

**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Odd Semester Mid-Term Examination, 2023-'24**

Course Code: CSC01  
 Course Name: Computer Programming

Full Marks: 25  
 Time: 1.5 Hours

**Instructions:** Answer all the questions.

Question No.	Body of the Question	Marks	Mapping CO
1.	<p>Richard has developed a programming language where the comparison operators have higher precedence than the arithmetic operators. The comparison operators output {0,1}, and arithmetic operators output the result as usual. What would be the output of the following statement?</p> $a * 5 > 6 * b$	1	CO1
2.	<p>Use the ternary operator ? :, to rewrite the logic of the following <i>if-else</i> block.</p> <pre> if(a&gt;b)     b = a; else     a = b; </pre>	2	CO2
3.	<p>Consider the <i>array</i> and the statement as below: Find the value of variable a.</p> <pre> int array[5] = {1,2,3,4,5};  int a = array[array[array[1]]]; </pre>	2	CO1
4.	<p>Identify the errors in the following code snippet. Mention the errors according to the line number.</p> <pre> 1.      int main(){ 2.          int 2wheeler, fourWheeler; 3.          ..... 7.          if(2wheeler&gt;=5){ 8.              fourWheeler = 0 9.          } 10.         return 0; 11.     } </pre>	2	CO2
5.	<p>If the arithmetic operators are right-to-left associative, then show that the following expression evaluates to <math>a = 5</math>.</p> $a = 5 + 12 * 3 / 4$	2	CO1
6.	Find the binary representation of the decimal 17.3125.	3	CO1
7.	<p>Let 200000 be the base address of the array A, declared as:</p> <pre> short A[4][4]={0,0}; </pre> <p>Find the address of the element A[1][3]. Considering the short to be of size 2 bytes.</p>	2	CO2

Question No.	Body of the Question	Marks	Mapping CO
8.	<p>Explain what would be the output of the following code snippet:</p> <pre>#define break continue for(i=0;i&lt;10;i++){     if(i%2 == 0) break;     print("%d",i+1); }</pre>	3	CO2
9.	<p>Justify what would be the output of the following code snippet</p> <pre>int a=3; printf("%d%d%d",a++,a++,++a);</pre>	2	CO2
10.	<p>Explain what would be the output of the following code snippet:</p> <pre>int a=11,b=5,r; r=a&lt;b &amp;&amp; printf("NITDGP"); printf("%d",r);</pre>	2	CO2
11.	<p>Find the error in the following switch-case statement</p> <pre>switch(var1){     case var2: print("I am in the variable case"); break;     case 2.5 : print("I am in the 2.5 case"); break; }</pre> <p>(NOTE: var1 and var2 are integer variables).</p>	2	CO2
12.	<p>Compare the two code snippets,, and find the value of sum. Justify your answer.</p> <pre>int A[5]={1,2,3,4,5}, sum=0, i=0; ----- for(; A[i] != 3; )             for(;;){     sum+=A[i++];                   if(A[i++]!=3) break;                                    sum+=A[i];                                }</pre>	2	CO2

### Course Outcomes

- CO1 To understand basics of computer programming, program flow, and programming constructs.
- CO2 Develop concepts on basic and complex data types, conditional and iterative statements.
- CO3 Exercise the concepts of user defined functions to solve real time problems.
- CO4 Inscribe C programs that use Pointers to access arrays, strings and functions.
- CO5 Exercise user defined data types including structures and unions to solve problems.



