MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY REGULAR EXAMINATIONS 2023/2024 ACADEMIC YEAR

SECOND YEAR 2ND SEMESTER EXAMINATIONS

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

COURSE CODE: **BCS 224**
COURSE TITLE: PRINCIPLES OF OPERATING SYSTEMS

DATE: FRIDAY 12TH APRIL, 2024 **TIME: 11:30AM – 1:30PM**

INSTRUCTIONS

Answer Question **ONE (1)** and Any **OTHER 2** questions
Ensure your answers/ideas are clearly expressed
All your answers must be clearly numbered
Write in ink. Rough work can be done (in answer booklet) in pencil and will not be marked. Cross out any rough work.
Calculators, phones, tablets, computers not allowed

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

QUESTION ONE **COMPULSORY** **30 MARKS**

a) Describe the two general roles of an operating system, and elaborate why these roles are important. [4 marks]

b) Using a simple system call as an example (e.g. getpid, or uptime), describe what is generally involved in providing the result, from the point of calling the function in the C library to the point where that function returns. [5 marks]

c) Why must the operating system be more careful when accessing input to a system call (or producing the result) when the data is in memory instead of registers? [3 marks]

d) Describe the *Five state process model,* describe what transitions are valid between the three states, and describe an event that might cause such a transition. [6 marks]

e) Multi-programming (or multi-tasking) enables more than a single process to apparently execute simultaneously. How is this achieved on a uniprocessor? [4 marks]

f) State **four** advantages of processes co-operating. [4 marks]

g) What is the function of the *ready queue*? [2 marks]

QUESTION TWO **20 MARKS**

a) Describe how a multi-threaded application can be supported by a *user-level threads package.* [6 marks]

b) Describe a sequence the sequence of step that occur when a timer interrupt occurs that eventually results in a context switch to another application. [6 marks]

c) State **four** advantages of processes co-operating. [4 marks]

d) Describe the critical section problem, clearly showing the conditions under which such mechanisms operate. [4 marks]

QUESTION THREE **20 MARKS**

a) What is a *race condition?* Give an example. [4 marks]

b) What is a critical region? How do they relate to controlling access to shared resources? [6 marks]

c) What are three requirements of any solution to the critical sections problem? Why are the requirements needed? [6 marks]

d) Interrupt disabling and enabling is a common approach to implementing mutual exclusion, what are its advantages and disadvantages? [4 marks]

QUESTION FOUR **20 MARKS**

a) What is *deadlock?* What is *starvations?* How do they differ from each other? [4 marks]

b) Describe the general strategy behind *deadlock prevention*, and give an example of a practical deadlock prevention method. [4 marks]

c) Give an example where contiguous allocation of file blocks on disks can be used in practice. [4 marks]

d) Assume a simple paging system with 232 bytes of physical memory, 248 bytes of logical address space and pages that are 220 bytes in size. Further assume that each page table entry contains 4 bits indicating protection and validity of the entry

(i) How many bits are used for the frame number and how many for the frame offset? [2 marks]

(ii) What is the total size of the page table in number of bits? [2 marks]

(iii) Assume that the working set of a typical process is fixed throughout the process lifetime and consists of 20 pages. How many entries would you suggest for the Translation Lookaside Buffer (TLB) for this system? What would its total size be in number of bits? Explain your answer. [4 marks]

QUESTION FIVE **20 MARKS**

(a) Consider the following four processes to run in a single CPU. What is the average waiting time and Turn Around Time when scheduling these processes according to FCFS, SJF (PREEMPTIVE) [8 marks]

Process	Burst Time	Arrival
P1	8	0
P2	3	2
P3	4	4
P4	3	4

(b) Assume n processes in the READY queue. Discuss which scheduling algorithm(s) from FCFS, SJF, and RR give(s) the minimum context switches for these n processes. Ignore any I/O burst. Explain your answer and clearly state your assumptions. [3 marks]

(i) Consider a computer with a CPU scheduler that implements the RR scheduling algorithm using a fixed time quantum that cannot be changed. Explain why RR provides a fair CPU allocation. [2 marks]

(c) Assume a Unix system with three users named user1, user2, and user3, and three groups named group1, group2, and group3. Assume group1 has members (user1, user2), group2 has members (user2, user3), and group3 has members (user3, user1). Consider three files with the following permissions:

rw-rw---- user1 group1 file1
rw-r--r-- user2 group3 file2
rwxr----- user3 group2 file3

(i) Which files can user1 read? Which files can user2 write? Which users can read file3? [3 marks]

(ii) User2 cannot execute file3. What permissions does file3 need so that all of its previous emissions are retained and user2 can further execute this file? What permissions does file3 need so that all of its previous permissions are retained and user2 can further execute this file as user3? [4 marks]