Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science and Engineering
3rd Year 1st Semester B.Sc. (Engg.) Final Examination-2021
Course Title: Operating System and System Programming

Course No.: CSE303

Time: 3 hours

Full Marks: 60

N.B.
i. Answer **SIX** questions taking any **THREE** from each section.
ii. All questions are of equal values.
iii. Sequence must be maintained for each question.

Section - A

1. a) What is an Operating system? Discuss the functions of operating system. — 4
   b) What is the relationship between operating systems and computer hardware? What is the difference between a Job and a Process? — 3
   c) What do you understand about user mode and kernel mode of operations? — 2

2. a) Define process. Draw the process state diagram and explain it. — 5
   b) What do you mean by thread? Is there any advantage of thread over process? — 3
   c) Explain the following allocation algorithm a) Best fit b) Worst fit — 2

3. a) Explain the situation when the CPU switches from a process to another process. — 3
   b) Define turnaround time, waiting time, and response time. — 3
   c) Briefly write the direct and indirect method for inter process communication. — 4

4. a) Explain the criteria for comparing CPU scheduling algorithms. — 3
   b) List the factors that affect a scheduling mechanism of processes. — 3
   c) What is semaphore? Explain how semaphore can be implemented. — 4

Section - B

5. a) Explain the Round-Robin algorithm with an example. — 6
   b) — 4

Process	Arrival Time	Burst Time
P0	1	4
P1	5	8
P2	6	10

   Calculate the waiting time, turn around time, average waiting time, average turn around time using SJF CPU scheduling algorithm.

6. a) Why are process control blocks important? — 3
   b) Define context switch. — 2
   c) Explain the paging system with proper examples. — 5

7. a) Write short note about i) Authentication ii) One Time Passwords iii) Program Threats — 3
   b) What is Deadlock and starvation? Write down necessary conditions for deadlock. — 3
   c) Discuss about deadlock detection and prevention algorithm with example. — 4

8. a) Discuss polling and interrupt. What is device driver and functions of device drivers? — 3
   b) What do you mean by virtual memory technique? What are the advantages of it? — 4
   c) Explain logical address and physical address. — 3

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3rd Year 1st Semester B.Sc. (Engg.) Final Examination-2021

Course No.: CSE307
Full Marks: 60

Course Title: Compiler Design
Time: 3 hours

N.B.:

i) Answer **SIX** questions taking any **THREE** from each section.
ii) All questions are of equal values.
iii) Sequence must be maintained for each question.

Section – A

1. (a) Write down briefly about Symbol table. Is it necessary for designing a Compiler? Justify the statement according to your opinion.   4

   (b) Define Automata. Discuss about importance of Automata Theory in building a Compiler.   3

   (c) Define empty string and powers of an alphabet. Suppose set of alphabet, $\Sigma = \{0,1\}$. Find out length of string consisting of binary representation of 25 and also find Σ^3.   3

2. (a) Draw the front end and back end of a compiler. Write down the difference between front end and back end of a compiler.   5

   (b) Show the representation of the following assignment after semantic analyzer: Amount=capital +rate*500 where Amount capital and rate are float.   5

3. (a) Design grammars for the following languages: 2
   (i) The set of all strings of 0s and 1s such that every 0 is immediately followed by at least one 1.
   (ii) The set of all strings of 0s and 1s that are palindromes; that is, the string reads the same backward as forward.

   (b) (i) Left-factor this grammar,   6
   $S \rightarrow T; S \mid \epsilon$
   $T \rightarrow UR$
   $R \rightarrow *T \mid \epsilon$
   $U \rightarrow x \mid y \mid [S]$
   Hence find FIRST and FOLLOW sets for each non-terminal in the grammar obtained.
   (ii) For the left-factored grammar in (i), construct an LL parsing table. Now show in detail what will happen if the string [x;y]*[; is parsed.

   (c) Explain the differences between top-down parsing and bottom-up parsing with examples.   2

4. (a) Explain clearly the difference among the following regular expressions in the context of Lex lexical analyzer generator.   4
   (i) {cse}{token}
   (ii) [cse]? [token]
   (iii) (csetoken) +
   (iv) (cse) * token +

   (b) Give the following grammar: 4
   $E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid int$
   Show leftmost and rightmost derivations of the string $int + int * int / int$. Also show the corresponding parse trees. Is the grammar ambiguous or unambiguous? Justify your answer.

