

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science & Engineering, Term Final (Spring) Examination 2024: Oct
2024 - Nov 2024

Student Group: 72<Earned Credit Hours ≤ 108

Subject: CSE 301, Database Management Systems

Time: 3.00 hours

Full Marks: 180

INSTRUCTIONS:

- a. Use **SEPARATE** answer scripts for each section.
- b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory.
- c. Answer any other **TWO** out of the remaining **THREE** questions from each section.
- d. Figures in the margin indicate full **marks**.
- e. Assume reasonable data if necessary.
- f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

Analyse the schema given below and answer the questions that follow:

Table name- Sales

sale_id	product_id	quantity_sold	sale_date	total_price
1	101	5	2024-01-01	2500.00
2	102	3	2024-01-02	900.00
3	103	2	2024-01-02	60.00
4	104	4	2024-01-03	80.00
5	105	6	2024-01-03	90.00

Table name- Products

product_id	product_name	category	unit_price
101	Laptop	E1	500.00
102	Smartphone	E2	300.00
103	Headphones	E2	30.00
104	Keyboard	E1	20.00
105	Mouse	E1	15.00

- a. Construct a query to calculate the total revenue generated from sales for each product CATEGORY. The output should have column headings as CATEGORY and TOTAL_REVENUE. Explain the query you have constructed in NOT more than 50 words. 10
- b. Construct a query to list out the sales of products where the quantity sold is greater than the average quantity sold for all products. The output should have column headings as SALE_ID, PRODUCT_NAME, UNIT_PRICE, QUANTITY SOLD, SALE_DATE, TOTAL PRICE. Explain the query you have constructed in NOT more than 50 words. 10
- c. Construct a query to list out the product_name, total price of that product and its percentage contribution towards total sale. Generate the list in decreasing order of the product's percentage contribution. The output should have column headings as PRODUCT_NAME, TOTAL_PRICE, PERCENTAGE_OF_TOTAL_SALES. Explain your query in NOT more than 50 words. 10

Question 2 A database management system stores data in such a way that it becomes easier to retrieve, manipulate and produce information. Keeping this in mind answer the questions that follow:

- a. Explain what you understand by ACID properties in a DBMS. Make sure to name these properties, bring out the meaning of each property and also mention how the responsibilities for implementing these properties are managed. 08
- b. With the help of a neat and labeled diagram explain the Three-tier architecture of a DBMS. Give a brief explanation for each of the three tiers clearly bringing out its requirements. 12
- c. List out and briefly explain five advantages and five disadvantages of a DBMS. 10

Question 3

- a. Relational Algebra is a widely used procedural query language. It collects instances of relations as inputs and gives occurrences of relations as outputs. Analyse the scheme given below and construct Relational Algebra expressions for the questions that follow:

branch (branch_name, branch_city, assets)
customer (customer_name, customer_street, customer_city)
account (account_number, branch_name, balance)
loan (loan_number, branch_name, amount)
depositor (customer_name, account_number)
borrower (customer_name, loan_number)

- i) Find all loans above 2000. 03
- ii) Find the loan number for each loan of an amount greater than 1500. 03
- iii) Find the names of all customers who have a loan, or an account, or both from the bank. 03
- iv) Find the names of all customers who have a loan AND an account at the bank. 03
- v) Find the names of all customers who have a loan at the "Gulshan" branch. 03
- b. The relational model of a DBMS uses a collection of tables to represent both data and the relationships among these data. Keeping this in mind answer the questions that follow:-
- i) What do you understand by CONSTRAINTS in a Relational Model? 03
- ii) When are these constraints checked? 02
- iii) Explain any three TYPES of Constraints in Relational Database Model with examples. 10

Data org
Data
Scalability
Secure data
Backup

core
performance
cost
limit user count

Question 4

- a. We know that Normalisation is the process of breaking down our data and storing them in different tables consistently. In view of the above, what are the conditions that must be satisfied for a relation to be in First Normal Form, Second Normal Form and Third Normal Form. Explain each with the help of examples.

15

- b. Study the "Employees" table given below which is in 1NF and answer the questions that follow:

employee_id	name	job_code	job	state_code	home_state
E001	Arif	J01	Chef	1204	Dhaka
E001	Arif	J02	Waiter	1204	Dhaka
E002	Deep	J02	Waiter	3101	Sylhet
E002	Deep	J03	Guard	3101	Sylhet
E003	Arif	J01	Chef	3101	Sylhet

- i) Normalise the above table to 2NF. Give suitable names to the newly created tables by you. Briefly justify your answer.

08

- ii) Normalise the tables you have achieved in the previous step to 3NF. Give suitable names to the newly created tables by you. Briefly justify your answer.

