King Saud University

College of Computer and Information Sciences
Computer Science Department

Course Code:	CSC 227
Course Title:	Operating Systems
Semester:	Spring-2015-16
Exercises Cover Sheet:	**Final-Exam**

Duration: 135 minutes

Student Name:	
Student ID:	
Student Section No.	

Note: Shaded cells in the table below should be updated by the instructor of the course as needed.

Computer Science B.Sc. Program: NCAAA: Intended Learning Outcomes (ILO) Student Outcomes ABET: Program Learning Outcomes (PLO) Student outcomes		Question No. Relevant Is Hyperlinked	Covering %
NCAAA	**1. Knowledge (NCAAA)** Suggested verbs (list, name, record, define, label, outline, state, describe, recall, memorize, reproduce, recognize, record, tell, write)		100%
ABET	a. Apply knowledge of computing and mathematics appropriate to the discipline;	5a-5c	20%
	(e) Understanding of professional, ethical, legal, security, and social issues and responsibilities;		
	(i) Use current techniques, skills, and tools necessary for computing practices;		
	(j) Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices;		
	(k) Apply design and development principles in the construction of software systems of varying complexity;		
NCAAA	**2. Cognitive Skills (NCAAA)** Suggested verbs (estimate, explain, summarize, write, compare, contrast, diagram, subdivide, differentiate, criticize, calculate, analyze, compose, develop, create, prepare, reconstruct, reorganize, summarize, explain, predict, justify, rate, evaluate, plan, design, measure, judge, justify, interpret, appraise)		85%
ABET	b. Ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.	1.1-1.12, 4a-4c	51%
	c. An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.	2a-2c, 3a-3c	34%
	g. An ability to analyze the local and global impact of computing on individuals, organizations and society.		
	h. Recognition of the need for, and an ability to engage in, continuing professional development.		
NCAAA	**3. Interpersonal Skills & Responsibility (NCAAA)** Suggested verbs (demonstrate, judge, choose, illustrate, modify, show, use, appraise, evaluate, justify, analyze, question, and write)		$\sum ABET\%$
ABET	d. Ability to function effectively on teams to accomplish a common goal.		
	e. Understanding of professional, ethical, legal, security, and social issues and responsibilities.		
NCAAA	**4. Communication, Information Technology, Numerical (NCAAA)** Suggested verbs (demonstrate, calculate, illustrate, interpret, research, question, operate, appraise, evaluate, assess, and criticize)		$\sum ABET\%$
ABET	f. An ability to communicate effectively with a range of audiences.		
NCAAA	**5. Psychomotor (NCAAA)** Suggested verbs (demonstrate, show, illustrate, perform, dramatize, employ, manipulate, operate, prepare, produce, draw, diagram, examine, construct, assemble, experiment, and reconstruct)		

King Saud University
College of Computer and Information Sciences
CSC 227: Operating Systems

Total Marks: 40 **Time: 8:00am – 10:00am (2hrs 15min)**
Spring 2016-17 **Name:** …………………………………….……………………………
Final Exam **ID#:** ………………………………………………………………………
Date: 10-May-2016 **Section#:**………………… **or Teacher Name**: ………………………

Instructions:

• This exam has 9 pages including the title page and the back page.

• Do not use pencil.

• Write clearly and neatly.

Question 1 [6 marks] Select ONLY ONE ANSWER (the best answer).
Copy your answer for question 1-1 to 1-12 in the table on page2. ONLY THAT TABLE WILL BE GRADED.