   (c) Explain the term 'Lexeme' and 'Token' with example.   2

Section – B

5. (a) Write a Yacc plus Lex program which calculates the value of an arithmetic expression which involves single line inputs only. The arithmetic expression comprises of numbers with decimal points, addition, subtraction, multiplication and division operators. Parentheses can be used in the expression. The expressions may also contain the sin, cos and tan trigonometric functions.   6

(b) Consider the following grammar:

$E \rightarrow E + T \mid E - T$

$T \rightarrow T * F$

$F \rightarrow (E) \mid id$

Translate the arithmetic expression $((a - b) - ((a - b) * (a + b))) + ((a - b) * (a + b))$ using above grammar into: 4

    1) DAG

    2) Three Address Code

6. (a) Differentiate with example between-

(i) Syntax-directed definition and syntax-directed translation.

(ii) Syntax tree and directed acyclic graph (DAG)

(iii) S-attributed definitions and L-attributed definitions.

(b) The following grammar generates binary numbers with a decimal point.   4

$A \rightarrow L.L \mid L$

$L \rightarrow L B \mid B$

$B \rightarrow 0 \mid 1$

(i) Design an SDT (Syntax-directed translation scheme) that computes the value of binary numbers generated from the above grammar.

(ii) The translation of string 110.101 should be the decimal number 6.625. Draw the annotated parse tree for this translation.

(c) Give an example of a SDD which is not L-attributed.   2

7. (a) Write down the difference between static and Dynamic Scoping?   2

(b) What is Garbage Collection? Write down the popular algorithms for garbage collection. Briefly explain about classification of Top down parsers with proper example.   8

8. (a) Consider the following grammar for declaration statement.   6

$D \rightarrow T \; id;$

$T \rightarrow B \; C$

$B \rightarrow int \mid float$

$C \rightarrow P \; A$

$P \rightarrow * P \mid \epsilon$

$A \rightarrow [num]A \mid \epsilon$

(i) Construct parse trees for the following declaration statements according to the above grammar.

    1) int x;

    2) float *y;

    3) int * [10] z;

(ii) Design a SDD for the above grammar that computes the type and width of a declared identifier. Assume, the width of an integer is 4 and that of a float is 8.

(b) Write down the names and purposes of the fields that might appear in a general activation record of a function. Also depict the division of tasks between the caller and callee in respect of function calling.   2+2

Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science and Engineering

3rd Year 1st Semester B.Sc. (Engg.) Final Examination-2021

Course Title: System Analysis and Design

Time: 3 hours

Course No.: CSE301

Full Marks: 60

N.B.
i. Answer **SIX** questions taking any **THREE** from each section.
ii. All questions are of equal values.
iii. Sequence must be maintained for each question.

SECTION-A

1. a) Define a system. What are the elements of a system? Describe shortly about them. **4**
   b) What is the relation between analysis and design? Is it possible to design a system without analysis? If yes how? If not why? **4**
   c) "Data may be inputted to a system for producing information" - explain this statement briefly. **2**

2. a) Write down the Life Cycle of Systems Analysis and Design. Briefly explain about the each steps of Life Cycle. **5**
   b) Write down the objectives of using structure flowcharts. **3**
   c) Write down the purposes of using logical and physical methods of system design. **2**

3. a) How to formulate project goals and quantify them? **3**
   b) What is Data Flow Diagram? Write down the advantages of Data Flow Diagram. **3**
   c) Let you are a system analyst, you have to analyze and design the information systems of BSMRSTU. Now describe the steps of system life cycle according to the BSMRSTU. **4**

4. a) Write down the basic elements of Data Flow Diagram and the rules to create a Data Flow Diagram. **3**
   b) Describe the properties and elements of a system. **2**
   c) Describe the steps involved in feasibility analysis. **4**

SECTION-B

5. a) Distinguish among technical, operational, and economic feasibility **4**
   b) Consider you are a member of receiving office of an organization, you have to receive the pre ordered items from vendors. Now draw the DFD for receiving process. **4**
   c) What should be the result of feasibility study? Explain. **2**

