Question Number	Solution	Marks Allocated

Module-1

1. a) **Operating System:-** An operating system is system software that manages computer hardware, software resources, and provides common services for computer programs. [07 M]

Key concerns of an operating system:-

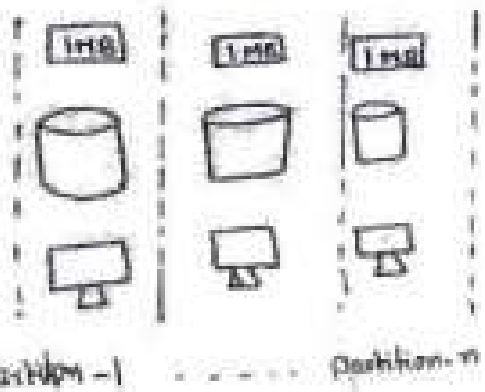
1. Programs : Initiation and termination of programs. Providing convenient methods so that several programs can work towards a common goal.
2. Resources : Ensuring availability of resources in the system and allocating them to programs.
3. Scheduling : Deciding when, and how long, to devote the CPU to a program.
4. Protection : Protect data and programs against interference from other users and their programs.

operating system definition = 1 mark

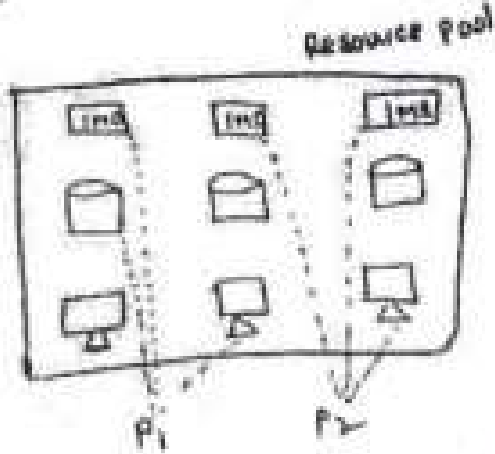
Key concern explanation each = 1.5 marks × 4 = 6 marks } 7M

1. b) **Resource Allocation strategies :-** [08 M]

i) Partitioning of resources :-
ii) Allocation from a pool :-



i) Resource partitioning.



ii) Pool based allocation

Subject Title : OPERATING System Subject Code : 17EC553

Question Number	Solution	Marks Allocated
	Resource sharing strategies:- i) Sequential sharing :- A resource is allocated for exclusive use by a program. ii) Concurrent sharing: Two or more programs can concurrently use the same resource. CPU sharing, Memory sharing, Disk sharing --- Resource allocation = 4 Marks Resource sharing = 4 Marks } 8 Marks.	
1. c)	**Common tasks performed by an operating system:-** i) Maintain a list of authorized users. ii) Construct a list of all resources in the system iii) Initiate execution of programs iv) Maintain resource usage information by programs and current status of all programs. v) Maintain current status of all resources and allocate resources to programs when requested vi) perform scheduling vii) Maintain information for protection viii) Handle requests made by users and their programs.	[05 M] ✓
2 a)	classes of operating system. OR i) Batch Processing ii) Multiprogramming iii) Time sharing iv) Real time v) Distributed. **Key features of classes of operating systems:-**	10 M ✓

OS class	period	Prime concern	key concepts
Batch Processing	1960s	CPU idle time	Spooling, command processor
Multi Programming	1970s	Resource utilization	Program priorities, Preemption.
Time sharing	1970s	Good response time	Time slice, R.R scheduling
Real time	1980s	Meet the deadline	Real time scheduling.
Distributed	1980s	Resource sharing	Transparency.

