

Bangabandhu Sheikh Mujibur Rahman Science and Technology University

Department of Computer Science & Engineering

3rd Year 1st Semester B.Sc. Engineering Examination-2020

Course Title: Operating System and System Programming

Course No: CSE303

Full Marks: 60

Time: 3 hours

N.B.

- i) Answer any **THREE (3)** from each section.
- ii) All questions are of equal values.

Section – A

- Q.1(a) What is operating system? Explain the main purposes of an operating system. 5
- (b) Describe the differences between multiprogramming and multitasking operating 3
- (c) What are the differences between blocking and non-blocking system call? 2
- Q.2(a) Show the states of a process and the possible transitions between the states in a diagram. Give an 4
- example for each possible transition.
- (b) Suppose you are willing to write a program that will compute the sum of all possible 32-bit 4
- integers. Discuss how a multithreaded version of the program will affect the time required in comparison to that by single threaded program.
- (c) What are the advantages of thread pool? 2
- Q.3(a) What is critical section problem and what are the requirements that need to be satisfied by any 4
- solution to critical section problem?
- (b) Consider the following code of producer process for a producer consumer system: 4
- ```
Semaphore empty = 10;
Semaphore full = 0;
Semaphore mutex = 1
void producer (void) {
 int item;
 while (TRUE) {
 item = produce_item();
 mutex.P();
 empty.P();
 insert_item(item);
 full.V();
 mutex.V();
 }
}
```
- Will the above code work correctly? If not, explain the problems and write down the correct code 4
- for producer. If you think this code to be correct, write down the corresponding code for consumer.
- (c) Explain System Call with appropriate figure in user program interacts with the Operating System. 2
- Q.4(a) What is meant by deadlock in operating system? Briefly discuss the four conditions for deadlock. 4
- (b) Given the following state for the Banker's Algorithm. 4
- There are 6 processes P0 through P5 and 4 resource types: A (15 instances); B (6 instances), C (9 instances); D (10 instances). For the following current allocation and maximum need, should a new request (3, 2, 3, 3) from P5 be granted?

| Current Allocation |   |   |   |   | Maximum Need |   |   |   |   |
|--------------------|---|---|---|---|--------------|---|---|---|---|
| Process            | A | B | C | D | Process      | A | B | C | D |
| P0                 | 2 | 0 | 2 | 1 | P0           | 9 | 5 | 5 | 5 |
| P1                 | 0 | 1 | 1 | 1 | P1           | 2 | 2 | 3 | 3 |
| P2                 | 4 | 1 | 0 | 2 | P2           | 7 | 5 | 4 | 4 |
| P3                 | 1 | 0 | 0 | 1 | P3           | 3 | 3 | 3 | 2 |
| P4                 | 1 | 1 | 0 | 0 | P4           | 5 | 2 | 2 | 1 |
| P5                 | 1 | 0 | 1 | 1 | P5           | 4 | 4 | 4 | 4 |

(c) What do you mean by preemptable and non-preemptable resources?

2

### Section – B

Q.5(a) What is multiprogramming? Suppose you have a single CPU system. Will implementing multiprogramming improve the efficiency of your system? Justify your answer.

4

(b) Which of the following are "per process item", which are "per thread item", and which are neither?

3

Program Counter, Stack, Address Space, Global Variables, Registers, Open Files, Local Variables

(c) Compare the advantages and disadvantages of implementing threads in user space and kernel space.

3

Q.6(a) What is meant by the term quantum in context of process scheduling? What are the disadvantages if the quantum for scheduling is too large or too small?

4

(b) Consider the following workload:

4

| Process | Priority (Lowest number has the highest priority) | Burst Time (sec) | Arrival Time (sec) |
|---------|---------------------------------------------------|------------------|--------------------|
| P1      | 4                                                 | 40               | 50                 |
| P2      | 3                                                 | 70               | 10                 |
| P3      | 1                                                 | 50               | 0                  |
| P4      | 5                                                 | 100              | 0                  |
| P5      | 2                                                 | 50               | 70                 |

Calculate the average waiting time for the following scheduling algorithms:

(i) Non-preemptive Shortest Job First

(ii) Round Robin with quantum 30 sec.

