(9)

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1565 **G**

Unique Paper Code : 2342012302

Name of the Paper : Operating Systems

Name of the Course : **B.Sc. (H) (Computer Science)**

Semester : III

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1 (Section-A)** is compulsory.
3. Attempt any **four** questions from **Section-B**.
4. Parts of a question should be attempted together.

(Section A)

1. (a) Briefly explain how an operating system provides efficiency to the system and convenience to the end user. (2)

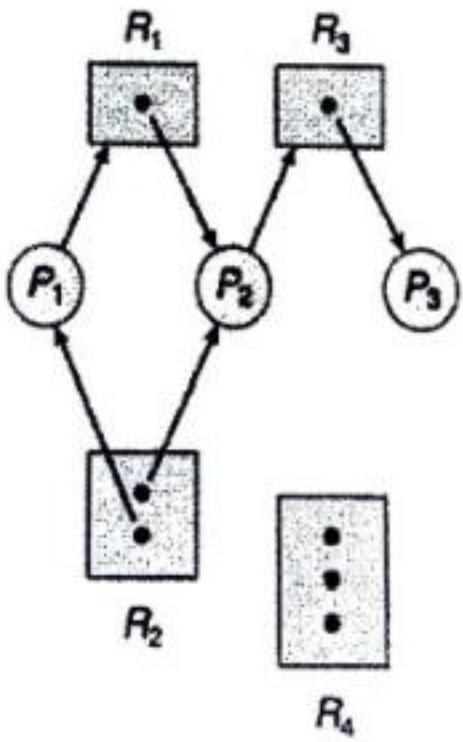
P.T.O.

(b) A bit, called the _____ bit, is added to the hardware of the computer to indicate the current mode: _____ (0) or _____ (1). (2)

(c) For a given set of I/O requests, argue that C-LOOK algorithm will perform more efficiently than LOOK algorithm. (2)

(d) List any two forms of user interface for an operating system? (2)

(e) Consider the following resource allocation graph



Identify the following :

(i) Processes

(ii) Resources

(ii) ssignment and Request edges (3)

(f) Give any three differences between paging and segmentation schemes of memory management. (3)

(g) Consider following statements executing processes P1 and P2:

P1 : counter++

P2 : counter– –

(Assume that Initial value of counter=10.)

Discuss the problem that can occur due to race condition in concurrent execution of these processes? (3)

(h) What is the Belady's anomaly in context of FIFO page replacement algorithm? (3)

(i) Consider a file "f1.txt" in Unix system with permission bits 072 (in 3 octal system). For this file, find the access permissions allowed for owner, group and others. (3)

(j) What will be the output of the given code segment? Briefly give reasons for your answer. (3)

```
int q = fork();
if (q == 0)
    cout<< "\n Inside the child";
else
 {
    wait (NULL);
    cout<< "\n Inside the parent";
}
```

(k) Differentiate between the following : (2+2)

(i) Data Parallelism and Task Parallelism

(ii) Turnaround Time and Waiting Time

(Section B)

2. (a) Under what condition will a child process become an orphan process? What is the role of init() process in the life cycle of an orphan process? (2+2)

(b) Give any two reasons due to which a parent process may terminate the execution of one of its child processes? Explain the phenomenon of cascading termination with respect to parent and child processes. Under what condition(s) will a terminated child process be known as a zombie process. (2+2+1)

(c) Consider the following page reference string

3 0 1 7 5 7 6 4 7 2 2 7 0

Assume that three frames are available. All frames are initially empty. How many page faults would occur for the following algorithms? Show the steps.

(i) FCFS page replacement algorithm

(ii) Optimal page replacement algorithm

(3+3)

3. (a) Mention any one limitation each of Monolithic and Microkernel approaches of Operating System design? How can the modular approach overcome each of these limitations? (2+2)

(b) Consider the following segment table :

Segment	Base	Length
0	250	100
1	350	40
2	1345	350
3	1673	600

What are the physical addresses corresponding to the following logical addresses?

(i) 0, 120

(ii) 1, 25

(iii) 2, 140

(iv) 3, 329 (4)

(c) Suppose there is a system with 128KB of memory with no memory initially allocated. Given the following sequence of requests by the processes, show the memory layout at intermediate stages that is, after allocation/deallocation of memory for each process. Assume that the system uses a best-fit allocation algorithm. (7)

Process Number	Nature of Request	Amount of memo requested (in KB)
P0	Allocation	20
P1	Allocation	30
P2	Allocation	22
P0	Deallocation	
P1	Deallocation	
P3	Allocation	50
P4	Allocation	20

4. (a) For a given queue of I/O requests 98, 183, 122, 14, 124, 65, 67 find total number of h movements using

(i) SCAN algorithm

(ii) C-SCAN algorithm

Assume that the head starts at 57 and st moving towards left end.