**NITDGP/BTECH/Reg/Odd/2023-24**  
**Odd Semester Mid-Term Examination, 2023-24**

Course Code: CSC301  
 Course Name: Discrete Mathematics

Full Marks: 25  
 Time: 90 Minutes

**Instruction:** Attempt all the questions. Write the answer of all the sub-parts of a question together in order.

Question No.	Body of Question	Marks	Mapped CO
1	<p>(A) Prove that there exist two irrational numbers <math>x</math> and <math>y</math> such that <math>x^y</math> is rational.</p> <p>(B) Prove or disprove the following.</p> <p>(i) <math>(\forall x)(\exists y)P(x, y) \implies (\exists y)(\forall x)P(x, y)</math></p> <p>(ii) <math>(\exists x)(\forall y)P(x, y) \implies (\forall y)(\exists x)P(x, y)</math></p> <p>You must explain your answers.</p>	2+2	CO1, CO3
2	<p>Prove that the regions formed by <math>n</math> circles in the plane can be colored with red and blue in such a way that any two regions that share a common boundary arc will be colored differently.</p> <p style="text-align: center;"><b>OR</b></p> <p>You are visiting a country of knights (speak truth always) and knaves (always lies) and have the following encounters with natives.</p> <p>i) Two natives A and B address you as follows: A says: Both of us are knights. B says: A is a knave. What are A and B?</p> <p>ii) Another two natives C and D approach you but only C speaks. C says: Both of us are knaves. What are C and D?</p> <p>iii) You then encounter natives E and F. E says: F is a knave. F says: E is a knave. How many knaves are there?</p>	5	CO3, CO4



3	<p>Are the following two graphs isomorphic? Justify.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> </div>	2	CO1, CO2
4	<p>Find the diameter, radius and center of the following graph:</p>	2	CO1
5	<p>Is the sequence (5,5,4,3,2,2,2,1) graphic? Justify.</p>	2	CO1, CO2
6	<p>Let <math>v</math> be a cut-vertex of a simple graph <math>G</math>. Prove that <math>\overline{G} - v</math> is connected.</p>	2	CO1, CO2
7	<p>Prove that for any nonempty sets <math>A, B</math>, and <math>C</math>, <math>A \times (B - C) = (A \times B) - (A \times C)</math>.</p> <p style="text-align: center;">OR</p> <p>If <math>A, B, C</math> be sets. prove that <math>A \cap (B \Delta C) = (A \cap B) \Delta (A \cap C)</math>.</p>	4	CO1, CO2
8	<p>Seventy-five children went to an amusement park where they can ride on the merry-go-round, roller coaster, and ferris wheel. It is known that 20 of them have taken all three rides, and 55 of them have taken at least two of the three rides. Each ride costs \$0.50, and the total receipt of the amusement park was \$70. Determine the number of children who did not try any of the rides.</p>	4	CO1, CO3



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Odd Semester Mid-Term Examination, 2023-24**

Course Code: CSC302

Full Marks: 25

Course Name: Digital Logic Design

Time: 90 Minutes

Instructions: Answer all the questions from Part A and any 2 from Part B.

<b>PART-A</b>			
Question No.	Body of the Question	Marks	Mapped CO
1	Simplify (algebraically): $(x + y)[x'(y' + z')] + x'y' + x'z'$	2	CO1
2	what are the values of w, x, y, z in the following simultaneous Boolean Expression? $x + y + z = 1$ $xy + w'z' = 0$ $xw' + yz' = 1$	1	CO1
3	$f(A, B) = A' + B$ then find $f(f(x+y, y), z)$	2	CO1
4	How do you convert a full adder to a full subtractor? Show with proper circuit diagram	2	CO2
5	Convert the following to other canonical form: $F(A, B, C, D) = \sum (0, 2, 6, 11, 13, 14)$	2	CO2
6	Minimize the following using K-map: $f = \sum_m(1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15)$ . Utilize first finding essential prime implicants techniques.	2	CO2
7	Design an <b>8X1 MUX</b> using <b>2X1 MUX</b> . Draw the block diagram	2	CO2
8	Prove or disprove that the distributive law is applicable on NAND Logic.	2	CO1
<b>PART-B</b>			
Answer Any <b>Two(2)</b> only from the Questions given below (9-12)			
9	A combinational circuit has 3 inputs A, B, C and output F. F is true for following input combinations: when A is False, B is True; when A is False, C is True; when A, B, C are False; when A, B, C are True (i) Write the Truth table for F. Use the convention True=1 and False = 0. (ii) Write the simplified expression for F in SOP form. (iii) Draw logic circuit using minimum number of 2-input NAND gates only.	5	CO2
10	Design a 8 to 1 multiplexer which will realise the four variable function given by $F(A, B, C, D) = \sum_m(0, 1, 3, 4, 8, 9, 15)$	5	CO2
11	Consider three 3-variable function $f_1(P, Q, R) = \sum(0, 1, 3)$ , $f_2(P, Q, R) = \sum(3, 5, 7)$ , $f_3(P, Q, R) = \sum(1, 3, 7)$ . These function are	5	CO1

## Course Outcomes

- CO1: Realize the various logic gates and laws of Boolean algebra. Analyse different types of digital electronic circuit using various mapping and logical tools.
- CO2: Design and analyses the various combinational circuits.