07

clwf J01 E001, E003
 Waiter J02 E001, E002
 Guard J03 E002

SECTION-B
Question 5 (Compulsory)

- a. A concurrent schedule S with transactions T1, T2, T3 and T4 are given below. By constructing a precedence graph, figure out whether the given schedule is conflict serializable.

15

T1	T2	T3	T4
		• Read(A)	
	• Read(A)		
• Write(A)			
		✓ Read(B)	
	✓ Write(B)		
			✗ Write(C)
✓ Read(B)			
	✗ Read(C)		
		✗ Write(C)	
			✓ Read(B)



5(A)

25

- b. Discuss the "Consistency" and "Isolation" properties of database system. Also, explain the "Shadow copy" scheme of the recovery management component of a database. 04+06=10
- c. "Every view serializable schedule is conflict serializable but every conflict serializable schedule is not view serializable" – Explain the statement with appropriate examples. 0

Question 6

- a. Discuss different "Deadlock Prevention Protocols". To break the deadlock, what recovery actions need to be taken? 10+05=15
- b. In which situation, validation based protocol is best suited? Briefly explain the phases, timestamps for validation test and the conditions of validation based protocol. 10
- c. "Strict two phase locking protocol always produces Recoverable and Cascadeless schedules". – Justify the statement with necessary examples. 05

Question 7

- a. The following figure presents a B^+ tree of order 5 ($n=5$). Perform deletion operation on the given tree in the following order: 20, 32, 11, 22, 21, 8, 27, 43 and 6. 15

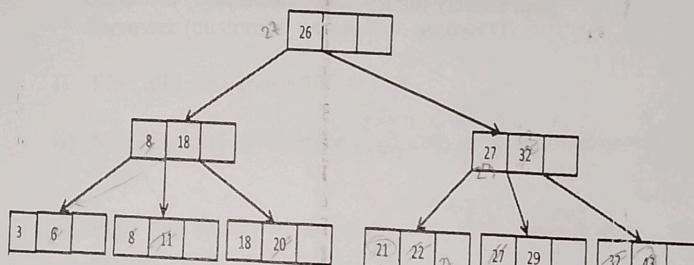


Fig: 7(a)

- b. Define the concept of Hashing. Among the two types of hashing, which one do you think is better and why? 10
- c. Differentiate between primary index and secondary index. 05

Question 8

- a. Define the terms "Cascading Rollback" and "Strict Schedule". Also, explain their implications in the context of database transactions. 03+03=06
- b. "Every Cascadeless schedule is also recoverable" – Justify this statement with appropriate example. 08
- c. Discuss the steps involved in inserting file records into a dense index and provide relevant examples to illustrate your points. 10
- d. During its execution, a transaction passes through several states until it finally commits or aborts. List three possible sequences of states through which a transaction may pass. 06

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SECTION-A

Question 1 (Compulsory)

- a. We have the following grammar for regular expressions over **05+12+07** symbols **a** and **b** only:

$$\begin{aligned} \text{rexpr} &\rightarrow \text{rexpr} + \text{rterm} \mid \text{rterm} \\ \text{rterm} &\rightarrow \text{rterm} \text{ rfactor} \mid \text{rfactor} \\ \text{rfactor} &\rightarrow \text{rfactor}^* \mid \text{rprimary} \\ \text{rprimary} &\rightarrow \text{a} \mid \text{b} \end{aligned}$$

- (i) Eliminate left recursion from the above grammar (if there is any)
- (ii) Now find FIRST and FOLLOW for each non-terminal
- (iii) Construct the predictive parsing table using the above information.

- b. Using the predictive parsing table derived from Question 1(a), identify whether the following statement is syntactically correct or not.

b * a + ab

Question 2

- a. Explain and justify the comment “Java language processors combine compilation and interpretation”. **10**
- b. Compiler is a language processing system which converts a source code to a target machine code. Now demonstrate the translation done by each phases of the compiler for the following statement considering all the variables are integers. **20**

result = num1 * 10 + num2 * 40

i₁ i₂ i₃

Question 3

15

- a. Consider the following grammar. Write down the patterns for identifying the tokens (mentioned in the question no 3(a)) and draw the transition diagram for each pattern.

stmt → for (expr; expr; expr)
expr → term assignment_operator term
| term increment_operator
| term relop term

term → id | number

Now, write down patterns for number, ID, parenthesis, assignment_operator and increment_operator. Draw transition diagram for the mentioned patterns.