(b) Under what conditions the SCAN and C-SCAN algorithms perform better than other disk scheduling algorithms. (3)

(c) Mention any three challenges that may be faced by a software developer in a multicore system. (3)

(d) In a file system, path names for a file can be of two types: absolute and relative. Differentiate giving an appropriate example. (3)

5. (a) Consider a 40-bit logical address. Find the number of bits required to represent the page number and page offset fields. It is given that the page size is 4 KB. (4)

(b) Modern operating systems are interrupt driven. Briefly explain how interrupts are signalled by the operating system. (2)

(c) Identify any two advantages of a multiprogramm system over a single programming system?

(d) What is external fragmentation? Does contigu memory organization scheme suffer from exte fragmentation? Give arguments to support y answer. (3

6. (a) Consider the following set of processes, with length of CPU burst time given in millisecon

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

(i) Draw Gantt chart for Shortest Job algorithm and calculate turnaround time every process.

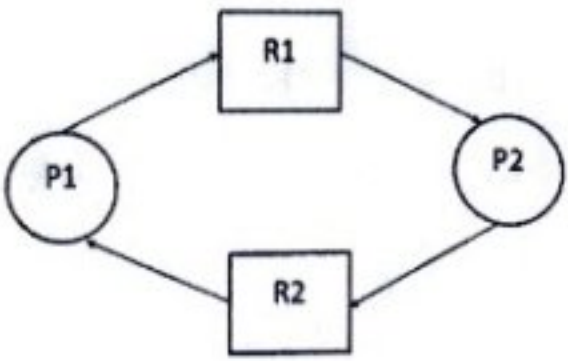
(ii) Draw Gantt chart for Priority based (preemptive) algorithm and calculate waiting time for every process. (4+4)

(b) Consider a demand paging system with the page table stored in memory. What should be the maximum page fault rate to achieve an effective access time of 200 nanoseconds if the time taken for a memory reference is 100 nanoseconds. Assume that a page fault is serviced in 10 ms. (2+3)

(c) Which scheduler controls the degree of multiprogramming? How? (2)

7. (a) What are the four necessary conditions for deadlock to occur? For the following resource allocation graph, find if the system is in a deadlock state. Justify your answer. (4+4)

P.T.O.



(b) Consider two processes p1 and p2. Write the structure of process p1 to solve the critical section problem using Peterson's solution? Justify that progress requirement is satisfied in this solution. (4+3)

(7)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4397 **G**

Unique Paper Code : 32341302

Name of the Paper : Operating Systems

Name of the Course : **B.Sc. (H) CS**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt any **4** questions from **Section B**.
4. Parts of a question must be answered together.

SECTION A

1. (a) Which of the CPU scheduler affects the degree of multiprogramming? (1)

P.T.O.

(b) In which of the access methods, the file is viewe as a numbered sequence of block or record that, one may read block 14 then block 59, an then can write block 13?

(c) In a general graph directory structure write possibl solutions to avoid infinite search loop. (2

(d) Write the bit vector representation for free space list for a disk (10 blocks) where blocks 2, 3 and 6 are free and rest of the block are allocated. (1)

(e) Briefly explain any two main advantages of multiprocessor systems. (2)

(f) A non-preemptive kernel is free from race conditions on kernel data structures. Then why would anyone favor a preemptive kernel over a non-preemptive one? (2)

(g) Why usage of an Application Program Interface (API) is preferred over system calls for writing programs? (2)

(h) Consider the following code segment and give output with justification. (Assuming all appropriate header files are included) (2)

```
int main()
{
    fork(); fork();
    fork(); fork();
    printf("hello\n");
    return 0;
}
```

(i) Consider a paging system with the page table stored in memory.

(i) If a memory reference takes 125 nanoseconds, how long does a paged memory reference take? (1)

(ii) If we add Translation Lookaside Buffer (TLBs) and 80% of all page table references are found in the TLBs, what is the effective memory access time? Assume that the time taken to access a TLB is 20 nanoseconds. (2)

(j) Consider the following segment table : (2)

Segment	Base	Length
0	500	600
1	1200	250
2	400	50

What are the physical addresses for the followin logical addresses? Justify your answer.

