



Bahria University, Isl

Department of Computer Science  
Final Term Exam  
BS (IT)-0 (S) Semester  
(Fall 2022 Session Evening  
Paper Type: Descriptive

Course:	Object Oriented Programming	Date: 26-01-2023
Course Code:	CSC 210	Session: II
Faculty's Name:	Muhammad Zeeshan Javed	Max Marks: 50
Time Allowed:	150 minutes	Total Pages: 2

**INSTRUCTIONS:**

- I. Attempt all the questions.
- II. Do not write anything on the question paper except your name and enrolment number.

Student's Name: Hamza Usman Enroll No: 01-135212-027  
(USE CAPITAL LETTERS)

**Question 1:** Following sub questions cover CLO-1 (6) 10 Marks

- a) What is meant by the term exceptions in programming? (1 mark)
- b) What is the importance of static data members? (1 mark)
- c) State the three keywords used to implement exception handling in C++. (1 mark)
- d) How the compiler decides which overloaded function to execute? (1 mark)
- e) How to give access of object's private data to non-member functions? (1 mark)
- f) When and why is a member function of a class kept constant? (1 mark)
- g) What is the importance of static data members? (1 mark)
- h) In the classroom, you are a student, in the market, you become a customer and at home you take the role of a son or a daughter. Which of the object-oriented programming concepts is similar to this scenario where the same class behaves differently in different roles? (1 mark)
- i) When using operator overloading, can we change the number of operands? (1 mark)
- j) cout is an object of which class/ library? (1 mark)

**Question 2:** Following sub questions cover CLO-1 (7) 10 Marks

- a) Given "fout" an object of class ostream, write C++ statement to move the file pointer associated with "fout" to the end of the file. (1 mark)
- b) Differentiate between the three levels of inheritance mentioned below. (3 marks)

Access Specifiers	Private Inheritance	Protected Inheritance	Public Inheritance
Private			
Protected			
Public			

- ✓ Rewrite the following class using templates so that data types of members **x** and **y** can be controlled. Both **x** and **y** can be of same or different data types. (2 marks)

**class Point { private: int x, y; };**

Template < class T >

class Point

Private:

T x;

T y;

**a) Write the output of the following statements. (2 marks)**

```
string s1 = "abc@xyz.com";
int index = s1.find("@");
string a = s1.substr(0, index);
string b = s1.substr(index + 1);
cout << a << endl << b << endl;
```

abc  
xyz.com

**b) Find two errors in the following output. (2 marks)**

```
class Office{
private:
    int room_num;
protected:
    string department;
public:
    •Office():room_num(0),department("nil"){}
};
int main(){
    Office f;
    •f.room_num=5;
    f.department="NC"; }
```

**Question 3:** Following sub questions cover CLO-2 10 Marks

- a) Create a class named **Vowel** and define its parameterized constructor such that the exception is thrown if any other character is passed. In main, create objects of the class with invalid parameters so that the exception is thrown and handled by exception handling class. Display the result using exception handling technique. (5 mark)
- b) Draw UML Diagram for the classes mentioned in the Question 4. (5 marks)

**Question 4:** Following question covers the CLO-3 20 Marks

Consider the class **LoanApplicant** that stores data of an applicant who has applied for a loan. The class includes *amount of loan*, *start date of loan*, *total number of months* in which the loan will be paid back and the *per month salary* of the applicant. Two types of loan applications can be made, **HomeLoan** and **CarLoan** respectively.

**HomeLoan** also includes information of the total *value of the land* on which the construction will be done while **CarLoan** includes informant on the *model of the car* to be purchased. Assume that the loan is interest free.

Add the following functionality to the above classes.

- A parameterized constructor in each of the three classes.
- A pure virtual function **Print()** in the class **LoanApplicant**. The function must be overridden in each of the child classes and should print loan application data.
- A pure virtual function **bool isApproved()** in the class **LoanApplicant** with functionality in the child classes. A home loan is approved if the land value is greater than the loan amount and the salary of the applicant is at least 50 times the amount of loan. Likewise, a car loan is approved if the car model is older than the year 2020 and the salary of the applicant is 20 times or more of the loan amount.
- In the main program, define an array of two pointers to the class **LoanApplicant**. Using dynamic memory allocation, create an object each of the two child classes and call the **print()** method of each object.

