CPE 460
OPERATING SYSTEMS DESIGN
FIRST EXAM

Department of Computer Engineering
Yarmouk University
March 15, 2017

This is a CLOSED BOOK exam. Textbooks, notes, laptops, calculators, personal digital assistants, cell phones, and Internet access are NOT allowed.

It is a 75 minute exam, with a total of 40 marks. There are 23 questions, and 7 pages (including this cover page). Please read each question carefully, and write your answers legibly in the space provided. You may do the questions in any order you wish, but please USE YOUR TIME WISELY.

When you are finished, please hand in your exam paper and sign out. Good luck!

Name: _____

Student I.D.: _____

Multiple Choice

Choose the best answer for each of the following 7 questions, for a total of 7 marks.

1. Which of the following instructions can be allowed in *user mode*?

   (a) Disable all interrupts
   (b) Read the version and type of the installed operating system
   (c) Set the time of day clock
   (d) Change the memory map
   (e) Change CPU scheduling algorithm
   (f) Installing Candy crush game

2. When a process is created using the classical `fork()` system call, which of the following is **not inherited** by the child process?

   (a) process address space
   (b) process ID
   (c) user ID
   (d) open files
   (e) executable code
   (f) none of the above

3. The *text segment* of a process address space contains:

   (a) the statically allocated data associated with the process
   (b) the dynamically allocated data associated with the process
   (c) the executable code associated with the process
   (d) the inter-process communication (IPC) messages for the process
   (e) the temporary data (such as: function parameters and return addresses)
   (f) all of the above

4. A newly process is brought to the ready queue through the following scheduler:

   (a) long-term scheduler
   (b) round-robin CPU Scheduler
   (c) short-term scheduler
   (d) medium-term scheduler
   (e) CPU dispatcher
   (f) none of the above

5. The time spent in saving the state of the currently executing process and loading the state of the process to be executed is called:

   (a) quantum time

   (b) context-switching time

   (c) waiting time

   (d) response time

   (e) turnaround time

   (f) read latency time

6. Assuming all `fork` system calls are successfull, how many times the following program will print out the word '`OS`':

   (a) `1`

   (b) `2`

   (c) `4`

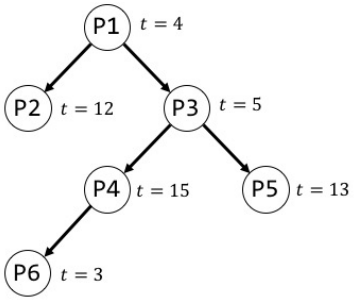
   (d) `8`

   (e) `16`

   (f) it depends on the order of execution

```
void main(){
    int x = 10, y = 50, z = 500;
    y = fork();
    x = fork();
    if(fork() == 0){z++;}
    x++;
    printf("OS\n");
}
```

7. Consider the process tree shown below of 6 processes running in a Linux system. Processes are marked with their termination times (i.e., `P1` terminates at time 4, and so on). Assuming that no one of the processes waits for its children (by calling the `wait` system call), which of the following is **not correct**:



   (a) `P2` process is an orphan process at $t = 2$.

   (b) `P6` process is a zombie process at $t > 3$.

   (c) `P3` process is the parent of `P4` at $t = 2$.

   (d) `init` or `systemd` process is the parent for process `P4` at $t = 8$.

   (e) There are 3 orphan processes at $t = 10$

   (f) none of the above

Operating System Principles

In chapters 1 and 2, we have illustrated operating system principles using examples from former and current operating systems, including Linux, Windows, and Mac OS. Answer the following questions based on your understanding:

(a) (2 marks) What is an *Operating System (OS)*?

(b) (2 marks) List and briefly describe any 3 of the typical services provided by an OS.

(c) (3 marks) What is a system call? and describe briefly the relation between a system call and the kernel and user modes.

Operating System Concepts and Definitions

For each of the following pairs of terms, define each term, making sure to clarify the key difference(s) between the two terms.

(a) (2 marks) "trap" and "hardware interrupt"

(b) (2 marks) "`fork()`" and "`exec()`"

(c) (1 mark) "Mansaf" and "Maklooba"

(d) (2 marks) "pre-emptive scheduling" and "non-preemptive scheduling"

(e) (2 marks) "CPU-bound process" and "I/O-bound process"

Processes

In Chapter 3, we have illustrated how processes are the basic units of work in an operating system. Answer the following questions based on your understanding:

(a) (2 marks) 'What is the difference between a *process* and a *program*?

(b) (3 marks) What is the process control block (PCB) and give at least 3 examples of attributes used in the PCB and their use.

(c) (3 marks) A process can be in many different states, what are those states? What is the situation under which the process will enter each of those states?

CPU Scheduling

In chapter 6, we have dicussed different CPU scheduling algorithms. Answer the following questions based on your understanding. Consider the following set of processes to be scheduled for execution on a single CPU system.

Process	CPU Burst Time(ms)	Arrival Time	Priority
P_1	12	0	1 (High)
P_2	4	2	3 (Low)
P_3	2	5	1 (High)
P_4	10	8	3 (Low)
P_5	6	10	2 (Medium)

(a) (1 mark) Discuss why CPU scheduling is essential part of the operating system.

(b) (2 marks) Draw a Gantt chart showing FCFS scheduling for these processes, and calculate the average process waiting time.

(c) (2 marks) Draw a Gantt chart showing non-preemptive SJF scheduling for these processes, and calculate the average process waiting time.

(d) (2 marks) Draw a Gantt chart showing RR (quantum = 4) scheduling for these processes, and calculate the average process waiting time.

(e) (2 marks) Draw a Gantt chart showing (preemptive) PRIORITY scheduling for these processes, and calculate the average process waiting time.