2016/2017 SEMESTER TWO EXAMINATION

Diploma in Computer Engineering
Diploma in Electrical & Electronic Engineering
3rd Year Full-Time

ET0023 OPERATING SYSTEMS Time Allowed: 2 Hours

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 8 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.

A1) The general registers and cache memory of the CPU are constructed with _____ .

a) static RAM
b) dynamic RAM
c) ROM
d) SSD

A2) Which one of the following bus systems below is **not** used by the CPU during the instruction processing?

a) Data bus
b) Peripheral bus
c) Address bus
d) Control bus

A3) Which one of the following technologies is least effective in improving the CPU processing speed of a computer process?

a) Linux OS
b) multi-threading
c) virtual memory
d) cache memory

A4) Which one of the following technologies is used in Solid State Drive for data storage?

a) Magnetic storage
b) Optical memory
c) Electrical Erasable PROM
d) Dynamic RAM

A5) Which one of the following components is shared among threads within a process?

a) Stack memory
b) Registers
c) Thread ID
d) Files

A6) Which one of the following is not a component of an Operating System?

a) The kernel
b) Device drivers
c) Application software
d) BIOS

A7) A portion of the File Allocation Table is shown in Table A7 below. The starting disk block for FileA is Block #2. What is the number of disk blocks required for FileA?

Block #	1	2	3	4	5	6	7	8	9
FAT entry	4	3	5	6	8	-1	-1	-1	7

Table A7

a) 2
b) 3
c) 4
d) 9

A8) A user on a Linux system wishes to back up the contents of his ~/work directory to an external USB disk-drive formatted in FAT32 format. Which one of the following file attibute information below would be lost?

a) File size
b) File name
c) File location
d) File protection

A9) Race condition in a multi-threaded computer process is hard to detect because

a) it is a timing-dependent error involving shared state.
b) there is too much overhead in solving the problem.
c) it has software bugs.
d) it is not important to solve such a problem.

A10) An 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-First scheduling algorithm 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

A11) A computer system has 4 GB of main memory divided into equal pages of 2KB size. 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

A12) Which one of the following RAID systems provides the highest efficiency (in %), assuming the RAID systems are constructed with **four** 1-TB hard disk drives?

a) RAID-1 system
b) RAID-5 system
c) RAID-6 system
d) RAID-1+0 system

A13) Processes running in the user space interact with the operating system in the kernel space through the

a) user interface.
b) Linux kernel.
c) system call.
d) device drivers.

A14) Which one of the following conditions is **not** necessary for causing deadlock in a multi-processing environment?

a) Mutual exclusion
b) Hold and wait
c) Allowed Preemption
d) Circular wait

A15) Which one of the following statements below is a characteristic of **pre-emptive** multi-tasking processes?

a) If a process requires more time to complete, it can request for more time slices to complete the process.
b) When the time slice of a process is up, the scheduler will remove the process and replace it with another process.
c) Each process is managed using first-come-first-serve scheduler till the process completion.
d) Multiple processes are run on a single processor in parallel at the same time.

A16) 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 – Cache – Solid State Drive
c) Main Memory – Hard Disk Drive –Solid State Drive – CDROM
d) Cache – Main memory – Solid State Drive – Hard Disk Drive

A17) Which one of the following would be the least important aspect of using Memory Multiplexing?

a) Isolate processes so that processes do not collide in physical memory
b) Ability to share and overlap memory between processes when desired
c) Create the illusion of more resources than there exist in the underlying physical system
d) Prevent deadlock from occuring in processes.

A18) Which one of the following file permissions would allow read-write access to the file owner and group members while granting only read access to other users in a Linux file system?

a) 640
b) 664
c) 770
d) 777

A19) In a Linux Apache server system, the daemon that listens for web service requests is _____.

a) syslog
b) vsftpd
c) crond
d) httpd

A20) The Android Operating System shares a similar kernel with

a) Microsoft OS.
b) Linux OS.
c) Unix OS.
d) Symbian OS.

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.

B1.

a) Briefly explain the role of an Operating System in situation when an application software wants to communicate with the hardware in a computer system.