1.	Which of these activities is NOT accomplished by the Operating Systems	2.	A trap or exception is	
a.	Creating and deleting processes	a.	a hardware-generated interrupt caused by a disk	
b.	**Generating interrupts**	b.	a software-generated interrupt caused either by an error or a user request	
c.	Providing mechanisms for deadlock handling	c.	a software-generated interrupt caused by the USB controller	
d.	Mapping files onto secondary storage	d.	a hardware-generated interrupt caused by the DMA	
3.	A process is a program in execution, it exists in main memory and it may be:	4.	The initial program that is run when the computer is powered up is called:	
a.	Either OS process or User process	a.	Booting program	
b.	Either I/O bound process or CPU bound process	b.	Boot loader	
c.	Either Independent process or Cooperating process	c.	Initializer	
d.	**All the above**	d.	**Bootstrap loader**	
5.	Processes may exchange information:	6.	If one thread opens a file with read privileges then:	
a.	on the same computer	a.	other threads in another process can also read from that file	
b.	between computers over a network	b.	other threads in the same process can also read from that file	
c.	via shared memory or through message passing (packets moved by the OS)	c.	any other thread cannot read from that file	
d.	**All the above.**	d.	all of the mentioned	
7.	Semaphore can be used for solving:	8.	Two types of Semaphores are:	
a.	Wait & signal	a.	Adding Semaphores and Binary Semaphores	
b.	Deadlock	b.	Analog Semaphores and Octal Semaphores	
c.	Priority	c.	**Counting Semaphores and Binary Semaphores**	
d.	**Synchronization**	d.	Critical Semaphores and System Semaphores	

9.	In a _____ scheduling, processes can be interrupted whether they have completed their current task or not.		10.	A segment table base register points to .....
a.	Dynamic		a.	The number of segments used by a process.
b.	Preemptive		b.	**The segment table location in memory**
c.	**Non-preemptive**		c.	The logical space
d.	Static		d.	The limit register
11.	The two memory access problem can be solved by the use of an associative memory. In this case, the effective access time (EAC) is based on:		12.	In three-level paging scheme, we need:
a.	Address binding time.		a.	2 memory accesses.
b.	Associative lookup time or hit ratio.		b.	3 memory accesses.
c.	**Associative lookup time unit and hit ratio.**		c.	**4 memory accesses.**
d.	Register access time.		d.	5 memory accesses.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

11.	12.

Question 2 [7.5 marks]

2-a) [1.5 marks] Explain why the operating system is defined as a resource allocator:

- OS is a resource allocator because it:
- Manages all resources
- Decides between conflicting requests for efficient and fair resource use

2-b) [1 mark] When a process is put in a device queue?

When it is waiting for an I/O device

2-c) [1.5 marks] Describe the time sharing scheduling. What is the advantage of using time sharing scheduling?

Time sharing is logical extension in which CPU switches jobs so frequently that users can interact with each job while it is running, creating interactive computing.

2-d) [1.5 marks] The principle of caching is an important principle, performed at many levels in a computer. What is Caching and why is it used?

Caching – copying information into faster storage system;

Cache memory is used to accelerate access to the RAM, and the main memory (RAM) can be used as a cache for secondary storage.

2-e)

 i) [1 mark] What is the role of the long term scheduler?

Long-term scheduler (or job scheduler) – selects which processes should be brought into the ready queue

ii) [1 mark] With which scheduling algorithm, the long term scheduler may be used?

Batch processing

Question 3 [7.5 marks]

3-a) [3 marks] Give and describe the three general methods used to pass parameters to the OS:

a.   Simplest: pass the parameters in *registers*

       i.   In some cases, may be more parameters than registers

b.   Parameters stored in a *block,* or table, in memory, and address of block passed as a parameter in a register

       i.   This approach taken by Linux and Solaris

c.   Parameters placed, or *pushed,* onto the *stack* by the program and *popped* off the stack by the operating system

3-b) [4 Marks] Multicore or multiprocessor systems putting pressure on programmers, challenges include:

a.   Dividing activities

b.   Balance

c.   Data splitting

d.   Data dependency

e.   Testing and debugging

Question 4 [6 marks]

4-a) [1 mark] Peterson's solution, `TestAndSet` and `Swap` instructions can be used to protect a critical section. What is their main problem?

<mark>These solutions to the critical-section problem rely on busy-waiting loops</mark>

4-b) [2 marks] Consider two processes P_a and P_b using two semaphores `S` and `Q` initialized to `1`. `S` and `Q` are implemented with waiting queues.

P_a	P_b
`wait(S);`	`wait(Q);`
`wait(Q);`	`wait(S);`
…	…
`signal(S);`	`signal(Q);`
`signal(Q);`	`signal(S);`

Explain how a deadlock situation may occur when P_a and P_b are running?