	<p>showing 4 prime implicant A, B,C,D all of them are pairs as shown</p> <p>Find A, B, C, D?</p>		
12	<p>A 4-bit carry lookahead adder, which adds two 4-bit numbers, is designed using AND, OR, NOT, NAND, NOR gates only. Assuming that all the inputs are available in both complemented and uncomplemented forms and the delay of each gate is one time unit, what is the overall propagation delay of the adder? Assume that the carry network has been implemented using two-level AND-OR logic.</p>	5	CO2

#### Course Outcomes

- CO1: Realize the various logic gates and laws of Boolean algebra. Analyse different types of digital electronic circuit using various mapping and logical tools.
- CO2: Design and analyses the various combinational circuits.



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR****Odd Semester Mid-Term Examination, 2023-24****Course Code:** CSC303

Full Marks: 25

**Course Name:** DATA STRUCTURES AND ALGORITHMS

Time: 90 Minutes

Instructions: Answer any FIVE questions. Answers to parts of a question should be written together under the properly mentioned question number.

Question No.	Body of the Question	Marks	Mappe d CO
1.	<p>a) Explain (with a suitable example) how the choice of data structure affects the performance of the implementation of an algorithm.</p> <p>b) What are the advantages of a linked list over an array? Write your answer considering the following points.</p> <ul style="list-style-type: none"> <li>• Insertion and Deletion of elements</li> <li>• Number of elements</li> <li>• Wastage of memory</li> <li>• Implementation of real-life applications</li> </ul>	5	CO3, CO1, CO4
2.	<p>Write an algorithm to evaluate a postfix expression. Consider the following arithmetic expression (with single digit operands) in Postfix form.</p> <p style="text-align: center;">7 5 2 + * 4 1 5 - / +</p> <p>Illustrate your algorithm for evaluating the above expression.</p>	5	CO3, CO5
3.	<p>What is a sparse matrix? Briefly discuss the method of storing only the non-zero elements of an asymmetric sparse matrix of order <math>m \times n</math>. Depict your solution with suitable diagram along with justification for the choice of appropriate ADT. No algorithm is required.</p>	5	CO1, CO4
4.	<p>Write an algorithm to add two single variable polynomials using singly linked lists. Clearly mention the assumptions, if any.</p>	5	CO5
5.	<p>Write an algorithm for checking the validity (whether matching parentheses have been used properly or not) of a parenthesized expression involving single-digit operands. Describe the suitable ADT used in your algorithm.</p>	5	CO1, CO3
6.	<p>Write an algorithm to insert a new node in a singly linked list at any specified position. Explain your algorithm with a suitable example.</p>	5	CO2, CO3

**Course Outcomes**

CO1: Understanding the fundamental concepts of data, data types and abstract data types

CO2: Implementation of different abstract data types using different data structures

CO3: Apply different types of data structures to implement different application problems

CO4: Analysis of the suitability/compatibility of different data structures based on the types of applications

CO5: Design and development of algorithms for real-life applications

7.	<p>What would be the worst case time complexity of fun()? Express the time complexity using suitable Asymptotic notation. Write a justification in support of your answer. Formally define the Asymptotic notation you have used in expressing the time complexity.</p> <pre> int fun(int n) {     int count = 0;     for (int i = n; i &gt; 0; i /= 2)         for (int j = 0; j &lt; i; j++)             count += 1;     return count; } </pre>	5	CO1
----	---	---	-----



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Odd Semester Mid-Term Examination, 2023-24**

Course Code: CSC 501

Full Marks: 25

Course Name: Operating System

Time: 90 Minutes

Instructions:

Answer any two from question no. 1 to 4 and any three from question no. 5 to 8.

Strictly each answer should be contiguous.