(i) 0, 300

(ii) 2, 100

(k) What is VoIP? Explain with an example. (2)

(l) Using semaphores, explain how can we achieve the condition of having statement 'x' of process PI to be executed only after statement 'y' of process P2? (2)

(m) Can a cache be made as large as the disk? Justify your answer. (2)

(n) Consider a disk pack with 4 surfaces, 32 tracks per surface and 64 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. Calculate the capacity of the disk pack and also, the number of bits required to specify a particular sector in the disk. (2)

(o) What is a page fault? (1)

(p) Write any two pieces of process information that changes during context switch? (2)

(q) Out of Peer-to-Peer and client-server networks, which one is more reliable. Justify your answer. (2)

(r) Write any two ways of deadlock handling. (2)

(s) Under what circumstances the process will become

(i) Zombie

(ii) Orphan (2)

SECTION B

2. (a) Consider the following set of processes, with the length of CPU burst time given in milliseconds : (6)

Process	Arrival Time	Burst Time	Priority
P1	0	2	2
P2	1	5	1 (Highest)
P3	4	3	3
P4	5	1	4

(i) Draw Gantt chart for Shortest Job First algorithm and calculate turnaround time for every process.

(ii) Draw Gantt chart for Priority based (preemptive) algorithm and calculate waiting time for every process.

(b) Given is a system with 128KB of memory (assuming no memory initially allocated). Show the memory layout at intermediate stages for best-fit allocation algorithm for the following given sequence of requests by the processes. (4)

Process Number	Nature of Request	Amount of memory requested (in KB)
P0	Allocation	30
P1	Allocation	10
P2	Allocation	15
P3	Allocation	22
P0	Deallocation	-
P2	Deallocation	-
P4	Allocation	8
P5	Allocation	10

3. (a) A system has three processes P1, P2 and P3 and four resources R1, R2, R3 and R4. There are two instances each of R1, R2 and R4, and one instance of R3. Given the edge set E = {R1 → P1, R2 → P2, P1 → R3, R1 → P2, P3 R1, R2 → P3, R3 → P3}.

(i) Draw the resource allocation graph. (3)

(ii) Is the system in a deadlock state? If yes, then which processes are in the deadlock else identify the sequence in which the processes will be executed. (2)

(b) "It is more economical to create and context switch threads in comparison to processes". Justify this statement. Write any three programming challenges in writing multithreaded programs for multicore systems. (2+3)

4. (a) Give the structure of processes in Peterson's solution and explain how mutual exclusion and progress is preserved. (4)

(b) Consider the following page reference string

0 3 1 5 7 6 5 7 2 2 7 0 4 7 3 2 1 2 1

How many page faults would occur with First-in, First-out (FIFO) and optimal page replacement algorithms assuming three frames? All frames are initially empty. (6)

5. (a) Consider a logical address space of 64 pages with 2 KB frame size mapped onto a physical memory of 256 KB. (2+4)

(i) How many bits are there in the logical and physical addresses?

(ii) How many bits will be used by page offset and page number in logical address?

(b) Compare and contrast the following : (4)

(i) Symmetric and Asymmetric multiprocessing

(ii) Microkernel and Monolithic approach of Operating System design

6. (a) Suppose a disk drive has 200 cylinders numbered from 0 to 199. The request for track 46 is being serviced and is moving towards track 199 and the disk request queue contains read/write requests for the sectors on tracks 113, 156, 22, 132 and 196, respectively. Represent the head movements diagrammatically and also calculate the total number of head movements needed to satisfy the requests in the queue, using : (6)

(i) First Come First Serve (FCFS)

(ii) Shortest Seek Time First (SSTF)

(b) Which are the two address space possibilities for the child process after the execution of fork() system call. (2)

(c) What issues will be faced by operating systems if it resides in read only memory (ROM) as in cellular phones and tablets? (2)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1402 **C**

Unique Paper Code : 32341302

Name of the Paper : Operating Systems

Name of the Course : **B.Sc. (H) Computer Science**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory. Attempt any **4** questions from **Section B**.
3. Parts of a question must be answered together.

SECTION A

1. (i) Which algorithm is the preemptive version of First in First out CPU scheduling algorithm? (1)

(ii) What is the name given to the section of code or set of operations in which process is working on its shared variables? (1)

P.T.O.

