UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE	**CSC3B10** COMPUTER SYSTEMS ARCHITECTURES
CAMPUS	**APK**
EXAM	**CHANCELLOR'S EXAMINATION — JANUARY 2015**

DATE 13-01-2015

ASSESOR(S) **DR ID ELLEFSEN**
MR M CILLIERS

EXTERNAL MODERATOR **DR WJC VAN STADEN (UNISA)**

DURATION 3 HOURS **MARKS** 150

NUMBER OF PAGES: 5 PAGES

INSTRUCTIONS: ANSWER ALL THE QUESTIONS

REQUIREMENTS: NON-PROGRAMMABLE CALCULATORS MAY NOT BE USED

SURNAME AND INITIALS _____

STUDENT NUMBER _____

CONTACT NR _____

SECTION A

QUESTION 1

(a) An Operating System has roles in providing abstraction through by extending the machine and providing resource management. Discuss these two concepts in relation to the Operating System. [2]

(b) Provide a clear and complete discussion of the Memory Hierarchy and why this concept is important to programmers. You may use diagrams to aid in your discussion. [4]

(c) List and discuss three different "small" devices where an operating system is like to be found. [3]

(d) Discuss the types of system calls that are like to be associated with file and directory operations. [2]

(e) **Monolithic kernels** and **Microkernels** are two possible types of kernel architectures that can be found in systems. Discuss the advantages and disadvantages of each architecture. [4]

[15]

QUESTION 2

(a) What are the events that can cause process creation and process termination? [4]

(b) List and explain the difference between the states that a process can be in, also discuss the transitions between the process states. [5]

(c) Compare **monitors**, **semaphores**, and **locking variables** as methods of synchronisation. [6]

[15]

QUESTION 3

(a) Discuss how the **LRU Page Replacement Algorthim** works, and the restrictions that exist for implementation of this algorithm. [4]

(b) Explain the term **Virtual Memory** and how this type of memory relates to **Physical Memory**. [4]

(c) Discuss two problems that can exist when there is a large amount of **physical memory** in relation to the management **Virtual Memory**. [2]

(d) List the differences between **paging** and **segmentation**. [5]

[15]

QUESTION 4

(a) What are the benefits of Contiguous allocation over Indexed, and Linked allocation? [2]

(b) What are the benefits of Index allocation over Contiguous, and Linked allocation? [2]

(c) What are the benefits of Linked allocation over Contiguous, and Indexed allocation? [2]

(d) The Journal plays an important role in the functionality that the Operating System provides. Provide a discussion of the Journal and elaborate how a Journal works. You may include a diagram to aid in your explanation. [5]

(e) Elaborate on three ways a file system can keep track of allocated and unallocated blocks. [3]

(f) What are we referring to when we talk about a **Triple indirect block**? [1]

[15]

QUESTION 5

(a) Discuss the differences between Programmed IO and Interrupt-Driven IO. [4]

(b) Discuss four elements that are managed by Device-Independent I/O Software components. [4]

(c) Provide a diagram and discuss how the **Elevator Algorthim** can be used to improve disk performance. [5]

(d) Discuss why special considerations have to be made for programmes that make heavy use of IO. [2]

[15]

QUESTION 6

(a) Provide a complete and concise definition of what constitutes a deadlock in a system. [2]

(b) When performing deadlock modeling, how can resource allocation be modelled in such a way that deadlocks can be detected? [2]

(c) Provide an algorithm that can be used to detect a deadlock when using a single resource type. [8]

(d) Discuss the bankers algorithm for avoiding deadlocks for multiple resource types. [4]

(e) Provide a discussion on the difference between communication timeouts and locking variables as methods of preventing deadlocks and starvation. [4]

[20]

QUESTION 7

(a) List[3] and provide a discussion[3] of the three different **multiprocessor operating system types**. [6]

(b) Explain how paravirtualisation is different to a Type-1 or Type-2 virtualised system. [2]

(c) With respect to virtualisation, explain what a sensitive instruction is. [2]

(d) List and discuss the types of middleware and the role that the middleware plays in distributed systems. [3]

(e) Discuss the role of DSM in distributed systems. [2]

[15]

QUESTION 8

(a) The operating system will provide protection and security for many of the components that the user interacts with. Provide a list of five different component of the operating system and the corresponding protection mechinism that the OS can use to restrict access. [5]

(b) You have been approached by a company to discuss the benefits of encryption within the operating systems. Provide a list and short discussion of five points relating to encryption and its use in the operating system. [5]

[10]

SECTION B

QUESTION 9

(a) Show the conversion of 32.325_{10} into IEEE Single-Precision Representation. Show all the steps of your calculation and show the result as a hexadecimal number. [5]

(b) Discuss the differences in operation between a stack-based machine and a register-based machine. How are these two machine types realised in an Intel system? [5]

(c) You must create a function that makes use of the Floating Point Unit and recursively performs the following operation on each element of an array: $(p/n) + 10.5$, where p is the current element, and n is the size of the array. You should have the user read in 5 integer values from the keyboard that you store in an array, the function should then accept an array as a parameter as well as the size of the array. The original array should be modified to store the new values in the function. Your function should be recursive. Your function should make use of the Floating Point Unit. Provide the **pseduocode** to realise this function. [5]

(d) Complete the assembly language code that can be used to realise algorithm outlined in the previous question making use of the skeleton provided below. Use the following skeleton in your answer: [15]

```
.386
.MODEL flat

ExitProcess      PROTO    NEAR32 stdcall, dwExitCode: DWORD

.DATA

; CODE GOES HERE

.CODE

; CODE GOES HERE

_start:

; CODE GOES HERE

PUBLIC _start
END
```

[30]

— End of exam —