OR iv. Write short note on: **5**
(a) Demand Paging
(b) Virtual memory

Q.6 i. Describe at least two file operations. **4**

ii. Discuss in detail any two free space management schemes. **6**

OR iii. Explain following disk scheduling algorithms: **6**
(a) SSTF (b) SCAN (c) C-SCAN

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem Examination May-2023

CS3CO36 / CS3CO09 Operating Systems

Programme: B.Tech. Branch/Specialisation: CSE /All

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. To avoid the race condition, the number of processes that may be simultaneously inside their critical section is- **1**
(a) 0 (b) 1 (c) 2 (d) Any number of processes

ii. In the non-blocking send _____. **1**
(a) The sending process keeps sending until the message is received
(b) The sending process sends the message and resumes operation
(c) The sending process keeps sending until it receives a message
(d) None of these

iii. An edge from process Pi to Pj in a wait for graph indicates that? **1**
(a) Pi is waiting for Pj to release a resource that Pi needs
(b) Pj is waiting for Pi to release a resource that Pj needs
(c) Pi is waiting for Pj to leave the system
(d) Pj is waiting for Pi to leave the system

iv. What is dispatch latency? **1**
(a) The time taken by the dispatcher to stop one process & start another
(b) The time taken by the processor to write a file into disk
(c) The whole time taken by all processor
(d) None of these

v. If the size of logical address space is 2 to the power of m, and a page size is 2 to the power of n addressing units, then the high order _____ bits of a logical address designate the page number, and the _____ low order bits designate the page offset. **1**
(a) m, n (b) n, m
(c) m – n, m (d) m – n, n

vi. Physical memory is broken into fixed-sized blocks called? **1**
(a) Frames (b) Pages
(c) Backing store (d) None of these

vii. A process is thrashing if _____. **1**
(a) It spends a lot of time executing, rather than paging
(b) It spends a lot of time paging than executing
(c) It has no memory allocated to it
(d) None of these

viii. Applying the LRU page replacement to the following reference string. **1**
1 2 4 5 2 1 2 4
The main memory can accommodate 3 pages and it already has pages 1 and 2. Page 1 came in before page 2.
How many page faults will occur?
(a) 2 (b) 3 (c) 4 (d) 5

ix. The heads of the magnetic disk are attached to a _____ that moves all the heads as a unit. **1**
(a) Spindle (b) Disk arm (c) Track (d) None of these

x. To create a file _____. **1**
(a) Allocate the space in file system
(b) Make an entry for new file in directory
(c) Allocate the space in file system & make an entry for new file in directory
(d) None of these

Q.2 i. Write the difference between process and thread. **2**
ii. Explain any three types of operating system. **3**
iii. Describe Inter-process communication along with its two models. **5**
OR iv. Write short note on: **5**
(a) Critical section (b) Operations on processes

Q.3 i. What is deadlock? Explain different conditions of deadlock. **4**
ii. Consider a system with three processes and three resource types and at time to the following snapshot of the system has been taken: **6**

Process	Allocated			Maximum			Available		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
P1	2	2	3	3	6	8	7	7	10
P2	2	0	3	4	3	3			
P3	1	2	4	3	4	4			

(a) Is the current allocation a safe state? Deduce safe sequence using Banker's Algorithm.
(b) Would the request (1,0,0) be granted for process P2?

OR iii. Assume you have the following jobs to execute with one processor, with the jobs arriving in the order listed here: **6**

Process	Arrival time	Burst Time(ms)
P1	0	80
P2	10	20
P3	10	10
P4	80	20
P5	85	50

Suppose a system uses RR scheduling with a quantum of 15 (ms).
(a) Create a Gantt chart illustrating the execution of these processes.
(b) What is the turnaround time for process P3?
(c) What is the average waiting time for the processes?

Q. 4 i. Define external and internal fragmentation with neat and clean diagram. **3**
ii. Explain Paging and Solve Logical address space =128KB, Physical address space =512KB, and page size =16KB, **7**
Calculate:
(a) Number of Bits for Logical Address (LA)
(b) Number of Bits for Physical Address (PA)
(c) Number of Pages in LAS or process
(d) Number of Frames in main memory or PAS
(e) Page Table size
OR iii. Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order) in fixed size partitioning? **7**

Q.5 i. Define Thrashing with diagram. **2**
ii. Explain the role of operating system in Security. **3**
iii. Given page reference string: **5**
1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6
Compare the number of page faults for LRU, FIFO and Optimal page replacement algorithm.

