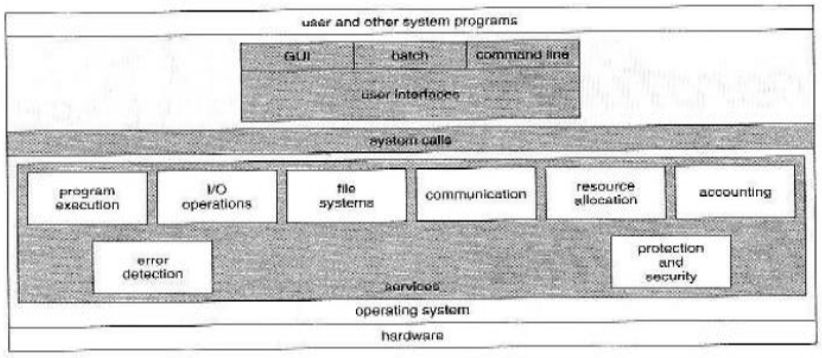
BANGALORE INSTITUTE OF TECHNOLOGY
K R ROAD, V V PURA, BENGALURU-04
DEPARTMENT OF CSE(DATA SCIENCE)
I Internals -2023-24 (ODD)
Scheme of Evaluation

BATCH: 2022
COURSE (CODE): OS (BCS303) **SEM**: 3
DATE & TIME: 12/01/24 &1:30pm-2:30pm **MAX MARKS:** 30

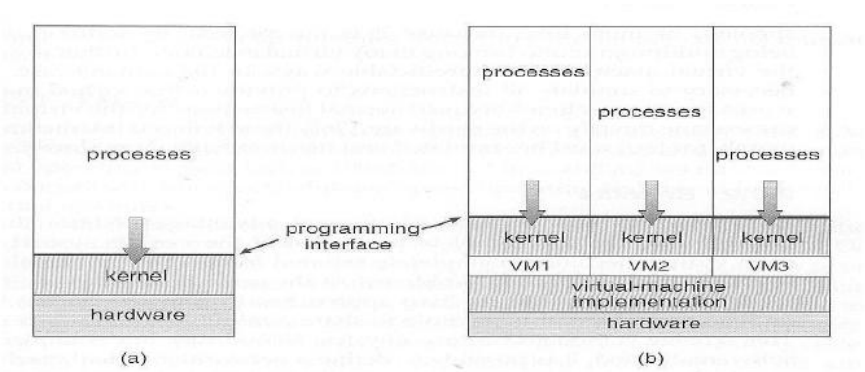
Question Number	Solution	Marks Allocated
1.a)	**Define operating system Definition carries 1 mark** An operating system is a system software that acts as an intermediary between a user of a computer and the computer hardware. **Explain the services of operating system with neat Diagram.** **Diagram Carries 2 marks**  **Figure 2.1** A view of operating system services. **Explanation carries 2 marks** ● **User Interfaces** - Means by which users can issue commands to the system. Depending on the operating system these may be a command-line interface (e.g. sh, csh, ksh, tcsh, etc.), a Graphical User Interface (e.g. Windows, X-Windows, KDE, Gnome, etc.), or a batch command systems. In Command Line Interface(CLI)- commands are given to the system. In Batch interface – commands and directives to control these commands are put in a file and then the file is executed. In GUI systems- windows with pointing device to get inputs and keyboard to enter the text. ● **Program Execution** - The OS must be able to load a program into RAM, run the program, and terminate the program, either normally or abnormally.	**1+2+2+2 =7 marks**

