KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2024/2025 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE DIPLOMA IN INFORMATION & COMMUNICATION TECHNOLOGY
<u>DIT 1004 – OPERATING SYSTEMS</u>

Date: 15TH April 2024
Time: 8:30AM – 10:30AM

<u>INSTRUCTIONS TO CANDIDATES</u>
<u>ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS</u>
<u>QUESTION ONE (30 MARKS)</u>

a) Windows, Linux, and Android are examples of operating systems that enable the user to use programs like MS Office, Notepad, and games on the computer or mobile phone. Discuss two core functions of Operating Systems. (4 Marks)

b) The evolution of operating systems underscores their pivotal role in shaping the computing landscape. From facilitating basic program execution to orchestrating complex distributed environments, OSs continue to evolve, driven by technological innovation and user-centric design principles. Discuss two features of Operating Systems in (4 Marks)

c) Application Program Interface (API): One pivotal role of an OS is to provide a designated Application Program Interface (API) through which application programs can request various services. This interface serves as a gateway, allowing applications to communicate with the underlying hardware and access essential resources. Distinguish between utility and applications software (4 Marks)

d) The API abstraction layer shields applications from intricacies of hardware management, enhancing portability and interoperability across different devices and architectures. Highlight the role of the Kernel (4 Marks)

e) As the digital ecosystem evolves, operating systems will remain at the forefront, enabling seamless integration of hardware, software, and services to meet the ever-changing needs of modern computing. Describe an interrupt (4 Marks)

f) When we write a program in C or C++ and compile it, the compiler creates binary code. The original code and binary code are both programs. When we actually run the binary code, it becomes a process. A process is an 'active' entity instead of a program, which is considered a 'passive' entity.
   i) Explain your understanding of the term Process Management (2 Marks)
   ii) Distinguish between active and passive entities (2 Marks)

g) Cloud Computing and Distributed Systems: Cloud computing technology has brought about a paradigm shift in how operating systems manage processes. Several distributed operating systems are now designed to manage processes spread across networks, including geographically dispersed datacenters.

   i) Single-tasking vs. multi-tasking operating systems (2 Marks)
   ii) Concurrency and Parallelism (4 Marks)

<u>QUESTION TWO (20 MARKS)</u>

a) When a program is executed, it needs a designated space in the memory to store its instructions and data. This space is known as a process memory. Process memory in operating systems is a critical concept that determines how programs and software function. The operating system keeps its

processes separate and allocates the resources they need, so that they are less likely to interfere with each other and cause system failures.

    i)   List two advantages of threads over processes   (2 Marks)
    ii)   With a diagram discuss the various parts of a process in memory   (8 Marks)
    iii)   Explain the term context switching   (2 Marks)
    iv)   Discuss any four process states   (8 Marks)

QUESTION THREE (20 MARKS)

a)   Linus Torvalds introduced the concept of a monolithic kernel in 1991 as a part of the Linux kernel. A monolithic kernel is a single large program that contains all operating system components. However, the Linux kernel evolved over the years and now consists of different types of kernels. The problem with this approach was that the whole kernel had to be recompiled for even a small change. In a modern-day approach to monolithic architecture, the kernel code size has been reduced to increase stability.

    i)   Discuss Microkernel and Hybrid Kernel   (4 Marks)
    ii)   Discuss the functions of the Kernel   (4 Marks)
    iii)   Discuss the role of the Shell in operating systems   (2 Marks)
    iv)   Discuss the system calls exec() and fork()   (6 Marks)
    v)   Differentiate between a Zombie and Orphan Process   (4 Marks)

QUESTION FOUR (20 MARKS)

a)   In addition to the core functions of an operating system (OS), there are several advanced and evolving functions that modern Operating Systems are increasingly incorporating. Describe the following.

    i)   Virtualization Support   (2 Marks)
    ii)   Cloud Integration   (2 Marks)
    iii)   Energy Management   (2 Marks)

b)   An interrupt is emitted by a device attached to a computer or from a program. It might be planned or unplanned. Interrupts are an event that causes a program to stop and start executing another program. Interrupts are like a phone call from some device telling the program to stop executing and execute some other code instead. Most often, the device that generates an interrupt is the hardware device such as a keyboard, mouse, printer, hard drive, etc. The program itself can also generate interrupts. Interrupts are used by device driver software to communicate with the operating system. Interrupts are also used to communicate between two programs running on the computer. It is a situation that changes the order in which the processor carries out instructions. Interruption occurs when one or multiple devices send interrupt signals to the CPU.

    i)   Distinguish maskable from non-maskable Hardware interrupts   (4 Marks)
    ii)   Provide a high-level view of the interrupt handling process   (6 Marks)
    iii)   Distinguish between normal and exception software interrupts   (4 Marks)

QUESTION FIVE (20 MARKS)

a)   Process Management in OS can be classified along two significant divisions - Based on Resource Allocation Strategy and Based on Scheduling Policy. Resource Management Based Classification: In terms of resource management, the process management is classified into Monoprogramming and Multiprogramming. Scheduling Policy Based Classification: Based on scheduling policy, the process management types include Batch Processing, Time-sharing, Real-time, and Parallel Processing.

    i)   Discuss the concept of time sharing in scheduling   (2 Marks)
    ii)   Compare monoprogramming to multiprogramming   (2 Marks)
    iii)   Describe the concept of real-time scheduling policy   (2 Marks)
    iv)   Discuss Parallel Processing   (2 Marks)
    v)   Describe the concept of Containerization   (2 Marks)
    vi)   Highlight two attributes of a process   (2 Marks)

b)   Process Synchronization is the task of synchronizing cooperative processes such that the processes do not have access to shared data or resources at the same time. This helps avoid inconsistency in data.

    i)   Discuss two conditions that may result in a deadlock   (4 Marks)
    ii)   Define the term critical section   (2 Marks)
    iii)   Describe the term mutex   (2 Marks)