**End of Paper**



Bahria University Islamabad Campus  
Department of Computer Science  
Mid Term Examination  
Class & Section: BS(IT)-5A,5B Morning  
(Fall 2023 Semester)  
Paper Type: Descriptive

Course:	Entrepreneurship	Date:	17/Nov/2023
Course Code:	HSS 410	Session:	IV
Faculty's Name:	Mudassar Ghafoor	Max Marks:	20
Time Allowed:	1.5 Hours	Total Pages:	(01)

**INSTRUCTIONS:**

1. This is closed book exam. Communication devices and any written material is strictly prohibited.
2. All questions are compulsory.
3. You will be rewarded for writing answers that are thoughtful, creative and concise.

Student's Name: HAMZA USMAN Enroll No: 01-136212-027  
(USE CAPITAL LETTERS)

**Question 1:** (3 Marks) (CLO-1)

Explain the concept of "idea generation". Define the various techniques of idea generation?

**Question 2:** (5 Marks) (CLO-3)

The Business Model Canvas is a visual one-page chart designed to help companies design their value proposition, challenges, and structure that includes elements Value propositions, Customer segments, Channels, Customer relationships, Key resources, Key Activities, Key Resources, Cost Structures and Revenue Streams.

Imagine you are an entrepreneur developing a business model for a business that will supply high-schools and universities with discounted desktop computers when ordered in bulk. Use the canvas elements to build a business model. Express your response to each element. Include a brief (1-2 sentence) description of each element.

**Question 3:** (3 Marks) (CLO-2)

State and explain five key characteristics of entrepreneurs?

**Question 4:** (3 Marks) (CLO-2)

What are five essential elements that lead the start-ups to success?

**Question 5:** (6 Marks) (CLO-5)

How can industry attractiveness be determined using a "five forces analysis"? Discuss. Give examples to support your answer?

**"Trust in your abilities. Good luck!"**



## Bahria University, Islamabad Campus

### Department of Computer Science

Mid Term Examination

Class/Section: BSIT 2A/2B

(Spring 2022 Semester)

Paper Type: Descriptive

Course:	Digital Design	Date: 14/5/2022
Course Code:	CEN 122	Time: 11:30am - 01:00am
Faculty's Name:	Engr. Farah Akif	Max Marks: 20
Time Allowed:	90 minutes	Total Pages: (02)

#### INSTRUCTIONS:

- All questions must be answered.
- Use the same question number in your answer sheet as mentioned in the question paper.
- Draw neat and labelled diagrams. Intermediate gate outputs must be written on the diagram. Gate terminals must be clearly drawn.

Student's Name: Hamza Usman (USE CAPITAL LETTERS) Enroll No: 01-135112-027

Question # 1 (1+1+1+1+1 Marks) Perform the following conversions:

- (198)<sub>12</sub> to ( )<sub>10</sub>
- (DADA.B)<sub>16</sub> to ( )<sub>10</sub>
- (64CD)<sub>16</sub> to ( )<sub>2</sub>
- Convert answer from part (c) to Octal
- (27.315)<sub>10</sub> to ( )<sub>2</sub>

Question # 2 (1+1+1+1+1 Marks) Implement the Boolean function:

$$F = xy + x'y' + y'z$$

- With AND, OR and inverter gates
- With OR and inverter gates
- With AND and inverter gates
- With NAND and inverter gates
- With NOR and inverter gates

Question # 3 (2.5x2 Marks) Simplify the following Boolean expressions using K-Maps:

- $AB'C + B'C'D' + BCD + ACD' + A'B'C + A'BC'D$
- $F(w, x, y, z) = \Sigma(0, 2, 4, 5, 6, 7, 8, 10, 13, 15)$

Enrollment Number: \_\_\_\_\_

**Question # 4 (2.5x2 Marks)**

a) Draw the multiple-level NOR circuit for the following expression:  
 $CD(B + C)A + (BC' + DE')$

b) Simplify the following expressions to (1) sum-of-products and (2) products-of-sums  $ACD' + C'D + AB' + ABCD$