Brief explanation of class of O.S contains 1½ mark each.
1.5 x 5 = 7.5 Marks
writing Prime concern and key concepts = 2.5 Marks

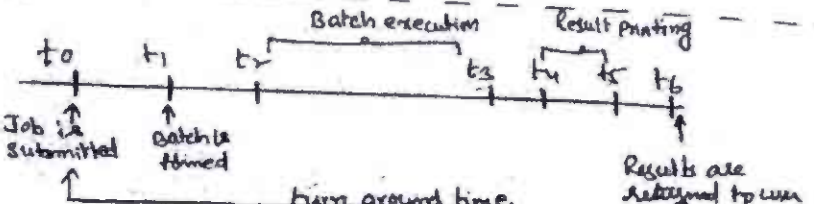
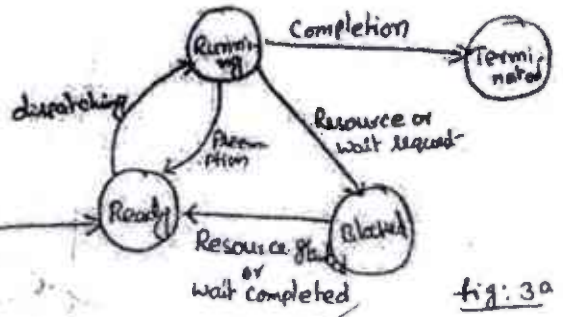
2. b)		06 M ✓

Diagram: 2 marks explanation fig: 2b

Subject Title : OPERATING SYSTEM (3) Subject Code : 17EC553

Question Number	Solution	Marks Allocated
2.c)	Computations in an OS :- i) Program ii) Job iii) Process iv) Subrequest. Brief explanation of each contains 1 mark. 1×4=4	04 M
	Module-2	
3.a)	Process :- A process is an execution of a program; it actully performs the actions specified in a program. An operating system considers processes as entities for Scheduling. Process states :- i) Running ii) Blocked iii) Ready iv) Terminated.  fig: 3a Process Definition – 1 Mark process states definition 1 Mark each = 1×4=4 Diagram with labelling – 2 marks, Explanation 3 marks.	10
3 b)	The Process control block (PCB) contains all information pertaining to a Process that is used in controlling its operation. PCB fields :- i) Process id ii) child and parent ids priority. iii) Process state iv) CPU registers v) event information vi) signal information vii) PCB pointer viii) PSW. should discuss any six of the above.	06M
3.c)	PROCESS: i) An instance of computer Program. ii) Heavyweight iii) Each has its own memory space iv) Requires more resources v) Difficult to create vi) In a multi-processing environment each process executes independently	THREAD: i) A component of a Process which is the smallest execution unit ii) Lightweight iii) Use the memory of Process they belongs to iv) Requires minimum resources. v) Easy to create. vi) A thread can read, write or modify data of another thread.	04M

Subject Title : OPERATING SYSTEM (Le) Subject Code : 17EC553

Question Number	Solution	Marks Allocated
4.a)	OR Performance of FCFS:	10 M

Time	FCFS				
	completed			Processes in system	scheduled
	id	ta	w		
0	-	-	-	{P1}	P1
3	P1	3	1.00	{P2, P3}	P2
6	P2	4	1.33	{P3, P4}	P3
8	P3	5	2.50	{P4}	P4
13	P4	8	1.60	{P5}	P5
16	P5	7	2.33	{ }	-

Ta = 5.40 seconds $\bar{w}$ = 1.75

Turnaround time (ta) = Time between submission of a job and its completion by system.

Weighted turnaround (w) = Ratio of the turnaround of own service time.

Performance of SRN:

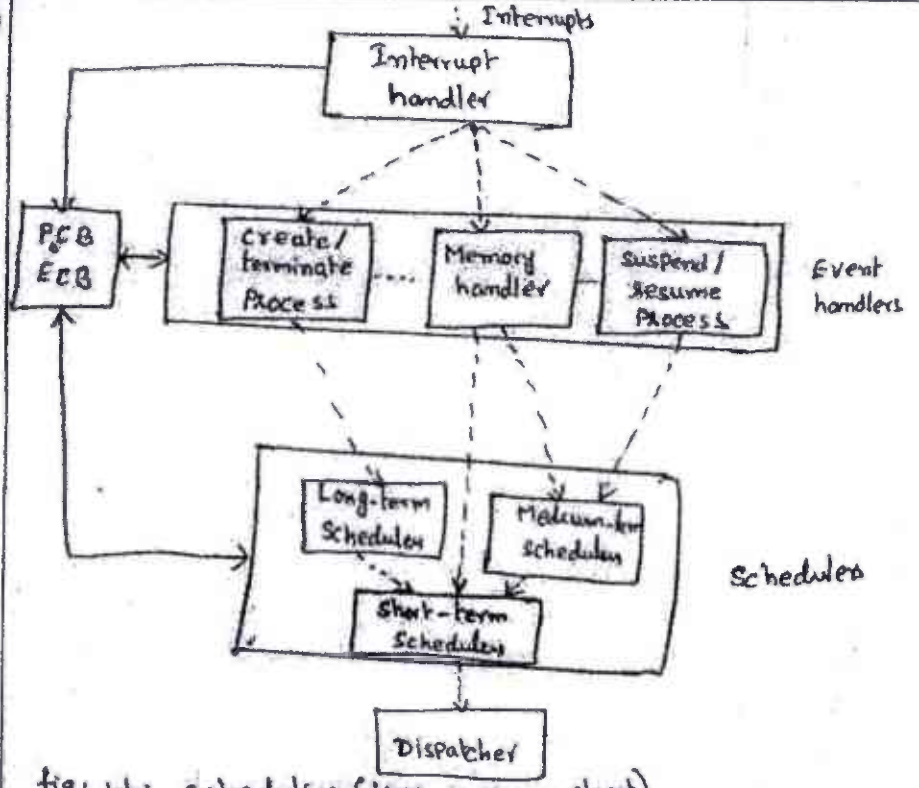
Time	SRN				
	id	ta	w	Process in system	scheduled
0	-	-	-	{P1}	P1
3	P1	3	1.00	{P2, P3}	P3
5	P3	2	1.00	{P2, P4}	P2
8	P2	6	2.00	{P4}	P4
13	P4	8	1.66	{P5}	P5
16	P5	7	2.33	{ }	-

Ta = 26/5 = 5.20 sec $\bar{w}$ = 7.99/5 = 1.58

The mean turnaround and weighted turnaround of SRN are better than in FCFS scheduling. The throughput is higher than in FCFS scheduling except at the end of the schedule, where it is identical.

Solution of FCFS contains – 4 Marks
solution of SRN " – 4 Marks
Performance Comparision – 2 Marks
} 10 marks

Subject Title : OPERATING SYSTEM (5) Subject Code : 17EC553

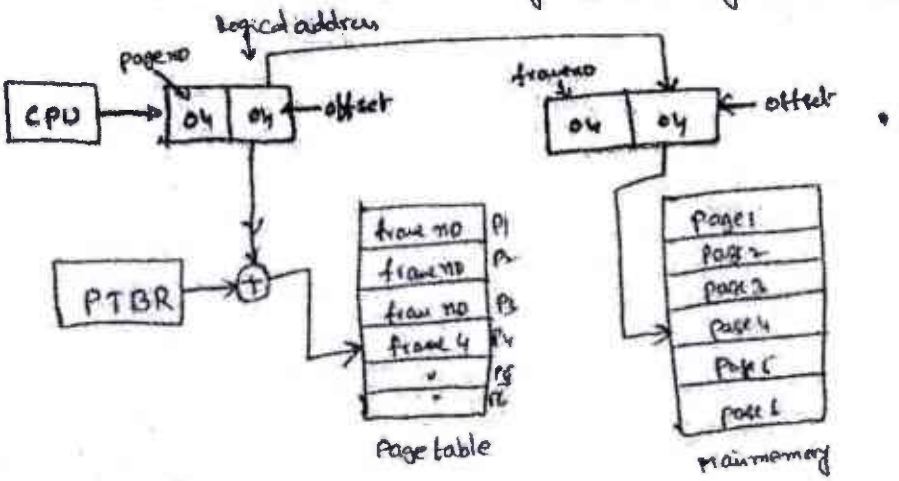
Question Number	Solution	Marks Allocated
4. b)	 fig: 4b: scheduling (long-medium, short) Diagram - 3 marks Explanation - 3 marks	06M
4. c)	Comparision Preemptive and non-Preemptive scheduling algorithm	04M

Preemptive scheduling	Non-Preemptive scheduling.
1. It can be Preempted that is Process can be scheduled.	1. Process cannot be preempted.
2. It is flexible.	2. It is rigid.
3. In this, the Process with higher Priorities are executed first.	3. In this, once the CPU has been allocated to a process, the process keeps the CPU until it releases.
4. windows-95 used	4. windows 3.x used.