- b. Identify the purpose of using two-buffer scheme instead of one-buffer scheme in the process of lexical analysis. 07

- c. Explain clearly the difference among the following regular expressions in the context of Lexical Analyzer Generator 08

- i) [spring 2024]
- ii) {spring}{2024}
- iii) (spring 2024)
- iv) spring 2024

Question 4

10

- a. Explain the back-tracking procedure of recursive-descent top-down parser with proper example. 10

- b. Explain whether the following grammars are LL(1) or not; your answer will not be accepted without proper explanation. 10

S → XxXy | YyYx
X → xX | ε
Y → yY | ε

- c. Perform left-factoring for the following grammars. 10

- i) S → S+S | SS | (S) | S * | a
- ii) S → bSSaaS | bSSasb | bsb | a

SECTION-B

Question 5 (Compulsory)

- a. The SDD in Fig. 5(a) takes a simple declaration D consisting of a basic type T followed by a list L of identifiers. Semantic rules of the SDD enter the type for each of the identifiers on the list into the symbol-table. 10

Now, modify the semantic rules in such a way so that it can calculate the width (in bytes) of the identifiers and enter it into the symbol-table. Assume the required attributes to do the task and give proper explanation for the addition of each attribute, rule or side -effect in the semantic rules column.

PRODUCTION	SEMANTIC RULES
1) $D \rightarrow T L$	$L.inh = T.type$
2) $T \rightarrow \text{int}$	$T.type = \text{integer}$
3) $T \rightarrow \text{float}$	$T.type = \text{float}$
4) $L \rightarrow L_1, id$	$L_1.inh = L.inh$ $\text{addType}(\text{id.entry}, L.inh)$
5) $L \rightarrow id$	$\text{addType}(\text{id.entry}, L.inh)$

Fig. 5(a): Syntax-directed definition for simple type declarations

- b. Fig. 5(b) is a syntax-directed definition (SDD) for constructing syntax trees during top-down parsing using the SDD of Fig. 5(b) answer the followings: 20

- i) Identify the class of the SDD with appropriate explanation
- ii) Draw parse tree for the expression,
$$(x+y) - (a-(4+b))$$
- iii) Construct dependency graph for the same expression and
- iv) Construct syntax tree using the semantic rules showing the node construction steps of the tree.

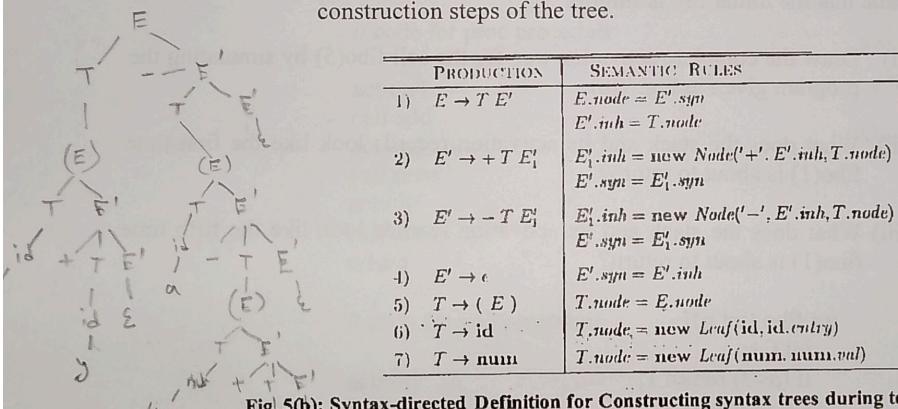


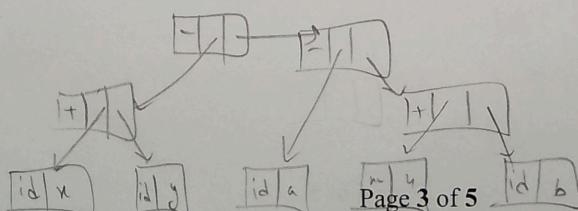
Fig. 5(b): Syntax-directed Definition for Constructing syntax trees during top-down parsing

Question 6

- a. Explain how indirect triples representation of three address code overcomes the problem of triples representation with appropriate example. 10
- b. The translation scheme in Fig. 6(b) generates three address code for expressions with array references. Considering the SDT given in Fig. 6(b) draw an annotated parse tree for the array referenced expression, 20

$$X = arr[i] + st[i][j+1];$$

and find out the generated three address code using the semantic actions assuming that **arr** is an array of integers and **st** is an array of floating numbers and **X, i, j** all are integers.



