

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

Course Code: CS0541

Full Marks: 25

Course Name: FUNDAMENTALS OF ALGORITHMS

Time: 90 Minutes

Question Paper No: NSTDGP/CS0541/77

Date of Exam: 15/09/2023

Instructions: Answer question of no 1 and any three from the rest. Different parts of a question must be written consecutively.

Written consecutively.

Question No.	Body of the Question	Marks	Mapped CO															
1	<p>Consider the array shown below:</p> <table><tr><td>7</td><td>5</td><td>9</td><td>3</td><td>1</td><td>6</td><td>2</td><td>4</td><td>8</td></tr></table> <p>Sort the array in ascending order by applying Selection Sort and Insertion Sort separately. Show the content of the array after each important step in both the cases. Also calculate the total number of comparisons performed in each of the cases.</p>	7	5	9	3	1	6	2	4	8	10	CO1, CO3						
7	5	9	3	1	6	2	4	8										
2	What do you mean by best case, average case and worst case of a given algorithm? Briefly describe how worst case performance of Quick sort depends on pivot selection.	2 + 3	CO1															
3	Briefly describe an efficient algorithm to merge two sorted arrays. Illustrate the algorithm using a suitable example.	5	CO2, CO3															
4	<p>Consider the array implementation of a binary tree as shown below:</p> <table><tr><td>F</td><td>A</td><td>D</td><td>E</td><td>K</td><td>H</td><td>G</td><td>-</td><td>-</td><td>C</td><td>-</td><td>-</td><td>-</td><td>B</td><td>-</td></tr></table> <p>Draw the tree and write down the sequence of nodes visited in preorder and inorder respectively.</p>	F	A	D	E	K	H	G	-	-	C	-	-	-	B	-	1 + 2 + 2	CO3
F	A	D	E	K	H	G	-	-	C	-	-	-	B	-				
5	We are given a set of n distinct elements and an unlabeled binary tree with n nodes. In how many ways can we populate the tree with the given set so that it becomes a binary search tree? Justify your answer.	2 + 3	CO3															
6	<p>a. The height of a tree is the length of the longest root-to-leaf path (i.e., equal to the number of edges in the longest root-to-leaf path). What will be the minimum and maximum number of nodes in a binary tree of height h?</p> <p>b. What is the worst case time complexity of insert operation in an arbitrary binary search tree of n nodes?</p>	3 2	CO2 CO1															

Course Outcomes

CO1: Will be able to analyse the time complexity of algorithms.
 CO2: Able to map real life problems into algorithmic framework.
 CO3: Will have concept of different algorithm design paradigm.

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

Course Code: CS0542

Full Marks: 25

Course Name: Database Management System (Open Elective)

Time: 90 Minutes

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	Discuss with example: a) Domain of an attribute b) Weak entity types and identifying owner.	2+3	CO1, CO2
2	What are the advantages of using Database system over file processing system? Enlist at least 5 differences or more. Discuss them in details with suitable examples.	5	CO1
3	Consider two database relations P (a,b) and Q (a,c) having 5 tuples in P and 4 tuples in Q respectively. What is the maximum number of tuples that could appear in natural join of P and Q and when? Explain with one example.	5	CO2
4	Consider the following relationships: The underlined attributes indicate the primary keys for the relation. COURSES (<u>CNo</u> , CName) STUDENTS(<u>RollNo</u> , Sname, Age, Year) Registered_FOR(<u>CNo</u> , RollNo) TEACHER (<u>TNo</u> , Tname, Designation, Dept) TEACHES(TNo, CNo) The underlined attributes indicate the primary keys for the relation. The 'Year' attribute for the STUDENTS relation indicate the year in which the student is currently studying. Express the following queries in relational algebra: a) Find the RollNo and name of the students who have registered for the CNo CS0542. b) Find which course no is opted by a student with name: "Alex". c) Find the teachers name and designation who teaches CNo CS0542 ? d) Find the list of students whom are taught by a teacher from Physics Department. e) Find the Name and age of Student with Rollno 301.	10	CO2, CO3

Course Outcomes

- CO1: Understand the basic concepts and appreciate the applications of database systems.
 CO2: Comprehend the fundamentals of design principles for logical design of relational databases.
 CO3: Apply the query writing skill and its subsequent optimization.
 CO4: Discuss the basic issues of transaction processing and concurrency control.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**Odd Semester Mid-Term Examination, 2023-24****Course Code:** CS0544

Full Marks: 25

Course Name: OPERATING SYSTEMS

Time: 90 Minutes

Instructions: Answer question No. 1 and any three from the rest (2 – 5).
Materials to be supplied: NIL.

