slit width be $6.24 \mu\text{m}$, and the viewing screen be at a distance $D = 3.30 \text{ meter}$. Let a y axis extend upward along the viewing screen, with its origin at the center of the diffraction pattern. Also let I_p represent the intensity of the diffracted light at point P at $y = 16.8 \text{ cm}$. (i) How would be the ratio of I_p to the intensity I_m at the center of the pattern? (ii) Determine where point P is in the diffraction pattern by giving the orders of nearest maximum (0 is the central maximum) and minimum between which it lies. (4 + 4 + 4)
 (CO3)
 (PO2)



ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF NATURAL SCIENCES

Semester Final Examination

Course Number: Math 4141

Course Title: Matrix and Differential Equations

Winter Semester: 2023-2024

Full Marks: 160

Time: 2 Hours

Please answer according to the order of the questions. Answer all the 4 (FOUR) questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written in the brackets.

1. (a) Consider the function $f(x) = 3x^4 + 4x^3 - 12x^2 + 2$, then [12]
- (i). find the intervals on which $f(x)$ is increasing and decreasing. (CO1)
 - (ii). find the intervals on which $f(x)$ is concave up and concave down. (PO1)
 - (iii). find the critical points and inflection points, if any.
 - (iv). sketch the graph of $f(x)$.
- (b) (i). Find the relative extrema of the function $f(x) = 3x^5 - 5x^3$ using both first and second derivative tests. [14] (CO2)
- (ii). Find the radius and height of the right circular cylinder of largest volume that can be inscribed in a right circular cone with radius 6 inches and height 10 inches. (PO2)
- (c) (i). Find the absolute maximum and absolute minimum values of the function $f(x) = x^3 - 3x^2 + 1$ on the interval $\left[-\frac{1}{2}, 4\right]$, and determine where [14] (CO3) (PO2)
these values occur.
- (ii). Write down the statement of Rolle's Theorem. Verify Rolle's Theorem for the function $f(x) = \ln(4 + 2x - x^2)$ on the interval $[-1, 3]$.
2. (a) (i). State and prove Euler's Theorem for a homogeneous function of three variables. Hence, verify Euler's Theorem for the function [20] (CO2) (PO2)
- $$u(x, y) = \frac{x(x^3 - y^3)}{x^3 + y^3}.$$

(ii). If $u = \tan^{-1}\left(\frac{x^2 + y^2}{x + y}\right)$, then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2} \sin 2u$.

(b) (i). Find the second-order partial derivatives of $f(x, y) = 4x^2 - 2y + 7x^4y^5$. [10]

(ii). Let $u(w, x, y, z) = xe^{yw} \sin^2 z$ be a given function, then find $\frac{\partial^4 u}{\partial x \partial y \partial w \partial z}$ and (CO3)
(PO2)
evaluate $\frac{\partial u}{\partial z}(0, 0, 1, \pi)$.

(c) (i). Define radius of curvature of a curve. Find the radius of curvature at the [10]

point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ of the curve $x^3 + y^3 = 3axy$. (CO4)
(PO2)

(ii). Find the n th Maclaurin polynomial for $\frac{1}{1-x}$.

3. Consider the four points $A(3, 6, 9)$, $B(1, 2, 3)$, $C(2, 3, 1)$, and $D(4, 6, 2)$. [40]

(i). Determine whether AB and CD intersect or not. If so, find the point of (CO1,
intersection. (CO2)

(ii). Find the equation of plane in normal form through the points A , B , and C . (PO1,

(iii). Find the perpendicular distance from the point D to the plane ABC . (PO2)

(iv). Find the angle between the line CD and the plane ABC .

4. (a) Find the length and equation of the shortest distance between the lines [20]

$3x - 9y + 5z = 0 = x + y - z$ and $6x + 8y + 3z - 13 = 0 = x + 2y + z - 3$. (CO3)

(PO2)

(b) Find the equations of the tangent planes to the sphere [20]

$x^2 + y^2 + z^2 + 6x - 2z + 1 = 0$ which pass through the line $\frac{16-x}{2} = \frac{z}{2} = \frac{y+15}{3}$. (CO4)
(PO2)

The End

Program: BSc Eng (CSE), 1st Sem
Semester: Winter

Date: 23rd April 2025(Wednesday)
Time: 10:00 am – 01:00 pm

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

Examination: Final Semester

Academic Year: 2023 - 2024

Course Number: HUM 4147

Full Marks: 120

Course Title: Technology, Environment, and Society

Duration: 3hrs

There are 4 (four) questions. Answer all the questions. The symbols have their usual meaning.