P.T.O.

Scheme of Marking

MEDI-CAPS UNIVERSITY Knowledge is Power	Faculty of Engineering End Sem Examination (Even) May-2023 Operating Systems - CS3CO36
Programme: B.Tech.	Branch/Specialisation:

Note: The Paper Setter should provide the answer wise splitting of the marks in the scheme below.

Q.1	i)	To avoid the race condition, the number of processes that may be simultaneously inside their critical section is? **b) 1**	1
	ii)	In the non blocking send _____ **b) the sending process sends the message and resumes operation**	1
	iii)	An edge from process Pi to Pj in a wait for graph indicates that? **a) Pi is waiting for Pj to release a resource that Pi needs**	1
	iv)	What is dispatch latency? **a) The time taken by the dispatcher to stop one process and start another**	1
	v)	Physical memory is broken into fixed-sized blocks called? **a) frames**	1
	vi)	If the size of logical address space is 2 to the power of m, and a page size is 2 to the power of n addressing units, then the high order _____ bits of a logical address designate the page number, and the _____ low order bits designate the page offset. **d) m – n, n**	1
	vii)	A process is thrashing if _____ **b) it spends a lot of time paging than executing**	1
	viii)	Applying the LRU page replacement to the following reference string. 1 2 4 5 2 1 2 4 The main memory can accommodate 3 pages and it already has pages 1 and 2. Page 1 came in before page 2. How many page faults will occur? b) 3 c) 4.	1
	ix)	[illegible] heads of the magnetic disk are attached to a _____ that moves all the heads as a unit. **b) disk arm**	1
	x)	To create a file _____ **c) allocate the space in file system & make an entry for new file in directory**	1
Q.2	i.	Write the difference between Process and Thread. **(1 mark each)**	2
	ii.	Explain any 3 types of Operating System. **(1 mark each)**	3
	iii.	Describe Inter-process communication **(2 marks)** along with its two models. **(1.5 marks each model)**	5
OR	iv.	Write short note on: a) Critical Section **(2.5 marks each)** b) Operations on processes **(2.5 marks each)**	5
Q.3	i.	What is deadlock? **(2 marks)** Explain different conditions of deadlock. **(2 marks)**	4
	ii.	Consider a system with three processes and three resource types and at time to the following snapshot of the system has been taken:	6

Process	Allocated			Maximum			Available		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
P1	2	2	3	3	6	8	7	7	10
P2	2	0	3	4	3	3			
P3	1	2	4	3	4	4			

(solution with calculation 2 marks)
(a) Is the current allocation a safe state? Deduce safe sequence using Banker's Algorithm. **(2 marks)**
(b)Would the request (1,0,0) be granted for process P2? **(2 marks)**

OR	iii.	Assume you have the following jobs to execute with one processor, with the jobs arriving in the order listed here:	6

Process	Arrival time	Burst Time(ms)
P1	0	80
P2	10	20
P3	10	10
P4	80	20
P5	85	50

Suppose a system uses RR scheduling with a quantum of 15 (ms).
(a) Create a Gantt chart illustrating the execution of these