(iii) What is 'Dirty bit' in Demand paging? Where this bit is stored by the Operating System? (2)

(iv) Why command interpreter is usually placed separate from the kernel? (2)

(v) Write any two problems that may occur in multiprogramming environment? (2)

(vi) How degree of multiprogramming affects CPU performance? (2)

(vii) Explain the type of fragmentation that occurs in segmentation? (2)

(viii) Using semaphores, how can we achieve the condition of having statement 'a' of process P1 to be executed only after 'b' condition of process P2. (2)

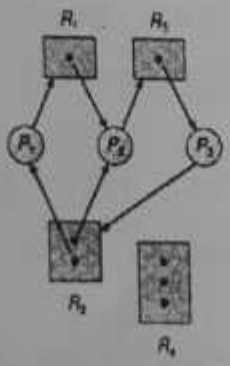
(ix) List any two privileged instructions? (2)

(x) What is the significance of two separate modes of operation in operating systems? (2)

(xi) Which are the two conditions under which a parent may terminate the execution of one of its children? (2)

(xii) Write the bit vector representation for free space list for a disk (10 blocks) where blocks 1, 2 and 5 are free and rest of the blocks are allocated. Give one advantage of this representation. (2)

(xiii) Determine whether the deadlock occur in the given resource 3 allocation graph of three processes as P_1, P_2 and P_3 and four resources as R_1 (one instance), R_2 (two instance), R_3 (one instance) and R_4 (3 instances)? Justify your answer. (3)



(xiv) How many child processes are created in the following fragment of code assuming essential header files are included? Explain the output with justification.

```
int main()
  {
  for (int i=0;i<4;i++)
     fork();
  return 0;
  }
```

(1+2)

(xv) Consider a system of five resources (assuming every resource is having one instance only) and four processes where every process requires two resources to complete its work. Is there any chance of deadlock in this scenario? Justify your answer after applying all the necessary conditions of deadlock. (3)

(xvi) Consider a logical address space of 512 pages with 4-KB page size, mapped onto a physical memory of 128 frames.

(a) How many bits are required in the logical address?

(b) How many bits are required in the physical address? (2+2)

SECTION B

2. (i) Consider the following set of processes, with length of the CPU burst and arrival time given in milliseconds :

Processes	Burst Time	Arrival Time
P1	9	0
P2	5	2
P3	6	3
P4	4	5
P5	8	6

(a) Draw the Gantt chart illustrating the execution of these processes using Shortest Remaining Time First (SRTF) algorithm? (3)

(b) Based on the above obtained Gantt chart, calculate the average turnaround time and average waiting time for the given processes. (3)

(ii) Illustrate with an example if the wait and signal operations are not executed atomically, then mutual exclusion is violated? (4)

3. (i) Differentiate the following :

(a) Long term schedular and Short term schedular

(b) Asymmetric multiprocessing and Symmetric multiprocessing

(c) Monolithic and Microkernel approach to Operating system design (3×2)

(ii) Consider the following page reference string :

7,0,3,1,5,2,3,4,0,7,2,1,0,4,2,0,1,7

Assuming demand paging with three frames, how many page faults would occur for the following page replacement algorithms :

(a) Optimal replacement

(b) FIFO replacement (4)

4. (i) Consider the following segment table :

Segment	Base	Length
0	219	600
1	1300	95
2	90	400
3	1327	480
4	1052	196

What are the physical addresses for the following logical addresses?

(a) 0, 230

(b) 1, 10

(c) 2, 300

(d) 3, 400

(e) 4, 200

(5)

(ii) For a paged system, Translation Lookaside Buffer (TLB) hit ratio is 80%. Let RAM access time, t is 20 ns and TLB buffer access time, T is 100 ns. Find out

(a) Effective memory access with TLB

(b) Effective memory access without TLB

(3)

(iii) Justify the requirement of logical and physical addresses in an operating system? (2)

5. (i) What is race condition in process synchronization? Explain it with an example.

(4)

(ii) Consider a disk drive of 5000 cylinders, numbered from 1 to 4999. (6)

The drive is currently serving a request at cylinder 143, and the previous request was at

cylinder 125. The queue of pending request in FIFO order is 86, 1470, 913, 1774, 948, 1509

Starting at current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all pending requests for each of the following disk scheduling algorithms.

(a) Shortest seek time first (SSTF)

(b) Circular SCAN (C-SCAN)

Give all the intermediate calculations.