Question No.	Body of the Question	Marks	Mapped CO																												
1	(a) How are time-sharing systems advanced (or complex) than multiprogramming systems? (b) Discuss the role of the size of the time-quantum in round-robin scheduling. (c) Write a short note on PCB. (d) What is fork?	2+2 +2+1	CO1, CO2																												
2	Suppose that the following processes arrive for execution at the times indicated. Each process will run the listed amount of time. <table><tr><th>Process</th><th>Arrival Time</th><th>CPU Burst</th></tr><tr><td>P₁</td><td>0</td><td>8</td></tr><tr><td>P₂</td><td>1</td><td>6</td></tr><tr><td>P₃</td><td>2</td><td>5</td></tr><tr><td>P₄</td><td>3</td><td>3</td></tr><tr><td>P₅</td><td>8</td><td>1</td></tr><tr><td>P₆</td><td>13</td><td>2</td></tr></table> Show in Gantt Chart to use Shortest Remaining Time first, Round Robin scheduling (quantum 2 unit), and Highest Response Ratio Next algorithms. Find average waiting time for each algorithm.	Process	Arrival Time	CPU Burst	P ₁	0	8	P ₂	1	6	P ₃	2	5	P ₄	3	3	P ₅	8	1	P ₆	13	2	6	CO2							
Process	Arrival Time	CPU Burst																													
P ₁	0	8																													
P ₂	1	6																													
P ₃	2	5																													
P ₄	3	3																													
P ₅	8	1																													
P ₆	13	2																													
3	What is deadlock? Explain the techniques for deadlock prevention.	6	CO2																												
4	Consider the following snapshot of a system having 5 processes. Apply the Bankers algorithm to check whether there is any safe sequence. Show the steps in detail. <table><tr><th>Process</th><th>Allocation</th><th>Max</th><th>Available</th></tr><tr><td></td><td>A B C</td><td>A B C</td><td>A B C</td></tr><tr><td>P0</td><td>1 1 2</td><td>5 4 4</td><td>3 2 1</td></tr><tr><td>P1</td><td>2 1 2</td><td>4 3 3</td><td></td></tr><tr><td>P2</td><td>3 0 1</td><td>9 1 3</td><td></td></tr><tr><td>P3</td><td>0 2 0</td><td>8 6 4</td><td></td></tr><tr><td>P4</td><td>1 1 2</td><td>2 2 3</td><td></td></tr></table>	Process	Allocation	Max	Available		A B C	A B C	A B C	P0	1 1 2	5 4 4	3 2 1	P1	2 1 2	4 3 3		P2	3 0 1	9 1 3		P3	0 2 0	8 6 4		P4	1 1 2	2 2 3		6	CO2
Process	Allocation	Max	Available																												
	A B C	A B C	A B C																												
P0	1 1 2	5 4 4	3 2 1																												
P1	2 1 2	4 3 3																													
P2	3 0 1	9 1 3																													
P3	0 2 0	8 6 4																													
P4	1 1 2	2 2 3																													
5	Explain Critical Section with a suitable example. Propose a solution for the critical section problem and validate your solution.	6	CO4																												

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: Implantation of standard FAT & UNIX file system.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-2024

