2017/2018 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) Which one of the following memory systems may not be found inside the CPU?

a) Cache
b) Stack
c) General register
d) Buffer

A2) Which one of the following advanced CPU designs below increases instruction throughput by performing different stages of CPU operations in parallel?

a) Instruction pipeline
b) Superscalar
c) RISC
d) Multi-core CPU

A3) Swap space in Linux Operating System is referred as the _____.

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

A4) Which one of the following technologies is used in DVD data storage?

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

A5) Which one of the following statements does not describe a user-level thread?

a) It is a mini-version of a process.
b) It is implemented by a thread library at user level.
c) It is supported by the kernel with kernel intervention when needed.
d) It is fast to create and manage.

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

a) Graphical User Interface
b) Command Line Interface
c) Application Programming Interface
d) Device drivers

A7) Which one of the following file allocation schemes is used in Linux ext4 file systems for effective utilization of RAM memory spaces and fast access of the files?

a) Contiguous allocation
b) Linked allocation
c) Indexed allocation
d) FAT32 allocation

A8) Which one of the following approaches is used to prevent the "Circular Wait" deadlock condition?

a) Spool everything.
b) Request all resources initially.
c) Take resources away.
d) Order resources numerically.

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 1KB. 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-0+1 system
d) RAID-1+0 system

A13) In the process state transition diagram, the Running State of a process occurs in the

a) CPU.
b) main memory RAM.
c) external I/O devices.
d) HDD.

A14) Which one of the following conditions is necessary for causing deadlock in a multi-processing environment?

a) Mutual exclusion
b) Hold and wait
c) Circular wait
d) All of the above

A15) Which one of the following statements below is a characteristic of **co-operative** 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-served 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 descending 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 an advantages of using memory virtualization?

a) Isolating 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 memory resources than there actually exist in the underlying physical system.
d) All the above.

A18) Which one of the following file permissions would allow read-write-execute access to the file owner and group members while granting no access permission to other users in a Linux file system?

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

A19) The Linux directory /etc is compressed using various compression schemes. Which one of the following compressed file from various schemes will likely have the highest compression efficiency?

a) etc.tar
b) etc.tar.bz2
c) etc.tar.gz
d) /etc (original directory)

A20) Which one of the following Operating Systems (OS) does not share a similar kernel?

a) Microsoft OS.
b) Linux OS.
c) Apple iOS.
d) Android 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 a computer system. Hence list any four functions of the Operating System.

[4 marks]

b) Briefly state two advantages of using Application Programming Interface (API) in the development of an application software.

[2 marks]

c) Briefly explain how cache memory in CPU works with the main memory to improve the processing speed of a computer system.

[2 marks]

d) Briefly describe the following two advanced CPU technologies that improve CPU processing speed in a computer system:

(i) Instruction pipelining (ii) Hyper-threading

[2 marks]

B2.

a) Give two situations where a running process may be forced to (involuntarily) terminate with an error code without completing its assigned job.

[2 marks]

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

[2 marks]

c) Briefly explain how multi-threading process improves CPU utilisation and user responsiveness in a web server process.

[2 marks]

d) In a web server, it takes 10 msec to get a request to work, when the data required is in the memory cache. However, when the required data is not in the memory cache, an additional 50 msec hard disk access is required. On average, four memory cache access is followed by one hard disk access.

(i) How many requests per second can the above web server handle if it is running as a single-threaded process?

(ii) How many requests per second can the above web server handle if it is running as a multi-threaded process?

[4 marks]

B3.

a) Briefly explain the following two scheduling schemes:
(i) First-Come-First-Served (FCFS) scheduling scheme.
(ii) Shortest-Job-First (SJF) scheduling scheme.

Hence, give one advantage for each the FCFS and SJF scheduling schemes.

[4 marks]

b) 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	4	2
P2	3	1
P3	6	3
P4	2	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) State briefly two advantages of using Virtual Memory in multi-tasking processes.

[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, 2, 3, 4, 5, 6, 4, 3, 2, 1, 3, 4, 5

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

[4 marks]

B5.

a) Briefly state two advantages of SSD over the hard disk drive in read-write access performance in a desktop computer.

[2 marks]

b) A 10000 rpm disk drive has an average 1200 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). What is the efficiency of this RAID-5 system?

[2 marks]

d) Briefly explain the function of flash memory in hybrid hard disk drives.

[2 marks]

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

[2 marks]

B6.

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

```
[root@stationX ~ ] $ ls -li /common
total 1
21216 -rw-r--r-- 1 root root 512 Sep 30 21:08 report
25243 -rw-r--r-- 1 root test 286 Sep 30 22:09 mydata
```

Figure B6

i) What is the file size (in byte) of file **/common/mydata**?
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 above **report** file is required to be **read-write**able by user **student** and members of the **test** group only, while all other users can only read the **report** file.
How do you prepare the **report** file using CLI **commands** for this purpose?

[4 marks]

c) An external USB drive partition is recognized as **/dev/sdb1** to the Linux filesystem. How do you mount the above **/common** directory to this external USB drive partition using CLI commands?

[2 marks]

– End of Paper –