1	2	4	5	2	1	2	4	
1	1	1	5	5	5	5	4	

		processes. **(2 marks)** (b) What is the turnaround time for process P3? **(2 marks)** (c) What is the average waiting time for the processes? **(2 marks)**	
Q. 4	i.	Define external **(1 marks)** and internal fragmentation **(1 marks)** with neat and clean diagram. **(1 marks)**	3
	ii.	Explain Paging and **(2 marks)** Solve Logical address space =128KB, Physical address space =512KB, and page size =16KB, Calculate: a) Number of Bits for Logical Address (LA). **(1 marks)** b) Number of Bits for Physical Address (PA). **(1 marks)** c) Number of Pages in LAS or process. **(1 marks)** d) Number of Frames in main memory or PAS. **(1 marks)** e) Page Table size. **(1 marks)**	7
	iii.	Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order) in fixed size partitioning? **(First Fit 2 marks), (Best Fit 2 marks), (Worst Fit 2 marks), (Show unallocated processes 1 marks)**	7
Q.5	i.	Define Thrashing with diagram. **(explanation 1 marks, diagram 1 mark)**	2
	ii.	Explain the role of operating system in Security. **(3 marks)**	3
	iii.	Given page reference string: 1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6 Compare the number of page faults for LRU, FIFO and Optimal page replacement algorithm. **(5 marks)**	5
OR	iv.	Write short note on: c) Demand Paging **(2.5 marks each)** d) Virtual memory **(2.5 marks each)**	5
Q.6	i.	Describe at least two file operations. **(2 marks each)**	4
	ii.	Discuss in detail any two free space management schemes. **(3 marks each)**	6
OR	iii.	Explain following disk scheduling algorithms: (a) SSTF (b) SCAN (c) C-SCAN **(2 marks each)**	6

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Q-5 (iii)

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6

Frame - 3

~~LRU~~ FIFO

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
	1	1	1	1	1	1	5	5	5	1	1	1	7	7	7	7	1	1	1	1
		2	2	2	2	2	2	6	6	6	2	2	2	6	6	6	6	6	3	3
			3	3	3	3	3	3	2	2	3	3	3	3	3	2	2	2	2	6
	*	*	*	*		*	*	*	*	*		*	*	*		*	*		*	*

Page fault = ~~15~~ 16

LRU

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	6	6	6	6	3	3	3	3	3	3	3	3	3
			3	3	3	3	5	5	5	1	1	2	2	6	6	6	1	1	1	6
	*	*	*	*		*	*	*	*	*		*	*	*		*	*		*	

Page fault = 15

Optimal

	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			3	4	4	4	5	6	6	6	6	6	6	6	3	3	3	3	3	6
	*	*	*	*		*	*	*					*		*					*

Page fault = 9

Q-5 (iii) 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.

Frames = 04

FIFO

1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
			4	4	4	4	4	4	1	1	1	1	1	1	2	2	2	2	2
		3	3	3	3	3	2	2	2	2	2	6	6	6	6	6	6	6	
	2	2	2	2	2	6	6	6	6	6	7	7	7	7	7	7	3	3	
1	1	1	1	1	1	5	5	5	5	5	3	3	3	3	3	1	1	1	1
*	*	*	*			*	*	*	*		*	*	*		*	*		*	

Page fault - 14 ✓

LRU

1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
			4	4	4	4	6	5	5	5	5	7	7	7	7	1	1	1	1
		3	3	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
1	1	1	1	1	1	1	1	1	1	1	1	1	6	6	6	6	6	6	6
*	*	*	*			*	*					*	*			*			

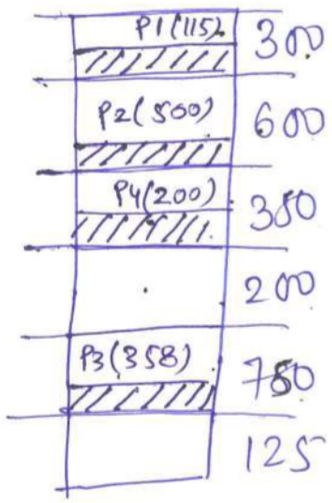
Page fault - 09. ✓

Optimal

1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
			4	4	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
*	*	*	*			*	*					*				*			

