

Model Entrance Paper for PhD Entrance

(Computer Science & Related Streams)

Marks: 100

Duration: 2 Hours

Instructions:

1. All the sections are compulsory
2. For objective questions write the question number and the choice.
3. For objective questions there shall be negative marking of 1/4 for every wrong answer.

Section 1 (Answer any FIVE) - 5 x 6m = 30 Marks

1. Write a program to find the factors of a number which are also prime numbers.
2. Using dynamic memory allocation, write a program to implement a simple linked list which stores the names and addresses of students. The program should also have a display function.
3. Briefly explain normalization.
The relation scheme Student Performance (name, courseNo, rollNo, grade) has the following functional dependencies:
name, courseNo, - grade
rollNo, courseNo - grade
name - rollNo
rollNo - name
What is the highest normalization form of this?
4. Differentiate flow with respect to congestion control and solve the following problem.
Station A uses 32 byte packets to transmit messages to Station B using a sliding window protocol. The round trip delay between A and B is 80 milliseconds and the bottleneck bandwidth on the path between A and B is 128 kbps. What is the optimal window size that A should use?
5. Explain time and space complexity of quick sort algorithm
6. Explain pipelining and solve the following problem.
A CPU has a five-stage pipeline and runs at 1 GHz frequency. Instruction fetch happens in the first stage of the pipeline. A conditional branch instruction computes the target address and evaluates the condition in the third stage of the pipeline. The processor stops fetching new instructions following a conditional branch until the branch outcome is known. A program executes 10 instructions out of which 20% are conditional branches. If each instruction takes one cycle to complete on average, what is the total execution time of the program ?
7. Compare Paging and Segmentation. Solve the following problem.
A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer (TLB) which can hold a total of 128 page table entries and is 4-way set associative. What is the minimum size of the TLB tag ?

Section 2 (Answer any FIVE) 5 x 4m = 20 Marks

1. Which are the essential prime implicants of the following Boolean function? $f(a,b,c) = a'c + ac' + b'c$
2. With an illustration explain push down automata?
3. Suppose that a project was estimated to be 400 KLOC. Calculate the effort and development time, productivity for each of the three modes i.e., organic, semidetached and embedded
4. Explain how you would implement a stack using a queue data structure only?
5. What does the following recurrence equation evaluate to ?
 $T(i) = i$
 $T(n) = 2T(n-i) + n, n \geq 2$

6. Consider the following set of processes, with arrival times and CPU burst times in milliseconds.

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

What is the average turnaround time for preemptive shortest remaining time first?

7. The following schema is available:

Hotel (Hotel_No, Name, Address)

Room (Room_No, Hotel_No, Type, Price)

Booking (Hotel_No, Guest_No, Date_From, Date_To, Room_No)

Guest (Guest_No, Name, Address)

- a) Write an SQL query to create the table Hotel
- b) Write an SQL query to list full details of all hotels in Dehradun
- c) Write an SQL query to list all double or family rooms with a price below Rs 3000 per night, in ascending order of price.
- d) Write an SQL query to find how many total hotels are there
- e) Write an SQL query to list the rooms that are currently unoccupied at the Hotel Madhuban.

Section 3 (Choose the correct option) 50 x 1m = 50 Marks

Note: Only a few sample questions have been shown for illustration purpose.

1. Assume the following C variable declaration `int * A[10], B[10][10];`
Of the following expressions
I. `A[2]` II. `A[2][3]` III. `B[1]`
IV. `B[2][3]`

which will not give compile-time errors if used as left hand sides of assignment statements in a C program?

- (a) I,II, and IV only
- (b) II and IV only
- (c) II, III, and IV only
- (d) IV only

2. The regular expression $0^*(10^*)^*$ denotes the same set as

- (a) $(1^*0)^*1^*$
- (b) $(0+1)^*10(0+1)^*$
- (c) $0+(0+10)^*$
- (d) None of the above

3. Which of the following suffices to convert an arbitrary CFG to an LL(1) grammar?

- (a) Removing left recursion alone
- (b) Factoring the grammar alone
- (c) Removing left recursion and factoring the grammar
- (d) None of the above

4. The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)?

- (a) 2
- (b) 3
- (c) 4
- (d) 6

5. Consider the following relation schema pertaining to a students database:

Students (rollno, name, address)

Enroll(rollno,courseno, coursename)

Where the primary keys are shown underlined. The number of tuples in the student and Enroll tables are 120 and 8 respectively. What are the maximum and minimum number of tuples that can be present in (Student * Enroll), where '*' denotes natural join?

- (a) 8,8
- (b) 120,8
- (c) 960,8
- (d) 960,120

6. In an SR latch made by cross-coupling two NAND gates, if both S and R inputs are set to 0, then it will result in

- (a) $Q=0, Q'=1$
- (b) $Q=1, Q'=0$
- (c) $Q = 1, Q' = 1$
- (d) Indeterminate states

7. The minimum number of page frames that must be allocated to a running process in a virtual memory environment is determined by

- (a) the instruction set architecture

- (b) page size
- (c) physical memory size
- (d) number of processes in memory

8. How many 8-bit characters can be transmitted per second over a 9600 baud serial communication link using asynchronous mode of transmission with one start bit, eight data bits, two stop bits, and one parity bit?

- (a) 600
- (b) 800
- (c) 876
- (d) 1200

9. Let A,B,C,D be $n \times n$ matrices, each with non-zero determinant. If $ABCD=I$, then B^{-1} is

- (a) $D^{-1} C^{-1} A$
- (b) CDA
- (c) ADC
- (d) Does not necessarily exist

10. The tightest lower bound on the number of comparisons, in the worst case, for comparison-based sorting is of the order of

- (a) n
- (b) n^2
- (c) $n \log n$
- (d) $n \log^2 n$

11. Which information about a client is NOT usually available to a server via the http protocol?

- (a) The IP address of a user.
- (b) The URL of the referring webpage.
- (c) For password protected pages: the username and password.
- (d) The URL of a user's homepage.
- (e) The MIME types of applications accepted by the user's browser

12. What is the most important software quality attribute of a web based transaction processing system?

- (a) Usability (b) Security (c) Efficiency (d) Safety (e) Modularity
