



UNIVERSITY OF GHANA
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BACHELOR OF SCIENCE IN ENGINEERING
FIRST SEMESTER EXAMINATIONS, 2012/2013
CPEN 307 OPERATING SYSTEMS (3 Credits)

TIME : 2 hours and 30 minutes

Answer All Questions

All abbreviations have their usual meanings

SECTION A - 30 MARKS

1. (a) What is a real-time OS? [1 mark]
(b) Differentiate between hard and soft real-time OS. [2 marks]
2. Processes P_1 , P_2 and P_3 arrive at time 0 with respective CPU burst times of 24ms, 3ms and 3ms. Using FCFS, calculate the average waiting and turn around times. [4 marks]
3. List and briefly explain any four (4) principal events that cause processes to be created. [4 marks]
4. Briefly explain the following concepts :
 - (a) ready queue [1 mark]
 - (b) device queue [1 mark]
 - (c) input queue [1 mark]
5. State four (4) benefits in creating threads. [4 marks]
6. What is the purpose of system calls? [2 marks]
7. List three (3) examples of deadlocks that are not related to a computer system environment. [3 marks]
8. An OS contains three (3) user processes each requiring three (3) units of resource R . State the minimum number of units of R such that no deadlocks will ever arise. Justify your answer. [3 marks]

9. Given n processes to be scheduled on one processor, how many different schedules are possible? Give a formula in terms of n . [2 marks]
10. Briefly explain the first fit memory allocation solution. [2 marks]

SECTION B - 70 MARKS

1. (a) State any **four** (4) types of OS. [2 marks]
- (b) Explain the two basic functions of an OS. [6 marks]
- (c) i. What is a deadlock? [1 mark]
- ii. List and **briefly** explain the **four** (4) conditions necessary for a deadlock to occur. [6 marks]
- (d) Consider the information below :
 - Process P_1 is holding an instance of resource type R_2 and is waiting for an instance of resource type R_1
 - Process P_2 is holding an instance of R_1 and an instance of R_2 and is waiting for an instance of R_3 .
 - Process P_3 is holding an instance of R_3
 - i. draw the resource allocation graph [5 marks]
 - ii. use your graph to determine whether there is a deadlock or not. Explain your reasoning. [4 marks]
2. (a) i. What is a process control block, **PCB**? [1 mark]
- ii. Briefly explain an **two** (2) pieces of information in the PCB data structure. [2 marks]
- (b) i. State and briefly explain the basic process states. [3 marks]
- ii. Briefly explain any **three** (3) transitions between the various states. [6 marks]
- (c) Explain the significance of the function **pthread_create()** and also briefly explain the various arguments that can be passed to this function. [6 marks]
- (d) Briefly explain the POSIX thread library. [2 marks]

3. (a) i. Briefly explain cache memory. [2 marks]
- ii. Each process must have a separate memory space. Explain how the OS protects user processes from writing to the memory space of other processes. [5 marks]
- (b) i. Explain the concept of swapping. [2 marks]
- ii. A user process is 120 MB in size and it is to be swapped to a backing store with a transfer rate of 40 MB/s. Assuming a latency of 5ms. Calculate the time it will take to roll out this process, roll in another 120 MB process and then roll the original process back in to memory. [4 marks]
- (c) Suppose that the following processes arrive for execution at the times indicated. Each process will run the listed amount of time.

Table 1: Three Processes, their arrival times and CPU burst times

Process	Arrival Time	Burst Time
P_1	0.0	8
P_2	0.4	4
P_3	1.0	1

Referring to Table 1, calculate :

- i. the average waiting time and turnaround time for these processes with the **SJF** scheduling algorithm? [6 marks]
- ii. the average waiting time and turnaround time for these processes with the **preemptive SJF** scheduling algorithm? [7 marks]
- iii. compare your answers in 3(c)i and 3(c)ii above and comment on them. [2 marks]