ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **WINTER SEMESTER, 2016-2017**

DURATION: 3 Hours **FULL MARKS: 150**

CSE 4501: Operating Systems

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) What is a system call? Name three process-related, three memory-related and three I/O-related system calls. 6

   b) What is the difference between polling and interrupt? Can or should operating system make a device driver using polling? Briefly describe. 7

   c) What is the main advantage for an operating system designer to use virtual machine architecture? How does the guest operating system function on the host operating system? Describe with a figure. [Hint: VMWare] 6

   d) Briefly describe Memory mapping, Message Passing and Socket as standard IPC mechanisms. 6

2. a) The system call *fork()* creates an exact replica of the parent process. Yet the call to *fork()* returns immediately without taking much time that was anticipated for creating the child process. How does operating system implement the faster version of *fork()*? Discuss in terms of memory management and paging. 7

   b) Briefly describe the authentication mechanism of linux. 6

   c) What are a user thread and a kernel thread? Briefly describe their advantages. 6

   d) 'Memory mapping is faster than message passing and of course faster than socket'- Explain why. Briefly describe with diagram. 6

3. a) Why is synchronization necessary in a concurrent execution environment? Relate shared data, critical section and race condition in synchronization problem. 6

   b) Write a program that will create four child processes under the same parent process. The parent process will wait for each of the child processes to finish and then exit normally. 7

   c) What is a File Descriptor? How is it maintained? 6

   d) What is a micro-kernel? What are the advantages of micro-kernel base operating system design? 6

4. a) Draw a communication diagram for centralized version of distributed coordination. Assume there are three processes to be coordinated. 8

   b) What are the differences between a virus and a worm? 5

   c) What are the problems with linked allocation in file systems? How does indexed allocation solve the problems? Discuss with diagrams. Mention some real implementations of the two types of file systems. 7

   d) Briefly describe the boot loading sequence of an operating system. 5

5. a) Given the memory requirements of 212KB, 300KB, 380KB and 430KB requested in order to allocate space for them into the fragments/partitions 300KB, 212KB, 400KB, 450KB using first-fit and best-fit algorithm. 6

   b) Differentiate between program address [*logical address*] and physical address. Draw a figure describing the paging scheme with TLB. 6

   c) In 32-bit addressing scheme, normally a page is constituted of 4Kbytes. So, how many pages are possible to be addressed in this paging scheme? If hierarchical paging is adopted with 10-bits for the inner page table, what will be the architecture of the memory management scheme? Draw a diagram to depict the above hierarchical paging scheme. 8

d) A paging scheme with TLB has 97% TLB hit ratio. It takes 20 nanoseconds to search a TLB and 100 nanoseconds to access the memory. What is effective memory access time for the scheme? 5

6. a) Suppose, the OS maintains 03 (three) different ready queues: first two queues for Interactive processes and the last one for Batch jobs. Interactive processes are scheduled in RR manner whereas Batch jobs are scheduled by FCFS algorithm. The first interactive queue has a quantum time of 2ms and the second interactive queue has a quantum time of 6ms. Processes are scheduled in the policy that 'no processes in a lower priority queue will be served until a process in higher priority queue exists'. Assume first queue has the highest priority and third queue has the lowest priority. Interactive processes mostly finishes within 8ms. To avoid starvation, the priority of a process in first two queues will be reduced by one (shifted to lower queue) once it gets the cpu. If an interactive job is placed in queue number three, it becomes batch job. By default interactive jobs enter into the first queue. 12

A set of processes have arrived at the CPU according to the chart given below in Table 1:

Table 1: Burst time requirements of processes and process types

Process	Burst Time in ms	Type (Interactive/Semi Interactive)
P1	5	I
P2	16	I
P3	3	I
P4	8	I
P5	17	I

Draw the Gantt chart for the processes and determine the average waiting time for them.

b) What is a semaphore? How can the two atomic operations of semaphore namely wait() and signal() be implemented? 7

c) Briefly describe the steps to perform DMA. 6

7. a) Consider the following page reference string: 12
1, 2, 3, 4, 2, 1, 5, 6, 2, 4, 2, 3, 6, 3, 2, 1, 2, 3, 6

How many page faults would occur for the following replacement algorithms, assuming 3(three) and 4(four) frames in the memory for this purpose? Assume all frames are initially empty.

i. Optimum replacement
ii. FIFO replacement

b) Briefly describe the minix process hierarchy. 7

c) What is a wait-for graph? How can a wait-for graph indicate a deadlock? 6

8. a) Suppose that a disk drive has 500 cylinders, numbered 0 to 499. The drive is currently serving a request at cylinder 150 and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is: 8
21, 86, 50, 147, 413, 174, 40, 450
Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk scheduling algorithms? Draw the head movement diagram for calculating the distance.

i. SSTF
ii. C-LOOK

b) Describe the two ways that free blocks of a mass storage can be maintained (i.e. kept track of). 6

c) Describe what happens to the process executable in different types of address binding. 7

d) Draw an example of graph based directory structure. 4