Module - 3

5. a)	Memory fragmentation is the existence of unusable areas in the memory of a Computer system. - Internal fragmentation occurs if a process is allocated more memory than it needs. - External fragmentation occurs if a memory area remains unused because it cannot be allocated. Eg:- Pi requires 2KB  internal fragmentation.	[12M]

Subject Title : OPERATING SYSTEM Subject Code : 17EC553

Question Number	Solution	Marks Allocated
	ii) Paging and segmentation:- Paging is a fixed-sized block, The hardware decides the page size. Segmentation:- is of variable size, The segmentation is specified by the user. iii) Logical address and physical address: Logical address is generated by CPU in perspective of a program. The physical address is a location that exists in the memory unit. iv) Page and page frame:- A page is fixed-length contiguous block of virtual memory. A page-frame is a fixed-length block of RAM. Each part contains 3 marks 3x4=12	
5. b.	Address translation in non-contiguous memory allocation.  fig: 5b Diagram contains 3 marks and explanation 5 marks.	[8M]
	OR	
6. a)	On demand paging, a page is loaded in memory when needed. Demand paging concepts: 1. Page faults 2) Page-in and Page-out operations 3) Page replacement. Page fault:- while performing address translation for a logical address, the MMU checks the valid bit of the page entry. If it indicates that page is not present in memory, The MMU raises an interrupt called a page fault	[12M]

Subject Title : OPERATING SYSTEM Subject Code : 17EC553

Question Number	Solution	Marks Allocated

Page-in:- A page is loaded in memory when a page fault occurs for it. This is called page-in.

Page-out:- If page being removed had been modified after it was last loaded in memory, such a page needs to be copied from the memory to the disk block allocated to it in the swap-space of the process. This operation is called a page out operation.

Page replacement:- Page replacement becomes necessary when a page fault occurs and no free page frame exist in memory.

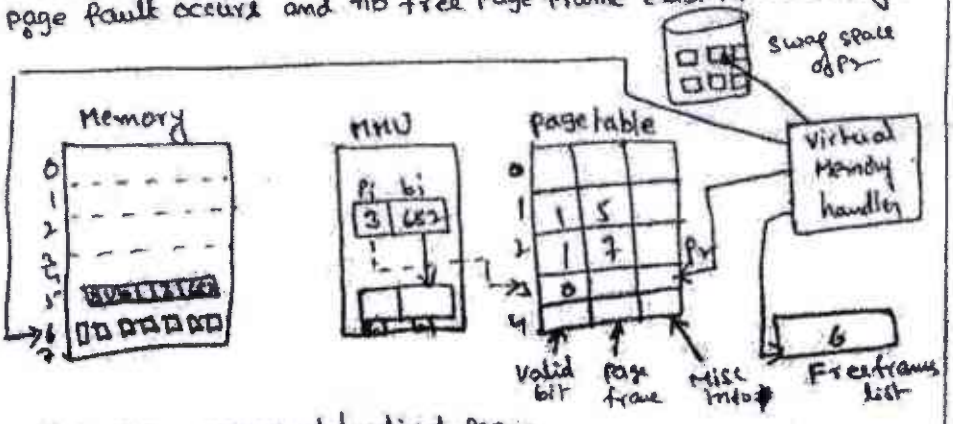


fig: 6a: Demand loading of pages.

Diagram contains 3 marks and each concept contains 3 marks. 3+3x3=12

[08]

6.b) **FIFO:-** Frames = 3

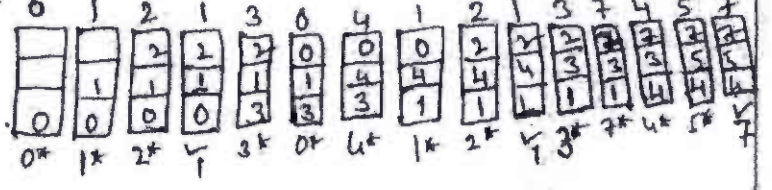
Page Reference: 0 1 2 1 3 0 4 1 2 1 3 7 4 5 7