Materials to be supplied: NA

Question No.	Body of the Question	Marks	Mapped CO
1	a) Write the difference between Batch Multi programming & Time shared Multiprogramming. b) Explain how a signal, system call and hardware interrupt is executed by OS?	2+3	CO1
2	What is the difference between process and program? show and describe the layout of a process inside the main memory. Explain the reason for context switching.	5	CO2
3	What is PCB, explain the fields used in the PCB? How is the PCB used in the multiprogramming operating system?	5	
4	a) Provide three reasons for the creation of a process by the operating system. (b) Identify possible causes for process termination due to unavailable memory and arithmetic errors.	2+3	CO2
5	Find the output of the following program segments: a) <pre>int main() { fork();   fork() &amp;&amp; fork ()    fork()   fork();   printf("\nHello\n");   return 0; }</pre> b) <pre>int main() { fork();   if (fork() == fork ())     printf("\nHello\n");   return 0; }</pre> Justify your answer with proper process hierarchy diagram.	2+3	CO2
6	a) Compare Zombie, Orphan, and Daemon processes,	2+3	CO2

**Course Outcomes**

- CO1: Explain the functional architecture of an operating system.
- CO2: Design the process control algorithms, solution to deadlocks and multi-threading applications
- CO3: Implement application programs using UNIX system calls.
- CO4: Design and solve control & data access synchronization problems.
- CO5: Explain virtual memory organization and management in OS.
- CO6: Implementation of standard FAT & UNIX file system.



	b) Write a program that is capable of creating and verifying the status of an orphan and a zombie process.																							
7	Write a code such that it takes input n and then the parent process p creates a child c1, then c1 creates c2, c2 creates c3... and so on till cn. Each process including the parent should display the pid and ppid once in the terminal.	5	CO2																					
8	<p>Find the gantt chart and average waiting time in Shortest Remaining Time first and Round Robin (time quantum 2) scheduling algorithms applied on the following processes:</p> <table><tr><th>Process</th><th>Arrival Time</th><th>CPU Burst</th></tr><tr><td>P<sub>1</sub></td><td>0</td><td>6</td></tr><tr><td>P<sub>2</sub></td><td>1</td><td>5</td></tr><tr><td>P<sub>3</sub></td><td>2</td><td>2</td></tr><tr><td>P<sub>4</sub></td><td>5</td><td>3</td></tr><tr><td>P<sub>5</sub></td><td>6</td><td>1</td></tr><tr><td>P<sub>6</sub></td><td>10</td><td>1</td></tr></table>	Process	Arrival Time	CPU Burst	P <sub>1</sub>	0	6	P <sub>2</sub>	1	5	P <sub>3</sub>	2	2	P <sub>4</sub>	5	3	P <sub>5</sub>	6	1	P <sub>6</sub>	10	1	5	CO2
Process	Arrival Time	CPU Burst																						
P <sub>1</sub>	0	6																						
P <sub>2</sub>	1	5																						
P <sub>3</sub>	2	2																						
P <sub>4</sub>	5	3																						
P <sub>5</sub>	6	1																						
P <sub>6</sub>	10	1																						



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Odd Semester Mid-Term Examination, 2023-24**

<b>Course Code:</b> CSC 501	<b>Full Marks:</b> 60
<b>Course Name:</b> Operating System	<b>Time:</b> 3 Hours
<b>Question Paper No.:</b> NITDGP/CSC 501/1	<b>Date of Exam:</b> 18/11/2023

Instructions:

**Answer each section separately**

**Strictly each section and each answer should be contiguous.**

Materials to be supplied: NA

Question No.	Body of the Question	Marks	Mapped CO
	Section-A Answer any 3 questions	10x 3=30	
1. (a)	Three concurrent processes X, Y, and Z execute three different code segments that access and update certain shared variables. Process X executes the P operation (i.e., wait) on semaphores a, b and c; process Y executes the P operation on semaphores b, c and d; process Z executes the P operation on semaphores c, d, and a before entering the respective code segments. After completing the execution of its code segment, each process invokes the V operation (i.e., signal) on its three semaphores. All semaphores are binary semaphores initialized to one. Compute a deadlockfree order of invoking the P operations by the processes.	3	CO 4
(b)	<pre>main() {     int i;     for (i=0; i&lt;10; i++)         if (i%2 == 0) fork ( );     return 0; }</pre> <p>Find the total number of child process created. Explain with a proper diagram.</p>	2	CO 2
(c)	Consider four processes P, Q, R and S scheduled on a CPU as per round robin algorithm with a time quantum of 4 units. The processes arrive in the order P, Q, R, S, all at time $t = 0$ . There is exactly one context switch from S to Q, exactly one context switch from R to Q, and exactly two context switches from Q to R. There is no context switch from S to P. Switching to a ready process after the termination of another process is also considered a context switch.	3	CO 1

