Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	OPERATING SYSTEMS
COURSE CODE	:	BIC 20803
PROGRAMME CODE	:	BIS / BIW / BIM / BIP
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

SECTION A
Instruction: Choose the BEST answer for each of the following questions.

Q1 If all processes I/O bound, the ready queue will almost always be _____ and the Short term Scheduler will have a _____ to do.

A. full,little
B. full,lot
C. empty,little
D. empty,lot

(1 mark)

Q2 If a process is executing in its critical section, then no other processes can be executing in their critical section. This condition is called _____.

A. critical exclusion
B. mutual exclusion
C. synchronous exclusion
D. asynchronous exclusion

(1 mark)

Q3 There are ten different processes running on a workstation. Idle processes are waiting for an input event in the input queue. Busy processes are scheduled with the Round-Robin time sharing method. Which of the following quantum times is the best value for small response times, if the processes have a short runtime (less than 10ms)?

A. Time Quantum = 15ms
B. Time Quantum = 40ms
C. Time Quantum = 45ms
D. Time Quantum = 50ms

(1 mark)

Q4 A computer system has six tape drives, with '`n`' processes competing for them. Each process may need three tape drives. The maximum value of '`n`' for which the system is guaranteed to be deadlock free is _____.

A. 1
B. 2
C. 3
D. 4

(1 mark)

Q5 Consider the following set of processes in **Table Q5**, the length of the CPU burst time given in milliseconds. Assuming the process is being scheduled with the Shortest Job First (SJF) scheduling algorithm, the waiting time for process P_1 is:

Table Q5

Process	Burst Time
P_1	6
P_2	8
P_3	7
P_4	3

A. 0ms
B. 3ms
C. 9ms
D. 16ms

(1 mark)

Q6 If a higher priority process arrives and requests service, the memory manager can swap out the lower priority process to execute the higher priority process. When the higher priority process finishes, the lower priority process is swapped back in and continues execution. This variant of swapping is sometimes called _____.

A. priority swapping
B. pull out, push in
C. roll out, roll in
D. none of the above mentioned

(1 mark)

Q7 When a program tries to access a page that is mapped in address space but not loaded in physical memory, then _____.

A. segmentation fault occurs
B. fatal error occurs
C. page fault occurs
D. no error occurs

(1 mark)

Q8 Which algorithm chooses the page that has not been used for the longest period of time whenever the page required to be replaced?

A. First in first out algorithm
B. Additional reference bit algorithm
C. Counting based page replacement algorithm
D. Least recently used algorithm

(1 mark)

Q9 When two users keep a subdirectory in their own directories, the structure being referred to _____.

A. tree structure
B. cyclic graph directory structure
C. two level directory structure
D. acyclic graph directory

(1 mark)

Q10 Ability to obtain data from a storage device by going directly to where it is physically located on device rather than by having to sequentially look for data at one physical location after another is _____.

A. sequential access
B. timed access
C. direct access
D. variable access

(1 mark)

SECTION B

Q11 (a) Outline **FIVE (5)** major states of a process with respect to process management, and briefly describe each state.

(5 marks)

(b) The following **Figure Q11(b)** is a Gantt Chart that shows the execution of four processes on a single processor for 35ms. The X-axis denotes the time in ms while the Y-axis denotes the frequency used to execute each process. Analyze the figure and answer the following questions.

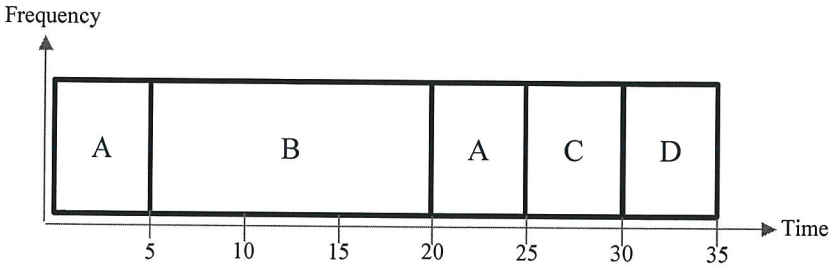

Figure Q11(b)

(i) Process C requires an input from Process B, and thus can only start at 25ms. Identify which state does Process C belongs to during 0ms to 24ms?

(2 marks)

(ii) What is the state of Process B at 15ms?

(2 marks)

(iii) What is the state of Process D at 35ms?

(2 marks)

(iv) The execution of Process A is interrupted by Process B at 5ms. What is the term used to describe this scenario and what happen during this time?

(4 marks)

Q12 Let three processes P_1, P_2 and P_3 all were arriving at time 0, with total execution of 10, 20 and 30 time units, respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible.

(a) Draw the possible Gantt Chart to illustrate the process execution.

(2 marks)

(b) How many percentage of time does the CPU remain idle?

(3 marks)

Q13 Consider three CPU-intensive processes, which require 10, 20 and 30 time units and arrive at times 0, 2 and 6, respectively. How many context switches are needed if the operating system implements a Shortest Remaining Time First scheduling algorithm? Do not count the context switches at time 0 and at the end.

(2 marks)

Q14 Assume every process requires 3 seconds of service time in a system with single processor. If new processes are arriving at the rate of 10 processes per minute, then estimate the fraction of time CPU is busy in the system.

