UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: May 2026

Module Number: EE6253

Module Name: Operating Systems and Network Programming (c-18)

[Three Hours]

[Answer **all questions**]

Index Number: _____

- Question paper consists of two parts. Part I: MCQs and Part II: Essay.
- **You should first answer the Part I on this paper itself.**
- **Part I will be collected after 30 minutes.**

Part I: Multiple Choice Questions

- Part I contains 20 MCQs. Time allocated is 30 minutes.
- Answer all questions. Each question carries 0.5 Marks.

Q1. 1) What is an operating system?

a) Interface between the hardware and application programs

b) Collection of programs that manage hardware resources

c) System service provider to the application programs

d) All of the mentioned

2) To access the services of operating system, the interface is provided by the _____

a) System calls

b) Dispatcher

c) Scheduler

d) None of the mentioned

3) Which statement best describes why the Linux kernel is called "monolithic"?

a) The kernel only handles basic hardware tasks, while most OS services run in user space

b) The kernel is split into separate modules that run-in user space instead of kernel space

c) The kernel manages all hardware, drivers, and core OS functions, with almost everything running in kernel space

d) None of the mentioned

4) Which type of operating system is used in life-saving medical devices and aircraft control?

a) Batch OS

b) Time-sharing OS

c) Real-Time OS

d) Network OS

5) Which of the following is/are mandatory requirements for a valid solution to the critical section problem?

a) Mutual exclusion

b) Race Condition

c) Mutual exclusion and progress

d) Mutual exclusion, progress and bounded waiting

6) The dining - philosophers' problem will occur in case of,

a) 5 philosophers with 5 chopsticks

b) 5 philosophers with 3 chopsticks

c) 3 philosophers with 5 chopsticks

d) 4 philosophers with 6 chopsticks

7) What is a key characteristic of a bounded buffer in producer-consumer problems?

a) It has a fixed maximum capacity and requires synchronization when full or empty

b) It allows unlimited item production without consumer constraints

c) Its size dynamically expands when the producer creates new items

d) It prevents the producer from ever waiting during operation

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8) Which of these can be used to allocate memory from a list of free holes?
   a) First Fit and Worst Fit
   b) Worst Fit and Best Fit
   c) Best Fit and First Fit
   d) Best Fit, First Fit and Worst Fit

9) In process synchronization, semaphores control access to shared resources using which pair of operations?
   a) start() and stop()
   b) wait() and signal()
   c) open() and close()
   d) lock() and signal()

10) Which of the following flags is used to open a file for both reading and writing?
   a) O_RDONLY
   b) O_WRONLY
   c) O_RDWR
   d) O_APPEND

11) What is the function of S_IXOTH in file permissions?
   a) Set write permission for others
   b) Set read permission for user
   c) Set execute permission for others
   d) Set execute permission for group

12) What does fclose() return if it fails to close a file?
   a) 0
   b) 1
   c) -1
   d) NULL

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13) Which open() flags match fopen() mode "w+"?

a) O_RDWR

b) O_RDWR | O_CREAT | O_TRUNC

c) O_RDONLY | O_CREAT

d) O_WRONLY | O_APPEND

14) Consider the following processes with Arrival Time (AT) and Burst Time (BT).

Process	AT	BT
P1	0	5
P2	1	3
P3	2	1
P4	3	4

What is the average waiting time? (Use Non-Preemptive Shortest Job First)

a) 3.5ms

b) 4.5ms

c) 5.5ms

d) None of the mentioned

15) Which of the following correctly describes a Bounded Buffer?

a) Producers can always produce new items without waiting

b) Consumers never have to wait for new items

c) Producer must wait if the buffer is full, and the consumer must wait if the buffer is empty

d) Buffer has no practical limit on its size

16) When the CPU is free, from which queue does the operating system choose a process to run next?

a) Execution queue

b) Process queue

c) Waiting queue

d) Ready queue

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17) Which of the following statements is correct about Logical Address Space and Physical Address Space in a computer system?

a) Logical Address is generated by the memory unit and always remains constant

b) Physical Address is generated by the CPU and can change during execution

c) Logical Address Space defines the size of the process and can be changed

d) Physical Address Space is defined as the size of the process and is computed by the CPU

18) What is dispatcher latency?

