UNIVERSITY OF KWAZULU-NATAL
School of Engineering
Electrical, Electronic and Computer Engineering
(Howard College Campus)

Examinations: **June 2014**

ENEL4OS H1 : Operating Systems for Engineers

DURATION :2 HOURS MARKS : 100

Examiners:

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Instructions:

1. Answer ALL 6 questions.
2. Start each question on a new page, and number all your answers clearly.
3. Scientific calculators may be used.
4. Ensure you have 5 pages, including this one.

Question 1: *Operating Systems Concepts and Definitions* **[26 marks]**

(a) What is an interrupt? [1]

(b) What is a process? Draw a diagram showing the various states of a process in the system, and label the transitions between the states with comments explaining what causes a process to make that transition. [6]

(c) What What are the objectives of an Operating system design. [4]

(d) What are the necessary and sufficient conditions for deadlock? Explain each of them. How can circular buffer be prevented? [8]

(e) What are the distinctions among logical, relative, and physical addresses ? [3]

(f) Describe the actions that occur when a context switch happens in an Operating System. [2]

(g) Why is the optimal page replacement policy impossible to implement? [2]

Question 2: *Processes and Threads* **[20 marks]**

(a) Suppose a single application is running on a multicore system with 16 processors. If 20% of code is inherently serial, what is the performance gain over a single processor system? [4]

(b) Consider the following set of processes, with the length of the CPU-burst time given in milliseconds, and the arrival time for each process:

Process	Burst Time	Arrival Time
P_1	9	0
P_2	8	1
P_3	2	2
P_4	6	3

(i) Draw two Gantt charts illustrating the execution of these processes using pre-emptive Short Job First and Round Robin (quantum = 5) scheduling. [6]

(ii) What is the turnaround time of each process for each scheduling algorithm in item (i)? Also provide the average turnaround time over all processes for each algorithm. [4]

(iii) What is the waiting time of each process for each scheduling algorithm in item (i)? Also provide the average waiting time over all processes for each algorithm. [4]

(iv) Which of the scheduling algorithms in item (i) is more efficient in terms of waiting time (over all processes)? [2]

Question 3: ***Virtual Memory Systems and Memory Management*** **[17 marks]**

(a) Consider a logical address space of eight pages of 2048 words each, mapped onto a physical memory of 64 frames.

(a.1) How many bits are there in the logical address? [2]

(a.2) How many bits are there in the physical address? [2]

(b) Consider a paging system with a 64-bit logical address space. Each address refers to a byte in memory. Let the page size be 32 KB, and main memory size be 512 MB. What is the minimal size (in bytes) of the page table? Please show your working. [5]

(c) Given memory partitions of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the First Best-fit, and Worst-fit algorithms place processes of 212K, 417K, 112K, and 426K (in order)? Which algorithm makes the most efficient use of memory? [8]

Question 4: ***File Systems*** **[9 marks]**

(a) What are the disadvantages of using a single directory in a file system . [2]

(b) Some systems provide file sharing by maintaining a single copy of a file; other systems maintain several copies, one for each of the users sharing the file. Discuss the relative merits of each approach. [7]

Question 5: ***Embedded OS and Multiprocessor Systems*** **[13 marks]**

(a) What is a multiprocessor system? Describe the three main categories of multiprocessor systems. [5]

(b) What are the advantages and disadvantages of writing an operating system in a high- level language, such as C? [4]

(c) Explain the relative advantages and disadvantages of an embedded Os based on an existing commercial OS compared to a purpose-built embedded OS. [4]

Question 6: ***Deadlocks*** **[15 marks]**

An hypothetical computing system currently has

- 4 processes (P_0 through P_3)
- 4 resources types: A (12 instances); B (5 instances); C (9 instances); D (8 instances)

Consider the following snapshot of a system:

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	4	1	0	2	7	4	4	4	5	3	5	3
P_1	1	0	1	1	4	4	4	4				
P_2	2	0	2	1	9	5	5	5				
P_3	0	1	1	1	2	2	3	3				

Answer the following questions using the banker's algorithm:

(a) Verify that the Available array has been calculated correctly. [1]

(b) What is the content of the matrix Need? [2]

(c) Is the system in a safe state? Show your working. [8]

(d) Given the request (0,1,2,2) from from process P_1, can the request be granted immediately? Why or why not? [4]