PES University, Bengaluru

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UE19CS254

March 2021: IN SEMESTER ASSESSMENT B Tech IV SEMESTER

TEST – 1
Scheme and Solution
UE19CS254: Operating Systems

Time: 2Hr | Answer All Questions | Max Marks: 60

1. a) What is peer to peer computing? Name the applications of the peer-to-peer computing environment. **2**

Ans:

- P2P does not distinguish clients and servers. Instead, all nodes are considered peers Where each peer acts as client, server or both--------**1M**
- Examples include Napster and Gnutella, **Voice over IP** (**VoIP**) such as Skype -------**1M**

b) What are the services provided by the operating systems? **3**

Ans

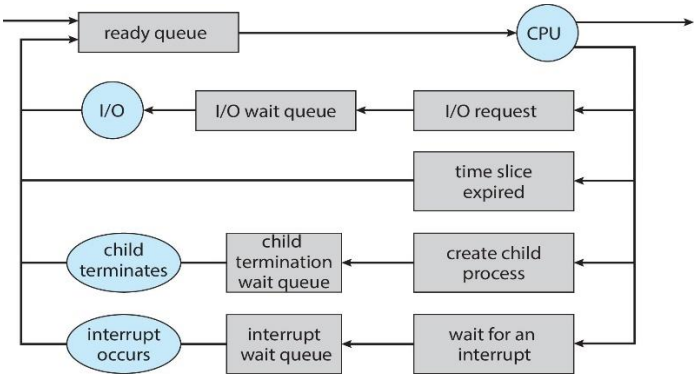
Services provided by OS are,

- **User interface** - Almost all operating systems have a user interface (**UI**).
  Varies between **Command-Line (CLI)**, **Graphics User Interface (GUI)**, **Batch**
  Program execution - The system must be able to load a program into memory and to run that program, end execution, either normally or abnormally (indicating error)
- **I/O operations** - A running program may require I/O, which may involve a file or an I/O device.
- **File-system manipulation** - The file system is of particular interest. Programs need to read and write files and directories, create and delete them, search them, list file Information, permission management.
- **Communications** – Processes may exchange information, on the same computer or between computers over a network
- Communications may be via shared memory or through message passing (packets moved by the OS)
- **Error detection** – OS needs to be constantly aware of possible errors.
- **Resource allocation** - When multiple users or multiple jobs running concurrently, resources must be allocated to each of them, types of resources are- CPU cycles, main memory, file storage, I/O devices.
- **Accounting** - To keep track of which users use how much and what kinds of computer resources

Any 3 services must be specified 1M each

c) Consider the set of 5 processes whose arrival time and burst time are given below- **5**

Process ID	Arrival time	Burst Time(ms)
P1	4	6
P2	2	4
P3	0	2
P4	3	3
P5	1	4

		i. Calculate the waiting time and average waiting for round Robin Scheduling algorithm (given time quantum= 3) P3 | P5 | P2 | P4 | P1 | P5 | P2 | P1 0 2 5 8 11 14 15 16 19 Waiting time for P1=16-3-4=9 Waiting time for P2=15-3-2=10 Waiting Time for P3=0 Waiting Time for P4=8-3=5 Waiting Time for P5=14-3-1=10 **Average waiting time=(9+10+0+5+10)/5=6.8ms----------(2+1)M** ii. What will be the number of context switches for process P5? (Exclude the context switches at the start of the process and at termination) **No.of context switches=2-------1/2M** iii. Does an increase in time quantum decrease the number of context switches? **Yes context switches are reduced--------1/2M** iv. List the processes in the ready queue after 11ms. Process in the ready queue: P5, P2, P1----------1M	
2.	a)	What are the possible conditions for the process to move from running state to ready state? A diagram depicting the same is required. Soln **Diagram—2M**  The process moves from running state to ready state when**,------2M** I process needs I/o II child process is created using fork() III time slice has expired (in case of RR scheduling) IV Process is interrupted	4
	b)	Why short-term scheduler executes at a higher frequency than long-term scheduler? The process executes for the few milliseconds before it goes for I/O. Context switch times is very less	2
	c)	An operating system uses Shortest Remaining Time First (SRTF) process scheduling algorithm. Consider the arrival times and execution times for the following processes: Process Execution time Arrival time P1 20 0 P2 25 15 P3 10 30 P4 15 45 i. What is the average waiting time for these processes?	4 (2+ 1+1)

Solution:

Gantt Chart:

P1	P2	P3	P2	P4
20	30	40	55	70

Waiting Time = Start Time - Arrival Time-execution time

i. Waiting time for P1=0

waiting time for P2=40-15-10=15

Waiting time for P3=30-30-0=0

Waiting time for P4=55-45-0=10

Average waiting time=(0+15+0+10)/4=6.25 time units----------1M

ii. No----------1M

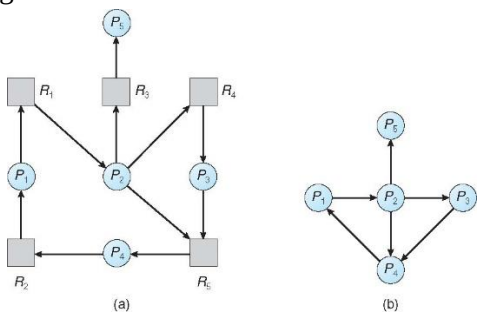
iii. Round Robin Scheduling algorithm----------1M