**Course Outcomes**

- CO1: Explain the functional architecture of an operating system.
- CO2: Design the process control algorithms, solution to deadlocks and multi-threading applications
- CO3: Implement application programs using UNIX system calls.
- CO4: Design and solve control & data access synchronization problems.
- CO5: Explain virtual memory organization and management in OS.
- CO6: Implementation of standard FAT & UNIX file system.



	Draw the Grant chart and find the possible CPU burst times (in time units) of these processes?		
(d)	At a particular time of computation the value of counting semaphore is 7. Then 20 P operations and x V operations were completed on this semaphore. If the new value of semaphore is 5, then compute the value of x.	2	CO 4
2. (a)	Consider three processes: P1, P2, and P3. P1 has two threads, P2 has only one thread, and P3 has three threads. Design a scheduling mechanism for a uniprocessor that supports multiprogramming, enabling interleaving of multi threads within multiple processes. Explain it with an appropriate timing diagram.	3	CO 2
(b)	Draw the schematic diagram that can explain the mechanism of jacketing to resolve the problem of user level thread	2	CO 2
(c)	Write the algorithm to prevent the deadlock by breaking the circular wait of the system processes.	2	CO2
(d)	Write a code in C that creates a parent process which creates two child processes; the 1st child waits for a random amount of time and displays "Hello" and the 2nd child waits for a random amount of time and displays "World". The parent waits for both the children to terminate, finally displays "Bye". use suitable system calls to create and synchronize with the termination of child processes.	3	CO3, CO4
3 (a)	<p>Synchronization in the classical readers and writers problem can be achieved through use of semaphores. In the following incomplete code for readers-writers problem, two binary semaphores mutex and wrt are used to obtain synchronization.</p> <pre> Writer_j(){ wait (wrt); writing is performed; signal (wrt); }  Reader_i() { wait (mutex); readcount = readcount + 1; if readcount == 1 then S1; S2; reading is performed; S3; readcount = readcount - 1; if readcount == 0 then S4; signal (mutex); } </pre> <p>The values of S1, S2, S3, S4, (in that order) are</p> <ul style="list-style-type: none"> <li>i) signal (mutex), wait (wrt), signal (wrt), wait (mutex)</li> <li>ii) signal (wrt), signal (mutex), wait (mutex), wait (wrt)</li> <li>iii) wait (wrt), signal (mutex), wait (mutex), signal (wrt)</li> <li>signal (mutex), wait (mutex), signal (mutex), wait (mutex)</li> </ul>	3	CO4
(b)	What are the components of a semaphore object? What is the physical significance of the value of the integer variable in a semaphore object?	3	CO4



(c)	Write an algorithm to ensure a deadlock-free solution to solve the dining philosopher's problem.	4	CO2
Q4. (a)	What is the difference between the signal operation in a semaphore and monitor? What are the basic operations that are permissible on a monitor condition variable? Write the significance of the condition variable in a monitor.	3	CO4
(b)	Write a multithreaded code where a parent thread creates 2 child threads to find prime numbers in a range [1-100], the 1st child thread checks the primeness of numbers in the range [1:50] and the second one in the range [51:100]. The parent thread terminates only after both child threads complete their checking reporting the total number of prime values found by both child threads.	5	CO2, CO3
(c)	Mention the two system calls along with their syntax used to issue a signal and set the signal handler.	2	CO3
Section-B Answer any 10 questions			
5	A disk has 200 tracks (numbered 0 through 199). At a given time, it was servicing the request of reading data from track 120, and at the previous request, service was for track 90. The pending requests (in order of their arrival) are for track numbers. 30, 70, 115, 130, 110, 80, 20, 25. How many times will the head change its direction for the disk scheduling policies SSTF (Shortest Seek Time First) and FCFS (First Come First Serve)?	3	CO6
6	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?	3	CO5
7	A computer uses 46bit virtual address, 32bit physical address, and a three-level paged page table organization. The page table base register stores the base address of the first level table ( $T_1$ ), which occupies exactly one page. Each entry of $T_1$ stores the base address of a page of the second level table ( $T_2$ ). Each entry of $T_2$ stores the base address of a page of the third level table ( $T_3$ ). Each entry of $T_3$ stores a page table entry (PTE). The PTE is 32 bits in size. The processor used in the computer has a 1 MB 16 way set associative virtually indexed physically tagged cache. The cache block size is 64 bytes. What is the size of a page in KB in this computer?	3	CO5
8	A system uses FIFO policy for page replacement. It has 4-page frames with no pages loaded to begin with. The system first accesses 100 distinct pages in some order and then accesses the same 100 pages but now in the reverse order. How many page faults will occur?	3	CO5