a) Time taken by CPU to execute a process

b) Time taken to select a process from the ready queue

c) Time taken to stop one process and start another process

d) Time taken for I/O completion

19) What is the return value of fprintf() when it executes successfully?

a) 0

b) -1

c) Number of bytes written

d) Pointer to file stream

20) Which option correctly matches each function with its appropriate header file in order?

fopen(), close(), exit(), printf(), chmod()

a) <stdio.h>, <unistd.h>, <stdlib.h>, <stdio.h>, <sys/stat.h>

b) <stdlib.h>, <unistd.h>, <stdio.h>, <sys/stat.h>, <stdio.h>

c) <stdio.h>, <stdlib.h>, <unistd.h>, <stdio.h>, <sys/stat.h>

d) <stdio.h>, <unistd.h>, <sys/stat.h>, <stdlib.h>, <stdio.h>

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[Answer **all questions**, each question carries **10 marks**]

Part II: Essay Questions

Q2

a) List two examples of deadlocks related to computer systems.

[1.0 Mark]

b) Explain four conditions to cause a deadlock.

[2.0 Marks]

c) List two data structures used in Banker's algorithm.

[1.0 Mark]

d) Suppose we have 3 processes (A, B, C) and 3 resource types (R1, R2, R3) each having 5 instances. Suppose at time T if the snapshot of the system is taken as represented in Table Q2 d).

Table Q2 d)

Process	Allocation			Max		
	R1	R2	R3	R1	R2	R3
A	1	2	1	2	2	4
B	2	0	1	2	1	3
C	2	2	1	3	4	1
Total allocation	5	4	3			

At time T, the available resources are:

R1 = 0, R2 =1, R3 =2

Apply the Banker's algorithm and determine whether the system is in a safe state or not.

[6.0 Marks]

Q3

a) Describe whether the following activities are preemptive or non-preemptive. Justify your answer.

i) Performing a surgery

ii) Watching a movie

iii) Reading a book

iv) Answering a phone call

[2.0 Marks]

b) Describe the following terms in CPU scheduling.

i) CPU burst

ii) I/O burst

iii) Convoy effect

iv) Dispatcher

[2.0 Marks]

c) The four processes arrive with the following attributes:

- P1: Burst time = 9, Arrival time = 0
- P2: Burst time = 4, Arrival time = 2
- P3: Burst time = 5, Arrival time = 4
- P4: Burst time = 7, Arrival time = 5

Calculate the average waiting time for the following scheduling algorithms. Draw the Gantt charts.

i) First Come First Serve (FCFS)

ii) Round Robin (Time Quantum = 5)

[6.0 Marks]

Q4 a) Write down Linux terminal commands to complete following tasks.

i) List all files in home directory.

ii) List all files in home directory with hidden files.

iii) List all files in home directory in long list format.

iv) Append content of Doc1.txt to Doc2.txt.

v) Copy the content of Doc1.txt to Doc2.txt.

vi) Observe the statistics of Doc1.txt.

vii) Clear the screen of the terminal.

viii) Log out user session using the terminal.

ix) Shutdown Ubuntu using the terminal.

x) Restart Ubuntu using the terminal.

[5.0 Marks]

b) i) Write the code line for following low level system calls and define all the arguments in each system call properly.

- lseek()
- chmod()
- read()
- write()

[2.0 Marks]

ii) Write a program to read from 15th byte to 30th byte and 40th byte to 50th byte from doc1.txt file and write to doc2.txt file using low level file I/O system calls.

[3.0 Marks]

Q5 a) When can a thread reach the terminated/end state?

[1.0 Mark]

b) State an advantage of implementing the Runnable interface over extending the Thread class to create a thread object in Java.

[1.0 Mark]

c) State two Java methods used to control thread execution and explain their functions.

[2.0 Marks]

d) Explain one advantage and one disadvantage of using UDP over TCP in real-world applications.

[1.0 Mark]

e) Write Java server-side snippets to:

- Create a ServerSocket on port '9090'
- Accept client connection
- Read a message sent from the client

[1.5 marks]

f) Write Java client-side snippets to:

- Connect to the server using IP address '127.0.0.1' and port '9090'
- Send a message to the server

[1.5 Mark]

g) State two applications of network programming that enable real-time communication and data exchange. For each application, briefly mention how threads are used.

[2.0 Marks]