6. a) What are the types of on site observation? What are the drawbacks of on site observation. **3**
   b) Describe different skills of a system analyst should have to perfectly analyze a system. **3**
   c) A customer enter an ATM card in a ATM machine system and enters PIN. Customer can access the system if it enters valid PIN. Customer requests a cash withdrawal. One of the business rules for the ATM is that the ATM machine pays out the amount if the customer has sufficient funds in their account or if the customer has the credit granted. Now Draw the data flow diagram. **4**

7. a) Write down the difference between Tangible and Intangible cost. **2**
   b) What is Project Management? Which factors must be considered when selecting a project team? **4**
   c) Define Coupling and Cohesion. Write down the factors those affect system complexity. **4**

8. a) What are the major roles of system analyst? **3**
   b) Describe briefly about information gathering tools and verify which tool is best according to your observation. **4**
   c) Define Testing. Decribe the types of Testing. **3**

Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science and Engineering
3rd Year 1st Semester B.Sc. (Engg.) Final Examination-2021

Course No.: CSE305
Full Marks: 60

Course Title: Computer Architecture and Organization
Time: 3 hours

N.B.
i. Answer **SIX** questions taking any **THREE** from each section.
ii. All questions are of equal values.
iii. Sequence must be maintained for each question.

Section - A

1. a) Write down the control steps including control signals in a multi (three) bus organization for the following instruction- ADD (R4), R5, (R6). 4

   b) Write a program that takes a line of characters one by one as input and show them in any output device. 3

   c) Draw the state diagram of a simple cache controller. 3

2. a) What is pipelining? Why pipelining is preferred over sequential approach? 3

   b) What is a pipeline hazard? What are the different types of pipeline hazards? Explain with examples. 3

   c) Assume (i) 1 memory bus clock cycles to send the address (ii) 10 memory bus clock cycles each DRAM access initiated (iii) 2 memory bus clock cycles to send a word of data. Now analyze miss penalty for the following memory organizations- (i) One-word-wide memory (ii) Wide memory (iii) Interleaved memory organization. 4

3. a) Describe following block placement mechanism in cache and analyze performance in terms of number of misses- (i) Fully associative (ii) Set-associative (iii) Direct-mapped. 3

   b) Write short note on (i) instructions with side effects (ii) software mechanism of handling data hazard 3

   c) Draw the state diagram of a simple cache controller. 2

   d) Write short note on (i) Control word (ii) μinstructions (ii) μPC. 2

4. a) What type of pipeline hazard occur in the following code segment? How can it be overcome? 3.5

   ```
   lw  $t1, 0($t0)
   lw  $t2, 4($t0)
   add $t3, $t1,$t2
   sw  $t3, 12($t0)
   lw  $t4, 8($t0)
   add $t5, $t1,$t4
   sw  $t5, 16($t0)
   ```

   b) A program runs in 8 seconds on computer A, which has a 4GHz clock. You want to help a computer designer build a computer B that will run this program in 6 seconds. The designer has determined that a substantial increase in the clock rate is possible, but this increase will affect the rest of CPU design, causing B to require 1.2 times clock cycles as computer A for this program. What clock rate should you tell the designer to target? 3

   c) Describe how virtual memory, TLB and cache work together with necessary figures. 3.5

Section - B

5. a) Draw the division hardware and write down the division algorithm.   3

   b) A complier designer is trying to decide between two code sequences for a particular computer. 3
   The hardware designers have supplied the fact in fiq-1(a).For a particular high-level-language
   statement, the compiler writer is considered two code sequences that require the instructions
   counts in fiq-1(b). Which code sequence executes the most instructions? Which will be faster?
   What is the CPI for each sequence?

   c) What is swapping? How virtual page number is mapped to secondary memory when page fault   4
   occurs?

6. a) Write down the different techniques of accessing data of I/O device.   2

   b) What do you understand by the 'virtual memory' scheme?   2

   c) What is data path? Describe single bus organization of a Central Processing Unit (CPU) with   3
   necessary figures.

   d) What is page table? Describe how page table is indexed with the virtual page number to obtain   3
   corresponding physical page number with necessary figures.

