UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

Main Examination, December 2009

Title of paper: **OPERATING SYSTEMS**

Course numbers: **CS442**

Time allowed: 3 hours

Instructions: Answer any 5 out of the 6 question. Each question carries 20 marks.

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Question 1

a) Briefly explain any 6 functions of the operating system. [6]

b)

i. According to Tanenbaum what is the relation of the operating system level to its two neighbouring levels? Explain. [4]

ii. The operating system itself can be viewed as a multi-level structure. Describe these levels, their components, and the interfaces between them. [10]

Question 2

a) Explain the main advantages of virtual memory over real memory. [4]

b)

i. Assume that a computer with 4 page frames in RAM follows the FIFO page replacement policy. Consider the case of a process with 10 virtual pages (numbered 0..9) making a sequence of accesses to locations in the following pages:

Pages accessed: 0,3,0,2,9,5,2,7,3,0,2,1,0,4,0,3

For each access, state whether a page fault is caused, and if so, which page is replaced. State any additional assumptions you make. [4]

ii. Repeat question i. above assuming that LRU page replacement policy is followed. [4]

c) Explain the role of the TLB and TSB in the implementation of paging on UltraSparc-II computers. [8]

Question 3

Give a detailed account of support provided by Pentium-II computers for virtual memory. Your answer should cover the following concepts: segment registers; segment descriptors; address translation (with and without paging); page directories; and protection levels. [20]

Question 4

a) With the aid of diagrams, describe 3 disk scheduling policies. [8]

b) In a particular Unix system, 2 users named *fred* and *bloggs* belong to a group called *print*. Another group to which *fred* belongs is *staff*. A file named *news* is owned by *fred* and assigned to the *staff* group. This file has protection mode 664. State what *fred* is permitted to do with *news*. In addition, state what *bloggs* is permitted to do. [3]

c) With the aid of a diagram, describe the structure of the file allocation table (FAT) in MS-DOS. [5]

d) Draw a diagram of a FAT clearly showing how 2 files, each consisting of 3 clusters, are organised on disk. [4]

Question 5

a) Draw a diagram showing the process-states (including suspended states) and the transitions between them. Briefly describe the processes and transitions shown. [9]

b) State the effects of the following process-related system calls in Unix: *fork, exec* and *wait*. [3]

c) Draw a process hierarchy diagram showing the relationships between all the processes mentioned in the following description:

> A Unix user runs a program named *abc* by entering its name at the command line of a shell program named *sh*. The *abc* process then creates 4 concurrent processes: 2 instances of a program named *pqr* and another 2 of a program named *xyz*. [3]

d) Define the operations on semaphores. [5]

Question 6

a) With regard to assembly language programming under MS-DOS, describe the manner in which system calls are used for input and output of single characters. [4]

b) Write the following program for the Turbo Pascal system running under MS-DOS:

> The program must declare an array of 100 characters. When it starts running, it must wait for a single key to be typed by the user, and then store the given character in all 100 locations of the array. It must end by displaying the message **OK** on screen.

The body of the program (i.e. everything below the BEGIN line), must be written in Intel x86 assembly language. The program must include all pertinent variable and label declarations. It must be well commented. [16]