King Saud University

College of Computer and Information Sciences
Computer Science Department

Course Code:	CSC 227
Course Title:	Operating Systems
Semester:	Spring 2017
Type of Examination:	**Final Exam.**

Student Name:	
Student ID:	
Student Section No.	
Instructor Name:	

Exam duration:

180 minutes.

08 May 2017
Time: 13:00-16:00

Tick the Relevant	Computer Science B.Sc. Program ABET Student Outcomes	Question No. Relevant Is Hyperlinked	Covering %
X	**a) Apply knowledge of computing and mathematics appropriate to the computer science;**	**6-8**	**45 %**
X	**b) Analyze a problem, and identify and define the computing requirements appropriate to its solution**	**1-3**	**37.5%**
X	**c) Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs;**	**4, 5**	**17.5%**
X	**d) Function effectively on teams to accomplish a common goal;**		

	Full Mark	Student's Mark
Question No.1	5	
Question No.2	6	
Question No.3	4	
Question No.4	4	
Question No.5	3	
Question No.6	4	
Question No.7	6	
Question No.8	8	
Total	40	

Question 1. [5=0.5x10 Marks] Select ONLY ONE ANSWER (the best answer). **Copy your answer to the Answers' Table.**

1.	To avoid the race condition, the number of processes that may be simultaneously inside their critical section is
A.	8
B.	16
C.	1
D.	15

2.	Fork is:
A.	the dispatching of a task
B.	the creation of a new job
C.	the creation of a new process
D.	increasing the priority of a task

3.	The strategy of allowing processes that are logically runnable to be temporarily suspended is called:
A.	Preemptive scheduling
B.	non preemptive scheduling
C.	shortest job first
D.	first come first served

4.	In which of the storage placement strategies a program is placed in the largest available hole in the main memory?
A.	best fit
B.	first fit
C.	worst fit
D.	Least fit

5.	Paging
A.	is a method of memory allocation by which the program is subdivided into equal portions or pages.
B.	consists of those addresses that may be generated by a processor during execution of a computation.
C.	is a method of allocating processor time.
D.	allows multiple programs to reside in separate areas of core at the time.

6.	Virtual memory is
A.	An extremely large main memory
B.	An extremely large secondary memory
C.	An illusion of extremely large main memory
D.	A type of memory used in super computers

7.	The number of processes completed per unit time is known as.... ?
A.	Output
B.	Throughput
C.	Efficiency
D.	Capacity

8.	Which of the following statements are true? **I**. Shortest remaining time first scheduling may cause starvation **II.** Preemptive scheduling may cause starvation **III**. Round robin is better than FCFS in terms of response time
A.	I only
B.	I and III only
C.	II and III only
D.	I, II and III

9.	When paging scheme is used
A.	We have no internal fragmentation
B.	We have no external fragmentation
C.	We have external and internal fragmentation
D.	A and B

10.	When **Valid-invalid** bit is attached to each entry in the page table, any access to invalid entry will result in
A.	Trap to the kernel
B.	Flush the whole memory
C.	I/O transfer
D.	Nothing will happen

Answers' Table:

1	2	3	4	5	6	7	8	9	10

Question 2. [6 Marks]

Multiprocessors systems growing in use and importance, also known as parallel systems or tightly-coupled systems.

2.1 Give the three main advantages of multiprocessors systems: **(1.5 Marks)**

- …… Increased throughput
- ……..... Economy of scale
- …… Increased reliability

2.2 What is the difference between symmetric and asymmetric multiprocessing or define each of them? **(3 Marks)**

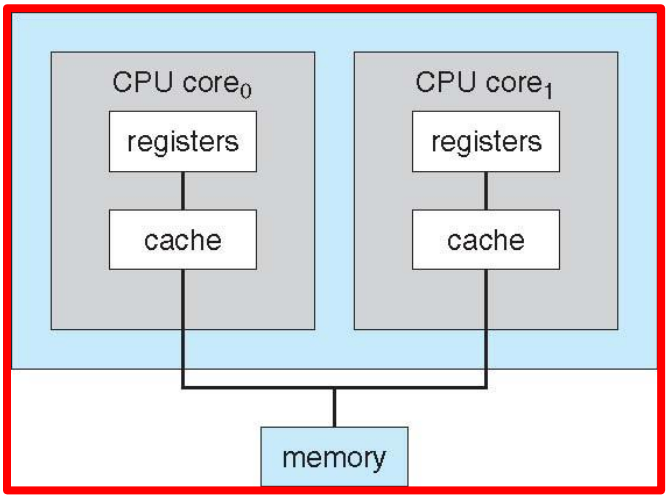
- Symmetric multiprocessing:

  each processor performs all tasks

- Asymmetric multiprocessing:

  each processor is assigned a specific task

2.3 Draw the design of a dual-core symmetric processor architecture. **(1.5 Marks)**



Question 3. [4 Marks]