<mark>P_a may wait in the queue Q for a signal from P_b which may be blocked in the queue S.</mark>

4-c) [2 points] What is priority inversion meant? How is it solved?

Ans: Priority inversion. It occurs only in systems with more than two priorities, so one solution is to have only two priorities. That is insufficient for most general-purpose operating systems, however. Typically these systems solve the problem by implementing a priority-inheritance protocol. According to this protocol, all processes that are accessing resources needed by a higher-priority process inherit the higher priority until they are finished with the resources in question. When they are finished, their priorities revert to their original values.

Question 5 [6 marks]

5-a) Consider the following processes shown in the table. A process with smaller priority number has a higher priority.

Process	CPU Burst	Arrival time	Priority	Finished	Waiting time
P1	23	0	4	60	37
P2	8	3	2	11	0
P3	17	18	3	47	12
P4	12	20	1	32	0

Show the Gantt chart for these processes and complete the table above using priority scheduling with preemptions.

Gantt chart:

P1	P2	P1	P3	P4	P3	P1
0   3   11   18   20   32   47   60

Question 6 [8.5 marks]

6-a) [1.5 marks] What are the different stages at which address binding of instructions and data to memory addresses can happen?

Compile time, load time, run-time.

6-b) [1 mark] What is memory management unit?

Hardware device that maps virtual to physical address

6-c) [1.5 marks] Explain the difference between internal and external fragmentations.

External fragmentation: total memory space exists to satisfy a request, but it is not contiguous.

Internal fragmentation: allocated memory may be slightly larger than requested memory; this size difference is memory internal to a partition, but not being used.

6-d) [3 marks] Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order)?

(a) First Fit: ....

(b) Best Fit: ....

(c) Worst Fit: ....

Rank the algorithms in terms of how efficiently they use memory.

6-e) [1.5 marks] The size of a page table may get very large. Give three memory structures of a page table to overcome this problem.

Hierarchical paging, hashed page tables, and inverted page tables.

RESULTS

Note: Shaded cells in the table below should be updated by the instructor of the course as needed.

Tick the Relevant	Computer Science B.Sc. Program: NCAAA: Intended Learning Outcomes (ILO) Student Outcomes ABET: Program Learning Outcomes (PLO) Student outcomes	Question No. Relevant Is Hyperlinked	Covering %	Full Mark	Student Mark
NCAAA	**1. Knowledge (NCAAA)** **Suggested verbs (list, name, record, define, label, outline, state, describe, recall, memorize, reproduce, recognize, record, tell, write)**	Exercie1-5	$\sum ABET\%$		
ABET	(a)	Exercise 1	5%		
	(e)	Exercise2	10%		
	(i)	Exercise3	5%		
	(j)	Exercise4	10%		
	(k)	Exercise5	5%		
NCAAA	**2. Cognitive Skills (NCAAA)** **Suggested verbs (estimate, explain, summarize, write, compare, contrast, diagram, subdivide, differentiate, criticize, calculate, analyze, compose, develop, create, prepare, reconstruct, reorganize, summarize, explain, predict, justify, rate, evaluate, plan, design, measure, judge, justify, interpret, appraise)**	Exercise6-9	$\sum ABET\%$		
ABET	(a)	Exercise6	5%		
	(b)	Exercise7	5%		
	(g)	Exercise8	5%		
	(h)	Exercise9	10%		
NCAAA	**3. Interpersonal Skills & Responsibility (NCAAA)**	Exercise10-11	$\sum ABET\%$		
ABET	d. Ability to function effectively on teams to accomplish a common goal.	Exercise10	5%		
	e. Understanding of professional, ethical, legal, security, and social issues and responsibilities.	Exercise11	15%		
NCAAA	**4. Communication, Information Technology, Numerical (NCAAA)**	Exercise12	$\sum ABET\%$		
ABET	f. An ability to communicate effectively with a range of audiences.	Exercise12	15%		
NCAAA	**5. Psychomotor (NCAAA)**	Exercise13	5%		

Feedback and Remarks:

I certify that the work contained within this assignment is all my own work and referenced where required. **Student Signature: Date:**		**Feedback Received:** **Student Signature: Date:**