	● **I/O Operations** - The OS is responsible for transferring data to and from I/O devices, including keyboards, terminals, printers, and files. For specific devices, special functions are provided(devicedrivers)byOS. ● **File-System Manipulation** – Programs need to read and write files or directories. The services required to create or delete files, search for a file, list the contents of a file and change the file permissions are provided by OS. ● **Communications** - Inter-process communications, IPC, either between processes running on the same processor, or between processes running on separate processors or separate machines. May be implemented by using the service of OS-like shared memory or message passing. ● **Error Detection** - Both hardware and software errors must be detected and handled appropriately by the OS. Errors may occur in the CPU and memory hardware (such as power failure and memory error), in I/O devices (such as a parity error on tape, a connection failure on a network, or lack of paper in the printer), and in the user program (such as an arithmetic overflow, an attempt to access an illegal memory location). **Services carries 2 marks** OS provide services for the efficient operation of the system, including: ● **Resource Allocation** – Resources like CPU cycles, main memory, storage space, and I/O devices must be allocated to multiple users and multiple jobs at the same time. ● **Accounting** – There are services in OS to keep track of system activity and resource usage, either for billing purposes or for statistical record keeping that can be used to optimize future performance. ● **Protection and Security** – The owners of information(file) in multiuser or networked computer system may want to control the use of that information. When several separate processes execute concurrently, one process should not interfere with other or with OS. Protection involves ensuring that all access to system resources is controlled. Security of the system from outsiders must also be done, by means of a password.	
1.b)	**Distinguish between the following terms:** **i) Multi-processor systems and clustered systems. carries 4 marks**	**4 + 4 =8marks**

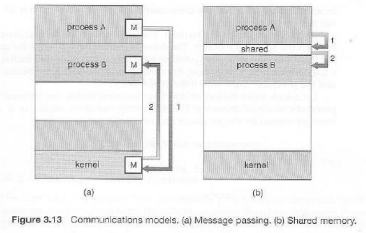
Feature	Multi-processor Systems	Clustered Systems
Interconnection	Shared bus or interconnect	High-speed network connecting independent nodes
Communication	Typically faster communication between processors on the shared bus	Communication involves message passing over the network between cluster nodes
Scalability	Limited scalability due to bus contention	Highly scalable, easy to add more nodes
Fault Tolerance	Limited fault tolerance	Improved fault tolerance, as tasks can be distributed among different nodes
Resource Sharing	Shared resources such as memory and I/O	Resources are usually not shared directly; each node has its own resources
Programming Model	Symmetric Multiprocessing (SMP)	Message Passing Interface (MPI) is commonly used for parallel programming

ii) Multi-programming and multitasking. carries 4 marks

Feature	Multiprogramming	Multitasking
Definition	Multiple programs are loaded into memory simultaneously, and the CPU switches between them for execution.	A single computer executes multiple tasks concurrently, giving the appearance of simultaneous execution.
CPU Utilization	The CPU is kept busy most of the time as it can switch to another program when one is waiting for I/O or is blocked.	CPU is also kept busy, but the focus is on providing a more interactive and responsive environment for users.
Goal	Enhance CPU utilization and throughput.	Provide better user interaction and responsiveness.
Switching Mechanism	Switching occurs at the program level.	Switching occurs at the task or process level.
Context Switching Cost	Context switching cost is relatively lower.	Context switching cost can be higher due to more detailed task information being saved and restored.

2.a)	**Explain the concept of virtual machine with neat diagram.** **Diagram carries 2 marks**  **Fig: System modes. (A) Nonvirtual machine (b) Virtual machine** **Concept of virtual machine carries 2 marks** ● The fundamental idea behind a virtual machine is to abstract the hardware of a single computer (the CPU, memory, disk drives, network interface cards, and so forth) into several different execution environments, thereby creating the illusion that each separate execution environment is running its own private computer. ● Creates an illusion that a process has its own processor with its own memory. Host OS is the main OS installed in system and the other OS installed in the system are called guest OS. **Benefits carries 2** ● Able to share the same hardware and run several different execution environments(OS). Host system is protected from the virtual machines and the virtual machines are protected from one another. A virus in guest OS, will corrupt that OS but will not affect the other guest systems and host systems. ● Even though the virtual machines are separated from one another, software resources can be shared among them. Two ways of sharing s/w resource for communication are: a)To share a file system volume(part of memory). b)To develop a virtual communication network to communicate between the virtual machines. ● The operating system runs on and controls the entire machine. Therefore, the current system must be stopped and taken out of use while changes are made and tested. This period is commonly called system development time. In virtual machines such problem is eliminated. User programs are executed in one virtual machine and system development is done in another environment. ● Multiple OS can be running on the developer's system concurrently. This helps in rapid porting and testing of programmers code in different environments. ● System consolidation – two or more systems are made to run in a single system. **Example carries 1 mark** **VMware** ● VMware is a popular commercial application that abstracts Intel 80X86 hardware into isolated virtual machines. The virtualization tool runs in the user-layer on top of the host OS. The virtual machines running in this tool believe they are running on bare hardware, but the fact is that it is running inside a user-level application.	**2+2+2+1 =7marks**