Page fault = 11

Page fault ratio = 12/15 = 0.80

LRU:- Least Recently used:-

Reference string:-



Page faults = 11

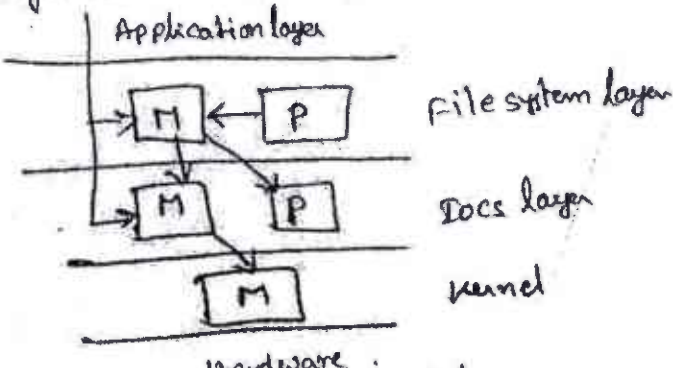
Page hits = 3

Page fault Ratio = 12/15 = 0.80.

Subject Title : OPERATING SYSTEM (8) Subject Code : 17EC553

Question Number	Solution	Marks Allocated
7. a)	Module – 4 File system :- The file system provides that enable a user to create files, assign meaningful names, manipulate them, and specify how they are to be shared with other users of the system. IOCS :- The Input output control system implements efficient organization and access of data in files.	[08 M]

fig : 7a.1 Layer structure of file system and IOCS.



M : Mechanism module P : Policy module.

fig : 7a.2 Logical organization in file system.

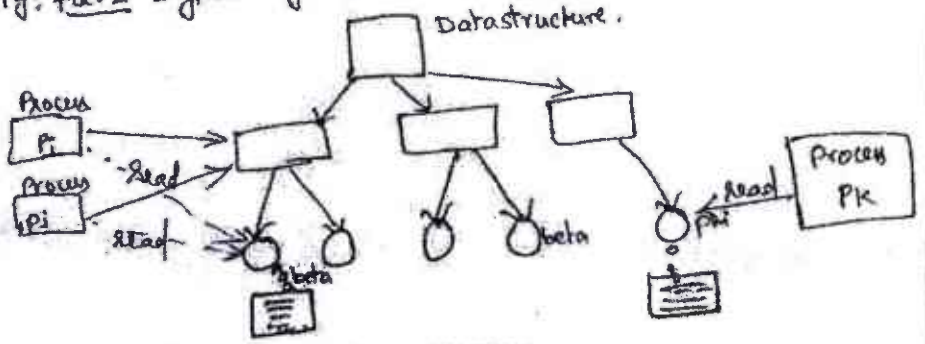
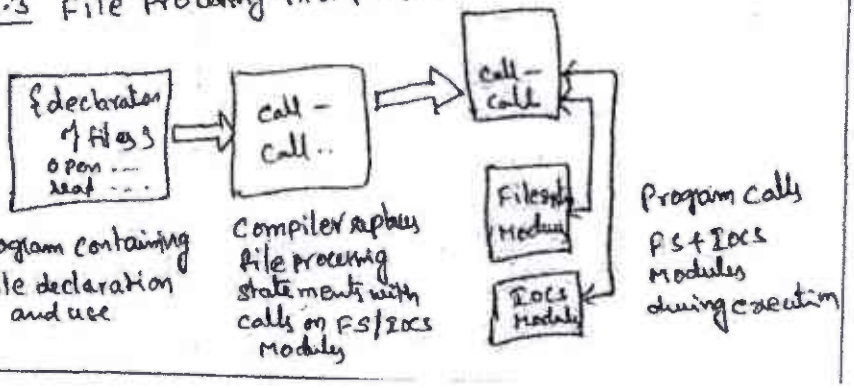
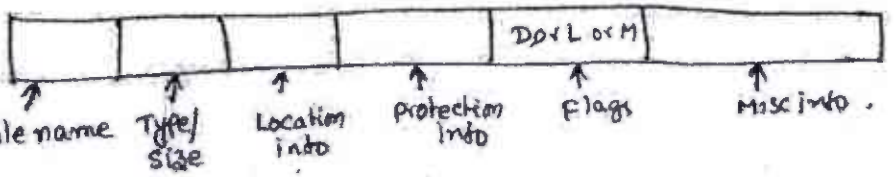