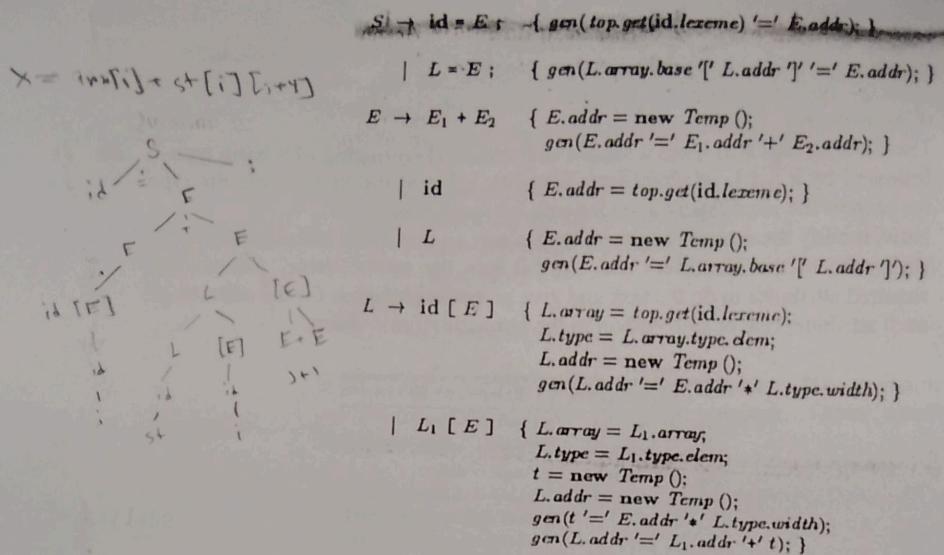


Fig. 6(b): Semantic actions for array references

Question 7

- Briefly explain the elements of a general activation record for the procedures 07 with appropriate examples.
- Fig. 7(b) is a C code to compute n^{th} Fibonacci numbers recursively. Suppose that the activation record for the function fibo includes the following elements in order: (return value, argument n, local s, local t); there will normally be other elements in the activation record as well. To answer the questions below assume that the initial call is fibo(5).
 - Draw the complete activation tree for the call fibo(5) by simulating the program given in Fig. 7(b).
 - What does the stack and its activation records look like the first time fibo(1) is about to return?
 - What does the stack and its activation records look like the fifth time fibo(1) is about to return?

```
int fibo (int n){
    int t, s;
    if (n<2) return 1;
    s = fibo(n-1);
    t = fibo(n-2);
    return s+t;
}
```

Fig. 7(b): Program to compute n^{th} Fibonacci Number

- Explain how non-local data on the stack can be accessed using the access control link of the activation record for a language which supports nested procedure declaration and procedure can have function-valued parameter with appropriate examples. 08

Question 8

- a. For a simple target machine explain how program cost can be estimated for 10 different types of instruction.

Now determine the total program cost of the following instruction sequences:

LD R0, y	1+1
LD R1, #10	1+1
ADD R0, R0, R1	1
INC R0, R0	1
LD R1, 200(R0)	1+2
ST x(R0), R1	1+1
BLTZ *R0, R1	1+1

- b. For the pseudo-code given in Fig. 8(b), considering the instructions of a simple target machine, generate machine code using stack allocation for procedures main, proc and add. Assume that code area for procedures main, proc and add start at the addresses 100, 200 and 500 respectively. Also assume that activation records size for the procedures main, proc and add are 20, 40 and 10 respectively. Further assume that, each action1, action2, action5 takes 16 bytes and each action3, action4, action6 and action7 instruction takes 10 bytes and the stack starts at address 740. Consider that action7 has a condition which is responsible for returning back to the caller procedure. Assume the registers and instructions as required for the target machine. 20

// code for main procedure

```
action1 16
action2 16
call proc
action3 10
halt
```

Code Area

```
main 100
proc 200
add 500
```

Activation record size

```
main 20
proc 40
add 10
```

Stack 740

// code for proc procedure

```
action4 10
call add
action5 16
call proc
action6 10
call proc
return
```

// code for add procedure

```
action7 10
action4 10
return
```

Fig. 8(b): Psuedo-code for a simple target machine.

LD SP, # start + stack

ADD SP, SP, caller. record size

ST *SP, then +16

BR callee - code Area

SUB

RET BR *0(SP)

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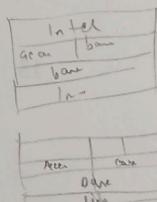
SECTION-A

Question 1 (Compulsory)

- a. Briefly describe the interrupts of 8086 predefined by INTEL. 12
- b. List and describe the steps INTEL microprocessor take when an external interrupt arrives. 12
- c. What address in the interrupt-vector table are used for a Type-1 interrupt? 6