1. a) Define the term Environmental Stewardship and explain its principles. (10) CO2 PO7
b) Explain the physical, chemical, and biological water quality parameters. (10)
c) Write a detailed note on incineration and pyrolysis. (10)

2. a) Explain the solid waste management objectives. (10) CO2 PO7
b) What are fossil fuels? Why are fossil fuels classified as non-renewable energy resources? (08) CO3
c) Explain the different disposal methods of municipal solid waste. (12) CO2

3. a) State the polluter pays principle. (05) CO3 PO7
b) With a general schematic flow sheet explaining the different stages and processes involved in the treatment of municipal sewage. (15)
c) List a few implementation strategies of the polluter pays principle. (10)

4. a) Describe the industrial hazards and how they can be prevented. (15) CO3 PO7
b) Could nuclear energy be classified as a renewable source of energy? (05)
c) Describe the most viable renewable energy source for your country to invest in. (10)

CSE 4108: Structured Programming I Lab Final

Duration: 1 Hour

Naming Convention: The task must be completed in one file. The file naming format is `ID_Final.c`, eg. `230041101_Final.c`. Ensure that your file is properly named; otherwise, it will not be evaluated.

Task — Covert Communication

Problem Statement

You and your friends, tired from the relentless exam pressure at *Institute of Unbearable Torture (IUT)*, have been forced to resort to “non-traditional” methods of survival. In order to exchange messages among each-other in the examination hall without getting caught, you have decided to use Shift Ciphers.

In a Shift Cipher, each encrypted letter in your message is replaced by another letter a fixed number of positions down the alphabet. For example, with a shift of 5, A becomes F, B becomes G, and so on. The alphabet is treated cyclically, so letters near the end wrap around to the beginning—Y becomes D, and Z becomes E.

Similarly, during decryption, letters are shifted *backward* by the same amount. So, F would become A, G becomes B, D becomes Y, and E becomes Z, completing the loop in the opposite direction.

To aid your covert communication efforts, your task is to implement the following set of structures and functions. Note that the functions are divided into three sub-tasks, and they should be done in the specified order.

Structure Definitions

- **EncText**

Represents an encrypted message with the following members:

- `enc_content` (character array): Stores the encrypted message text (up to 500 characters).
- `sender_id` (character array): Holds a short identifier for the sender (up to 10 characters).
- `category` (integer): Indicates the priority of the message — '2' for Urgent, '1' for Normal, and '0' for Low.
- `length` (integer): The actual length of the encrypted content.

- **DecText**

Represents a decrypted message with the following members:

- `content` (character array): Stores the decrypted message text (up to 500 characters).
- `shift` (integer): The shift value used to decrypt the message.
- `length` (integer): The actual length of the decrypted content.

Subtask 1: Message Parsing

Write a function that returns a variable of the `EncText` structure with all the message details organized.

Function Prototype:

```
EncText parse_message(char enc_content[], char sender_id[], int category);
```

The function will:

- Assign all the member variables of the `EncText` structure from the given arguments.
- Print the message details, including:
 - Sender ID
 - Message category (Urgent, Normal, or Low)
 - Length of the encrypted message

In the format

```
Sender ID: <sender_id> (<category>), Length: <length>
```

See the Sample Test Cases section for more clarity and an example of the output format.

- Return the corresponding `EncText` structure variable.

Subtask 2: Message Decryption

Write a function that decrypts a message stored in an `EncText` and stores it in a `DecText`.

The function will be provided with a variable of the `EncText` structure and a shift value as arguments. The `EncText` structure will contain the encrypted message and the shift value will determine how many positions each letter should move backward (cyclically) in the alphabet to recover the decrypted message.