(c) What is Convoy Effect?

2

Q.7(a) What is swapping? Discuss the swapping process with appropriate figure.

4

(b) Given five memory partitions of 100KB, 500KB, 200KB, 300KB and 600KB (in order), how would the first-fit, best-fit and worst-fit algorithms place processes of 212KB, 417KB, 112KB and 426KB (in order)? Which algorithm makes the most efficient use of memory?

4

(c) What are the differences between Paging and Segmentation?

2

Q.8(a) What is Belady's Anomaly? Explain it.

5

(b) What are requirements of memory management? Explain segmentation with example.

5

i. Answer **SIX** questions, taking any **EIGHT** questions.

ii. All questions are of equal values.

1. (a) Define system and system analysis. Describe briefly the properties of a system. 4  
(b) What key elements must be considered while reconstructing a system? 2  
(c) Distinguish between I) Physical and Abstract system. 4  
II) Deterministic or Probabilistic System
2. (a) Describe the main roles of a system analyst. 3  
(b) Elaborate on the technical and interpersonal skills required of systems analysts. 4  
When is one skill favored over the other? Why?  
(c) Why is it difficult to determine user requirements? Illustrate with example. 3
3. (a) Write down the rules of Data Flow Diagram. 3  
(b) Describe the properties and elements of system. 3  
(c) Describe the steps of feasibility analysis. 4
4. (a) What are the types of observation method in case of human observer? 3  
(b) What important information does the user's request for provide? Why is it so 4  
important in the initial investigation?  
(c) What kinds of information do we need to design a system? 3
5. (a) What traditional information-gathering tools are available for the analyst? 4  
Explain each tool briefly.  
(b) How important is a project team in feasibility analysis? Is it mandatory in 3  
every study? Where are the exceptions?  
(c) Define integration testing and functional testing. 3
6. (a) How to formulate project goals and quantify them? 3  
(b) What is level DFD? Write down the advantages of level DFD. 3  
(c) Describe the general strategy an analyst should use to gather information and 4  
Mention the possible sources of information when you are asked to analyze  
the department of CSE,BSMRSTU.
7. (a) "Many feasibility studies produce disillusion to users and analysts" Do you 3  
agree? Why? Explain.  
(b) Distinguish between the following: 4  
i) Coupling and Cohesion  
ii) HIPO and IPO  
(c) What are the objectives of using Structure Flowcharts? 3
8. (a) What is meant by cost-benefit analysis? What cost elements are considered 4  
in this analysis? What are the steps involved in this analysis?  
(b) Write down i) Direct vs Indirect costs. 3  
ii) Fixed vs variable costs.  
(c) Define the factors that contribute to the quality of the candidate system. 3

# Bangabandhu Sheikh Mujibur Rahman Science and Technology University

## Department of Computer Science and Engineering

### 3<sup>rd</sup> Year 1<sup>st</sup> Semester Final B.Sc. Engineering Examination-2020

Course Title: Computer Architecture and Organization

Course Code: CSE305

Total Marks: 60

Time: 3 (Three) Hours

N.B.: Answer **SIX** questions taking from **EIGHT** questions.

1. a) Write down the difference between computer Architecture and Computer 4  
b) What is the instruction set? With n bit instruction words, how many instructions can 3  
be formulated?  
c) Why do you need to know computer architecture and organization? 3
2. a) Explain different types of instructions with proper examples. 4  
b) Draw the timing diagram of the given instruction in 8085 4  
MOV B, C  
c) Give examples of different Addressing Modes. 2
3. a) Consider the following set of instructions: ADD, JUMP. Draw the single cycle 6  
datapath and control that can execute the above set of instructions. Minimize the  
number of hardware used as much as possible, i.e., there should be no redundant  
hardware in your design. (Note that explanation is not required.)  
b) Write the purpose of using ALU unit for R-type, load/store, and branch instructions. 2  
c) Your friend is claiming that *MemtoReg* signal is not necessary in the datapath of 2  
MIPS Architecture. Do you agree with him? Justify your answer.
4. a) How to design an ALU? 4  
b) What is datapath ? Explain it with a proper example. 3  
c) Write about Booth's Algorithm 3