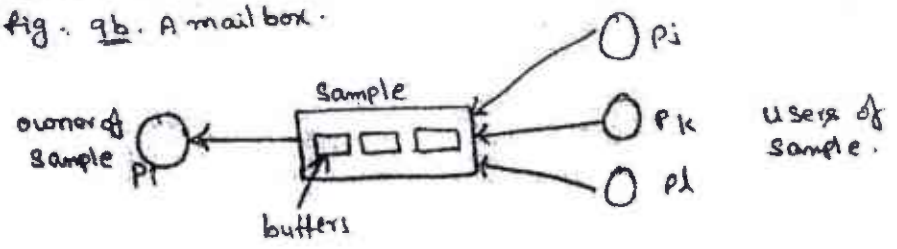
fig : 7a.3 File Processing in a program



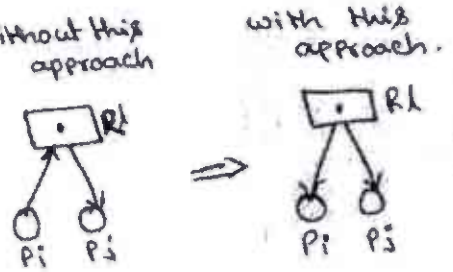
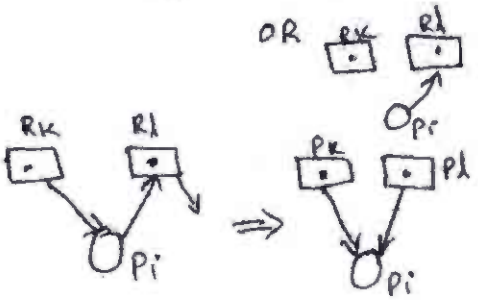
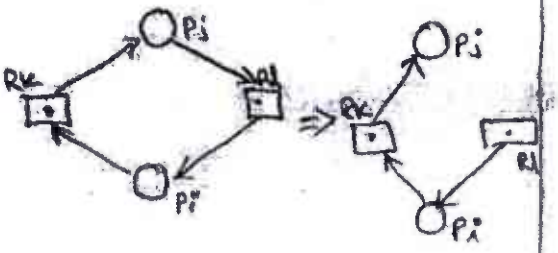
Subject Title : OPERATING SYSTEM (9) Subject Code : 17EC553

Question Number	Solution	Marks Allocated
7. b.	Allocation of disk space to files has several methods. i) contiguous allocation ii) linked allocation iii) FAT iv) Indexed allocation v) clustering vi) Linked Indexed allocation vii) Multilevel Indexed allocation viii) Inode. explain any 3 allocation methods with advantages and disadvantages of them. 3 x 4 = 12 Marks.	[12 M]
8. a)	Directory:- A directory contains information about a group of related files. OR each entry in it contains information concerning one file - location, type, the manner in which it may accessed. Directory entry:-  Directory structures:- i) Single - level directory ii) Two-level directory. iii) Tree structured directories. Directory definition - 1 Mark Directory entries - 2 Marks. Directory structures each 3 Marks. 1+2+3x3 = 12	[12 M]
8. b)	File system actions at close:- The file system performs the following actions. 1. If the file has been newly created or updated. a) If a newly created file, use directory FCB pointer to locate the FCB of the directory. Create an entry for the file in this directory. b) If the file has been updated and its size has changed, the directory entry of the file is updated using directory FCB pointer. c) If necessary, repeat 1(b) - 1(c) to update other directories in the path name after setting file FCB pointer = directory FCB pointer. 2. The FCB of the file and FCB's of its parents and ancestor directories are erased from the AFT.	[8M]