6. (i) Compare and contrast the following : (4)

(a) Peer to Peer Computing and Client-Server Computing

(b) Data parallelism and Task parallelism

(ii) What is the role of virtualization in cloud computing? (4)

(iii) Compute the context switch time for a user process of 100 MB using the swapping memory management scheme, if the backing store has a transfer rate of 50MB per second. (2)

This question paper contains 7 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **2047**

Unique Paper Code : **32341302** **GC-3**

Name of the Paper : **C-2 Operating Systems**

Name of the Course : **B.Sc. (H) Computer Science (CBCS)**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. **1** is compulsory.

Attempt any *four* questions out of the questions from

Question No. **2** to Question No. **6**.

Parts of a question must be answered together.

1. (*a*) Give *one* word answers for the following : 6×0.5=3

(*i*) In this address binding scheme the logical and physical addresses are same.

(*ii*) Time taken by the disk arm to reach the appropriate cylinder.

(*iii*) The scheduler responsible for transition of a process state from ready to running.

(*iv*) Fragmentation that occurs when there is enough space in main memory but is not contiguous.

(*v*) The in-memory strucutre that stores the information about all the files which are opened in the system.

(*vi*) Privileged instructions can execute in this mode.

P.T.O.

(*b*) What will be the output of the following code segment ? Justify your answer : 3

```
int i;
cout<<"Hello"<<endl;
for (i=1; i<3; i++)
    fork();
cout<<"Over"<<endl;
```

(*c*) Consider the following memory address references :

0345, 0312, 0347, 0732, 0679, 0732, 0642, 0478, 0425, 0324, 0368, 0841, 0974

What will the reference string corresponding to the addresses given above (assuming page size is 200 bytes) ? How many page faults will occur with this reference string assuming that the process can have only one frame ? 3

(*d*) Differentiate between the following : 3×2=6

(*i*) Tree structured Directories and Acyclic-Graph directories

(*ii*) Asynchronous and Deferred cancellation of threads

(*iii*) Peer-to-peer and client server computing.

(*e*) What is the difference between the following two cases ? 2

Case 1 : copying a file.

Case 2 : sharing a file through linking.

(*f*) Consider the following segment table :

Segment	Base	Lenght
0	219	600
1	1300	95
2	90	400
3	1327	480
4	1052	196

What are the physical addresses for the following logical addresses ?

(*i*) 0, 230

(*ii*) 1, 110. 2

(*g*) If the total number of frames in main memory is 80 and there are 4 processes in the system with the demand as 40, 20, 90 and 50 frames, respectively. What will be the number of frames allocated using the following allocation strategies ?

(*i*) equal allocation 1

(*ii*) Proportional allocation. 2

(*h*) Can use of semaphores lead to deadlocks ? Justify your answer. 2

(*i*) What are the three methods to pass parameters to the operating system ? 3

(*j*) Briefly explain the microkernel approach to operating system design. 2

(*k*) What are the advantages of multiprocessor systems ? 3

(*l*) How UNIX maintains the access control list for a file protection ? 3

2. (*a*) Consider the following set of processes, with the length of CPU burst time given in milliseconds :

Process	Arrival Time	Burst Time	Priority
P_1	0	4	2
P_2	2	5	1
P_3	5	7	3
P_4	6	6	4 (Highest)

(*i*) Draw Gantt chart for Shortest Job First algorithm and calculate turnaround time for every process.

(*ii*) Draw Gantt chart for Priority based (preemptive) algorithm and calculate waiting time for every process. 6

(*b*) Suppose there is a system with 128 KB of memory with no memory initially allocated. Given the following sequence of requests by the processes, show the memory layout at intermediate stages for best-fit allocation algorithm. 4

Process Number	Nature of Request	Amount of memory requested (in KB)
P0	Allocation	40
P1	Allocation	15
P2	Allocation	10
P3	Allocation	25
P0	Deallocation	
P2	Deallocation	
P4	Allocation	18
P5	Allocation	15

3. (*a*) Consider the following scenario :

Process P1 is waiting for resource R1 and using (holding) R2

Process P2 is using R1

Process P3 is using R1 and waiting for R2

Process P4 is using R2

(*i*) Draw the resource allocation graph. 3

(*ii*) Is the system in a deadlock ? If the answer is yes, then mention the processes in the deadlock else identify the sequence in which the processes can execute. 2

(*b*) Discuss the linked allocation of files and its variant FAT. 5

4. (*a*) The concurrent processes P1 and P2 execute the following code segments in a uniprocessor environment :

P1 : x=x+1

P2 : x=x–1

where x is a shared variable. What would be the problem of such concurrent execution ? 4

(*b*) Consider the following page reference string :

7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 0, 4, 2, 0, 1, 7.

