King Saud Un.			d Univ ter and Information S Science Department	•		
	200.0 <del>7</del> 592	Course Code:	CS	SC 227		
		ing Systems				
		Course Title:Operating SystemsSemester:Spring-2015-16				
		Exercises Cover Sheet: Final-Exam				
		Duratio	on: 135 minutes			
St	udent Name:					
	Student ID:					
Stud	ent Section No.					
	Note: Shaded cells	in the table below should be updated by t	he instructor of the co	ourse as needed.		
NCAAA: I	gram Learning Outcon           1.         Knowledge (NC.)	omes (ILO) Student Outcomes nes (PLO) Student outcomes AAA) 7, name, record, define, label, outline, state, describe,	recall. memorize.	Question No. Relevant Is Hyperlinked	Covering %	
		reproduce, recognize, record, tell, write)				
	a. Apply knowledge	5a-5c	20%			
	(e) Understanding of					
	(i) Use current techn					
ABET	(j) Apply mathemati modeling and design tradeoffs involved in					
	complexity;	I development principles in the construction of software	systems of varying			
NCAAA	2. Cognitive Skills Suggested verbs (est differentiate, criticiz reorganize, summar justify, interpret, ap			85%		
	b. Ability to analyze solution.	e a problem, and identify and define the computing requ	irements appropriate to its	1.1-1.12, 4a-4c	51%	
ABET	c. An ability to desi program to meet desir	2a-2c, 3a-3c	34%			
ABEI	g. An ability to analyz society.					
	h. Recognition of the					
NCAAA	<ul> <li>h. Recognition of the need for, and an ability to engage in, continuing professional development.</li> <li>3. Interpersonal Skills &amp; Responsibility (NCAAA) Suggested verbs (demonstrate, judge, choose, illustrate, modify, show, use, appraise, evaluate, justify, analyze, question, and write)</li> </ul>				$\sum ABET\%$	
ABET	d. Ability to functio					
ADEI	0 1	rofessional, ethical, legal, security, and social issues and	d responsibilities.			
NCAAA	4. Communication Suggested verbs (der appraise, evaluate, a	uestion, operate,		$\sum ABET\%$		
ABET	f. An ability to comm	unicate effectively with a range of audiences.				
NCAAA	00	CAAA) monstrate, show, illustrate, perform, dramatize, emp oduce, draw, diagram, examine, construct, assemble	• / • /			

	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).

# <u>Copy your answer for question 1-1 to 1-12 in the table on page2. ONLY THAT TABLE WILL BE</u> <u>GRADED.</u>

1.	Which of these activities is NOT accomplished by the Operating Systems				
a.	Creating and deleting processes				
b.	Generating interrupts				
c.	Providing mechanisms for deadlock handling				
d.	Mapping files onto secondary storage				
3.	A process is a program in execution, it exists in main memory and it may be:				
a.	Either OS process or User process				
b.	Either I/O bound process or CPU bound process				
c.	Either Independent process or Cooperating process				
	All the above				
d.	All the above				
d. 5.	All the above         Processes may exchange information:				
5.	Processes may exchange information:				
5. a.	Processes may exchange information: on the same computer				
5. a. b.	Processes may exchange information:on the same computerbetween computers over a networkvia shared memory or through message				
5. a. b. c.	Processes may exchange information:         on the same computer         between computers over a network         via shared memory or through message         passing (packets moved by the OS)				
5. a. b. c. d.	Processes may exchange information: on the same computer between computers over a network via shared memory or through message passing (packets moved by the OS) All the above.				
5. a. b. c. d. 7.	Processes may exchange information:         on the same computer         between computers over a network         via shared memory or through message         passing (packets moved by the OS)         All the above.         Semaphore can be used for solving:				
5. a. b. c. d. 7. a.	Processes may exchange information:         on the same computer         between computers over a network         via shared memory or through message         passing (packets moved by the OS)         All the above.         Semaphore can be used for solving:         Wait & signal				

2.	A trap or exception is
a.	a hardware-generated interrupt caused by a disk
b.	a software-generated interrupt caused either by an error or a user request
c.	a software-generated interrupt caused by the USB controller
d.	a hardware-generated interrupt caused by the DMA
4.	The initial program that is run when the computer is powered up is called:
a.	Booting program
b.	Boot loader
c.	Initializer
d.	Bootstrap loader
d. 6.	Bootstrap loader           If one thread opens a file with read privileges then:
	If one thread opens a file with read privileges
6.	If one thread opens a file with read privileges then: other threads in another process can also read
6. a.	If one thread opens a file with read privileges then: other threads in another process can also read from that file other threads in the same process can also read
6. a. b.	If one thread opens a file with read privileges then: other threads in another process can also read from that file other threads in the same process can also read from that file
6. a. b. c.	If one thread opens a file with read privileges then:         other threads in another process can also read from that file         other threads in the same process can also read from that file         any other thread cannot read from that file         all of the mentioned
6. a. b. c. d.	If one thread opens a file with read privileges then:other threads in another process can also read from that fileother threads in the same process can also read from that fileany other thread cannot read from that file
6. a. b. c. d. 8.	If one thread opens a file with read privileges then:other threads in another process can also read from that fileother threads in the same process can also read from that fileany other thread cannot read from that fileall of the mentionedTwo types of Semaphores are:
6. a. b. c. d. 8. a.	If one thread opens a file with read privileges then:other threads in another process can also read from that fileother threads in the same process can also read from that fileany other thread cannot read from that fileall of the mentionedTwo types of Semaphores are: Adding Semaphores and Binary 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				
с.	Non-preemptive				с.	The logical space				
d.	Static				d.	The	e limit regis	ster		
11.	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:				ed:	
a.	Address binding time.				a.	2 memory accesses.				
b.	Associative lookup time or hit ratio.				b.	3 memory accesses.				
с.	Associative lookup time unit and hit ratio.			с.	4 memory accesses.					
d.	Register access time.			d.	5 memory accesses.					
1	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?

These solutions to the critical-section problem rely on busy-waiting loops

**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 <sub>a</sub>	P <sub>b</sub>
wait(S);	wait(Q);
wait(Q);	wait(S);
	•••
<pre>signal(S);</pre>	signal(Q);
signal(Q);	signal(S);
	•

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

 $P_a$  may wait in the queue Q for a signal from  $P_b$  which may be blocked in the queue S.

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	<b>CPU Burst</b>	Arrival time	Priority	Finished	Waiting time
P1	23	0	4		
P2	8	3	2		
P3	17	18	3		
P4	12	20	1		

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

#### 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	$\sum ABET\%$					
	(a)	Exercise 1	5%					
	(e)	Exercise2	10%					
ABET	(i)	Exercise3	5%					
	(j) (k)	Exercise4 Exercise5	10% 5%					
NCAAA	<ul> <li>Cognitive Skills (NCAAA)</li> <li>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)</li> </ul>	Exercise6-9	$\sum ABET\%$					
	(a)	Exercise6	5%					
	(b)	Exercise7	5%					
ABET	(g)	Exercise8	5%					
	(h)	Exercise9	10%					
NCAAA	3. Interpersonal Skills & Responsibility (NCAAA)	Exercise10-11	$\sum ABET\%$					
	d. Ability to function effectively on teams to accomplish a common goal.	Exercise10	5%					
ABET	e. Understanding of professional, ethical, legal, security, and social issues and responsibilities.	Exercise11	15%					
NCAAA	4. Communication, Information Technology, Numerical (NCAAA)	Exercise12	∑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       Feedback Received:         my own work and referenced where required.       Student Signature: Date:         Student Signature: Date:       Student Signature: Date:								