5. a) What is computer architecture? Why computer architecture need to study? 2  
 b) The hardware designer supplied the instruction class and average clock cycles per instruction (CPI) (see table-1) and two code sequences and instruction counts for instruction class (see table-2). 6

Table-1

| Instruction Class | CPI for these classes |
|-------------------|-----------------------|
| A                 | 1                     |
| B                 | 2                     |
| C                 | 3                     |

| Code Sequence | Instruction Counts for instruction class |   |   |
|---------------|------------------------------------------|---|---|
|               | A                                        | B | C |
| 1             | 2                                        | 1 | 2 |
| 2             | 4                                        | 1 | 1 |

- i. Which code sequence executes the most instructions?  
 ii. Which will be faster?  
 c) If machine A runs a program in 10 seconds and machine B runs the same program in 15 seconds, how faster is A than B? 2

6. a) Explain data bus, control bus and address bus. 4

b) 6

| S2 | S1 | S0 | Cin | X | Y  | Operation                    |
|----|----|----|-----|---|----|------------------------------|
| 0  | 0  | 0  | 0   | A | 0  | Transfer A                   |
| 0  | 0  | 0  | 1   | A | 0  | Increment A                  |
| 0  | 0  | 1  | 0   | A | B  | Add B to A                   |
| 0  | 0  | 1  | 1   | A | B  | Add B to A plus 1            |
| 0  | 1  | 0  | 0   | A | B' | Add 1's complement of B to A |
| 0  | 1  | 0  | 1   | A | B' | Add 2's complement of B to A |
| 0  | 1  | 1  | 0   | A | 1  | Decrement A                  |
| 0  | 1  | 1  | 1   | A | 1  | Transfer A                   |

Draw the ALU from the truth table

7. a) What is Pipelining? Give an example of pipelining. 4  
 b) Reorder the following sequence of instructions to avoid pipeline stalls: 4

```
lw $t1, 20($t7)
add $t3,$t1,$t2
add $t5,$t3,$t4
sub $t3,$t2,$t4
```

Assume that forwarding is available in this pipelined processor.

- c) What is interrupt? 2
8. a) Which one is the best: hardware control unit or microprogrammed control unit and why? 3  
 b) Explain block diagram of hardware control unit. 4  
 c) Draw diagram of microprogrammed control unit. 3



Course Title: **Compiler Design**  
 Full Marks: **60**

Course No: **CSE307**  
 Time: **3 hours**

**N.B.**

- i) Answer **SIX (06)** questions taking any **THREE (03)** from each section.  
 ii) The figures in the right margin indicate full marks for each question.

**Section – A**  
 (Answer any **03** questions from this section)

- Q.1 (a) Explain the phases of a compiler for the following assignment statement: 6  
 $\text{average} = (\text{height1} + \text{height2}) / 2$   
 (b) What do you mean by annotated parse tree? Draw the annotated parse tree for the string “100 – 50 + 25” by using the following CFG: 4

| Productions:                                        | Semantic Rules:                                                        |
|-----------------------------------------------------|------------------------------------------------------------------------|
| $\text{expr} \rightarrow \text{expr} + \text{term}$ | $\text{expr.t} := \text{expr.t} \parallel \text{term.t} \parallel '+'$ |
| $\text{expr} \rightarrow \text{expr} - \text{term}$ | $\text{expr.t} := \text{expr.t} \parallel \text{term.t} \parallel '-'$ |
| $\text{expr} \rightarrow \text{term}$               | $\text{expr.t} := \text{term.t}$                                       |
| $\text{term} \rightarrow 0$                         | $\text{term.t} := '0'$                                                 |
| $\text{term} \rightarrow 1$                         | $\text{term.t} := '1'$                                                 |
| ....                                                | ....                                                                   |
| $\text{term} \rightarrow 9$                         | $\text{term.t} := '9'$                                                 |

- Q.2 (a) Design DFA for the following language: 4  
 “All strings of lowercase letters in which the letters are in ascending lexicographic order.”  
 (b) For the NFA of Fig. 2.1, indicate all the paths labeled aabb. Does the NFA accept aabb? 4  
 Explain the answer.