3.	a)	Why is it that threads are faster to create than processes? What are the benefits of threads? Threads are faster than process as they share parent processes address space.**—1M** Benefits of threads • **Responsiveness –** may allow continued execution if part of process is blocked or performing lengthy operations. • **Resource Sharing –** threads share resources of process, easier than shared memory or message passing. • **Economy –** cheaper than process creation, thread switching lower overhead than context switching. • **Scalability –** process can take advantage of multiprocessor architectures. Any 3 benefits specified—**3M**	4

	b)	Write Peterson's solution to the critical section problem.
		Ans
		do {
		flag[i] = true;---------1m
		turn = j;----------1m
		while (flag[j] && turn == j);--------1m
		/* critical section */
		flag[i] = false;----------1m
		/* remainder section */
		}while (true);
			4

	c)	List two programming examples of multithreading giving improved performance over a single-threaded solution. Ans • A Web server that services each request in a separate thread. • A parallelized application such as matrix multiplication where different parts of the matrix may be worked on in parallel. • An interactive GUI program such as a debugger where a thread is used to monitor user input, another thread represents the running application, and a third thread monitors performance.	2

4	a)	Does the following code satisfy the requirements for solution to critical section problem?
		while(true) {
		while(lock!=0);
		lock=1;
		Critical section
			4

		lock=0; Remainder section } If not, suggest the solution to critical section problem. **Ans**: Does not satisfy the requirements for critical section problem,----------1M Suggested solution Test and set must be atomic operation **boolean test_and_set (boolean *lock)-----3M** **{** **boolean rv = *lock;** ***lock = TRUE;** **return rv:** **}**	
	b)	What is the significance of wait-for graph and resource allocation graph? Give an example for each. **Solution** A **wait-for graph** is a directed graph used for deadlock detection in operating systems. IT is applicable for single instance resource type. **Resource allocation graph:** The resource allocation graph is a directed graph. the resource allocation graph gives the complete information about all the processes which are holding some resources or waiting for some resources  Resource-Allocation Graph wait for graph **2M each**	4
	c)	A counting semaphore S is initialized to 20. Then, 10 P operations and 6 V operations are performed on S. What is the final value of S? Ans: Final value of semaphore variable S = 20 – (10 x 1) + (6x 1) = 20 – 10 + 6 S=16---------2M	2
5	a)	Consider a program of size 26 bytes and a page size of 4 bytes. The physical address consists of 200 frames. The user program consists of 26 instructions a, b, c, . . . z. Assume the size of each instruction to be 1byte. Given a page table entry as shown below Page number | Frame number 0 | 7 1 | 26 2 | 52 3 | 20	5

4	55
5	6

Page table

i. What will be the number of pages for a given process?

No.of pages=26/4=6.5(7 pages)--------1M

ii. Find the physical addresses for the instructions a, e , i, o, u? **---2M**

PA for a=7x4+0=28

PA for e=26x4+0=104

PA for i=52x4+0=208

PA for o=20x4+2=82

PA for u=6x4+0=24

iii. Calculate the fragmentation if exists? **----1m**

Yes, internal fragment exists.

Size of fragment=4-2=2bytes

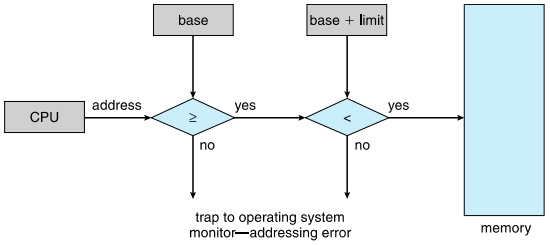
iv. Reference to which instruction causes page fault?**----------1m**

Reference to instruction y or z causes page fault

b) How are the processes protected from each other during their execution? 3

Ans:

Protection is provided by using two registers base and limit.—**1M**



The logical address generated bust be greater than or equal to base register content and it must be less than base+limit. ----2M

c) Consider the following segment table: 2

Segment #	Base address	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?

a. 0,430

Physical address for segment 0, byte 430=219+430=649

b. 1,10

Physical address for segment 1, byte 10=2300+10=2310

c. 2,500

Physical address for segment 2, byte 500 is invalid address

d. 3,400

Physical address for segment 3, byte 400=1327+400=1727

½ mark for each correct answer

6	a)	Consider the reference stream 1,4,3,4,2,1,5,6,2,1,2,3,7,6 for a particular process execution. How many page faults occur while using LRU page replacement algorithms with 4 frames? I. Calculate the number of page faults----------**2M** No.of page faults=9--------**1M** II. What are the data structures used to implement this algorithm?----**1M** Counter and stack is used in implementing LRU page replacement algorithm III. Does it suffer from Belady's anomaly? It does not suffer from Belady's anomaly **--1M**	5
	b)	What is the significance of valid-invalid bits of page table in paging and in demand paging? Paging: **Valid** indicates that the associated page is in the logical address space. **Invalid** indicates that the associated page is not in logical address space. Demand Paging: a bit 1 in **valid-invalid** bit signifies that the page is in memory and 0 signifies that the page may be invalid or haven't brought into the memory just yet. **1M each**	2
	c)	What is thrashing? What are the methods to prevent thrashing? Ans: Thrashing is a condition or a situation when the system is spending a major portion of its time in servicing the page faults, but the actual processing done is very negligible **--1M** Methods to prevent thrashing----**2M** 1. Working set model 2. Page-fault frequency	3

1	4	3	4	2	1	5	6	2	1	2	3	7	6
1	1	1	hit	1	hit	1	1	hit	hit	hit	1	1	6
	4	4		4		4	6				6	7	7
		3		3		5	5				3	3	3
				2		2	2				2	2	2