---

---

*End of Question Paper*

---

---



Bahria University, Islamabad Campus  
Department of Computer Science  
Mid Term Examination  
Class & Section: BS(IT)-4A & B Morning  
(Spring 2023 Semester)  
Paper Type: Descriptive

Course:	Software Engineering	Date:	12/April/2023
Course Code:	SEN 220	Session:	II
Faculty's Name:	Zubaria Inayat	Max Marks:	20
Time Allowed:	1.5 Hours	Total Pages:	(1)

**INSTRUCTIONS:**

1. This is closed book exam. Communication devices and any written material is strictly prohibited.
2. All questions are compulsory.

Student's Name: \_\_\_\_\_ Enroll No: \_\_\_\_\_  
(USE CAPITAL LETTERS)

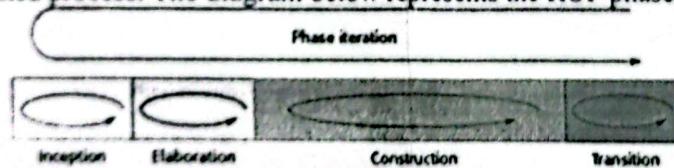
**Question # 1 (04 Marks) (CLO-03)**

The most appropriate software process model that might be used as a basis for managing the development of the following systems is GIVEN. Explain the working of software being developed:

- I. A system to control antilock braking in a car *Waterfall*
- II. A virtual reality system to support software maintenance *ASSET*
- III. A university accounting system that replaces an existing system *Incremental*
- IV. An interactive travel planning system that helps users plan journeys with the lowest environmental impact *spiral*

**Question # 2 (04 Marks) (CLO-01)**

Rational Unified process is a modern generic process derived from the work on the UML and associated process. The diagram below represents the RUP phases:



Write and explain the Static and dynamic perspective of the rational unified process with respect to it phases.

**Question # 3 (08 Marks) (CLO-2)**

You have developed a prototype of a software system and your manager is very impressed by it. She proposes that it should be put into use as a production system, with new features added as required because this avoids the expense of system development and makes the system immediately useful BUT the concept of prototyping is not clear to your client. Hence you must make a presentation for your client to explain him the whole concept of prototyping.

Your task is to draw the prototyping process's block diagram and write its merits and demerits to convince the client.

***The End***



Bahria University, Islamabad Campus  
Department of Computer Science  
Mid Term Examination  
Class & Section: BS(IT)-5A & 5B Morning  
(Fall 2023 Semester)  
Paper Type: Descriptive

Course Title:	IT Project Management	Date: 14 /Nov/2023
Course Code:	ITC-311	Session: IV
Faculty's Name:	Ms. Ameena Saeed	Max Marks: 20
Time Allowed:	90 Minutes	Total Pages: (1)

**INSTRUCTIONS:**

1. This is closed book exam. Communication devices and any written material is strictly prohibited.
2. All questions are compulsory.

Student's Name: Hamza Usman Enroll No: 01-135212-027  
(USE CAPITAL LETTERS)

**Question # 1 (5 Marks) (CLO-1, BT= 2)**

Explain how organizational culture impact project management processes and outcomes? Provide examples to illustrate your answer.

**Question # 2 (5 Marks) (CLO= 2, BT= 3)**

A company is considering two potential projects for expansion. The details of each project are as follows:

**Project X:**

Initial Investment: \$200,000  
Annual Cash Inflows: \$50,000  
Project Duration: 6 years

4

**Project Y:**

Initial Investment: \$150,000  
Annual Cash Inflows: \$45,000  
Project Duration: 5 years

2 3

Cost of capital: 12%

- Calculate the Net Present Value (NPV) for each project.
- Calculate the Return on Investment (ROI) for each project.
- Interpret the results and recommend the best project based on the financial analysis. (Show the selection of the best project with the help of a diagram).

**Question # 3 (10 Marks) (CLO= 3, BT= 3 )**

Apply Work Breakdown Structure (WBS) and WBS dictionary for an IT-related project, focusing on the development of a mobile application.