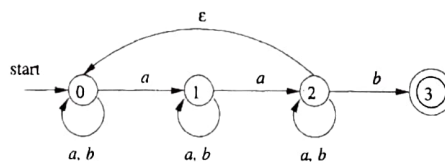


Fig. 2.1: An NFA.

- (c) What do you mean by dependency graph and evaluation order? Give examples. 2
- Q.3 (a) Explain the following terms. 4  
 (i) LL(k) grammar  
 (ii) Recursive-descent parser  
 (iii) Lexeme  
 (b) Eliminate left recursion from the following grammar: 4  
 $S \rightarrow Aa \mid Bb$   
 $A \rightarrow Aa \mid Abc \mid c \mid Sb$   
 $B \rightarrow dA \mid bb$   
 (c) Explain the differences between top-down parsing and bottom-up parsing. 2
- Q.4 (a) What is the difference between quadruples and triples representations of three-address codes? Illustrate with an example three-address code. 4  
 (b) Given the following expression: 4  
 $((a - b) - ((a - b) * (a + b))) + ((a - b) * (a + b))$   
 (i) Construct the DAG  
 (ii) Construct three address code for DAG  
 Assume the following grammar for this question.  
 $E \rightarrow E + T \mid E - T$   
 $T \rightarrow T * F$   
 $F \rightarrow (E) \mid id$   
 (c) Write a short note on three-address instructions. 2

**Section – B**  
(Answer any 03 questions from this section)

- Q.5 (a) `a*b printf( "1" );`  
`(ab)*b printf( "2" );`  
`c* printf( "3" );`  
We have the above snippet, with patterns and their associated actions, from a Lex code.  
Show the output, with detailed explanations, that is produced when this scanner is run over the following strings:  
(i) aaabccabbb  
(ii) cbbbabab  
(iii) cbabc
- (b) Elucidate, with necessary examples, how separating the analysis portion of a compiler into lexical analysis and parsing (syntax analysis) phases, achieves simplicity of design. 3
- (c) We want to develop the transition diagram for certain operators in a programming language. 3  
The operators are,  $=$ ,  $!=$ ,  $=$ ,  $>$ ,  $>=$ . Show that using an appropriate transition diagram how these operators can be tokenized in lexical analysis.
- Q.6 (a) Compute FIRST and FOLLOW sets for the following grammar: 4  
 $S \rightarrow TB$   
 $T \rightarrow (S) \mid a$   
 $A \rightarrow +S \mid TB \mid *$   
 $B \rightarrow AB \mid \in$
- (b) Consider the context-free grammar  $S \rightarrow (L) \mid a$  and  $L \rightarrow L, S \mid S$  with string  $((a, a), a, (a))$ . 6  
Answer the following:  
(i) Give a leftmost derivation for the string.  
(ii) Give a rightmost derivation for the string  
(iii) Is the grammar ambiguous or unambiguous? Justify your answer.
- Q.7 (a) Give bottom-up parses for the input string 00011, according to the following grammar: 4  
 $S \rightarrow 0 S 1 \mid 0 1$
- (b) Construct the DAG with mentioning the steps for the following expression: 4  
 $((x + y) - ((x + y) * (x - y))) + ((x + y) * (x - y))$
- (c) Find the instruction cost for the following instructions. 2  
(i) MOV b, R0  
ADD c, R0  
MOV R0, a  
(ii) MOV Mj, R  
MOV b, a(R)
- Q.8 (a) Differentiate with example between- 6  
(i) Syntax-directed definition and syntax-directed translation.  
(ii) Static and dynamic storage allocation in run-time environment.  
(iii) Syntax tree and directed acyclic graph (DAG)  
(iv) S-attributed definitions and L-attributed definitions.
- (b) Define L-attributed SDD (Syntax-Directed Definition). Give an example of a SDD which is 4  
not L-attributed.