[2 marks]

b) Briefly state two advantages when a user uses the Command Line Interface in an operating system.

[2 marks]

c) Briefly explain how cache memory in CPU improves the processing speed of a computer system.

[2 marks]

d) Briefly explain why a computer system uses many types of memory sub-systems.

[2 marks]

e) Briefly describe two advantages of using cloud computing.

[2 marks]

B2.

a) In process scheduling, when a process completes its task, it exits without error from the process table. Give one situation where a running process may voluntarily terminate with an error code without completing its assigned task.

[2 marks]

b) Briefly explain how multi-tasking is achieved in a single core CPU computer system.

[2 marks]

c) State two benefits of using Application Programming Interface (API) in the development of application software.

[2 marks]

d) State two benefits of using multiple threads in a web server process.

[2 marks]

e) In a web server, it takes 20 msec to get a request to work, when the data needed is in the memory cache. However, a hard disk access is required when the data is not in the memory cache. If a hard disk access is needed, as is the case one-fifth of the time, an additional 80 msec is required (on average, four memory cache access is followed by one hard disk access).

How many requests per second can the above web server handles if it is running a single-threaded process?

[2 marks]

B3.

a) Briefly explain how race condition occurs in a multi-threaded computer process. Suggest one solution for preventing the occurrence of race condition.

[2 marks]

b) Briefly state how jobs are chosen to be processed in Shortest-Job-First (SJF) scheduling scheme. Hence give one advantage of SJF scheduling scheme.

[2 marks]

c) The burst time and arrival time of four non-preemptive processes P1, P2, P3 and P4 are given in Table B3.

Process	Burst time (min)	Arrival time (min)
P1	8	2
P2	4	4
P3	2	3
P4	6	0

Table B3

Assuming that the first process P4 will start at time t=0. 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 a diagram, briefly explain how Virtual Memory works. Your diagram should clearly label and show the use of:

(i) pages and frames
(ii) physical memory and virtual memory
(iii) Memory Management Unit
(iv) cache hits and cache misses

[4 marks]

b) Briefly explain the following two aspects of memory multiplexing:

i. Isolation
ii. Virtualization

[2 marks]

c) 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, 3, 2, 4, 2, 5, 6, 3, 4, 2, 6, 3, 4

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

[4 marks]

B5.

a) Briefly describe two technologies to improve the performance of hard disk drive read-write access in a desktop computer.

[2 marks]

b) A 10000 rpm disk drive has an average 900 sectors per track. Each sector stores 512 bytes of user data. What is the internal transfer rate (in Mbytes per second) of this disk drive?

[2 marks]

c) Using a schematic diagram, show the construction of a RAID-5 system using **four** hard disk drives (HDD). [2 marks]

d) Briefly state one advantage of using memory cache in hard disk drives.

[2 marks]

e) Briefly state one advantage of using index-nodes to keep track of file attributes and disk block addresses of files in modern Linux systems.

[2 marks]

B6.

a) Figure B6 shows the output of shell command **ls** on directory **/home/common.** You may assume that directory **/home/common** is **read-write-execute**-able by all users. Note that user john is not a member of the test group.

```
[student@stationX ~ ] $ ls -li /home/common
total 1
21216 -rw-r--r--    1    student  john  512   Sep 30 21:08   report
12543 -rw-rw-r--    1    student  test  86    Sep 30 22:09   mydata
```

Figure B6

i) What is the size of the file **mydata** in bytes?
ii) Which users (other than root) can write into the file **mydata**?
iii) What is the i-node number of the file **mydata?**

[4 marks]

b) The user student requires the above **report** file to be **read-write-**able by user **student** and members of the **test** group only, while all other users can neither read nor write into the **report** file.
How do you prepare the **report** file using CLI **commands** for this purpose?

[4 marks]

c) The user root wishes to mount an external USB drive partition recognized as /dev/sdb1 to the filesystem. How do you mount the above **/home/common** directory to the external USB drive partition using CLI commands?

[2 marks]

– End of Paper –