3.1 Describe the activity of each of the following schedulers in the operating system of a computer: **(2 Marks)**

- **Long-term scheduler**:

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

- **Short-term scheduler**:

  (or CPU scheduler) – selects which process should be executed next and allocates CPU

3.2 Give the main characteristics of each of the following processes: **(2 Marks)**

- **I/O-bound process**:

  spends more time doing I/O than computations, many short CPU bursts

- **CPU-bound process** :

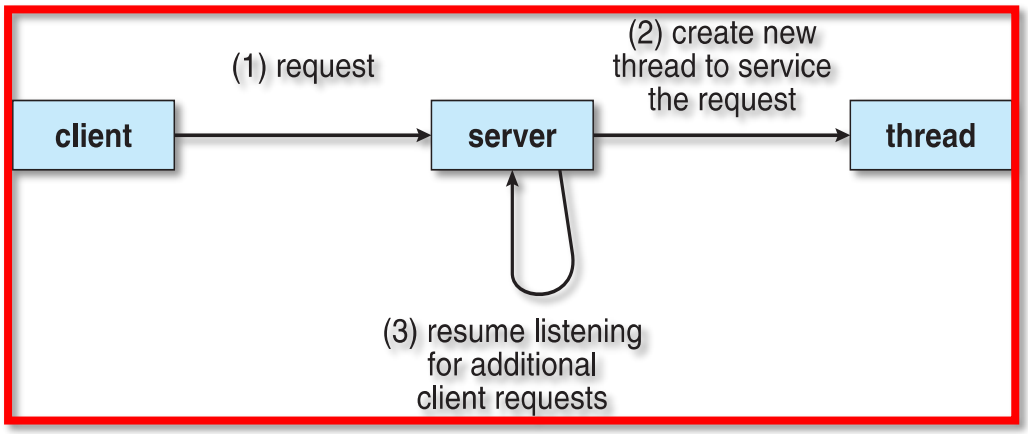
  spends more time doing computations; few very long CPU bursts

Question 4. [4 Marks]

4.1 Most modern applications are multithreaded, in that, multiple tasks of an application can be implemented by separate threads. Give three example of such tasks implemented by threads: **(2 Marks)**

- Update display
- Fetch data
- Spell checking
- Answer a network request

4.2 Draw the Multithreaded Server Architecture: **(2 Marks)**



Question 5. [3 Marks]

5.1 When a CPU scheduling decisions may take place? **(1.5 Marks)**

- Switches from running to waiting state
- Switches from running to ready state
- Switches from waiting to ready
- Terminates

5.2 Give the five scheduling algorithm optimization criteria? **(1.5 Marks)**

- Max CPU utilization
- Max throughput
- Min turnaround time
- Min waiting time
- Min response time

Question 6. [4 Marks]

Consider system of *n* processes $\{p_0, p_1, \ldots, p_{n-1}\}$ where each process has critical section segment of code.

6.1 Give example of three critical sections that may exist between processes: **(1 Mark).**

- Process may be changing common variables,
- Updating table,
- Writing file, etc.

6.2 Give the general structure of process P with its **critical section** and **remainder section**: **(1 Mark).**

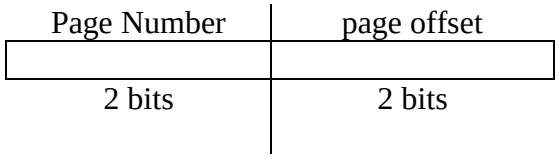
```
do {
    entry section
        critical section
    exit section
        remainder section
} while (true);
```

