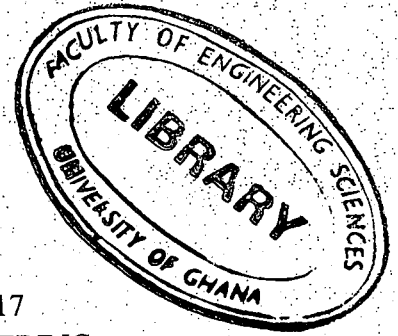




UNIVERSITY OF GHANA

SCHOOL OF ENGINEERING SCIENCES
FIRST SEMESTER EXAMINATIONS: 2016/2017
LEVEL 300: BACHELOR OF SCIENCE IN ENGINEERING
CPEN 307: OPERATING SYSTEMS [3 Credit]



INSTRUCTION:

ANSWER ALL QUESTIONS IN SECTION A, AND THREE (3) OTHER QUESTIONS FROM SECTION B

TWO HOURS, THIRTY MINUTES

SECTION A [40 MARKS]

Attempt ALL questions in this section.

- A1. a) On early computers, every byte of data read or written was directly handled by the CPU when there was no DMA.
What implication does this organization have for multiprogramming? [4 marks]
b) A system has three processes and four identical resources. Each process needs a maximum of two resources. Is deadlock possible? Explain your answer. [5 marks]
- A2. a) What is the meaning of spooling? [1 mark]
b) Differentiate between input and output spooling. [4 marks]
c) Do you think that advanced personal computers will have input and output spooling as a standard feature in the future? Give reasons for your answer. [3 marks]
- A3. a) Why is the process table needed in a timesharing system? [2 marks]
b) Is it also needed in personal computer systems in which only one process exist, that process taking over the entire machine until it is finished? [3 marks]
c) A computer system has enough room to hold seven programs in its main memory. These programs are idle waiting for I/O half the time. What fraction of the CPU time is wasted? [2 marks]
d) In file system implementation, the file allocation table put all links in one table, thus one entry per physical block in disk. Suggest one merit and two demerits for this arrangement. [3 marks]

A4: A fast food restaurant has four kinds of employees:

- (1) Order takers, who take customer's order;
- (2) Cooks, who prepare the food;
- (3) Packaging specialist, who stuff the food into bags; and
- (4) Cashiers, who give the bags to customers and take their money,

Each employee can be regarded as a communicating sequential process.

- a) What form of interprocess communication do they use? [2 marks]
- b) Relate this model to processes in UNIX. [2 marks]

A5: Five batch jobs A through E, arrive at a computer center at almost the same time. They have estimated running times of 10, 6, 2, 4, and 8 minutes. Their priorities are 3, 5, 2, 1, and 4 respectively, with 5 being the highest priority. [Hint: priorities are externally determined and ignore process switching overhead].

For each of the following scheduling algorithms, determine the mean process turnaround time.

- a) Round robin. [2 marks]
- b) Priority scheduling. [2 marks]
- c) First-come, first-served (run in order 10, 6, 2, 4, and 8). [3 marks]
- d) Shortest job first. [2 marks]

SECTION B [60 MARKS]

Attempt any **THREE** questions in this section.

- B1.** a) Can a thread ever be preempted by a clock interrupt? If so, under what circumstances? If not, why not? [3 marks]
- b) In a system with threads, is there one stack per thread or one stack per process when user-level threads are used? What about when kernel-level threads are used? Explain. [5 marks]
- c) If a system has only two processes, does it make sense to use a barrier to synchronize them? [3 marks]
- d) Which procedure call will a thread invoke to voluntarily give up the CPU for another thread? [1 mark]
- e) What effect will question B1 (d) have on the first thread? [2 marks]
- f) In round-robin scheduling, new processes are placed at the end of the queue, rather than at the beginning. Give reasons. [3 marks]

g) With the aid of simple diagram, briefly explain how single threaded code turn to be multithreaded on a UNIX platform when they share global variable, 'errno'. [3 marks]