9	Assume that there are 3 page frames which are initially empty. If the page reference string is 1, 2, 3, 4, 2, 1, 5, 3, 2, 4, 6. Count the number of page faults using the optimal replacement policy.	3	CO5
10	Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 10 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 0.6, what is the effective memory access time (in milliseconds)?	3	CO5
11	Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. Find the capacity of the disk pack and the number of bits required to specify a particular sector in the disk.	3	CO6
12	In a virtual memory system, size of virtual address is 32-bit, size of physical address is 30-bit, page size is 4 Kbyte and size of each page table entry is 32-bit. The main memory is byte addressable. What is the maximum number of bits that can be used for storing protection and other information in each page table entry?	3	CO5
13	Suppose the head of a moving head disk, with 200 tracks numbered 0-199, is currently serving a request at track 100. The queue of pending requests, in order: 86, 2, 147, 91, 177, 10, 94, 150, 102, 175, 130. Starting from the current head position, show the movement in a diagram and find the total head movement to satisfy these requests for SSTF disk scheduling algorithms.	3	CO6
14	Consider 4 processes: P1 – 400KB, P2 – 100KB, P3 – 150KB, P4 – 350KB (in order) in the system. 6 free memory holes are there: M1 – 505KB, M2 – 110KB, M3 – 1000KB, M4 – 600KB, M5 – 260KB, M6 – 240KB. Assume the system runs a variable size allocation scheme, where one hole can hold multiple processes. Run the First Fit, Best Fit, and Worst Fit allocation and show the mapping $P_i \rightarrow M_j$ .	3	CO5
15	What is thrashing? Discuss one technique that can be utilized to handle thrashing.	3	CO5
16	Explain the differences between paging and segmentation.	3	CO5
17	Explain the Linked File Allocation technique with its pros & cons.	3	CO6

---



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Odd Semester Mid-Term Examination, 2023-24**

Course Code: CSC502

Full Marks: 25

Course Name: Database Management System

Time: 90 Minutes

Instructions: **ANSWER ANY TWO QUESTIONS FROM GROUP A AND ANSWER ALL QUESTIONS FROM GROUP B**

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
<b>GROUP A</b>  Q 1	<p>Major airlines companies that provide passenger services in Taiwan are: UniAir, TransAsia Airways, Far Eastern Transport, Great China Airlines etc. Taiwan's Federal Aviation Administration (TFAA) keeps a database with lots of information on all airlines. This information is made accessible to all airlines in Taiwan with the intention of helping the Companies assess their Competitive position in the domestic market. The information kept consists of:</p> <p>(i) Each airplane has an identification number, name of the contact person, and telephone number.</p> <p>(ii) For each aircraft identification number, capacity, and model is recorded.</p> <p>(iii) Each employee has an employee identification number, name, address, birthday, sex, position with the company, and qualification.</p> <p>(iv) Each route has a route identification number, origin, destination, classification (into domestic or international route), distance of the route, and price charged per passenger.</p> <p>(v) Each airline keeps information about their buy/sell transactions (for example, selling an airplane ticket is a sell transaction, and paying for maintenance is a buy transaction).</p> <p>(vi) Each transaction has a transaction identification number, date, description, and amount of money paid/received.</p> <p>Draw an E-R diagram for the database presented above. Make Sure to identify the associative entity (entities) and provide corresponding key attribute (attributes).</p>	9	CO1, CO2
<b>GROUP A</b>  Q2	<p>Consider the following relations for a company database</p> <p>Employee (Ename, SSN, Bdate, Address, Sex, Salary, SuperSSN, Dno)</p> <p>Department (Dname, Dno, MgrSSN, Mgrstartdate)</p> <p>Project (Pname, Pno, Plocation, Dno)</p> <p>Works_On (Essn, Pno, Hours)</p> <p>Dependent (Essn, Dependent name, Sex, Bdate, Relationship)</p>	3 × 3	CO2

