



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : OPERATING SYSTEM
- COURSE CODE : BNF 32303
- PROGRAMME CODE : BNF
- EXAMINATION DATE : JULY 2024
- DURATION : 2 HOURS 30 MINUTES
- INSTRUCTION :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 - Open book
 - Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

TERBUKA

CONFIDENTIAL

- Q1** (a) During start-up, a computer runs an initial program known as the bootstrap program.
- (i) Explain the boot sequence of a general-purpose computer system. (3 marks)
 - (ii) Describe the role of the bootstrap program during the boot sequence. (2 marks)
- (b) The dual-mode operation of operating systems provides a mechanism to protect the computer's hardware by distinguishing between execution at the user level and the kernel (privileged) level. Give suggestion whether the following instructions can be done in user mode or kernel mode. Provide reason for the mode suggested for each instruction:
- (i) Change process priority.
 - (ii) Allocate system memory.
 - (iii) Read a file from disk.
 - (iv) Enable a firewall.
 - (v) Issue a halt command to stop the system.
 - (vi) Get system uptime. (12 marks)
- (c) (i) Describe the hierarchy of storage in a computer system. Explain the roles of main memory and secondary storage, and discuss how caching improves system performance. (4 marks)
- (ii) Draw a diagram representing the memory hierarchy in a typical computer system based on speed, cost, and volatility. Label each level of the hierarchy clearly and explain the role of each type in the storage system. (4 marks)

TERBUKA

- Q2** (a) As a process scheduler, the OS must select processes from queues. Describe the differences between short-term scheduler, long-term scheduler and mid-term scheduler.

(9 marks)

- (b) A program that has process creation is called parent process that can create children processes, which, in turn create other processes, forming a tree of processes. Give **ONE (1)** example of application software in your laptop that implements process creation and explain its operation.

(4 marks)

- (c) Using Amdahl's Law, calculate the speedup gain of an application that has a 80 percent parallel component as listed below. Given the formula

$$Speedup \leq \frac{1}{S + \frac{(1-S)}{N}}$$

Where S is the portion of the application that must be performed serially on a system with N processing cores.

- (i) Two processing cores
- (ii) Four processing cores
- (iii) Eight processing cores

(6 marks)

- (d) Support for threads may be provided either at the user level or by the kernel called user threads or kernel threads. To establish relationship between user threads and kernel threads, there are **THREE (3)** common models used. Describe and differentiate these models. Draw diagram to aid your explanation.

(6 marks)

TERBUKA

Q3 (a) Given the system model:

Processes, $P = \{P_1, P_2, P_3, P_4, P_5\}$

Resources, $R = \{R_1, R_2, R_3, R_4\}$

Resource instances, $W_1 = 2, W_2 = 3, W_3 = 1, W_4 = 4$

Edges, $E = \{P_1 \rightarrow R_1, P_1 \rightarrow R_4, P_2 \rightarrow R_2, P_3 \rightarrow R_1, P_3 \rightarrow R_3, P_4 \rightarrow R_2, P_5 \rightarrow R_4, R_1 \rightarrow P_2, R_2 \rightarrow P_1, R_3 \rightarrow P_4, R_4 \rightarrow P_3\}$

(i) Draw the corresponding resource allocation graph based on the system model.

(4 marks)

(ii) Determine whether the resource allocation graph in question **Q3(a)(i)** is in deadlock or not.

(3 marks)

(iii) Determine the condition if P_5 request for R_2 is granted.

(3 marks)

(b) Consider the resource allocation of a system as shown in **Table Q3.1**. Analyse the system and answer the following questions using the banker's algorithm.

Table Q3.1

	Allocation	Max	Available
	ABCD	ABCD	ABCD
T_0	0021	0024	3012
T_1	1100	2122	
T_2	0210	0222	
T_3	1202	3222	
T_4	0111	2115	

(i) Determine what is the content of the matrix **Need**.

(5 marks)

(ii) Determine whether the system in a safe state.

(6 marks)

(iii) If a request from thread T_2 arrives for $(0,1,0,1)$, can the request be granted immediately?

(2 marks)

(iv) Continuing from the system state in **Q3(a)(iii)**, if a request from thread T_4 arrives for $(3,3,0,4)$, can the request be granted immediately?

(2 marks)

TERBUKA

- Q4 (a)** Consider the set of processes given in **Table Q4.1**, with the length of the CPU burst time given in milliseconds. The processes are assumed to have arrived in the order P₁, P₂, P₃, P₄, P₅, all at time 0.

Table Q4.1

Process	Burst time	Priority
P ₁	4	3
P ₂	9	3
P ₃	5	1
P ₄	7	2
P ₅	2	4

- (i) Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, non-preemptive priority (a larger priority number implies a higher priority), and RR (quantum = 2).
(8 marks)
- (ii) Calculate the turnaround time of each process for each of the scheduling algorithms in **Q4(a)(i)**.
(5 marks)
- (iii) Calculate the waiting time of each process for each of these scheduling algorithms.
(5 marks)
- (iv) Determine which of the algorithms results in the minimum average waiting time (over all processes). Justify your answer.
(2 marks)
- (b) Assuming a 1-KB page size, determine the page numbers and offsets for the following address references (provided as decimal numbers):
- (i) 8000
 - (ii) 16384
 - (iii) 65536
 - (iv) 512000
 - (v) 1048576
- (5 marks)

- END OF QUESTIONS -

TERBUKA