Student ID:_____

Seat No.:_____

CITY UNIVERSITY OF HONG KONG

Course code & title : CS3103 Operating Systems

Session : Semester A 2006/07

Time allowed : Two hours

This paper has SEVEN pages (including this cover page).

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1. This paper consists of 5 questions in 2 sections A & B
2. Question 1 and 2 are compulsory. Answer any 3 questions out of 4 in section B.
3. Answer question 1 and 2 on the question paper.
4. Start a new page for each question in section B.

Materials, aids & instruments permitted to be used during examination:

1. Approved calculator

Section A (40%)

Attempt ALL questions from this Section

Question 1

(i) A monolithic kernel contains _____, whereas a microkernel is a _____ of the operating system.

2 marks

(ii) Applications use system calls to invoke _____.
The system call results in transfer from _____ to _____ mode.

2 marks

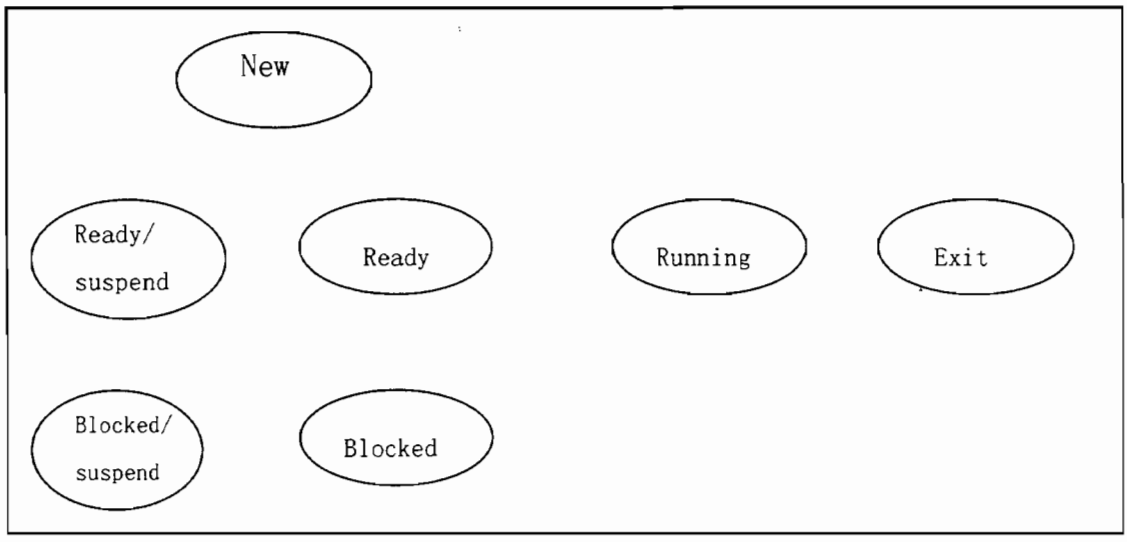
(iii) For the following process states, classify them in terms of long term, medium-term and short term scheduling

	Long-term	Medium-term	Short-term
1. New	☐	☐	☐
2. Ready	☐	☐	☐
3. Ready Suspended	☐	☐	☐
4. Running	☐	☐	☐
5. Blocked	☐	☐	☐
6. Blocked Suspended	☐	☐	☐
7. Exit/Terminated	☐	☐	☐

2 marks

(iv) Draw the state transition & label the transitions between the states

4 marks



(v) Define the following CPU scheduling performance measures:

(1) Turnaround time _____

(2) Throughput _____

(3) CPU Utilization _____

3 marks

(vi) The jobs in a multiprogramming system are identical. For a period T of each job, half of it goes to I/O & the other half to CPU. If each job runs for N periods & assuming Round Robin scheduling with I/O overlap, compute the turnaround time (TAT) and processor utilization for

	Turnaround Time	CPU utilization
1 job	_____	_____
2 jobs	_____	_____

2 marks

(vii) If the disk system under MSDOS has the following parameters:

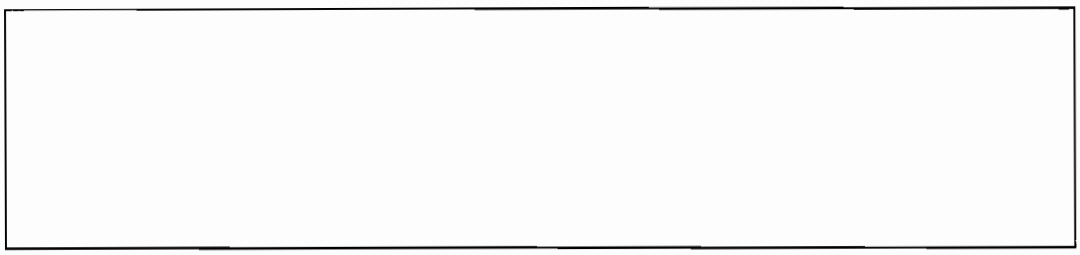
Capacity = 30 Mbytes
Block size = 512 bytes
Blocks/cluster= 4

The number of entries in the FAT table is _____.