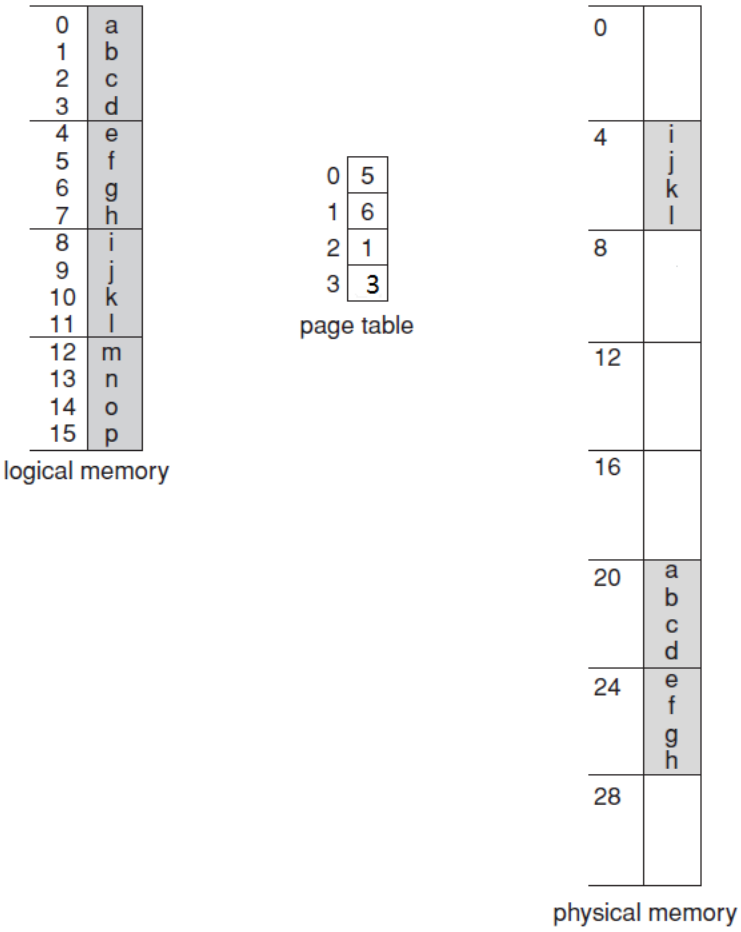
6.3 Suppose we have two processes P_i and P_j, give the structure of process P with its **critical section** and **remainder section using Mutex Locks**: **(2 Marks).**

```
do {
    acquire lock
        critical section
    release lock
        remainder section
} while (true);
```

Question 7. [6 Marks]

Consider the memory illustrated below with a logical address of size 4 (m=4) , and offset (n=2), and a page size of 4 bytes and physical memory of 32 bytes (8 pages).





7.1 Find the corresponding physical address by mapping the logical address "8" (which contains i in the figure above) and using the page table provided **[1 mark]:**

= (1*4)+0 = 4

7.2 Find the corresponding physical address by mapping the logical address "13" (which contains n in the figure above) and using the page table provided **[1 mark]:**

= (3*4)+1 =13

7.3 Complete the figure above by mapping the content (m,n,o,p) to the appropriate location in physical memory **[2 marks]**

(m,n,o,p) has to be filled in physical memory at 12,13, 14, 15 respectively

7.4 Giving that the page table are stored in physical memory and that this system uses Associative Memory. Assume if the access time to physical memory is 200 ns and the access time to associative memory is 20ns. If the hit ratio is 90%, what is the effective access time (EAT)? **[2 marks]**

EAT = (access time for associative memory for page# + access time for memory) × hit ratio + (access time for associative memory for page# + access time for memory for page table + access time for memory) × (1 - hit ratio)

(200 + 20) × (0.90) + (20 + 200 + 200) × (0.10) = 220 x 0.90 + 220 x 0.10 = 198 + 44 = 242 ns

Question 8. [8 marks]

Consider the following memory representation, where free areas are indicated with their sizes. The filled areas are indicated with their sizes and the process number.
Draw the final memory state after executing the following events in sequence. Use memory maps given below to answer the question.

1. P7 Arrives (requires 14KB),
2. P8 Arrives (requires 10KB),
3. P9 Arrives (requires 8KB),
4. P5 TERMINATED
5. P10 Arrives (requires 5KB)
6. P11 Arrives (requires 30KB)

a) Use First-Fit Allocation technique: **[2 marks]**

	P1	P2	P3		P4		P5		P6
20K	10K	20K	6K	15K	8K	9K	15K	22K	20K

P7	P10		P1	P2	P3	P8		P4	P9	P11		P6
14K	5K	1K	10K	20K	6K	10K	5K	8K	8K	30K	8K	20K

b) Use Best-Fit Allocation technique: **[2 marks]**

	P1	P2	P3		P4		P5		P6
20K	10K	20K	6K	15K	8K	9K	15K	22K	20K

P8	P10		P1	P2	P3	P7		P4	P9	P11		P6
10K	5KB	5K	10K	20K	6K	14K	1K	8K	8K	30K	8K	20K

c) Use Worst-Fit Allocation technique: **[2 marks]**

	P1	P2	P3		P4		P5		P6
20K	10K	20K	6K	15K	8K	9K	15K	22K	20K

P8		P1	P2	P3	P9		P4	P10		P7		P6
10K	10K	10K	20K	6K	8K	7K	8K	5K	19K	14K	8K	20K

d) In the situation above, when applying worst-fit allocation technique, P11 has to wait, why? what are the solution? **[2 marks]**

Insufficient contiguous memory due to external Fragmentation, the solution is to apply compaction

END OF EXAM