2018/2019 SEMESTER ONE EXAMINATION

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

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. Fill in the Question Numbers in the order that it was answered, in the box found on the front cover of the answer booklet, under the column "Question Answered".

6. This examination 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.

A1)   Which one of the following bus systems is **NOT** used by the CPU during the instruction processing?

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

A2)   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

A3)   Which one of the following is not a component of an Operating System?

      a)   The kernel
      b)   Device drivers
      c)   Application software
      d)   Storage management

A4)   A _____ scheduling algorithm selects a process and allows it run until it has completed or interrupted.

      a)   real-time processing
      b)   batch processing
      c)   non-preemptive
      d)   preemptive

A5)   The memory space of _____ of a running process can grow as temporary data is stored in the process.

      a)   the stack segment
      b)   the heap segment
      c)   the program code segment
      d)   both the stack and heap segments

A6) A process loads and reads a file for processing. The requested file exists and has all the data required. The process is completed without error and is terminated with an exit status of _____.

a) normal exit (voluntary)
b) normal exit (involuntary)
c) error exit (voluntary)
d) error exit (involuntary)

A7) Which one of the following scheduling algorithms is the easiest to implement?

a) Priority Scheduling
b) Shortest Job First
c) Round Robin
d) First Come First Served

A8) Which one of the following technologies is used in DVD-ROM for data storage?

a) Magnetic storage
b) Optical memory
c) EEPROM
d) DRAM

A9) An operating system has just loaded five processes in the following order: A, B, C, D and E. They have estimated running times of 6, 4, 3, 5 and 2 minutes and their priorities are 3, 5, 2, 1, and 4, respectively, with 5 being the highest process priority.

If first-come-first-served 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

A10) Which one of the following is a shared component among threads within a process?

a) Thread Identifier
b) Registers
c) Program Counter
d) Address Space

A11) Race condition is hard to detect in multiple threads from a single process because _____.

   a)   a powerful CPU is needed for complex computation
   b)   the OS needs to allocate large amount of resources to detect race condition
   c)   race condition is intermittent and timing dependent
   d)   race condition is OS and resources dependent

A12) Which one of the following is **NOT** a necessary condition for causing a Deadlock?

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

A13) For a home computer, a RAID-1+0 system is constructed with four 1 TB hard disk drives. What is the efficiency of this RAID-1+0 system?

   a)   25 %
   b)   50 %
   c)   75 %
   d)   100 %

A14) When virtual memory is used, the physical address space (RAM) is divided into equal sized chunks called _____.

   a)   pages
   b)   frames
   c)   segments
   d)   clusters

A15) 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

A16)   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.

A17)   Which one of the following is the home directory of user **root**?

     a)   /home/student
     b)   /home/root
     c)   /etc
     d)   /root

A18)   In modern Linux systems, configuration files are mostly stored in _____.

     a)   /etc
     b)   /home
     c)   /var
     d)   /misc

A19)   If /home/student/data is a non-empty directory (contains files), then the Command Line Interface command **rmdir /home/student/data** will _____.

     a)   remove all files in the directory
     b)   delete the directory from the filesystem
     c)   do nothing and have no reply
     d)   not remove all files in the directory and shows an error message

A20)   In modern Linux systems, the swap partition used as virtual memory is stored in _____.

     a)   secondary memory
     b)   main memory
     c)   logical volume manager
     d)   ROM BIOS

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.

(2 marks)

b) Briefly explain the following terms using examples, when applied to Operating Systems.
    (i)   Batch Processing
    (ii) Spooling

(4 marks)

c) Explain the purpose/function of each of the following hardware components of a CPU.
    (i)   General Registers
    (ii) Program Counter

(2 marks)

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

(2 marks)

B2.
a) State two similarities and two differences between process and thread in a multi-programming environment.

(4 marks)

b) Using the process control block, name two shared elements in threads.

(2 marks)

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

(4 marks)

B3.

a) Briefly explain the following two scheduling criterion used in real-time Operating Systems.
   (i) Throughput
   (ii) Response Time

(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 four processes above using the Shortest-Job-First (SJF) process scheduling. Show your workings.

(6 marks)

B4.

a) Draw a diagram to show 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

(5 marks)

b) Assume that a paging system has 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.

(5 marks)

B5.

a) Briefly describe two technologies used 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.

(2 marks)

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

(2 marks)

e) Briefly explain the following two terms with regards to Disk Storage.
   (i)   Sector
   (ii)   Latency

(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 file system. How do you mount the above **/home/common** directory to the external USB drive partition using **CLI commands**?

(2 marks)

– End of Paper –