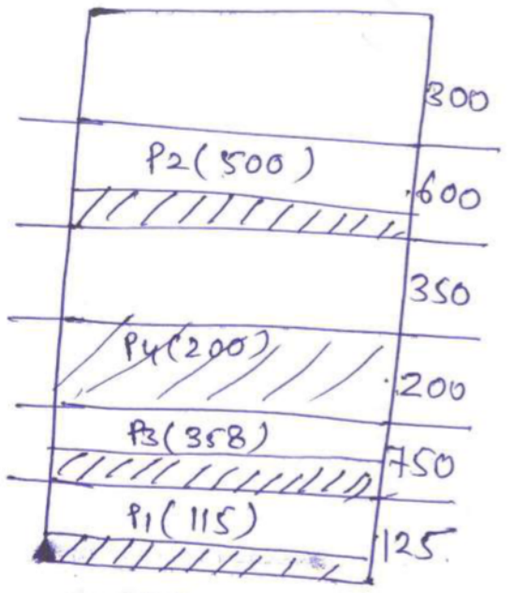
Page fault - 09 ✓

Q.4(iii) $P_1 = 115$, $P_2 = 500$, $P_3 = 358$, $P_4 = 200$ $P_5 = 375$



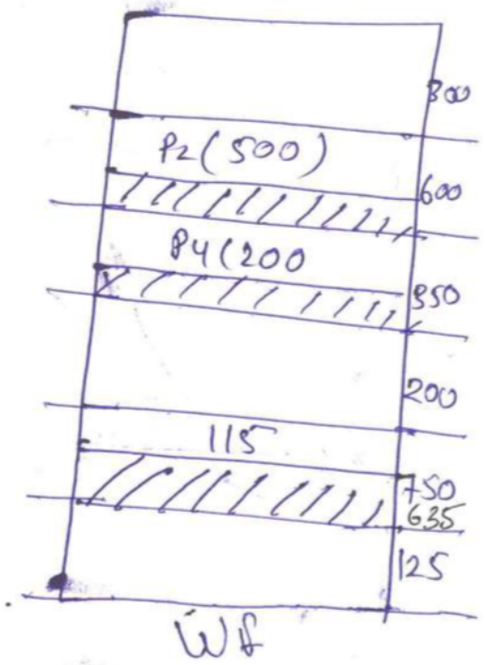
Ff

$P5 = 375$ (waiting)



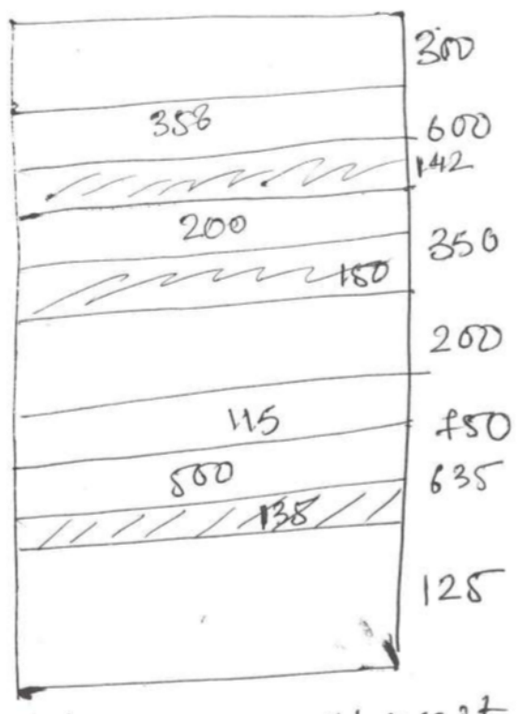
Bf.

$P5 = 375$ (waiting)
Unallocated



Wf

$P3 = 358$ (unallocated)
$P5 = 375$ (unallocated)



375 will wait

Q.3(iii)

	Allocation			Maximum			Available		
P_1	2	2	3	3	6	8	7	7	10
P_2	2	0	3	4	3	3			
P_3	1	2	4	3	4	4			

(1)

need = max - Allocation

$P_1 = (3\ 6\ 8) - (2\ 2\ 3)$

$P_2 = (4\ 3\ 3) - (2\ 0\ 3)$

$P_3 = (3\ 4\ 4) - (1\ 2\ 4)$

	need
P_1	1 4 5
P_2	2 3 0
P_3	2 2 0

(1,3,0)
(1 0 0)

for process — need (1 4 5) (7 7 10)

$P_1 = (1\ 4\ 5) \leq (7\ 7\ 10)$

(True).

If need ≤ available (True).