Subject Title : OPERATING System (10) Subject Code : 17EC553

Question Number	Solution	Marks Allocated
9.a)	i) Module-5 issues in message passing:- • Naming of processes • Methods for transferring messages • Kernel responsibilities. ii) Direct and indirect naming:. In direct naming, sender and receiver processes mention each other's names using the following syntax: send (<destination_Processes), <message>); receive (<source_Proces>, <message-area>); In indirect naming, process do not mention each other's names in Send and receive statements. iii) Blocking and non-blocking sends:. A blocking send blocks a sender process till the message being sent is delivered to the destination. A non-blocking send permits a sender to continue execution after executing a send irrespective of whether the message is delivered immediately. each part explanation Contains 4 marks.	[12M]
9.b)	A mailbox is a repository for interprocess messages. It has a unique identity. The owner of a mail box is typically the process that created it. only the owner process can receives messages from a mailbox. Any Process that knows the identity of a mail box can send messages to it. We will call these processes the users of a mailbox. fig. 9b. A mail box.  Advantages of mailbox:- i) Anonymity of receiver ii) classification of messages. Mailbox explanation – 5 marks Advatages Explanation – 3 marks.	[08M]

Subject Title : OPERATING SYSTEM (11) Subject Code : 17EC553

Question Number	Solution	Marks Allocated
10.a)	**Dead-lock Prevention approaches:-** Deadlocks can be prevented if the Kernel uses a resource allocation policy that ensures that one of these conditions cannot arise. **Conditions:-** Resources are non-sharable Hold and wait No preemption Circular waits. **Approaches:-** i) Make resources sharable • Process Pi does not get blocked on resources Rl  ii) Prevent Hold-and-waits → No paths with >1 process  iii) Make resources preemptive → No circular paths  iv) Prevent circular waits  Explaining Each approach contains 2½ marks. 2.½ x 4 = 10 marks.	[10 M]

Subject Title : OPERATING SYSTEM (12) Subject Code : 17EC553

Question Number	Solution	Marks Allocated

10.b) A system has four processes P1 – P4, and 5, 7 and 5 units of resource classes R1, R2 and R3, respectively.

i) Initial state

	R1	R2	R3
P1	2	1	0
P2	1	3	1
P3	1	1	1
P4	1	2	2

Allocated Resources

	R1	R2	R3
P1	2	1	3
P2	1	4	0
P3	0	0	0
P4	1	0	2

Requested Resources

Free Resources

R1	R2	R3
0	0	1

ii) After simulating allocation of resources to P4 when process P3 completes.

	R1	R2	R3
P1	2	1	0
P2	1	3	1
P3	0	0	0
P4	2	2	4

Allocated Resources

	R1	R2	R3
P1	2	1	3
P2	1	4	0
P3	-	-	-
P4	-	-	-

Requested Resources

Free resources.

R1	R2	R3
0	1	0

iii) After simulating allocation of resources to P1 when process P4 is completes.

	R1	R2	R3
P1	4	2	3
P2	1	3	1
P3	0	0	0
P4	0	0	0

Allocated Resources

	R1	R2	R3
P1	-	-	-
P2	1	4	0
P3	-	-	-
P4	-	-	-

Free Resources

R1	R2	R3
0	2	1

Subject Title : OPERATING SYSTEM Subject Code : 17EC553

Question Number	Solution	Marks Allocated
	(d) After simulating allocation of resources to P_2 when process P_1 completes.	[10M]

	R_1	R_2	R_3
P_1	0	0	0
P_2	2	7	1
P_3	0	0	0
P_4	0	0	0

Allocated Resources

	R_1	R_2	R_3
P_1	-	-	-
P_2	-	-	-
P_3	-	-	-
P_4	-	-	-

Requested Resources

Free Resources

R_1	R_2	R_3
3	0	4

Explanation:- Inputs to it are the sets Blocked and Running initialized to $\{P_1, P_2, P_4\}$ and $\{P_3\}$,

The algorithm transfers process P_3 to the set Finished and frees the resources allocated to it.

The no of free units of the resource classes is now 1, 1, 2.

The algorithm finds that process P_4's pending request can now be satisfied, so it allocates the resources requested by P_4 and transfers P_4 to the set running, and set finished. After freeing P_4's resources, the algorithm finds P_1's resource request can be satisfied and after P_1 completes, P_2's resource request can be satisfied.

∴ The set Running is now empty so the algorithm completes.

A deadlock does not exist in the above system because the set blocked is empty.