How many page faults would occur with LRU and optimal page replacement algorithms assuming four frames ? All frames are initially empty. 6

5. (*a*) Consider a logical address space of 64 pages with 1-KB frame size mapped onto a physical memory of 128 KB :

(*i*) How many bits are there in the logical and physical addresses ? 2

(*ii*) How what is the breakup of offset and page number in the logical address ? 2

(*iii*) How is the maximum number of entries in the conventional page table and in the inverted page table ? 2

(*b*) Which of the following components of a program state are shared across different threads in a multithreaded process and why ? 4

(*i*) global variables

(*ii*) stack memory

(*iii*) registers values

(*iv*) files.

6. (*a*) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order is :

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130.

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk-scheduling algorithms :

(*i*) SSTF

(*ii*) SCAN. 3+2

(*b*) Draw the process state diagram and explain its various states. 5

[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 1562 **C** **Roll No.....**

Unique Paper Code : 234461

Name of the Course : B.Sc. (Prog.)

Name of the Paper : Operating Systems (CSPT–404)

Semester : IV

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory.
3. Attempt any **Five** from remaining **seven** questions.
4. In all **six** questions are to be attempted.
5. Marks are indicated against each question.
6. All parts of a question must be done together.

1. (a) Define the essential properties of handheld systems. (2)

   (b) What are system calls ? List any four different types of system calls. (3)

   (c) What are the different states that a process can be in ? (2)

   (d) What is the process control block ? What are its components ? (4)

   (e) Differentiate between trap and interrupt. (2)

   (f) Why is it important for the scheduler to differentiate between I/O bound and CPU bound programs ? (2)

   (g) What do you understand by starvation of processes ? Suggest a solution to handle this problem. (2)

P.T.O.

(h) What are cooperating processes ? What are the requirements to solve critical-section problem of cooperating processes. (4)

(i) Explain the purpose of open () and close () operations of a file. (2)

(j) List the different layers of file system. (2)

2. (a) What is the dual mode operation of the operating system ? How does the dual mode feature provide greater protection for the operating system ? (5)

(b) List any four services provided by OS. Explain how each provides convenience to the user ? (4)

(c) List any two ways to pass parameters to system calls. (1)

3. (a) What are the main advantages and disadvantages of microkernel approach to OS design ? (3)

(b) Describe the actions taken by the kernel to context switch between processes. (3)

(c) Differentiate between single threaded and muti-threaded process with the help of diagram. What are the benefits of multithreaded programming ? (4)

4. Consider the following processes for execution :

Process	Priority	Burst Time
P_1	3	10
P_2	1	1
P_3	3	2
P_4	2	1

The Processes are assumed to have arrived in order P_1, P_2, P_3, P_4 all at time 0.

(i) Draw the Gantt Charts to illustrate the execution of these processes using FCFS, SJF, non preemptive priority and RR (quantum = 1).

(ii) Calculate the turnaround time and waiting time for each process for each scheduling algorithm in part (i).

(iii) Which algorithm proves to be more efficient ? Justify your answer. (10)

5. (a) Consider a paging system with the page table stored in memory.

(i) If a memory reference takes 200 nanoseconds, how long does a paged memory reference take ?

(ii) If we add TLBs, and 75% of all page-table references are found in the TLB's, what is the effective memory access time ? (Assume that finding a page-table entry in the TLB takes 20 nanoseconds.) (4)

(b) Assuming a 1-KB page size, what are the *page numbers* and *offsets* for the following address references ?

(i) 2375

(ii) 19366 (2)

(c) Given five memory partitions of 100 KB, 500 KB, 200 KB, 300 KB, and 600 KB (in order), how would each of the first-fit, best-fit, and worst-fit algorithms place processes of 212 KB, 417 KB, 112 KB, and 426 KB (in order) ? Which algorithm makes the most efficient use of memory ? (4)

6. (a) What is virtual memory ? What are the benefits of virtual memory systems ? (3)

(b) What is a page fault ? What steps are taken by the OS to handle page faults ? (4)

P.T.O.

(c) How many page faults occur for FCFS algorithm for the following reference string, for three page frames ?

1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7 (3)

7. (a) Explain indexed allocation method for allocating blocks to a file. What are mechanisms used for deciding the size of index block ? (8)

(b) How does ACL help in providing file protection ? (2)

8. Write short notes on any **two** of the following :

(i) Tree structured directories

(ii) Acyclic graph directory structure

(iii) File allocation table (FAT)

(iv) Segmentation memory management scheme

(v) Contiguous Memory Allocation schemes (10)