*Best of Luck*



Bahria University, Islamabad Campus  
Department of Computer Sciences  
Mid-Term Examination  
BS (IT)- 0(S)  
(Summer 2023)  
Paper Type: Descriptive

Course: Linear Algebra  
Course Code: GSC-121  
Faculty's Name: Nomana Abid  
Time Allowed: 90 mins

Date: 18<sup>th</sup> August, 2023  
Time: Session I  
Max Marks: 20  
Total Pages: 1

**INSTRUCTIONS:**

- I. All questions are compulsory.
- II. There are total three questions.
- III. Calculators are allowed. Programmable Calculators are NOT allowed.
- IV. Use blue, black or blue-black ink only. Do NOT use lead pencil especially.

Student's Name: Hanifa Usman Enroll No: 01-135212-027  
(USE CAPITAL LETTERS)

**Q1. (4 marks, (CLO-1))**

- a) Find M<sub>34</sub> (Minor) of matrix A by arrow technique.

$$A = \begin{bmatrix} 1 & 1 & 2 & 10 \\ 0 & 2 & 3 & 0 \\ 2 & 9 & 1 & -1 \\ 0 & 8 & 5 & 4 \end{bmatrix}$$

**Q2. (5+5 marks, (CLO-2))**

- a) Evaluate the determinant of matrix B by row reduction method.

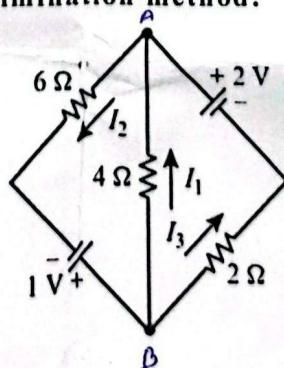
$$B = \begin{bmatrix} 2 & 3 & 2 \\ 1 & 2 & 9 \\ 4 & 6 & 1 \end{bmatrix}$$

- b) Find LUD-decomposition of matrix C.

$$C = \begin{bmatrix} 2 & 5 & 3 \\ 3 & 1 & -2 \\ -1 & 2 & 1 \end{bmatrix}$$

**Q3. (6 marks, (CLO-3))**

- b) Set up a linear system of equations for the following electrical circuit and find the solution by Gaussian elimination method.





Bahria University, Islamabad Campus  
Department of Computer Sciences  
Mid Term Examination  
Class/Section: BSIT - 4 A & B  
(Spring 2023 Semester)  
Paper Type: Descriptive

Course: Information Security Date: 10 - 04 - 2023  
Course Code: CSC 407 Session: II  
Faculty's Name: Dr Faisal Bashir & Dr Moneeb Gohar Max Marks: 20  
Time Allowed: 90Mins Total Pages: 2 (including this)

**INSTRUCTIONS:**

- I. All questions are compulsory.
- II. There are four questions in the exam.
- III. The paper is closed book.
- IV. Calculators are allowed.
- V. Understanding the question paper is part of the examination.

Student's Name: Hamza Usman Enroll No: 01-135212-027  
(USE CAPITAL LETTERS)

Q1) Encrypt the given plain text using AutoKey / Autoclave Cipher: (CLO-2) [marks = 4]

Plain Text: NOT ENOUGH TO PROTECT

Key: RULE

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	
D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	
E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	
F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	
G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	
H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	
I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	
J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	
K	L	H	H	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	
L	H	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	
M	H	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	
N	H	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	
O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	
P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	
Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	

- 2) Consider a new encryption scheme that uses the following operations stepwise to generate the given cipher text. You are required to understand the encryption process and then carefully decrypt the given cipher text to generate plain text. (CLO-3) [marks = 2+2+2]

**Cipher text:** 12 22 22 42 45 52 21 33 45 45 32 34

### Encryption Scheme.

STEP 1	Apply Caesar Cipher on the plain text
STEP 2	On the output of step 1, apply Polybius square
STEP 3	On the output of step 2, apply columnar transposition with key (4 x 6): <b>BACKUP</b> to generate the final cipher text.