Function Prototype:

```
DecText decrypt_shift(EncText msg, int shift);
```

The function will:

- Create a backward-shifted (decrypted) version of the `enc_content` of the `msg` variable and store it into the `content` of a `DecText` structure.

You must apply the shift only to alphabetic characters, non-alphabetic characters must remain unchanged.

You can safely assume that the characters will either be upper-case alphabetic (no lowercase characters or digits), or non-alphabetic.

- Print the decrypted content in the format:

```
Shift-<shift> Decryption: <decrypted_content>
```

See the Sample Test Cases section for more clarity and an example of the output format.

- Return the corresponding `DecText` structure variable assigning all the members properly.

Since the most commonly used shift cipher uses a shift of 3, the main program requires you to apply `decrypt_shift()` function with a shift of 3.

Subtask 3: Shift Analysis

In the English language, the most commonly occurring letter is 'E'. Cryptanalysts often take advantage of this fact by identifying the most frequent letter in an encrypted message and assuming it was originally an 'E' before encryption.

Based on this idea, write a function to calculate and print the most likely character to be shifted to 'E', the shift value required, and its associated probability. Then, use pass-by-reference to assign this best shift value to a passed argument.

Function Prototype:

```
void analyze_shift (EncText msg, int* best_shift);
```

The function will:

- Identify the most frequently occurring **uppercase letter** in the encrypted message and calculate the shift value that would transform this letter into the letter 'E'.
- If multiple letters have the highest frequency, **choose the letter that minimizes the shift value**.
- Estimate the probability that this shift is correct, based on the relative frequency of the most common letter in the text.
 - The relative frequency is calculated using the formula:

$$\text{Relative Frequency} = \frac{\text{Count of the Letter}}{\text{Total Number of Uppercase Letters}}$$

- This value is stored as a probability between 0 and 1 which must then be converted to a percentage.
- Print the letter shifted to 'E', the shift value required and its probability (in percentages, upto 2 decimal digits) in the format

Analysis: '<letter>' -> E (Shift <shift>, <probability>%)

See the Sample Test Cases section for more clarity and an example of the output format.

- Store the calculated shift using pass-by-reference.

You can assume that the message contains at least one uppercase letter.

Input

The input will contain the three lines.

The first line will contain the string `enc_content`. This string can contain whitespaces. It will only contain upper-case alphabets and non-alphabetical characters. This string will have a maximum length of 500.

The second line will contain the string `sender_id` which will not contain any whitespaces. This string will have a maximum length of 10.

The third line will contain the integer `category` with a value of either 2, 1, or 0 (referring to the categories *Urgent*, *Normal* and *Low* respectively.)

Main Program

Your program must:

- Take enc_content, sender_id and category as inputs.
- Call parse_message() with the appropriate parameters to parse and display message details and return an EncText.
(Up-to this part will be used to evaluate Subtask 1)
- Call decrypt_shift() with the previously returned EncText and shift=3 to perform standard decryption
(Up-to this part will be used to evaluate Subtask 2)

- Call analyze_shift() to determine the best shift value
- Call decrypt_shift() again with the previous EncText and best shift value to show optimal decryption

(Up-to this part will be used to evaluate Subtask 3)

Sample Test Cases

Input	Output
VKRZ PH WDVN WZR ID18 2	Sender ID: ID18 (Urgent), Length: 16 Shift-3 Decryption: SHOW ME TASK TWO Analysis: 'R' -> E (Shift 13, 15.38%) Shift-13 Decryption: IXEM CU JQIA JME
TTKTT XH BN UPKDGXIT ID17 1	Sender ID: ID17 (Normal), Length: 20 Shift-3 Decryption: QQHQQQ UE YK RMHADUFQ Shift Analysis: 'T' -> 'E' (Shift 15, 29.41%) Shift-15 Decryption: EEVEE IS MY FAVORITE
DDD EEE FFF ID9 0	Sender ID: ID9 (Low), Length: 11 Shift-3 Decryption: AAA BBB CCC Shift Analysis: 'E' -> 'E' (Shift 0, 33.33%) Shift-0 Decryption: DDD EEE FFF