UNIVERSITY OF THE PUNJAB

Roll No. in Fig. .....

Roll No. in Words. .....

.....

.....

Signature of Supdt.:

M.Sc. I.T. (Second Year) : Annual Examination – 2022

Subject: Information Technology

Paper: VII (Operating Systems & Analysis of Algorithm) Time: 30 Min. Marks: 20

This Paper will be collected back after expiry of time limit mentioned above, then Subjective paper shall be attempted.

ATTEMPT THIS PAPER ON THIS QUESTION SHEET ONLY.

Question 1.

Select the most appropriate option from the following: **(10x1=10)**

1) What are the entry points to kernel?
   a) System call
   b) Interrupt
   c) Signal
   d) All of these
2) The information about number of files opened by a process is stored in
   a) PCB
   b) PPFDT
   c) System wide file table
   d) Inode table
3) PCB of a process is updated when _____ happens
   a) Context switch
   b) Mode switch
   c) Interrupt
   d) None of the above
4) The _____ of the child is returned in the status argument of wait()?
   a) PID
   b) PCB
   c) SIGNAL
   d) Return value
5) If the Base and Limit registers of a process contain 100 and 200 respectively, then the range of the valid addresses will be_____
   a) 100 to 200
   b) 100 to 199
   c) 100 to 300
   d) 100 to 299
6) In User Level Threads 1:1 mapping can be done using:
   a) Ready State
   b) Scheduling
   c) pthread
   d) Kernel level libraries
7) The return value of fork() in parent code is the:
   a) PID of parent
   b) PID of child
   c) Address of PCB of parent
   d) Address of PCB of child
8) When several processes access the same data concurrently and the outcome of the execution depends on the particular order in which the access takes place, is called?
   a) dynamic condition
   b) race condition
   c) essential condition
   d) critical condition
9) The child process completes execution, but the parent keeps executing, then the child process is known as _____
   a) Orphan
   b) Zombie
   c) Body
   d) Dead
10) In the non-blocking send _____
   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) the sending process terminates

P.T.O.

Question#2

Select the most appropriate option from the following: **(10X1=10)**

1) For the merge sort algorithm, what is the time complexity of the best/worst case?
   a) best case: O(n) worst case: O(n*n)
   b) best case: O(n) worst case: O(n*log(n))
   c) best case: O(n*log(n)) worst case: O(n*log(n))
   d) best case: O(n*log(n)) worst case: O(n*n)
   e) best case: O(n*log(n)) worst case: O(n*n*n).
2) Two main measures for the efficiency of an algorithm are
   a) Processor and memory
   b) Complexity and capacity
   c) Time and space
   d) Data and space
3) The time factor when determining the efficiency of algorithm is measured by
   a) Counting microseconds
   b) Counting the number of key operations
   c) Counting the number of statements
   d) Counting the kilobytes of algorithm
4) The Worst case occur in linear search algorithm when
   a) Item is somewhere in the middle of the array
   b) Item is not in the array at all
   c) Item is the last element in the array
   d) Item is the last element in the array or is not there at all
5) The complexity of the average case of an algorithm is
   a) Much more complicated to analyze than that of worst case
   b) Much more simpler to analyze than that of worst case
   c) Sometimes more complicated and some other times simpler than that of worst case
   d) None or above
6) The complexity of Binary search algorithm is
   a) O(n)
   b) O(log)
   c) O(n2)
   d) O(n log n)
7) The complexity of merge sort algorithm is
   a) O(n)
   b) O(log n)
   c) O(n2)
   d) O(n log n)
8) Consider the following Algorithm:

```
Factorial (n){
if (n=1)
        return 1
else
        return (n * Factorial(n-1))
}
```

Recurrence for the following algorithm is:
   a) T(n) = T(n-1) +1
   b) T(n) = nT(n-1) +1
   c) T(n)= T(n-1) +n
   d) T(n)=T(n(n-1)) +1
9) For the heap sort we store the tree nodes in
   a) level-order traversal
   b) In-order traversal
   c) pre-order traversal
   d) post-order traversal
10) Quick sort is
   a) Stable & In place
   b) Not stable but in place
   c) Stable but not in place
   d) Sometimes stable & sometimes in place

UNIVERSITY OF THE PUNJAB

M.Sc. I.T. (Second Year) : Annual Examination – 2022

Roll No. .....

Subject: Information Technology

Paper: VII (Operating Systems & Analysis of Algorithm)

Time: 2 Hrs. 30 Mins. Marks: 80

THE ANSWERS MUST BE ATTEMPTED ON THE ANSWER SHEET PROVIDED

Note: Attempt TWO Questions from each section. All Questions carry equal marks.