1	2	3	4	5
1 A	B C	D E		
2 F	G H	I/J K		
3 L	M N	O P		
4 Q	R S	T U		
5 V	W X	Y Z		

- 3) First apply DES Expansion Permutation on the given input and then on its result, perform S-box substitution. You are required to provide the Outputs (hexadecimal) of Permutation table, S-Box 2 and S-Box 7. (CLO-2) [marks = 2+2+2]

**Input (hexadecimal):** FE EF 7F BD

32	01	02	03	04	05
04	05	06	07	08	09
08	09	10	11	12	13
12	13	14	15	16	17
16	17	18	19	20	21
20	21	22	23	24	25
24	25	26	27	28	29
28	29	30	31	32	01

Expansion Permutation Table

$S_2$															
15	1	8	14	6	11	3	4	9	7	2	13	12	0	5	10
3	13	4	7	15	2	8	14	12	0	1	10	6	9	11	5
0	14	7	11	10	4	13	1	5	8	12	6	9	3	2	15
13	8	10	1	3	15	4	2	11	6	7	12	0	5	14	9

$S_7$															
4	11	2	14	15	0	8	13	3	12	9	7	5	10	6	1
13	0	11	7	4	9	1	10	14	3	5	12	2	15	8	6
1	4	11	13	12	3	7	14	10	15	6	8	0	5	9	2
6	11	13	8	1	4	10	7	9	5	0	15	14	2	3	12

Tables for S-Box 2 and S-Box 7

- 4) A popular bank that provides comprehensive online banking services to end users through its cloud-based web servers. In this scenario, answer the following: (CLO-1) [marks = 2+2]

- a) Why integrity and non-repudiation are necessary for providing the banking services (Justify, each requirement separately along with possible threats and consequences).
- b) Explain the concepts of Intrusion and Incapacitation with respect to a compromised web server.



**Bahria University, Islamabad Campus**  
**Department of Computer Sciences**  
**Mid-Term Examination**  
**Class/Section: BS (IT)-0 (S) Morning**  
**(Summer Semester 2023)**  
**Paper Type: Descriptive**

Course:	Data Communication and Networking	Date: 19/08/2023
Course Code:	CEN 222	Time: Session-I
Faculty's Name:	Dr. Moneeb Gohar	Max Marks: 20
Time Allowed:	90 min	Total Pages: 2 (including this)

**INSTRUCTIONS:**

- I. All questions are compulsory.
- II. There are total 8 questions.
- III. The paper is closed book.
- IV. The students are not allowed any helping material (books, tables, formulas, etc).
- V. Calculators are allowed. Programmable Calculators are NOT allowed.
- VI. Use blue, black or blue-black ink only. Do NOT use lead pencil especially.

Student's Name: Mamza Umar Enroll No: 01-BS212-027  
(USE CAPITAL LETTERS)

**Q.1** What does a data communication mean? What are the key elements of the communication model? (CLO-1) (marks=2)

**Q.2** In TCP socket programming, which methods are used on server side and which methods are used on client side. (CLO-1) (marks=2)

socket (), listen (), accept (), connect () .

