

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

**Total Marks: 20**

**Time: 6:30pm – 8:00pm (90 minutes)**

**Fall 2016-17**

**Name: .....**

**Midterm Exam I**

**ID#: .....**

**Date: 30-October-2016**

**Section#:..... or Teacher Name: .....**

**Instructions:**

- This exam has 8 pages.
- Do not use pencil.
- Write clearly and neatly.

**Question 1. (8 marks)** Select ONLY ONE ANSWER (the best answer).

**Copy your answer for question 1-1 to 1-16 in the table on page3. ONLY THAT TABLE WILL BE GRADED. (your answer should be one of the letters A, B, C or D)**

1.	The OS data structure that contains entry for each I/O device indicating its type, address, and state is called:
A	Hardware operations table
B	Device-status table
C	Device identification table
D	Device controllers table

2.	Which one is NOT a class of interrupts?
A	Input-Output Interrupt
B	Timer interrupt
C	Driver interrupt
D	Hardware failure interrupt

3.	What is the definition of I/O?
A	I/O is transfer of data from CPU to memory (RAM)
B	I/O is transfer of data from external device to memory
C	I/O is transfer of data from main memory to/from local buffers
D	I/O is transfer of data from the device to local buffer of the controller

4.	What is DMA?
A	Dynamic Management accelerator
B	Direct Memory Access
C	Decentralized Memory Access
D	Direct Management Agent

5.	Single-threaded process has one <b>program counter</b> specifying location of next instruction to execute, however, multi-threaded process:
A	Has one program counter.
B	<b>Has one program counter per thread.</b>
C	Does not have a program counter.
D	None of the above

6.	<b>Multiprogramming</b> needed for efficiency in which:
A	Multiprogramming organizes jobs (code and data) so CPU always has one to execute
B	Motivated by the idea, single user cannot keep CPU and I/O devices busy at all times
C	One job is selected and run by allocating CPU
D	<b>All of the above</b>

7.	Clustering provides a <b>high-availability</b> service which survives failures. It can be structured asymmetrically or symmetrically. Asymmetric clustering has
A	<b>has one machine in hot-standby mode (replacing the active server in case of fails, otherwise waits)</b>
B	has multiple nodes running applications, monitoring each other
C	A single machine that are robust and never fails
D	None of the above

8.	Memory management activities
A	Keeping track of which parts of memory are currently being used and by whom
B	Deciding which processes (or parts thereof) and data to move into and out of memory
C	Allocating and deallocating memory space as needed
D	<b>All of the above</b>

9.	When power initialized on system, execution starts at a fixed memory location called:
A	“Boot Block” on disk
B	<b>Firmware used to hold initial boot code</b>
C	Pre-configured file
D	None of the above

10.	The system call function “fork()” is used:
A	In Unix operating system to allocate the processor to a process
B	In Unix operating system to free the dynamically allocated data associated with the process
C	<b>In Unix operating system to create a new process</b>
D	In window operating system to terminate a process

11.	SYSGEN program obtains information concerning the specific configuration of the:
A	Operating system generation
B	Hardware system
C	Processor type
D	All the above

12.	Among the benefits of Microkernel System structure that is:
A	More code is running in kernel mode
B	difficult to port the operating system to new architectures
C	Easier to extend a microkernel
D	All the above

13.	Modular operating systems are the best current methodology for operating-system design were
A	The kernel provides core services
B	Each module is loadable as needed within the kernel
C	Each talks to the others over known interfaces
D	All of the above

14.	Layered approach
A	Layers need to be carefully designed and they tend to be less efficient than other type
B	More efficient than monolithic structure and modular structures
C	Has loadable modules
D	All of the above

15.	In MS-DOS, the interfaces and levels of functionality are not well separated, For instance, application programs are able to access the basic I/O routines to write directly to the display and disk drives due to
A	Intel 8088 for which it was written provides no dual mode and no hardware protection
B	Easier for programmers write directly to the display and disk drives
C	In MS-DOS, the interfaces and levels of functionality are well separated and based on system with dual mode.
D	None of the above

16.	FreeBSD is
A	Unix variant
B	Multitasking OS.
C	Can execute fork()
D	All of the above

**Your Answer should be written in the following table:**

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
11.	12.	13.	14.	15.	16.				

## Question 2. (7 marks)

**2.1** Real-time embedded systems are one of the most prevalent form of computers, in which some have operating systems. Therefore, a real-time operating system has a well-defined time constraint. Give at least two examples of real-time embedded systems and show how each system might fail if the defined time constraints were ignored. **(3 marks)**.

**Answer:**

There are many examples of real-time embedded systems including (not limited to):

1. medical imaging systems, patient and radiologist expect imaging system to operate in a limited time frame. Ignoring this constraint might let the patient wait in-front of the imaging system for hours.
2. Airplane control system has a defined time constraint; human life's can be lost due to ignoring such constraints.
3. The list of examples are long.

**2.2** When emulation can be used? How is it in term of speed? **(2 marks)**

**Answer:**

**Emulation** used when source CPU type different from target type (i.e. PowerPC to Intel x86)

Generally slowest method

When computer language not compiled to native code – **Interpretation**

**2.3** Protection and security are one of the services provided by operating systems, show how it is provided by operating systems? and mention two possible attacks. **(2 marks)**

**OS provides** mechanism for controlling access of processes or users to resources defined by the OS, e.g. by using dual mode (kernel mode and user mode)

Access control, and user authentication (e.g. using username and passwords).