Question 2

- a. Analyze how protection among tasks or users are ensured in 80286. 10
- b. Suppose DS [Data Segment] register contains $(00FF)_{16}$ which points to a segment descriptor which is described in memory as $(0000912021145678)_{16}$.
Analyze
(i) Segment start address,
(ii) Size of the segment in bytes,
(iii) Who can use this segment and
(iv) Type of the segment (code/data(stack)). $(6+6+6+2=20)$



Question 3

- a. In 80286, returning from "protected mode" to "read mode" is not allowed and not possible without "rebooting". How 80386 made this possible? 12
- b. Analyze 80386 segment descriptor. 18

Question 4

- a. Explain why Pentium is known as 'superscalar' microprocessor. 6
- b. Illustrate how paging memory management of Pentium is different from that of 80386 processor. 12
- c. The control register of an 8255 contains $(F7)_{16}$. Analyze the operations of 8255 ports. 12

SECTION-B

Question 5 (Compulsory)

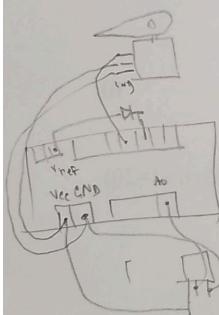
Mr. X owns a small green house where he grows temperature sensitive plants. To automate the environment control, he wants to build a system using two microcontroller boards. One microcontroller, placed in his control room, will act as the Host, while the other will be inside the greenhouse as the local device. The host microcontroller will be connected to a LED and will send command to the Local microcontroller through UART communication. The local microcontroller, equipped with an LM35 temperature sensor and a servo motor, will read the temperature of the greenhouse and send it back to control panel. If the temperature exceeds a set threshold, the host will instruct the local to adjust the vents via the servo motor, maintaining an ideal environment for the plants.

Now, Mr. X wants to design and develop a microcontroller based system that will do the following:

- If the temperature of the greenhouse goes under 25 degree, then LED will turn off and the vents will be adjusted to 90°.
- If the temperature of the greenhouse goes above 25 degree, then the LED will turn on and the vents will be adjusted to 180°.

Note that, LED is connected with the Host and the vent is connected with the Local microcontroller.

You need to answer the followings based on the above scenario:



Question 6

- Identify the hardware requirements
- Draw the hardware connections.

5

10

- Write down the code accordingly to the hardware connection of 5(b).

15

10

- Describe the effect of MUL and IMUL on the status flags of 8086.

15

For the following instructions find the new value of AH, AL and CF/OF.

- MUL BL; if AL contains 80H and BL contains FFH.
- IMUL BL; if AL contains 80H and BL contains FFH.

0 - 256

- Describe the following instructions with appropriate examples:

15

(i)PUSH

(ii)POP

(iii)CALL

Question 7

- Find out the value of DL register and carry Flag status after the execution of each code snippet:

15

(i) MOV CL, 03H

(ii)MOV CL, 03H

MOV DL, 18H

MOV DL, -18H

SHL DL, CL

SAR DL, CL

NEG DL

10

- b. Construct a program in assembly language to display the following patterns. For example, $n = 5$ will print the below pattern where n is the user input. Note that, the range of n is 0 to 5.

```
1
2 3
3 4 5
4 5 6 7
5 6 7 8 9
(j>0, i<n, i++) {    ig
(j=i, i<n; i++) {    ige
        out << j+1
```

15

Question 8

- a. Write an assembly program that lets the user type some text, considering words separated by spaces, ending with a carriage return, and displays the text in the same word order as entered, but with the letters in each word reversed.

15

Sample Input-Output:

Enter a string: this is a test

Output: siht si a tset

- b. One of the fundamental differences between an Arduino and Raspberry Pi is the presence of an operating system. Describe the implications of using an OS (like Linux) on Raspberry Pi compared to the Base-metal programming Approach on Arduino.

10

- c. Describe how an Arduino Uno sends an analog output.

5

```
mnv ah,
int zin
mnw bl,ah
jmp ouew
clrn:
mnw ah,1
int zin
mnw bl,
```

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SECTION-A

Question 1 (Compulsory)

- a. Describe the general methods of passing parameters in a system call. **06**
- b. Define Fork. Consider code written in 'C' below. Write down the output **2+4** of the code:

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <unistd.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);
    printf("I am: %d \n", (int)getpid());
    return 0;
}
```

- c. Firewall is used to protect the system and network – briefly explain. **06**
- d. Explain any 4 types of security violation methods with necessary diagrams and example. **12**

Question 2

- a. Compare between user level thread and kernel level thread. **6**
- b. Different types of scheduler play an important role in the process life cycle. Enumerate their role in details with appropriate figure. **8**
- c. Multi process or Multi thread – which one do you prefer to use for implementing a web server? Defend your answer by proposing algorithm for the server process to handle client process? **8**
- d. "Each thread has its own stack". Do you agree with this statement? Justify your answer. **8**

Suspended next

Question 3

- a. Describe the idea of race condition with a proper example. Also represent the solution requirements. 4+4
- b. Explain the concept of Mutual Exclusion. Clarify with a suitable example that "Mutual Exclusion with busy waiting" has some issues and can lead to a dead lock situation. 3+5
- c. Describe Mutex. Suppose in a restaurant kitchen, there is a single counter where chefs (producer) place prepared meals and servers (consumer) pick them up to serve the customers. The counter has limited space, and it's full; chefs must wait to place more meals. Similarly, if the counter is empty, servers must wait for the chefs to place meals. How can the kitchen manages the synchronization between chefs and serves to ensure that meals are efficiently prepared and served without overcrowding the counter or bearing servers idle? 2+12

Question 4

- a. Define seek time. Discuss the advantages and disadvantages of FCFS and scan algorithm with appropriate example. 1+8
- so, 4, 5, 8, 17, 19, 20*
b. Assume, Azmin has a 12MB solid-state drive in her PC. There is currently only one partition and no file in the SSD. The advertised block size of the SSD is 1 MB. Blocks 0, 2, 5, 7 and 9 have already been allocated to different file. Now, Azmin wants to create 4 files in the only partition of the SSD.

File A – size 3.6 MB

File B – size 1.0 MB

File C – size 0.9 MB

File D – size 0.6 MB

How will the file system (installed in SSD) allocate hard disks blocks to the above files, if it uses the following schemes? Considering the pointer size negligible (where applicable), produce the file allocation schemes using illustration figure:

- 1) Contiguous allocation
- 2) Linked-list allocation
- 3) Linked-list allocation using FAT in the memory

- c. Write short notes with appropriate figure (if applicable) on the following: 12

- 1) Partition Table
- 2) Strict Alteration
- 3) Boot Block

SECTION-B**Question 5 (Compulsory)**

- a. List and define atleast Four different types of operating systems. Provide a brief description and example of each type highlighting their key characteristics. 08

Open OS
Mainframe OS
FreeBSD
MVS

Personal
Embedded

- b. Consider the following five processes with their respective arrival times and burst times in Table 1

Process	P1	P2	P3	P4	P5
Arrival Time	0	1	2	3	4
Burst Time	8	4	9	5	2

Table 1

- (i) Apply the Shortest Job First (SJF) scheduling algorithm (non-preemptive) to the given processes and determine the Gantt chart, average waiting time and average turn around time. 09
- (ii) Apply the Round robin (RR) scheduling algorithm with a time quantum of 3 units to the process mentioned at Table1 and determine the Gantt chart, average waiting Time and average turn around time. 09
- (iii) Explain the key differences between shortest Job First (SJF) and Round Robin (RR) scheduling algorithms. 04

Question 6

- a. Identify the most suitable type of operating system by analyzing the characteristics of the following scenarios as mentioned below 08
- (i) Managing the server farms with high computational demands
 - (ii) Operating an automated factory that requires precision timing and control
 - (iii) Powering a small device with limited resources and battery life
 - (iv) Hashing web services that need to handle fluctuating traffic loads
- b. Explain the different levels of storage pyramid. Describe the characteristics of each level including access speed and capacity. Discuss how the storage pyramid affects data management and performance in operating system. 10
- c. Compare and contrast the advantages and disadvantages of Type1 and Type2 Hypervisors. 12

Question 7

Consider the following system with five processor (P1, P2, P3, P4 and P5) and four resources (R1, R2, R3 and R4). The current state of the system is represented by the following resource allocation of table 2.

Process	P1	P2	P3	P4	P5
Holds	R1	R2	R3	R4	-
Requests	R2	R3	R4	R1	R2

Table 2

- a. Draw the resource allocation graph based on Table-2. Clearly show the allocation and request edges between processes and resources. 08