SECTION – 1 (OPERATING SYSTEMS)

Q.3. Briefly answer the following questions: (5X4=20)

a) How **message passing** can be used to communicate between processes?

b) Differentiate between **binary** and **counting** semaphore.

c) Explain the usage of **dirty bit** in page table.

d) Differentiate between **suspended blocked** and **suspended ready** state of 7-state process model.

e) Why **compaction** is used in memory management?

Q.4.

A) How many times the string "Lahore" will be printed in the following code? Explain your answer with reasons. [10]

```
int main(){
int cpid = fork();
if (cpid == 0){
     execl("/usr/bin/gnome-calculator", "mycalc",NULL);
     printf("Lahore\n");
}
else{
     wait(NULL);
     printf("Lahore\n");
     int x= fork();
     if (x)
          printf("Lahore\n");
}
return 0;
}
```

B) Draw Gantt chart to show timeline for the execution of following processes using **priority scheduling** algorithm. Here least value in priority number is highest priority. [10]

Also calculate average waiting time and average turnaround time.

Process ID	Priority #	Arrival Time	Burst Time	Completion Time	Waiting Time	Turnaround Time
p1	11	0	5			
p2	22	1	4			
p3	33	2	2			
p4	44	4	1			

P.T.O.

Q.5. (a)

Assuming a 1-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers): [4]

a. 2375
b. 30000
c. 256
d. 16385

(b)

The following table shows the first 8 entries in the page map. If there are 1024 (2_{10}) bytes per page, what is the physical address corresponding to the decimal virtual address 4012? [6]

Virtual page #	Valid bit	Physical page #
0	0	7
1	1	9
2	0	3
3	1	2
4	1	5
5	0	5
6	0	4
7	1	1

(c)

Consider the system having four frames in memory. Initially pages 1,2,3 and 4 are loaded. Compare the performance of LRU and FIFO page replacement algorithms if the page excess sequence is 3, 4, 5, 6, 7, 6, 5, 4, 3, 4, 5, 6, 7, 6. Count the number of hits (hit means when required page is already in memory) for each algorithm. Also write miss-rate. [10]

SECTION – 2 (ANALYSIS OF ALGORITHMS)

Q.6. Explain the following: (4x5=20)

1) Define dynamic programming. What are features of dynamic programming?
2) Explain big-theta and Little-Omega. Write their set definitions and also draw figures to explain.
3) Draw recursion tree to analyze worst case of quick sort. Why is it worst?
4) Write invariant of quick-sort algorithm.

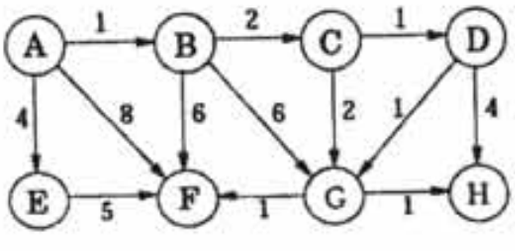
Q.7.

A) Component of a Graph: "In graph theory, the complement or inverse of a graph G is a graph H with vertices such that two vertices of H are adjacent if and only if they are not adjacent in G."
Assume that graph with n vertices is represented by adjacency matrix G[n][n]. Give Pseudocode/Algorithm taking G, as input and giving as output the corresponding adjacency matrix of complement graph H. [10]

B) Write down steps to find strongly connected components from a digraph. [10]

Q.8.

Suppose Dijkstra's algorithm is run on the following graph, starting at vertex A. If you find a tie while selecting a vertex, then resolve the tie by selecting in alphabetical order.



P.T.O.

The table is storing following three pieces of information for each vertex 'v'.

visited = set to True if 'v' is visited, False otherwise
dist = Distance of the vertex 'v' from source vertex
prev = prior vertex connecting vertex 'v' to source vertex and improving its dist

A) Show the vertex visited on the top of each table and then show the updates made in table after visiting it. [15]

1) Initial state

Vertices	visited	dist	prev
A	F	0	0
B	F	∞	0
C	F	∞	0
D	F	∞	0
E	F	∞	0
F	F	∞	0
G	F	∞	0
H	F	∞	0

2) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

3) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

P.T.O.

4) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

5) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

6) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

7) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

8) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

9) After visiting _____

Vertices	visited	dist	prev
A			
B			
C			
D			
E			
F			
G			
H			

B)

Redraw the graph, now showing only those edges and their weights making shortest paths to all vertices from source vertex.

[5]