2.b)	● **(or)** **The Java Virtual Machine** ● Java was designed from the beginning to be platform independent, by running Java only on a Java Virtual Machine, JVM, of which different implementations have been developed for numerous different underlying HW platforms. **What are system calls? carries 2 mark** System calls is a means to access the services of the operating system. Generally written in C or C++, although some are written in assembly for optimal performance. **Briefly explain types of system call. carries 6 marks** The system calls can be categorized into six major categories: ● **Process Control** - Process control system calls include end, abort, load, execute, create process, terminate process, get/set process attributes, wait for time or event, signal event, and allocate and free memory. Processes must be created, launched, monitored, paused, resumed, and eventually stopped. When one process pauses or stops, then another must be launched or resumed Process attributes like process priority, max. allowable execution time etc. are set and retrieved by OS. After creating the new process, the parent process may have to wait (wait time), or wait for an event to occur(wait event). The process sends back a signal when the event has occurred (signal event). ● **File management** - The file management functions of OS are – File management system calls include create file, delete file, open, close, read, write, reposition, get file attributes, and set file attributes. After creating a file, the file is opened. Data is read or written to a file. The file pointer may need to be repositioned to a point. The file attributes like filename, file type, permissions, etc. are set and retrieved using system calls. ● **Device management** - Device management system calls include request device, release device, read, write, reposition, get/set device attributes, and logically attach or detach devices. When a process needs a resource, a request for resource is done. Then the control is granted to the process. If requested resource is already attached to some other process, the requesting process has to wait. In multiprogramming systems, after a process uses the device, it has to be returned to OS, so that another process can use the device. Devices may be physical (e.g. disk drives), or virtual / abstract (e.g. files, partitions, and RAM disks).	**2+6=8 marks**

3.a)	● **Information management** - Information maintenance system calls include calls to get/set the time, date, system data, and process, file, or device attributes. These system calls care used to transfer the information between user and the OS. Information like current time & date, no. of current users, version no. of OS, amount of free memory, disk space etc. are passed from OS to the user. ● **Communications** - Communication system calls create/delete communication connection, send/receive messages, transfer status information, and attach/detach remote devices. The message passing model must support calls to: o Identify a remote process and/or host with which to communicate. o Establish a connection between the two processes. o Open and close the connection as needed. o Transmit messages along the connection. o Wait for incoming messages, in either a blocking or non-blocking state. o Delete the connection when no longer needed. The shared memory model must support calls to: o Create and access memory that is shared amongst processes (and threads) o Free up shared memory and/or dynamically allocate it as needed. ● **Protection** - Protection provides mechanisms for controlling which users / processes have access to which system resources. System calls allow the access mechanisms to be adjusted as needed, and for non-priveleged users to be granted elevated access permissions under carefully controlled temporary circumstances. **What is Inter process communication? carries 1 marks** Inter-process communication (IPC) is a mechanism that allows processes to communicate with each other and synchronize their actions **Explain message passing carries** **Diagram Carries 1 marks**  Figure 3.13 Communications models. (a) Message passing. (b) Shared memory. **Explanation Carries 2 marks** Shared Memory is faster once it is set up, because no system calls are required and access occurs at normal memory speeds. Shared memory is generally preferable when large amounts of information must be shared quickly on the same computer. Message Passing requires system calls for every message transfer, and is therefore slower, but it is simpler to set up and works well across multiple computers. Message passing is generally preferable when the amount and/or frequency of data transfers is small Shared-Memory Systems	**1+1+2+3 =7 marks**

A region of shared-memory is created within the address space of a process, which needs to communicate. Other processes that needs to communicate uses this shared memory.

The form of data and position of creating shared memory area is decided by the process. Generally a few messages must be passed back and forth between the cooperating processes first in order to set up and coordinate the shared memory access.

The process should take care that the two processes will not write the data to the shared memory at the same time.