2 marks

(viii) Show the timing for double buffering with the help of a timing diagram, where

TAi = Time to transfer i^{th} data block into buffer A
TBi = Time to transfer i^{th} data block into buffer B
MAi=Time to move block i from buffer A to work area
MBi= Time to move block i from buffer B to work area
Pi = Time to process block i



3 marks

Question 2

Give three of the advantages of user-level threads over kernel-level threads:

1. _____

_____

2 marks

2. _____

_____

2 marks

3. _____

_____

2 marks

(A) For the following processes A, B, C & D with arrival and processing times as given in the table:

Process Name	Arrival Time (T_a)	Processing Time (T_s)
A	0	1
B	1	9
C	2	1
D	3	9

Compute the finished times, average turnaround time & normalized turnaround time for the following Scheduling Algorithms:

1. FCFS (same as FIFO)
2. RR (time quantum = 4)
3. SPN (same as SJF)
4. SRT
5. HRRN

Draw the schedule for each algorithm using squares (with each square represents one time unit); the name in the square refers to the currently-running process. 14 marks

FCFS
RR, q = 4
SPN
SRT
HRRN

If T_f is the finished time, T_r is the turnaround time and T_r/T_s the normalized turnaround time, fill in the table for the different scheduling algorithms:

		A	B	C	D
	T_a	0	1	2	3
	T_s	1	9	1	9
FCFS	T_f				
	T_r				
	T_r/T_s				
RR $q = 4$	T_f				
	T_r				
	T_r/T_s				
SPN	T_f				
	T_r				
	T_r/T_s				
SRT	T_f				
	T_r				
	T_r/T_s				
HRRN	T_f				
	T_r				
	T_r/T_s				

Section B (60%)

Attempt THREE questions from this Section

Question 3

(A) The processes in the ready queue is given in the order below together with the run-times, calculate the waiting time and also the ratio wait-time/run-time for the FCFS and SPN (shortest process next). Comment on the significance of the ratio 7 marks

Process	Run-time
1	10
2	50
3	2
4	100
5	5

(B) The following formulas are adopted by most UNIX scheduling systems:

$$CPU_j(i) = CPU_j(i-1)/2$$

$$P_j(i) = Base_j + CPU_j(i)/2 + nice_j$$

Where $CPU_j(i)$ = Processor utilization by process j through interval i

$P_j(i)$ = Priority of j at beginning of interval i; lower has higher Priority

$Base_j$ = base priority of process j

$Nice_j$ = user adjustable factor

The nice values are assumed to be zero for 3 processes A, B and C and each with base priority 60. $CPU_j(i)$ is measured in terms of the value of a counter that is incremented by the clock that interrupts the system 60 times per second (priority is increased by one for every interrupt). Both $CPU_j(i)$ & Pj are recomputed every second. Give the running process for the first 5 seconds and the priorities of A, B and C at the start of the 5th second.

13 marks

Question 4

(A) Describe with the help of pseudo-code, how one can solve the producer consumer problem with the help of semaphores. Three semaphores are used

12 marks

Semaphores	Purpose	Initial value
free	Mutual exclusion for buffer access	1
space	space available in buffer	N
data	data available in buffer	0

(B) A system with three processes has the following resource needs

Process	Maximum Need	Current Usage
P1	8	3
P2	5	1
P3	8	2

If the available resources at this point are 4, show that the above is in safe state.

8 marks

Question 5

(A) In a segmentation-page system, the virtual address consists of 32 bits of which 12 bits are the offset, 11 bits are a segment number and 9 bits are a page number, calculate

(a) Page size

(b) Maximum segment size

(c) Maximum number of segments

(d) Maximum number of pages

6 marks

(B) A process contains 8 virtual pages on disk & is assigned 4 page frames in main memory. The page reference trace is:

1 0 2 2 1 7 6 7 0 1 2 0 3 0 4 5 1 5 2 4 5 6 7 6 7 2 4 2 7 3 3 2 3

Show the pages residing in the 4 frames using LRU and FIFO replacement policies. Compare the effectiveness of the two replacement strategies & compute their hit ratios.

14 marks

Question 6

(A) Define the seven RAID levels 10 marks

(B) Analyze the following disk scheduling policies: FIFO, SSTF, SCAN, C-SCAN. The assumption is that the disk has 200 tracks and the disk requests queue has random requests in it, in the order of the following sequence of disk track requests:

27, 129, 110, 186, 147, 41, 10, 64, 120

Disk head is initially moving in the direction of decreasing track number.

10 marks

- END -