

**2015/2016 SEMESTER TWO EXAMINATION**

Diploma in Computer Engineering  
3rd Year Full-Time

**ET0023 OPERATING SYSTEMS**

Time Allowed: 2 Hours

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**Instructions To Candidates:**

1. The examination rules set out on the last page of the answer booklet are to be complied with.
2. This paper consists of **TWO** sections:

Section A - 20 Multiple Choice Questions, 2 marks each.

Section B - 6 Short Answer Questions, 10 marks each.
3. **ALL** questions are **COMPULSORY**.
4. All questions are to be answered in the answer booklet. Start each question on a new page for Section B.
5. This paper consists of 9 pages (inclusive cover page).

**SECTION A: MULTIPLE CHOICE QUESTIONS (2 marks each)**

1. For each question, select ONE correct answer
  2. Tick your answers in the box behind the front cover of the answer booklet.
  3. No marks will be deducted for incorrect answers.
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- 1) The CPU contains \_\_\_\_\_ to hold key variables and temporary results.
  - a) general registers
  - b) program counters
  - c) Arithmetic and Logic Units (ALU)
  - d) program status words
  
- 2) Which one of the following statements below is **not** a characteristic of **pre-emptive multi-tasking**?
  - a) If a job requires more time to complete, it can request for more time slices to complete the job.
  - b) When the time slice of a job is up, the scheduler will remove the job and replace it with another job.
  - c) The time-slice of each job is managed by the Job Scheduler.
  - d) Multiple jobs are run on a single processor one at a time.
  
- 3) Which one of the following terms below is **not** related to the low level formatting of hard disk drive?
  - a) Sectors
  - b) Tracks
  - c) Clusters
  - d) Cylinders
  
- 4) Which one of the following components is shared among threads within a process?
  - a) Stack
  - b) Registers
  - c) Program Counter
  - d) Files
  
- 5) Which one of the following state transitions is not allowed for a process?
  - a) Waiting -> Ready
  - b) Running -> Ready
  - c) Waiting -> Running
  - d) Running -> Waiting

- 6) Which one of the following technologies is used in solid state drive for data storage?
- a) Magnetic storage
  - b) Optical memory
  - c) EEPROM
  - d) DRAM
- 7) Sector 0 of a hard disk drive is also called the \_\_\_\_\_.
- a) Master Boot Record (MBR)
  - b) Boot block
  - c) Partition table
  - d) Root directory
- 8) Which one of the following statements is generally **not** an advantage in using a modern Linux operating system (OS) over a proprietary OS such as Windows OS?
- a) Low cost – Most Linux OSs are freely downloadable.
  - b) Good technical community support.
  - c) Ease of use and trouble-free installation.
  - d) Bug fix is fast and frequent, you can even do it yourself.
- 9) Modern Linux systems use \_\_\_\_\_ to keep track of file attributes and disk block addresses of files.
- a) Contiguous Allocation
  - b) Linked-list Allocation
  - c) File Allocation Table (FAT)
  - d) I-nodes
- 10) Which one of the following enabling technologies is responsible for the invention of the first generation of Apple computer by Steve Jobs and his team?
- a) Transistor
  - b) Microprocessor
  - c) Vacuum tube
  - d) Solid state drive
- 11) An Operating System provides five important functions as depicted in the Operating System pyramid diagram. The part of the operating system that manages the CPU is the \_\_\_\_\_.
- a) Memory management
  - b) File and Storage allocation
  - c) Software program compilation
  - d) Processes and scheduling management

- 12) Arrange the following memory components in decending access time (from fastest to the slowest) in the memory hierarchy.
- a) Main Memory – Registers – Solid State Drive – Cache
  - b) Register - Main Memory – Solid State Drive – Hard Disk Drive
  - c) Main Memory – Hard Disk Drive –Solid State Drive - ROM BIOS
  - d) Main memory – Cache – Hard Disk Drive - Solid State Drive
- 13) A process is calculating a mathematical equation, however, an unexpected over-flow error occurred. The process will be terminated with an exit status of
- a) normal exit (voluntary).
  - b) error exit (voluntary).
  - c) fatal error (involuntary).
  - d) killed by another process (involuntary).
- 14) The operating system has just loaded five processes, A, B, C, D and E. They have estimated running times of 6, 4, 3, 5 and 2 minutes. Their priorities are 3, 5, 2, 1, and 4, respectively, with 5 being the highest process priority.
- If shortest-job-scheduling is used, what is the scheduling order of these processes?
- a) A --> B --> C --> D --> E
  - b) E --> C --> B --> D --> A
  - c) B --> E --> A --> C --> D
  - d) D --> C --> A --> E --> B
- 15) Assume that a system has 4 GB of main memory divided into 2KB pages. How many pages will be required to access all the 4 GB main memory?
- a) 1 M
  - b) 2 M
  - c) 4 M
  - d) 16 M
- 16) What is the average rotational latency time for a 7200 RPM hard disk drive?
- a) 4.2 msec
  - b) 6.0 msec
  - c) 8.3 msec
  - d) 10 msec