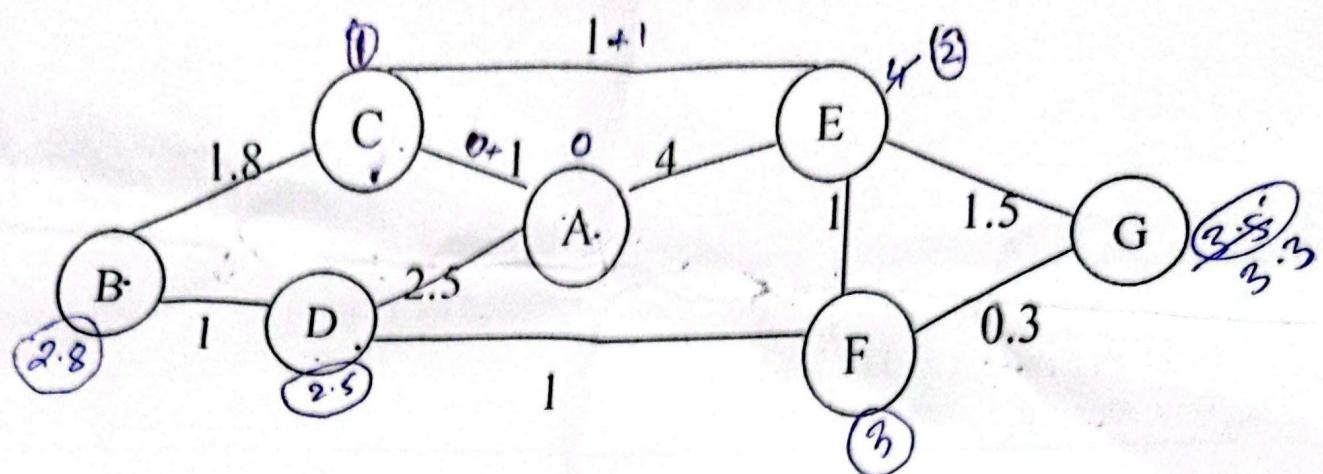
**Q.3** What is circuit switching? Write down the problems of circuit switching. (CLO-1) (marks=2)

**Q.5** Briefly explain non-persistent connection and persistent connection with proper example. (CLO-2) (marks=2)

**Q.6** Briefly explain the congestion control techniques with proper example. (CLO-2) (marks=3)

**Q.7** Consider the host asks with a local DNS (dns1.khu.ac.kr) to resolve the hostname khu.ac.kr. Assume there are no cached entries relevant to this request in local DNS (dns1.khu.ac.kr). Identify and write the steps taken to resolve khu.ac.kr and respond to host. (CLO-3) (marks=5)

Q.8 Identify and find the shortest path from vertex A to every other vertex through Link State Algorithm? (CLO-3) (marks=4)



---

*The End of Question Sheet*

---



Bahria University, Islamabad Campus  
Department of Computer Sciences  
Midterm Examination  
Class/Section: BSIT-0S  
(Fall 2023 Semester)  
Paper Type: Descriptive

---

Course: Operating System Date: 16-11-2023  
Course Code: CSC 320 Time: Session: IV  
Faculty's Name: Saeed ur Rehman Max Marks: 20  
Time Allowed: 90 Mins Total Pages: 1 (including this)

---

**INSTRUCTIONS:**

- I. All questions are compulsory.
- II. Please be precise and to the point.
- III. Total number of question 4

---

Student's Name: Hamza Usman Enroll No: 01-135212-027  
(USE CAPITAL LETTERS)

---

**Question #1)** Answer the following questions [2+2+2=6] [CLO-1, BT-2]

- a. Illustrate is peer to peer computing with the help of an example?
- b. What is Process scheduling? What is the purpose of process scheduling?
- c. Explain Process Control Block in detail?

**Question #2)** Analyze shared memory in the context of operating system and how it is different from message passing with suitable diagram. [4] [CLO-3, BT-4]

**Question #3)** Explain the concept of race condition in context of process synchronization. Why it is problem and how it can be reducing. [5] [CLO-2, BT-3]

**Question #4)** Assume that a set of three processes, P1, P2, and P3, with CPU burst times as indicated below, arrive at time instant 0 in the following order: P1, P2, P3. Create a Gantt chart and use the FCFS algorithm to determine the average waiting time, average turnaround time, and average response time. [5] [CLO-3, BT-4]

Processes	Burst Time
P1	26
P2	5
P3	3
P4	4
P5	1



## Mid Term Examination

Bahria University, Islamabad Campus  
Department of Computer Sciences  
Mid-Term Examination  
BS (IT)- 0(S)  
(Summer 2023)  
Paper Type: Descriptive

Course: Linear Algebra

Date: 7<sup>th</sup> September, 2023

Course Code: GSC-121

Time: Session I

Faculty's Name: Nomana Abid

Max Marks: 50

Time Allowed: 150 mins

Total Pages: 2 (including this)