B2. a) A soft real-time system has four periodic events with periods of 75, 125, 225, and 300 microseconds each. Suppose that the four events require 60, 45, 35, and q microseconds of CPU time, respectively.

i) What is the largest value of q for which the system is schedulable? [2 marks]

ii) What effect will adding a fifth periodic event of 500 microseconds that require 1000 microseconds of CPU time have on the real time system. [3 marks]

b) On all current computers, at least parts of the interrupt handlers are written in assembly language. Why? [4 marks]

i) What are the differences between a trap and an interrupt? [3 marks]

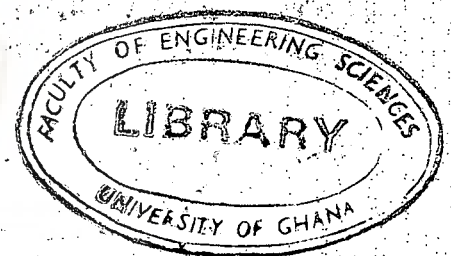
ii) Can traps be generated intentionally by a user program? If so, for what purpose? [4 marks]

c) "In a Batch system, the allocation of the processor is said to be user-dependent whereas in Time Sharing System the allocation is said to be processor-dependent". Briefly discuss. [4 marks]

B3. (a) List and briefly explain the parameters that a multilevel feedback queue scheduler may need to execute its task. [5 marks]

(b) The following table contains five processes with their burst times. All processes start execution from level 1 ready queue and they are moved to the succeeding level of the ready queue if it does not finish executing its job at preceding level. This continues until it finally finished its execution at level 3.

Process	Burst Time
P1	87
P2	95
P3	56
P4	43
P5	102



There are three multilevel feedback ready queues schedule as follows:

Level 1: time quantum 12 milliseconds (with first-come, first-served, FCFS)

Level 2: time quantum 23 milliseconds (with shortest job first, SJF)

Level 3: FCFS

i) Demonstrate on the Gantt chart the order in which the processes will take turns to execute. [3 marks]

- ii) What is the mean execution time after second round? [2 marks]
- iii) What is the overall mean time? [2 marks]
- iv) What is the total execution time? [2 marks]
- v) What conclusion can you draw from this CPU scheduling? [2 marks]
- c) On the WINDOWS IPC platforms, message-passing are centric via advanced local procedure call facility. Suggest how communication works on the platform. [4 marks]

- B4. a) Can process make transition from ready state to blocked state? Explain your answer with the aid of a well-labelled diagram. [7 marks]
- b) Compare and contrast deadlock and starvation. [4 marks]
- c) Assuming the operating system detects the system is deadlocked, what can it do to recover from the deadlock? [9 marks]

- B5. a) State the difference between *external* and *internal fragmentation*. [2 marks]
Indicate which of the two are most likely to be an issue on the following:

- i) a simple memory management machine using base limit registers and static partitioning, and [1 mark]
- ii) a similar machine using dynamic partitioning. [1 mark]
- b) The problem of core fragmentation can be solved by effecting two methods, name and explain them. [6 marks]
- c) Describe the difference between preemptive and non-preemptive scheduling algorithms. Which one is more suitable for a timesharing system and why? [4 marks]
- d) The following table contains job queue, which consists of job number, job size and burst time. Assuming that the queue is serviced on first-come, first-served basis with round-robin scheduling during burst times on 256MB variable partition memory allocation and the operating system is loaded into 60MB any time the system is booted.

Job Queue		
Job Number	Job Size	Burst Time
1	70MB	9
2	80MB	5
3	15MB	16
4	78MB	8
5	25MB	10

- (i) Construct the final memory structure after all jobs have been scheduled. [2 marks]
- (ii) Demonstrate the allocated partition status table. [2 marks]
- (iii) Demonstrate the unallocated area status table. [2 marks]