- 17) The data structure which contains the starting and ending addresses of each partition is called the \_\_\_\_\_.
- a) Master boot record (MBR)
  - b) Partition table
  - c) Boot block
  - d) Super block
- 18) USB thumb drives generally use \_\_\_\_\_ file system to share files between Linux and Windows operating systems.
- a) xfs
  - b) NTFS
  - c) ext4
  - d) FAT
- 19) Which one of the following file permissions would only allow read-write access to the file owner and no access to group members or other users in a Linux file system?
- a) 640
  - b) 600
  - c) 770
  - d) 777
- 20) In a Linux Apache server system, the daemon that listens for web service request is \_\_\_\_\_.
- a) syslog
  - b) vsftpd
  - c) httpd
  - d) crond

**Section B: Short Answer Questions (60 Marks)**

1. Answer all questions in this section in your answer booklet.
  2. Start each question on a new page.
  3. Each question carries 10 marks.
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B1.

- a) Briefly explain the role of an Operating System in a computer system. [2 marks]
- b) Briefly explain the difference between a real resource and a virtual resource in a computer system. [2 marks]
- c) Briefly explain how **Time Slice operation** technique allows an operating system to manage **multi-tasking** in a computer system. [2 marks]
- d) The four necessary conditions for causing a deadlock in process execution are given in Table B1. Write short notes on any **two** of the necessary conditions for causing deadlock, and suggest the appropriate approach to avoid deadlock for each of the two conditions. [4 marks]

Deadlock Condition	Possible Approach
Mutual Exclusion	
Hold and Wait	
No preemption	
Circular wait	

Table B1

B2.

- a) What is a process control block (PCB)? Name one data item in PCB that is useful in process scheduling. [2 marks]
- b) Name one function that may be performed by the Operating System using information stored in the process control block. [2 marks]
- c) State one advantage of using multiple threads in a process. [2 marks]
- d) Briefly explain why process switching in a pre-emptive multitasking environment is considered more expensive than threads switching. [2 marks]
- e) In a server, it takes 20 msec to get a request to work, dispatch and do the rest of the necessary processing, when the data needed are in the block cache. On average, every three block cache accesses is followed by one hard disk access when the data required is not in the block cache. During hard disk access operation, an additional 80 msec is required and the thread sleeps.

How many requests per second can the above server handle if it is a multi-threaded process?

[2 marks]

B3.

- a) Briefly explain why race condition is hard to detect in a multi-threaded environment. [2 marks]
- b) Starvation is a common problem in priority process scheduling in a computer system. Describe a situation how starvation may occur in priority process scheduling and suggest one method to reduce the problem. [2 marks]
- c) Assuming the four processes P1, P2, P3 and P4 arrive at the same time at  $t=0$ . The order of the jobs, burst time and priority (4 being highest priority) are given in Table B3.

Order	Process	Burst time (min)	Priority
1	P1	10	1
2	P2	2	4
3	P3	8	3
4	P4	4	2

Table B3

Calculate the average turnaround time and average waiting time for the 4 processes above using the Shortest-Job-First (SJF) process scheduling. Show your workings.

[6 marks]

B4.

- a) Using the Virtual Memory schematic diagram shown in Figure B4, explain how virtual memory system works with the logical address space and the physical address space. Your explanation should show clearly what happens during cache hits and cache misses.