7. a) Write short note on (i) Throughput (ii) Response time (iii) Performance   2

   b) Verify the following statement with necessary reasoning- Increase in performance resulting from   3
   pipelining is proportional to the number of pipelining stages

   c) Perform the necessary modification of the single-cycle data path in the following figure for   5
   pipeline implementation by inserting pipeline registers and a forwarding unit. Describe the
   modification step by step and draw the final modified data path with all necessary control signals.
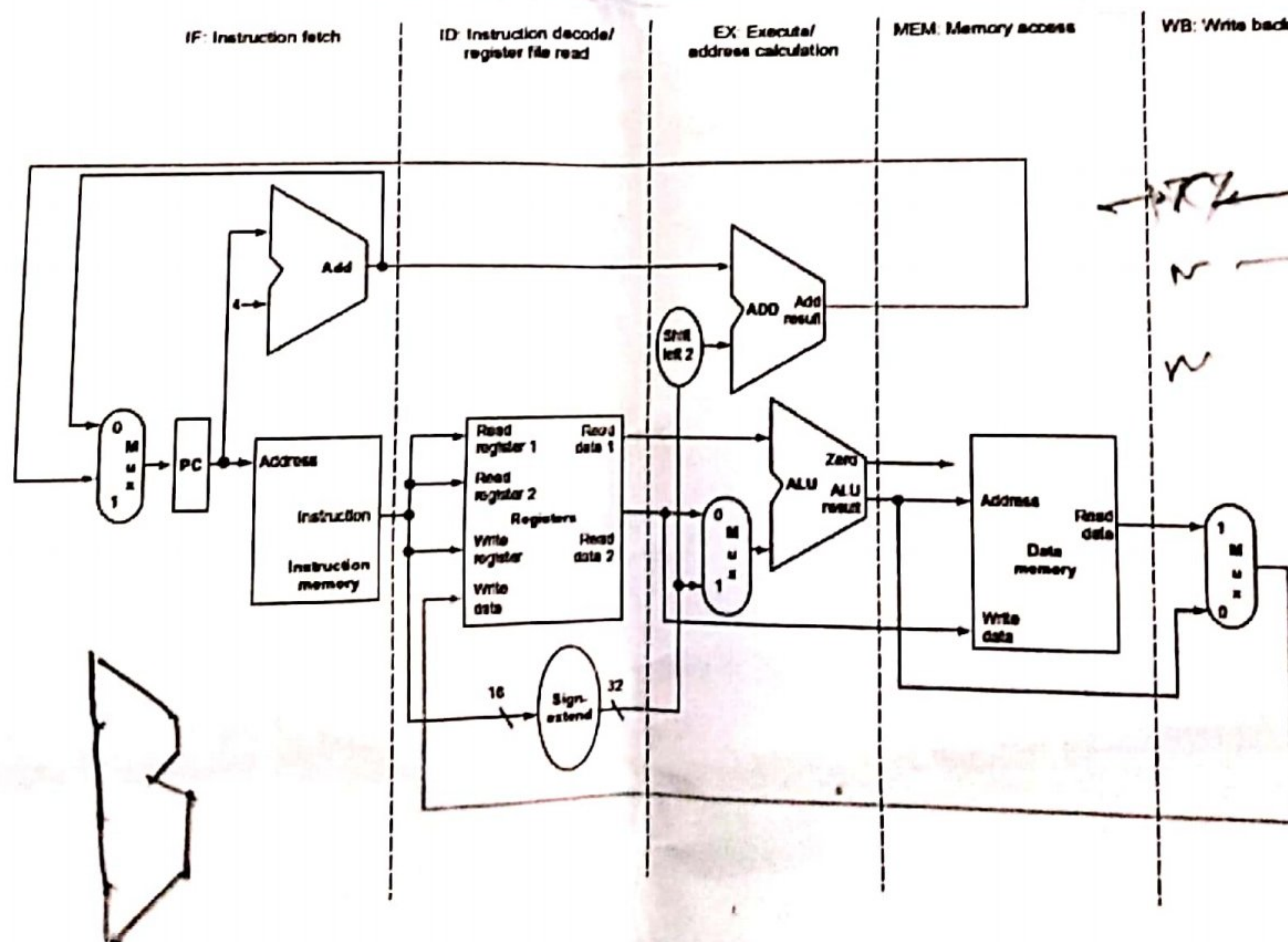
8. a) Draw organization of a hardware controlled control unit. Describe each component of it. Describe   3
   how control signals are generated.

   b) What is cache memory? Draw a block diagram of a 16KB cache which contains 256 blocks with   4
   16 words per block.

   c) Write down the differences between SRAM and DRAM.   3

Course No.: CSE309
Full Marks: 60

Course Title: Database Management Systems
Time: 3 hours

N.B.:

i) Answer SIX questions taking, any THREE from each section.
ii) All questions are of equal values.
iii) Sequence must be maintained for each question.