Course Outcomes

CO1:

CO2:

CO3:



	<p><i>Write the queries of the following in relational algebra.</i></p> <p>(i) Retrieve the names of all employees in department 5 who work more than 10 hours per week on the "Product X" project.</p> <p>(ii) For each department, retrieve the department name, and average salary of all employees working in that department.</p> <p>(iii) List the names of all department managers who have no dependents.</p>		
<p><b>GROUP A</b></p> <p>Q3</p>	<p>Consider a disk with block size <math>B = 512</math> bytes. A block pointer is <math>P = 6</math> bytes long and a record pointer is <math>P_r = 7</math> bytes long. A file has <math>r = 30,000</math> EMPLOYEE records of fixed length. Each record has the following fields: NAME (30 bytes), SSN (9 bytes), DEPARTMENT CODE (9 bytes), ADDRESS (40 bytes), PHONE (9 bytes), BIRTHDATE (8 bytes), SEX (1 byte), JOBCODE (4 bytes), SALARY (4 bytes). An additional byte is used as a deletion marker.</p> <p>(i) Calculate the record size <math>R</math> in bytes.</p> <p>(ii) Calculate the blocking factor (bfr) and the number of file blocks in <math>B</math>.</p> <p>(iii) Calculate the average time it takes to find a record by doing linear search on the file.</p> <p>(iv) Suppose the file is ordered by the key field SSN and we want to construct a primary index on SSN. Calculate the number of block accesses needed to search for the retrieval a record from the file.</p>	<p>1+2+1+5</p>	<p>C02</p>
<p><b>GROUP B</b></p> <p>Q4</p>	<p>Explain the term "foreign key" with the help of an example and highlight its importance in design of databases. Critically compare the relative advantages and disadvantages of a Relational Database vis-à-vis hierarchical database.</p>	<p>2+3</p>	<p>CO1</p>
<p><b>GROUP B</b></p> <p>Q5</p>	<p>Explain with two examples why the set <math>\{\sigma, \Pi, U, -, X\}</math> is called the complete set of relational algebra operation.</p>	<p>2</p>	<p>CO2</p>



**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Even Semester End-term Examination, 2022-23**

Course Code: CSC 503

Full Marks: 25

Course Name: Compiler Design

Time: 90 Minutes

Question Paper No.: NITDGP/CSC503/

Date of Exam: 13/09/2023

Instructions: Answer any five questions. Sub-parts of a question must be attempted together.

Question No.	Group – A	Marks	Mapped CO
1	<p>(a) What is bootstrap compiler?</p> <p>(b) Obtain a regular expression for NIT Durgapur website address: <a href="https://www.nitdgp.ac.in">https://www.nitdgp.ac.in</a>.</p> <p>(c) Consider a string <math>aabb</math> which is accepted by the following NFA. Write the path to the accepting state, labelled by the symbols of the input string in order. If more than one path is found, that lead to different states than the final state, can the same string be considered to be accepted by the NFA? Explain briefly.</p>	(1+2+2)	CO1 & CO2
2	<p>Obtain a regular expression from the following automaton using state elimination method.</p>	5	CO2
3	<p>(a) Describe the regular expression: <math>a^*b^*(a^+ b^+)aab</math>.</p> <p>(b) Write the regular expression for the description: "All strings of zero or more occurrences of <math>a</math> and <math>b</math> with no single <math>a</math> and <math>b</math> together".</p> <p>(c) If the alphabet <math>\Sigma = \{a, b, c\}</math>, language <math>L = \{aa, ab, bb, ababc\}</math> and input string <math>s = aaababc</math>, then draw the automaton that accepts the language <math>LL^*</math> where <math>s \in LL^*</math>.</p>	(1+1+3)	CO2
4	Explain the maximal tokenization algorithm with a suitable example. Show that the naive version of the algorithm has a tight bound of quadratic complexity.	5	CO2
5	Explain what each of the following extended-regular-expression-based searches using the 'grep' utility, does (HERE, GPL-3 is the GNU Public License ver 3 text file). Give	(2.5+2.5)	CO2