Full Marks: 60

Times: 3 Hours

**N.B.:**

- i. Answer **SIX** questions, taking any **THREE** questions from each section.
- ii. All questions are of equal values

### SECTION A

1.
  - a) What is Database Management System? 1
  - b) Differentiate between the DDL and DML. Write down some DDL and DML operations. 4
  - c) Justify DBMS is more preferable to a file-processing system. 3
  - d) What are the five main functions of a database administrator? 2
2.
  - a) What is the difference between super key, candidate key and primary key? 3
  - b) Consider the following relational schema of employee database for a bank, where the primary keys are underlined.  
*employee* (person-name, street, city)  
*works* (person-name, company-name, salary)  
*manages* (person-name, manager-name)  
 Write down relational algebra for the following queries:
    - i. Find the names, street address, and cities of all managers who do not work for Citi Bank Limited and earn more than BDT 100,000 per annum. 2
    - ii. Increase the salary of all employees of Citi Bank Limited by 10 percent whose salary is more than BDT 150,000 per annum; Otherwise, increase only 5 percent. 2
    - iii. Delete all tuples in the *works* relation for the employees of Agrani Bank Limited. 1
    - iv. Find the number of employees in each company. 2
3.
  - a) List two reasons why we may choose to define a view. 2
  - b) There are many books in a library of different subjects. Each book must have an ISBN number, title, name of authors, subject and number of copies. A book can have multiple copies and each copy is identified by an accession number. The descriptive attributes of each copy of book are edition, price and date of purchase. A publisher publishes many books and a book is published by only one publisher. A publisher is identified by publisher id and described by name, country of origin, address and contact numbers.  
 Book supplier's supply many copies of books to the library by tender in each year. A tender has an id, name, total price and year. For each copy of books, you must store the record of which copy of book has been supplied by which supplier in which tender. A supplier is identified by supplier id and described by name, address and contact numbers.  
 One copy of a book (book-copy) can be issued to multiple borrowers in different times and a borrower can borrow multiple numbers of book-copies. Borrowers can be teachers, students or staffs. Each borrower must have a borrower id, name, contact number and address. Teachers are described by joining date and designation. Students are described by session, level and term. Staffs are described by office name.  
 When a book-copy is issued to borrower, some information such as issued date, accession number, borrower id, length of period for issue and return date are needed to enter into the database. At the same time, the status of the borrowed book should be labeled as issued and will be cleared after return by the borrower. **Draw an ERD for the above library management system.** 6
  - c) Why is indexing so important in SQL. 2



4. a) What is SQL? 1  
b) List all nontrivial functional dependencies satisfied by the following relation: 2

| A  | B  | C  |
|----|----|----|
| a1 | b1 | c1 |
| a1 | b1 | c2 |
| a2 | b1 | c1 |
| a2 | b1 | c3 |

$A \rightarrow B$   
 $C \rightarrow B$   
 $AC \rightarrow B$

- c) Consider the following relational schema of student database:

*student(student\_id, student\_name, student\_department)*

*course(course\_id, course\_title)*

*registered(student\_id, course\_id)*

Write down SQL for the following queries:

- Insert the information in the database specifying that a new student named Tarik in CSE department with id 2017CSE120, registered the course Database System with course id: CSE309. 1
  - Find the students of EEE department and their registered courses. List the records in alphabetical order according to the names of the students. 1
  - Find how many students registered their courses in each department. 1
  - Update the title of the course "Database System" to "Database Management System". 1
- d) Explain different types of constraints in SQL. 3

## SECTION B

- What is Database Normalization? Explain its role in database design. 3
  - What do you know about functional dependency and data redundancy? 2
  - What are the advantages and disadvantages of B+-tree index files? 2
  - What are the causes of bucket overflow in a hash file organization? What can be done to reduce the occurrence of bucket overflows? 3
- Explain recoverable schedule with an example. 3
  - Describe log-based recovery system with example. 3.5
  - Write down an algorithm for testing conflict serializability. 3.5
- Given a schedule below, Justify whether the schedule is conflict serializable or not. 4

| $T_1$                 | $T_2$                 |
|-----------------------|-----------------------|
| read (A)<br>write (A) | read (A)<br>write (A) |
| read (B)<br>write (B) | read (B)<br>write (B) |

- During its execution, a transaction passes through several states. Draw the state diagram of transaction and define each of them briefly. 3
  - Describe Lock-Based concurrency control protocol with example. 3
8. a) What is trigger in SQL? When should we not use the triggers? 3  
b) What stable storage? What are the differences between volatile and non-volatile storage? 3  
c) Explain cascading rollbacks with an example where schedule is rollbacks. 4