Section-A

1. a) How do relational database systems overcome the problem of data redundancy and inconsistency?   3
    b) Write the main tasks of DML.   3
    c) Define primary key, foreign key, composite key and super key. Give example for each.   4

2. a) A university registrar's office maintains data about the following entities: (a) courses, including   8
        number, title, credits, syllabus, and prerequisites; (b) course offerings, including course number,
        year, semester, section number, instructor(s), timings, and classroom; (c) students, including
        student-id, name, and program; and (d) instructors, including identification number, name,
        department, and title. Further, the enrollment of students in courses and grades awarded to students
        in each course they are enrolled for must be appropriately modeled. Construct an E-R diagram for
        the registrar's office. Document all assumptions that you make about the mapping constraints.
    b) Distinguish between strong entity set and weak entity set.   2

3. a) Transform the following ER diagram (Fig-3.1) into relations. [(*) sign indicates the identifying   8
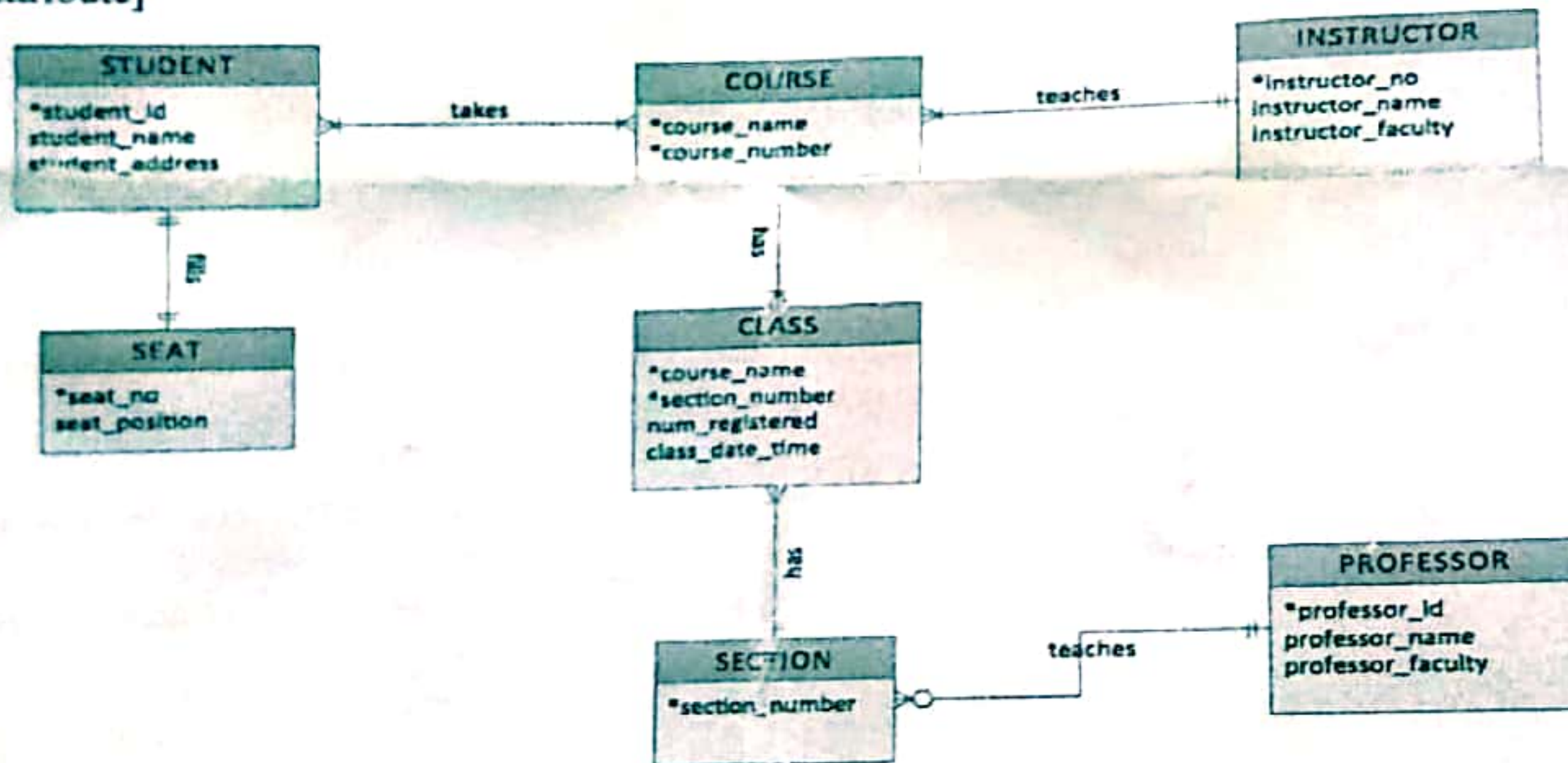   attribute]