Check new A0.

if need ≥ available (false)

Break. | SO system will move for next process.

new Available = old Available + Allocation of P_1

$= (7\ 7\ 10) + (2\ 2\ 3)$

$= (9\ 9\ 13)$.

for process P_2 — need (2 3 0)

Available (9 9 13)

need ≤ Available (true)

$(2\ 3\ 0) \leq (9\ 9\ 13)$

new Available = old Available + Allocation of P_2

$(9\ 9\ 13) + (2\ 0\ 3)$

for Process P_3 → need = (2 2 0)

Available = (11 9 16)

need ≤ available (true)

(2 2 0) ≤ (11 9 16)

new available = old Available + allocation of P_3

= (11 9 16) + (1 2 4)

= (12 11 20)

(a) Yes This current allocation is safe state

Safe Sequence = (P_1 P_2 P_3)

(b) request (1,0,0) ≤ (1,3,0)

Available (7 7 10)

request ≤ 7 7 10 (Available) { request ≤ Available (True).

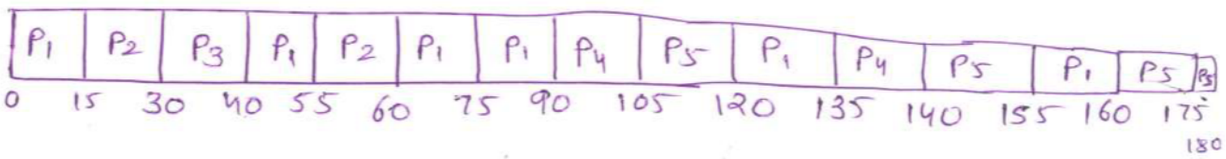
So request (1,0,0) will be granted for P_2.

1. req. < available.
2. req. < need.
3. Safe sequence. } req granted

Ready Queue - | P_1 | P_2 | ~~P_3~~ | P_1 | ~~P_2~~ | P_1 | P_4 | P_5 | P_1 |

Q.3
iii)

a)



$P_1 = \overset{①}{80} - \overset{②}{15} = 65 - \overset{③}{15} = 50 - \overset{④}{15} = 35 - \overset{⑤}{15} = 20 - \overset{⑥}{15} = 5 - 5 = 0$

$P_2 = 20 - 15 = 5 - 5 = 0$

$P_3 = 10$

$P_4 = 20 - 15 = 5 - 5 = 0$

$P_5 = 50 - 15 = 35 - 15 = 20$

b) TAT. P_3 = completion time - Arrival time

= 40 - 10

= 30

c) waiting time = P_1 = TAT - B.T.

$P_1 = 160 - 80 = 80$

$P_2 = 50 - 20 = 30$

$P_3 = 30 - 10 = 20$

$P_4 = 60 - 20 = 40$

$P_5 = 95 - 50 = 45$

$\frac{215}{5} = 43$

TAT

$P_1 = 160 - 0 = 160$

$P_2 = 60 - 10 = 50$

$P_3 = 40 - 10 = 30$

$P_4 = 140 - 80 = 60$

$P_5 = 180 - 85 = 95$

Q4, ii) given: LAS = 128 KB ; PAS = 512 KB, Pg Size = 16 KB

a) Ans:- LAS = 128 KB

$= 2^7 \times 2^{10}$ B

$= 2^{17}$ B

∴ LAS = 17 Bits

(b) Ans:- PAS = 512 KB

$= 2^9 \times 2^{10}$ B

$= 2^{19}$

∴ PA = 19 Bits

(c) No. of pages = $\frac{\text{Size of process (LAS)}}{\text{Pg Size}}$

$= \frac{2^{17}}{2^{14}} = 2^{17-14} = 2^3$

∴ No. of Pages = 2^3 = 8 pages

(d) No. of frames = $\frac{\text{Size of main Memory (PAS)}}{\text{frame Size}}$

$= \frac{2^{19}}{2^{14}} = 2^{19-14} = 2^5$

∴ No. of frames = 2^5 = 32 frames

(e) Page table Size = No. of entries Pg table X ~~Bits in one frame~~

∴ No. of entries in Pg table = No. of pages in a process

$? = 2^3$

∴ No. of entries in pg table = 2^3

$2^3 \times ?$; 5. bits to represent no. of frames.

2^{14} → 14 Bits

frame size = 2^{14}

$\therefore$ Size of pg table = $2^3 \times 14$

Size of page table = no. of pages × page entry size

$2^3 \times 5$

$= 40$