- b. Apply deadlock detection techniques to analyse the Resource graph. Identify if a deadlock exists and if so, list the process involved in the deadlock. 10
- c. Propose methods to recover from deadlock if detected. 12

Question 8

- a. Compare and contrast the advantages and disadvantages of Paging and Segmentation. 06
- b. Discuss the need of page replacement algorithms in modern operating system. Explain how they contribute to efficient memory management. 06
- c. Describe the significance of Reference (R) and Modified (M) bits in the second chance and clock page replacement Algorithm. 06
- d. Explain the demerits of second chance page replacement algorithm. 06
- e. Highlight the features of Clock page replacement Algorithm and explain its procedure with a neat diagram. 06

BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Computer Science and Engineering, Term Final (Spring) Examination 2024:
Oct 2024 - Nov 2024

Student Group: 72<Earned Credit Hours <108

Subject: CSE 317, Data Communication

Time: 3.00 hours

Full Marks: 180

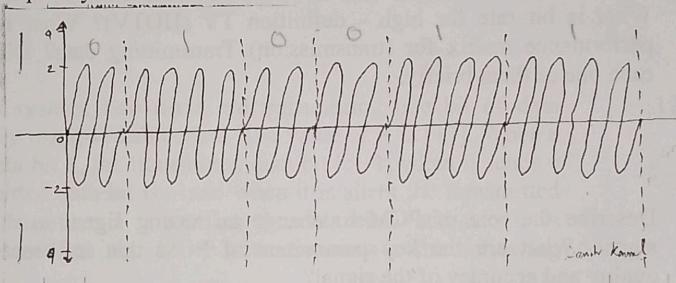
INSTRUCTIONS:

- a. Use **SEPARATE** answer scripts for each section.
- b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory.
- c. Answer any other **TWO** out of the remaining **THREE** questions from each section.
- d. Figures in the margin indicate full **marks**.
- e. Assume reasonable data if necessary.
- f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

- a. Determine the digital bit stream from the analog signal below. The signal was modulated using Binary FSK, where 0 means signal element with frequency of 2 and 1 means signal element with frequency of 4. 8



- b. Based on the data from question A, let us assume it is encoded using Manchester scheme. First, visualize the Manchester encoding. Then, convert this encoding to the differential Manchester scheme and visualize that as well. Also discuss the Manchester scheme. 4

- c. A smart home system uses different modulation techniques to communicate data between various devices. Such as smart lights, thermostats, and security cameras and a central hub. 3*6=18

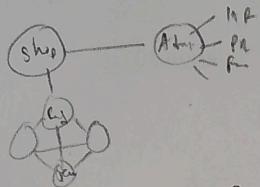
(i) Smart light control: The lights on and off are managed by high amplitude (1) and low amplitude signals (0).

(ii) The temperature data for thermostat: The thermostat uses two frequencies - a lower frequency to represent a temperature below a set point (binary) '0' and a higher frequency to indicate a temperature above the set point (binary) '1'. ASK

(iii) Security camera: The cameras encode the video data by changing the phase of the signal. For instance, a phase shift of 0° could represent a certain frame, while a phase shift of 180° represents a different frame. PSK

Discuss, these three technologies relating with the shift keying concept, and also, visualize data for each case. 25

- Question 2** Suppose, you are working in a market and you have to make a network topology to support the network system of that market. There are 2 types of departments, which are shopkeepers and



admins. These two departments should be connected with a link so that they could transfer data. Precisely, for the Admin department there should be a hub which will be in the chairman's room and creative team, HR team, PR team, Finance team will be connected with that hub which is in Chairman's room. However, for the shopkeeper department (food store, dress shops, shoe shops, jewelry shops) each of the shops will be connected with each other.

$3+3=6$

- a. Draw the topologies that are needed for this network system according to the above scenario.

25

- b. Write two advantages and disadvantages according to this scenario for those topologies.

$3*4=12$

- c. Suppose, you have these types of markets in two other cities, explain how you can use LAN, MAN, PAN in these scenarios with their advantages in that particular situation.

12

Question 3

$$B = 1000 \text{ Hz}$$

$$\text{SNR} = 20 \text{ db}$$

$$C = B \log_2(1 + \text{SNR})$$

a. Attenuation
d. Intensity
noise

20

- a. You are designing a communication system to transmit digital data over a noisy channel. The channel has a bandwidth of 10 kHz and an SNR (Signal-to-Noise Ratio) of 20db. You need to determine the maximum data transfer (transmission) rate (in bits per second) that the channel can handle based on noiseless and Noisy channel theorem.
- b. What is transmission impairment? Discuss the parameters of transmission impairment briefly.
- c. What is bit rate for high - definition TV (HDTV)? What is the performance matrix for (transmission) Transmitting data? Discuss each one of them briefly.

7

12

$2+(3*3)=11$

$$1000 \times 1000 \times 20 \times 24$$

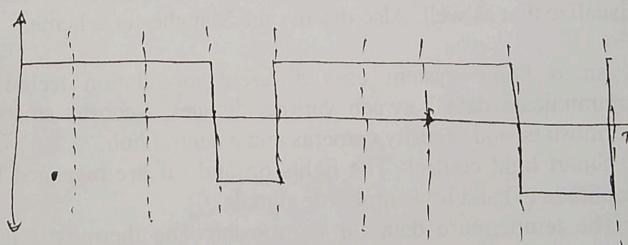
Question 4

- a. Describe the role of PCM to change an analog signal to digital signal. What are the key parameters of PCM that influence the quality and accuracy of the signal?

12

- b. Find the value from this graph and think it has worked as NRZ-L and then convert it into NRZ-I.

6



Lambda Wave