(2 marks)

Q15 Five jobs A, B, C, D and E are waiting in ready queue. Their expected runtimes are 9, 6, 3, 5 and x respectively. All jobs entered in ready queue at time zero. In which order they must run to minimize average waiting time if $3<x<5$.

(1 mark)

Q16 Consider three processes P_0, P_1 and P_2 respectively with compute time bursts 2, 4 and 8 time units. All processes arrive at time 0. Consider the Longest Remaining Time First (LRTF) scheduling algorithm. In LRTF ties are broken by giving priority to the process with the lowest process ID.

(a) Draw Gantt Chart to illustrate the process execution.

(3 marks)

(b) Calculate the average turnaround time.

(2 marks)

Q17 Processes P_1 and P_2 are using two shared resources R_1 and R_2. Each process has a certain priority for accessing each resource. Let T_{ij} denotes the priority of P_i for accessing R_j. A process P_i can grab a resource R_h from process P_j if T_{ik} is greater than T_{jk}. Given the following conditions:

$$T_{11} > T_{21} \; ; \; T_{12} > T_{22} \; ; \; T_{11} < T_{21} \; ; \; T_{12} < T_{22}$$

Identify **ONE (1)** possible pair of conditions that ensures P_1 and P_2 can never be in deadlock.

(2 marks)

Q18 Consider a system with four types of resources R_1 (3 units), R_2 (2 units), R_3 (3 units) and R_4 (2 units). A non-preemptive resource allocation policy is used. At any given instance, a request is not entertained if it cannot be completely fulfilled by the system. Three processes P_1, P_2, P_3 request the sources as in **Figure Q18** if executed independently.

```
Process P1:
t=0: requests 2 units of R2
t=1: requests 1 unit of R3
t=3: requests 2 units of R1
t=5: releases 1 unit of R2 and 1 unit of R1
t=7: releases 1 unit of R3
t=8: requests 2 units of R4
t=10: Finishes

Process P2:
t=0: requests 2 units of R3
t=2: requests 1 unit of R4
t=4: requests 1 unit of R1
t=6: releases 1 unit of R3
t=8: Finishes

Process P3:
t=0: requests 1 unit of R4
t=2: requests 2 units of R1
t=5: releases 2 units of R1
t=7: requests 1 unit of R2
t=8: requests 1 unit of R3
t=9: Finishes
```

Figure Q18

If all the three processes run concurrently starting at time `t=0`,

(a) Draw the resource allocation graph at time:

(i) `t=8`
(ii) `t=9`
(iii) `t=10`

(6 marks)

(b) Determine whether deadlock occurs or not. If yes, which processes are in deadlock?

(2 marks)

Q19 A system shares nine tape drives. The current allocation and maximum requirement of tape drives for four processes are shown in **Table Q19** below.

Table Q19

Process	Maximum Need	Current Allocation	Current Available	Remaining Need
P_1	9	3		
P_2	6	1		
P_3	5	3		
P_4	10	0		

(a) Calculate the "Remaining Need" resource of each process:

(i) P_1
(ii) P_2
(iii) P_3
(iv) P_4

(4 marks)

(b) Explain why the current state of the system is "not safe and deadlocked" based on **Table Q19**.

(4 marks)

Q20 Given five memory partitions in order of 100KB, 500KB, 200KB, 300KB, and 600KB and four processes in **Table Q20**.

Table Q20

Process	Size (KB)
P_1	214
P_2	420
P_3	115
P_4	430

(a) Illustrate the new memory partitions after all processes are loaded using the following algorithms:

(i) Best-fit
(ii) Worst-fit
(iii) First-fit

(6 marks)

(b) Based on algorithms listed in **Q20(a)**, discuss algorithm that makes the most efficient of the following criteria:

(i) Speed
(ii) Memory utilization

(5 marks)

Q21 (a) Determine the number of page faults from the following page replacement information. Show your works.

Reference strings: `0,2,4,6,2,0,9,5,3,8,1,7,1,7,4,1,3,8,7`
Number of page frames: 4
Algorithm: Least Recently Used (LRU)

(5 marks)

(b) Discuss Belady's anomaly scenario in **Q21(a)** by illustrating a graph for the number of page frames from 1 until 5.

(10 marks)

Q22 (a) Select the best file organization to maximize the speed of access, use of storage space and ease of updating for the following scenarios.

(i) Updated infrequently and accessed frequently, in random order.
(ii) Updated frequently and accessed in its entirety relatively frequently.
(iii) Updated frequently and accessed frequently, in random order.

(3 marks)

(b) Outline **FOUR (4)** important criteria in choosing a file organization.

(4 marks)

(c) Illustrate a tree-structured directory for the following pathname by using block diagrams.

```
/USER/My Documents/myFile.docx
```

(4 marks)

(d) **Figure Q22(d)** shows a set of blocks of a secondary storage. The number on each block is its index. A grey-coloured block represents a used block while a white-coloured block represents an unused block. Analyse the figure and answer the following questions.

0	1	2	3	4
5	6	7	8	9
10	11	12	13	14
15	16	17	18	19
20	21	22	23	24

Figure Q22(d)

(i) What is the vector value of the disk blocks using bit tables approach?

(1 mark)

(ii) A sequential file with length equal to three disk blocks needs to be allocated to the disk. Which file allocation method is best for storing the file to avoid external fragmentation, and how it works?

(3 marks)

(iii) With contiguous allocation method, what should be done first to store a file with length equal to five disk blocks to the disk?

(1 mark)

- END OF QUESTIONS -