[4 marks]

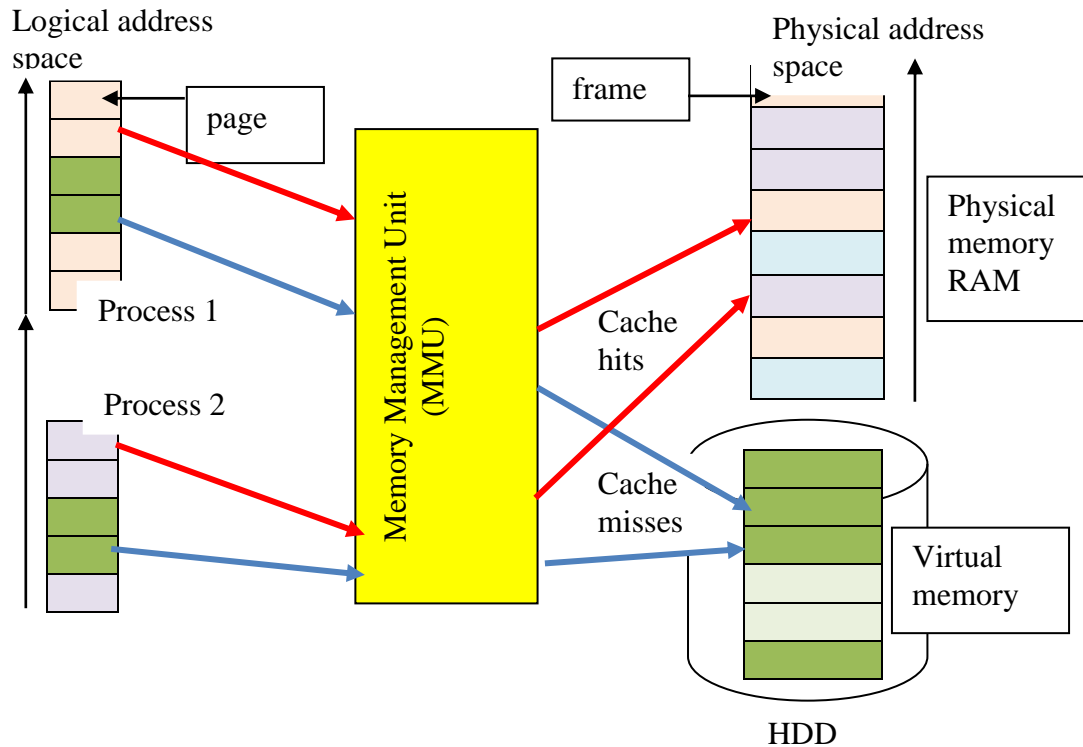


Figure B4

- b) We have a paging system with 4 frames and 13 pages. The number of frames denotes the number of pages that can be held in RAM at any given time. The pages are accessed by some processes in the order shown below. The paging system has just started and the frames are initially empty.

**Order in which pages are accessed: from left to right**

**1, 2, 3, 4, 2, 4, 5, 6, 4, 5, 6, 3, 2**

If the LRU (Least Recently Used) algorithm is used, how many page faults will be generated? Show your working.

[6 marks]



B5.

- a) Name one comparative advantage each for a RAID-10 system and a RAID-5 system.  
[2 marks]
- b) Using a schematic diagram, show the construction of a RAID-10 system using **four** hard disk drives (HDD).  
[2 marks]
- c) How would you store user data pattern of **10110011** in the above RAID-10 storage system?  
[2 marks]
- d) What is the efficiency (in %) of the above RAID-10 system constructed with **four** 1-TB hard disk drives?  
[2 marks]
- e) Name one advantage and one disadvantage of using solid state drive to replace HDD in mass storage system management.  
[2 marks]

B6.

- a) Figure B6 shows the output of an **ls** shell command on directory **/common**. You may assume that directory **/common** is **read-write-execute**-able by all users.

```
[student@stationX ~] $ ls -l /common
total 5
drwxrwxr-x  1 student test 4096 Sep 30 21:09 projects
-rw-rw-r--  1 student john 512 Sep 30 21:08 report
lrw-rw-r--  1 student test 6 Sep 30 22:09 etcptr -> /etc/
```

Figure B6

- i) What is the size of the file **report** in bytes?
- ii) Which users (other than root) can write into the file **report**?
- iii) What information will be displayed when listing the file **etcptr** (i.e. **ls etcptr**)?
- iv) What is the bash shell command for creating a directory **/common/Prog** by user **student**?  
[6 marks]
- b) The student user requires the above **report** file to be **read-write-execute**-able by user **student** and members of the **test** group, while all other users can only read the file.
- How do you prepare the **report** file using CLI **commands** for this purpose?  
[4 marks]

- End of Paper -