### **INSTRUCTIONS:**

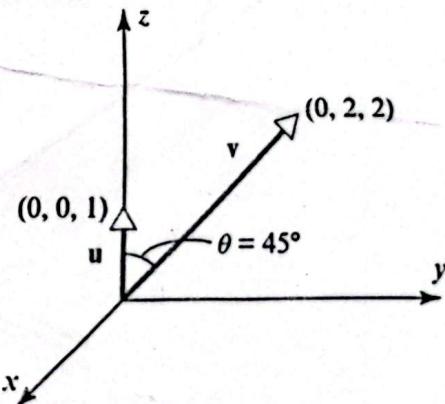
- I. All questions are compulsory.
- II. There are total three questions.
- III. Calculators are allowed. Programmable Calculators are NOT allowed.
- IV. Use blue, black or blue-black ink only. Do NOT use lead pencil especially.

Student's Name: Hamza Usman  
(USE CAPITAL LETTERS)

Enroll No: 01-136212-027

### **Q1. (6+4 marks, (CLO-1))**

- a) Find distance between the vectors ( $\mathbf{u}$  and  $\mathbf{v}$ ) given in the following figure. Also, find whether the vectors  $\mathbf{u}$  and  $\mathbf{v}$  are orthogonal or not.



- b) Find the standard matrix for the operator on  $\mathbb{R}^2$  that first compresses by a factor of  $\frac{1}{2}$  in the x-direction, then shears by a factor of 2 in the y-direction and then reflects about the y-axis.

### **Q2. (12+8 marks, (CLO-2))**

- (a) Find Eigen values and Eigen vectors of the following matrix.  
Also, find a diagonal matrix B that is similar to A.

$$A = \begin{bmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$$

**(b) Find least squares solution of the following inconsistent system of linear equations. Also, find least squares error.**

$$\begin{bmatrix} 1 & -1 \\ 2 & 3 \\ 4 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 5 \end{bmatrix}$$

**Q3. (8+4+8 marks, (CLO-3))**

**(a) Decode the following Hill-3 cipher with key  $k = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 0 & -1 \\ 2 & -1 & 5 \end{bmatrix}$ .**

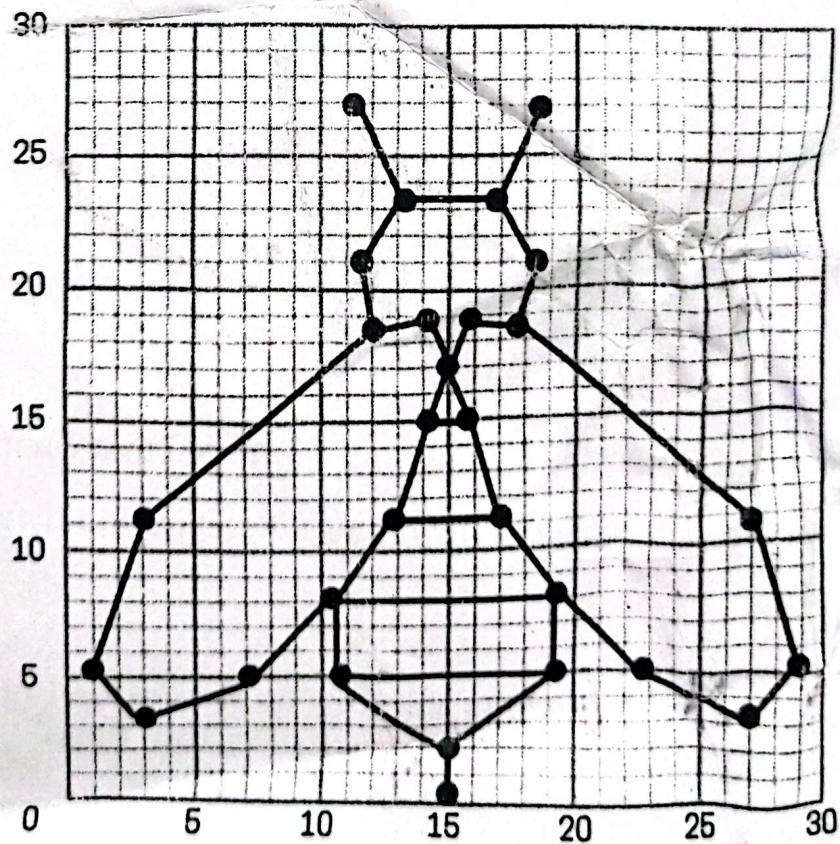
WJD NSBCPURYIEHB

Mention all steps for inverse of  $k$  and  $(\det k \text{ mod } 26)^{-1} \text{ mod } 26$ .