Possible attacks: denial-of-service, worms, viruses, identity theft, and theft of service

### **Question 3. (4 marks)**

3.1 . Explain how the CPU is informed after the end of a data transfer from/to controllers to/from memory, using programmed I/O: **(1.5 marks)**

Answer:

I/O operation is performed, then  
Sets the appropriate bits in I/O status register.  
Processor is not alerted (No interrupts).  
Processor must take action by periodically checking I/O status register.

3.2 . Explain how the CPU is informed after the end of a data transfer from/to controllers to/from memory, using a DMA: **(1.5 marks)**

Answer: (Slides 28-29)

Device driver tells the disk controller to transfer a bloc of data  
Disk Controller initiates a DMA transfer.  
Disk Controller sends each byte to DMA controller.  
DMA controller transfers the byte to memory.  
When transfer of ALL bytes is finished, DMA sends interrupt to the CPU.

3.3 Compare between Symmetric and Asymmetric multiprocessing systems? **(1 marks)**

Answer:

Asymmetric Multiprocessing – Boss processor controls the systems and assigns tasks to other processors. Other processors, are either has a predefined task or follow instructions from Boss processor.

Symmetric Multiprocessing (SMP) – each processor performs all tasks

#### Question 4. [6 Marks]

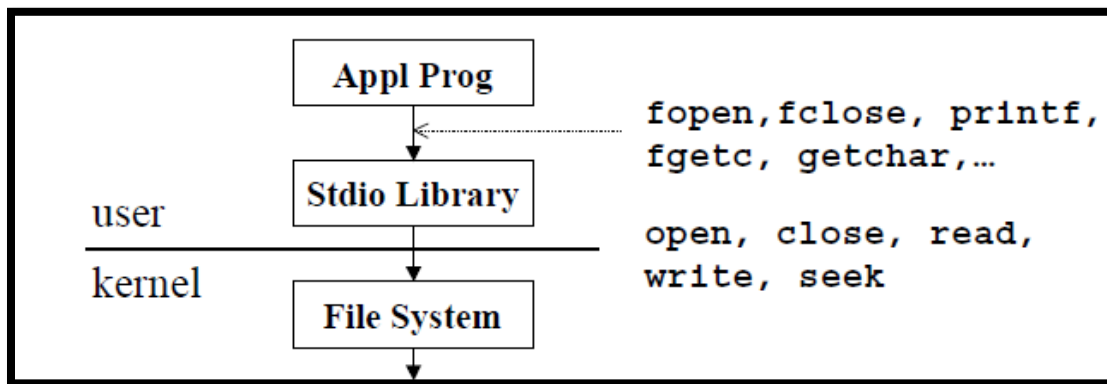
4.1 Give at least three functions that operating-system services should provide as a help to the user. (1.5 Marks).

1. User interface - Almost all operating systems have a user interface (UI)  
Varies between Command-Line (CLI), Graphics User Interface (GUI), Batch
2. Program execution - The system must be able to load a program into memory and to run that program, end execution, either normally or abnormally (indicating error)
3. I/O operations - A running program may require I/O, which may involve a file or an I/O device
4. File-system manipulation - The file system is of particular interest. Obviously, programs need to read and write files and directories, create and delete them, search them, list file information, permission management.
5. Communications – Processes may exchange information, on the same computer or between computers over a network
  1. Communications may be via shared memory or through message passing (packets moved by the OS)
6. Error detection – OS needs to be constantly aware of possible errors
  1. May occur in the CPU and memory hardware, in I/O devices, in user program.
  2. For each type of error, OS should take the appropriate action to ensure correct and consistent computing
  3. Debugging facilities can greatly enhance the user's and programmer's abilities to efficiently use the system
7. **Resource allocation** - When multiple users or multiple jobs running concurrently, resources must be allocated to each of them
  1. Many types of resources - Some (such as CPU cycles, main memory, and file storage) may have special allocation code, others (such as I/O devices) may have general request and release code
8. **Accounting** - To keep track of which users use how much and what kinds of computer resources
9. **Protection and security** - The owners of information stored in a multiuser or networked computer system may want to control use of that information, concurrent processes should not interfere with each other
  1. **Protection** involves ensuring that all access to system resources is controlled

2. **Security** of the system from outsiders requires user authentication, extends to defending external I/O devices from invalid access attempts. If a system is to be protected and secure, precautions must be instituted throughout it. A chain is only as strong as its weakest link.

**4.2 System Calls** are methods by which user processes invoke kernel services: such as “protected” procedure call shown in Figure 1.

**What the three general methods used to pass parameters to the operating system calls? (1.5 Marks)**



**Figure 1 shows protected procedure call.**

**Answer:**

1. Simplest: pass the parameters in *registers*
  - In some cases, may be more parameters than registers
2. Parameters stored in a *block*, or table, in memory, and address of block passed as a parameter in a register
  - This approach taken by Linux and Solaris
3. Parameters placed, or *pushed*, onto the *stack* by the program and *popped* off the stack by the operating system

4.3 During, the operating system **Design** and **Implementation** phases, the **Policy** and **Mechanism** principles should be considered and separated.

**4.3.1 Give the definition of each principle: (2 Points)**

1. **Policy:**.....  
.....  
.....  
.....
2. **Mechanism:** .....  
.....  
.....  
.....

**4.3.2 What is the main advantage of such separation between Policy and Mechanism principles? (1 Point)**

Answer:

**Policy:** What will be done?

**Mechanism:** How to do it?

- Mechanisms determine how to do something, policies decide what will be done

The separation of policy from mechanism is a very important principle,  
it allows maximum flexibility if policy decisions are to be changed later

**END OF THE EXAM.**