Fig-3.1: ER diagram.

    b) Compare between disjoint and overlap rule of subtype-super type relationship.   2

4. a) Write down the BCNF decomposition algorithm.   3
    b) Normalize the table below up to 3NF which is about owners and the boat(s) they owned.   7

Table-4.1: Owners and their boats.

OwnerNum	LastName	FirstName	BoatName	Weight	Marina
AD57	Adney	Bruce and Jean	AdBruce X	1,000 lbs	East
			Zinger	1,500 lbs	East
AN75	Anderson	Bill	Yellow Beast	2,000 lbs	West
BL72	Blake	Mary	Kumodo	1,200 lbs	East
			Kryptonite	1,000 lbs	West
EL25	Elend	Sandy and Bill	Shark Fin	1,300 lbs	East
			Two Cute	900 lbs	East

Section B

5. a) Consider the relational database of **Figure-5.1**, where the primary keys are underlined. Give an expression in the **relational algebra** to express each of the following queries: 6

BRANCH(*branch name*, branch city, assets)
CUSTOMER (*customer name*, customer street, customer city)
LOAN (*loan number*, branch name, amount)
BORROWER (*customer name, loan number*)
ACCOUNT (*account number*, branch name, balance)
DEPOSITOR (*customer name, account number*)

Figure-5.1: Database schemas

i. Find the names of all customers who have a loan of greater than $50,000 at the Gopalganj branch.
ii. Delete all loan records with amount in the range of 0 to 50 from Gopalganj branch.
iii. Insert information in the database specifying that Karim has $500 in account A-100 at the Gopalganj branch.

b) Consider the following two relations, customer and balance: 4

Customer

customer	account	email
Kalam	1001 .	kalam@gmali.com
Rahim	1004	rahim@gmali.com
Khaled	1003 `	khaled@gmali.com

Balance

account	balance
1005	100000
1003	50000
1001	80000

Now do the following joining operation with showing the output value:

i. Natural join   ii. Left-outer join   iii. Right-outer join   iv. Full-outer join

6. a) Consider the following relational schema: 10

employee (*empno*, name, office, age)
books (*isbn*, title, author, publisher)
loan (empno, isbn, date)

where the primary keys are underlined. Note that in 'loan' schema empno and isbn are foreign keys.

Write SQL statements to answer the following queries:

i. Find the names of employees who have borrowed a book published by McGraw-Hill.
ii. Find the names and ages of employees who have borrowed all books written by Carl Hamacher.
iii. Find the names of employees who have borrowed more than five different books published by Pearson Education.
iv. For each publisher, find the names of employees who have borrowed more than five books of that publisher.

Find the titles and authors of the books that have been borrowed by Peter Hart.

7. a) "Indexing improves the performance of RDBMS" – justify this. 2
b) Compare between dense and sparse index. 2
c) The following set of key values are given for constructing B⁺ tree: 4

(2, 12, 19, 25, 30, 37, 43, 49, 55, 60, 68, 75, 90, 98, 103, 108)

Assume that the tree is initially empty and values are added in ascending order. Now Construct B⁺ tree such that maximum four pointers are fitted in each node.

d) What are the ACID properties in a DBMS? 2

8. a) Give the main principle of the timeout-based schemes for handling deadlock state. 3
b) Explain the wait-for graph technique for detecting the deadlock. 3
c) Specify the four considerations to select a transaction (or set of transactions) is needed to be rollback after detection of deadlock. 4