**(b) Find value of check digit number A for the following ISBN (international standard book number).**

0-453-27380-A

**(c) Find the image of the following figure under a counterclockwise rotation of  $\frac{\pi}{2}$  about the origin.**





Bahria University, Islamabad Campus  
Department of Computer Sciences  
Final-Term Examination  
BS (IT)-3(A&B)  
(Fall 2022 Semester)  
Paper Type: Descriptive

Course: Linear Algebra

Date: 26<sup>th</sup> January, 2023

Course Code: GSC-121

Time: Session I

Faculty's Name: Dr. Jafar Hasnain

Max Marks: 50

Time Allowed: 150 mins

Total Pages: 2 (including this)

**INSTRUCTIONS:**

- I. All questions are compulsory.
- II. There is a total of three questions.
- III. The paper is closed book.
- IV. Calculators are allowed. Programmable Calculators are NOT allowed.
- V. Use blue, black or blue-black ink only. Do NOT use lead pencils especially.
- VI. Attach the Question Paper along with the answer book.

Student's Name: HAMZA USMAN Enroll No: 01-135212-027  
(USE CAPITAL LETTERS)

Q1. (5+5+7 Marks)

(a) Find the least squares solution and least square error of the following inconsistent system of linear equations. (CLO-2)

$$\begin{bmatrix} 1 & -1 \\ 2 & 3 \\ 4 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 5 \end{bmatrix}$$

(b) Find the Hill-3 cipher for the following message. (CLO-3)

Message: Attack at Dawn.

Where the key is 'ZIGZAGGED'.

(c) Decode the following Hill 2-cipher if the last four plaintext letters are known to be ATOM. (CLO-3)

LNGI HGYBVREN JYQO  
2 7 0 0

Q2. (5+3+5 marks)

(a) Find the LDU-decomposition of the following matrix. (CLO-2)

$$A = \begin{bmatrix} 6 & -2 & 0 \\ 9 & -1 & 1 \\ 3 & 7 & 5 \end{bmatrix}$$

$L_2 \leftarrow L_2 + 6L_1$   
 $L_2 \leftarrow -L_2$

(b) Draw a figure that shows the image of the triangle with vertices  $(0,0), (1,0)$  and

(c)  $\left(\frac{1}{2}, 1\right)$  under multiplication by

(CLO-3)

$$T = \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}$$

(d) Find the standard matrix under the operator on  $\mathbb{R}^2$  that first reflects about the  $y$ -axis, then expands by a factor of 5 in the  $x$ -direction, and then reflects about  $y=x$ .  
Also, sketch the image of the unit square under this operator. (CLO-3)

**Q3. (8+5+4+2)**

(a) Find Eigen values and Eigen vectors for the following matrix. (CLO-2)

Also, find a matrix  $P$  that diagonalizes the matrix  $A$  and diagonal matrix  $B$  that is similar to  $A$ .

$$A = \begin{bmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$$

(b) Show that the vector  $v_1 = (9, 2, 7)$  is a linear combination of  $v_2 = (1, 2, -1)$ , and  $v_3 = (6, 4, 2)$ . (CLO-2)

(c) Form an ISBN (international standard book number) if the first nine digits are 055327380. (CLO-3)

(d) What is the dimension of row space, column space and nullity of the matrix

$$D = \begin{bmatrix} 3 & -5 & 0 & -1 & -3 \\ -7 & 9 & -4 & 9 & -11 \\ -5 & 7 & -2 & 5 & -7 \\ 3 & -7 & -3 & 4 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 5/2 & -9/2 & 7/2 \\ 0 & 1 & 3/2 & -5/2 & 3/2 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Where the reduced form of  $D$  is

(CLO-1)

Best of luck