**Course Outcomes**

- CO1: Understand Compilation and various phases
- CO2: Understand Lexical Analyzer and its Design
- CO3: Realize Syntax Analyzer - Top Down and Bottom UP
- CO4: Understand Semantic Analyzer and Intermediate Code
- CO5: Realize Code Optimization
- CO6: Idea of Code Generation, Instruction Costs
- CO7: Idea of Symbol Table, Implementation of Symbol Table



	<p>examples of what these searches may return. (There is no need to quote exact lines from the GPL 3 file; only examples will do):</p> <p>1.grep -E "[AEIOUaeiou]{3}" GPL-3  2.grep -E "(copy)?right" GPL-3</p>		
6	<p>List the tokens that are supposed to be generated by a typical Lexical Analyzer of the compiler, for the following C-Code:  [Your answer need not be an exact of what GCC does, conceptual illustration of token classes and lexeme pairs would suffice]  #include &lt;stdio.h&gt;</p> <pre> int main() {     int num1 = 5;     int num2 = 10;     int sum = num1 + num2;      printf("Sum: %d\n", sum);      return 0; } </pre>	5	CO2



NITDGP/BTECH/Reg/MT/2023-24

**NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**  
**Odd Semester Mid-Term Examination, 2023-24**

Course Code: CSC504

Course Name: EMBEDDED SYSTEMS

Full Marks: 25

Time: 90 Minutes

Instructions: Answer all the questions.

Question No.		Marks	Mapped CO
<b>SECTION: A ( Answer All)</b>			
1	An analog signal is passed through a low-pass filter of bandwidth 8 KHz. The filter output is sampled by a S/H (sample and hold) circuit by Nyquist sampling rate. The sampling period of the clock used to sample the signal is (a) $6.25 \times 10^{-5}$ s (b) $1.25 \times 10^{-5}$ s (c) $2\pi \times 10^{-5}$ s (d) $4 \times 10^{-5}$ s	1	CO3
2	The analog signal volts (where is expressed in seconds) is to be sampled at the Nyquist rate. The sampling frequency to sample the signal will be (a) 400 Hz (b) 600 Hz (c) 800 Hz (d) 1200 Hz	2	CO3
3	The analog signal volts ( is in seconds) is sampled at a rate of 1000 Hz. The sampled signal is filtered by a low pass filter of bandwidth 900 Hz. The alias frequency components at the output of the filter will be (a) 200 Hz, 700Hz (b) 200 Hz, 400 Hz (c) 600 Hz, 800 Hz (d) None of these	2	CO3
<b>SECTION: B (Answer Any Four)</b>			
4	What is an embedded system? What is meant by six box model of an embedded system?	1+4=5	CO1
5	What is FPGA? Explain the primary blocks of FPGA and how does a FPGA function with a proper example.	1+4=5	CO2
6	What are the difference between Harvard Architecture and Von-Neumann Architecture? Design a combinational circuit with three inputs a, b, and c, and two outputs x and y. When y is 1 if a is equal to 1, or b and c is equal to 1. z is 1 if b or c is equal to 1, but not both.	2+3=5	CO1
7	What is a microcontroller? Explain the differences between microprocessor and microcontroller.	1+4=5	CO3
8	Why we should use Arduino? What are interrupts? What is the purpose of PWM in Arduino? How many times does the setup () function run on every startup of the Arduino System?	2 1 1 1	CO3

Course Outcomes

- CO1: Understand the Building Blocks of Embedded Systems  
 CO2: Learn to implement circuits using FPGAs and HDL programming  
 CO3: Learn the working of microcontrollers in building embedded systems  
 CO4: Understand the importance of power in the design process  
 CO5: Understand the concepts and constraints of real-time systems.