Explain shared memory concept of IPC in detail carries 3 marks

A mechanism to allow process communication without sharing address space. It is used in distributed systems.

Message passing systems uses system calls for "send message" and "receive message".

A communication link must be established between the cooperating processes before messages can be sent.

There are three methods of creating the link between the sender and the receiver-

o Direct or indirect communication (naming)

o Synchronous or asynchronous communication (Synchronization)

o Automatic or explicit buffering.

a) Naming

b) Synchronization

c) Buffering

Explain the different multi-threading models. carries 3 marks

1. Many to One Model

3.b)

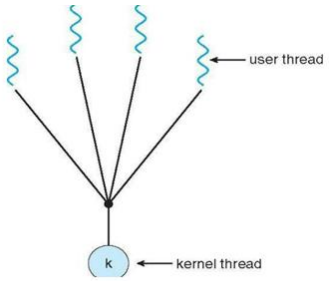


Figure: Many-to-one model.

2. One to One Model

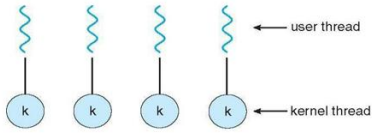


Figure: One-to-one model

3. Many to Many Model

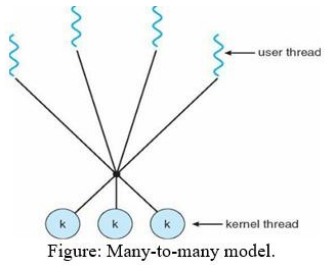


Figure: Many-to-many model.

3 marks

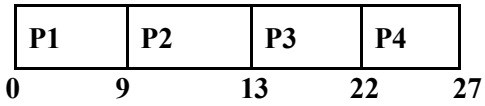
Calculate the average waiting time and the average turnaround time by drawing the Gantt chart using FCFS, SRTF, RR(q=2ms) and priority(Preemptive) algorithms. Lower priority number represents higher priority.

Process	Arrival Time	Burst Time	Priority
P1	0	9	3
P2	1	4	2
P3	2	9	1
P4	3	5	4

4.a)

(i)FCFS

Gantt chart carries 1 marks



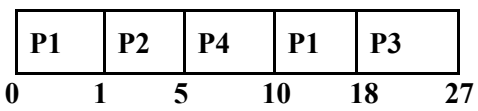
Average TAT=16.25 ms **TAT and WT carries 1 marks**

Average WT=9.5 ms

1+1+1+1+1+1+1+1=8 marks

(ii)SRTF

Gantt chart carries 1 marks

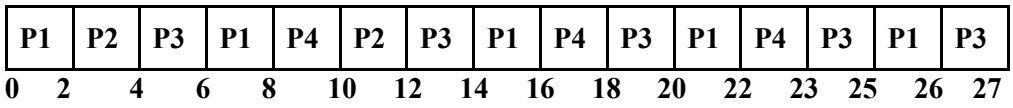


Average TAT=13.5 ms **TAT and WT carries 1 marks**

Average WT=6.75 ms

(iii) RR

Gantt chart carries 1 marks

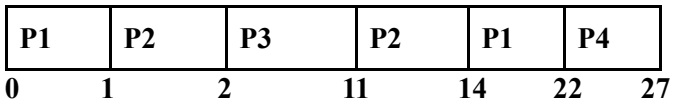


Average TAT=20.5 ms **TAT and WT carries 1 marks**

Average WT=13.75 ms

(iv)Priority (Preemptive)

Gantt chart carries 1 marks



Average TAT=17 ms **TAT and WT carries 1 marks**

Average WT=10.25 ms

Distinguish between process and threads. carries 2 marks.

- A process is independent and not contained within another process, whereas all threads are logically contained within a process.
- Processes are heavily weighted, whereas threads are light-weighted.
- A process can exist individually as it contains its own memory and other resources, whereas a thread cannot have its individual existence.
- A proper synchronization between processes is not required. In contrast, threads need to be synchronized in order to avoid unexpected scenarios.

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4.b)

	○ Processes can communicate with each other using inter-process communication only; in contrast, threads can directly communicate with each other as they share the same address space.	**2marks**

Faculty-Incharge

Course Coordinator **Module Coordinator** **IQAC** **Programme Coordinator**