- c. Imagine you are working on a project involving the transmission of audio signals over a low-bandwidth communication channel. You need to choose a signal encoding technique that minimizes complexity and bandwidth uses while ensuring that the audio quality remains acceptable. This techniques makes a staircase as its middle step to convert the data. Given these constraints, discuss briefly which modulation is used here.

12

SECTION-B

Question 5 (Compulsory)

- a. Data is being transmitted at 1500 bps when a 2-millisecond burst of noise occurs. What is the maximum number of bits affected by this 2-ms noise burst?
- b. You are a network engineer working with error detection in a communication system. The system uses Hamming codes to detect and correct errors in transmitted data. While reviewing some data transmissions you find the following codewords, representing two different message sent over the network. For the following pairs of code words, calculate the hamming distance to determine the number of bit errors between the transmitted and received messages. Explain the significance of each hamming distance in terms of error detection.
- (i) $d(10000, 00000) = 1$
 - (ii) $d(10101, 10000) = 2$
 - (iii) $d(11111, 11111) = 0$
 - (iv) $d(000000) = 0$
- c. If both ALOHA and Slotted ALOHA are implemented in a network with a high probability of collision, which protocol would you recommend and why? Discuss in the context of collision reduction and throughput.
- slotted aloha*
- d. Define BSS and ESS in WLANs. How do they impact network coverage?

5

1500 bps \times 2 ms

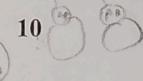
3 bits

5

20

Collision *Slotted*

10 $2 \times T_{\text{fr}}$
 T_{fr}
 $\geq 2t$
 $\geq t$
 $\geq t$



10

10

Question 6

- a. In a CDMA system, two users are transmitting one bit of data simultaneously using Walsh coders. The value of w is [+1]. When a user sends data bit 1, the transmitted data bit is +1, when it sends a 0, the transmitted data bit is -1 and when it is silent the transmitted bit is 0. Assume user 1 is sending the data bit 1 and user 2 is sending 0. Based on the above scenario answer the following questions.
- (i) Calculate the total received signal.
 - (ii) Extract and decode user 1's original data from the total received signal.
 - (iii) Extract and decode user 2's original data from the total received signal.
- b. A sender is preparing to transmit four data items represented in hexadecimal: 3456, ABCC, 02BC and EEEE.
- (i) Calculate the checksum at the sender's site.
 - (ii) Calculate the checksum at the receiver's site, assuming no errors during transmission.
- c. What are the key difference between CSMA/CA and CSMA/CD? Why is CSMA/CA preferred in wireless networks?

10

20

10

Question 7

- a. Explain the concept of piconet and scattered in Bluetooth networks. How do they differ in terms of device connectivity and network topology? 5
- b. In a wireless LAN, there are four devices: P, Q, R and S. Device P can communicate with Q, but not with R due to distance. Similarly, R can communicate with Q but not with P. Device S is located such that it can hear R but not Q.
(i) Explain how the hidden station problem could affect communication between devices P and R when both try to send data to device Q. How can this problem be mitigated?
(ii) Suppose, devices S need to send data to R, but overhears R communicating with Q. How does the exposed station problem manifest in this scenario? 15
- c. Consider a network where a station (station A) is sending a frame to an access point (AP1), and the frame is intended to be forwarded to another access point (AP2) before reaching the destination address (station B). How would the addressing mechanism work in this case? Discuss the values of To DS and From DS, and include a figure illustrating the frame's journey through the network. 10

Question 8

- 10x8*
a. A telecommunication company is upgrading its fiber-optic network to enhance data transmission capacity. The network will use 8 different wavelength to transmit data simultaneously over a single fiber optic cable. If each wavelength can carry a data rate of 10 Gbps, how much total data can the fiber optical cable transmit simultaneously? 4

- achieve more DS*
multiple channels →
b. If there are four channels with bit rates of 10 Kbps, 15 Kbps, 15 Kbps and 30 Kbps that need to be multiplexed together, create a time Division Multiplexing (TDM) scheme using bit rate management and illustrate the resulting output. 8

- c. In a university where multiple classroom are connected to a central server for online learning, the network administrator implements a scheduling system that dynamically allocated bandwidth to each classroom based on real-time data usage and demand. If one classroom is actually streaming a lecture, it receives more bandwidth, while others that are idle get less. What type of TDM is being utilized in this scenario and why? 10

- d. How is statistical TDM different from synchronous TDM? Explain. 8