Course Code: CSO 741

Full Marks: 25

Course Name: SOFTWARE ENGINEERING

Time: 90 Minutes

Instructions: Answer Question 1 and any 4 (Four) from the rest

Question No.	Body of the Question	Marks	Mapped CO
1	A local telephone company uses a software to process requests for field services. A customer complains of a problem. If on diagnosis it is found that the problem is relatively simple, a single repair action occurs. However, if it is a complex problem then multiple repair actions may be required. Show and explain the Relationship, Cardinality and Modality between data objects, customer and the corresponding repair action	5	CO2
2	i) What is an SRS? State and explain the characteristics of an SRS. ii) What is Superclass and subclass	3 2	CO2 CO1
3	i) Compare and Contrast <i>generalization</i> and <i>specialization</i> with example. ii) Explain <i>Aggregation</i> with an example iii) What are the two main phases of a V model? Explain	2 2 1	CO2 CO2 CO1
4	i) What does an ER Diagram express? ii) Which model is not suitable for accommodating any change? iii) What is an Entity iv) What is the requirement of an EER? v) What is a Prototype?	1 1 1 1 1	CO2 CO1 CO2 CO2 CO1
5	Case Study: This is a risk driven model. At a first sight, it may seem like this model is complicated and clumsy, and that there are no reasons to consider this approach as one of your options. But, like any other SDLC models, this model, besides its disadvantages, has its unique strong sides. i) What model are we talking about and who proposed it? ii) Give two advantages and two disadvantages of this model. iii) What is Risk and give one example of risk. iv) Give one difference of this model with any other SDLC model	1 2 1 1	CO1
6.	The Library Management System database keeps track of readers with the following considerations – The system keeps track of the staff with a single point authentication system comprising login Id and password. Staff maintains the book catalog with its ISBN, Book title, price (in INR), category (novel, general, story), edition, author Number and details. A publisher has publisher Id, Year when the book was published, and name of the book.	5	CO2

Course Outcomes

- CO1: Identify and describe software life cycle model and their roles in building software project.
- CO2: Recognize the feasibility of functional and non-functional requirements applying decision tree/table minimization techniques/methodologies for a particular problem.
- CO3: Apply modularity in project resulting design of flexible software code with reusability.
- CO4: Effectively use existing testing strategy to test the software and make sure the reliability of the software and analysis of quality of the software.
- CO5: Apply the project management tools, estimation techniques to handle the project.

	<p>Readers are registered with their user_id, email, name (first name, last name), Phone no (multiple entries allowed), communication address. The staff keeps track of readers.</p>		
--	--	--	--

	<p>Readers can return/reserve books that stamps with issue date and return date. If not returned within the prescribed time period, it may have a due date too. Staff also generates report that has reader's id, registration no of reports, book no and return/issue info.</p>		
--	--	--	--

	<p>Draw the ER diagram for the above Library Management System.</p>		
--	---	--	--

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: CSO-742


Full Marks: 25

Course Name: Multimedia Technologies

Time: 90 Minutes

Instructions: Answer any five questions.

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

Question No.	Body of the Question	Marks	Mapped CO
1a	What is perception medium, representation medium, presentation medium, storage medium etc. in multimedia?	2	CO1
1b	Why multimedia files are difficult to handle than text files?	2	CO1
1c	Name any 2 file formats	1	CO1
2a	With a neat diagram, explain vector quantisation. Is it lossless or lossy encoding?	3+1	CO2
2b	Why is Arithmetic encoding preferred over Huffman encoding?	1	CO2
3a	Explain linear list notation or general purpose language as an animation language.	2	CO1
3b	What is kinematic description of a scene and what is dynamic description of a scene?	3	
4a	What is perceptual encoding? Where is it used? How is it different from predictive encoding? Where is predictive encoding used? Which gives a better compression ratio?	1+1+1	CO2
4b		+1+1	
5a	Generate the Huffman code for the following string characters. Show the steps to derive the codes of A,B,C and D characters  Initial string	3	CO2
5b	What is the difference between entropy encoding and source encoding?	2	CO2
6a	What is vertical and horizontal blanking?	3	CO1
6b	What is aspect ratio and Kell factor?	1+1	CO1

Course Outcomes

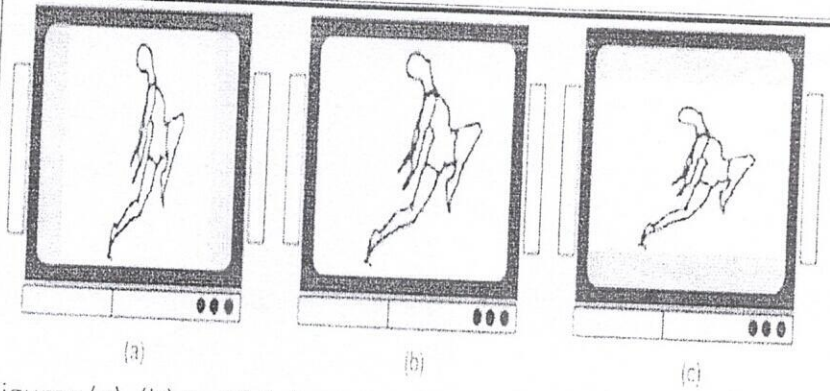
CO1:Indepth understanding of media and data stream, audio, image, video, graphics and animation

C02: Understand multimedia compression techniques, multimedia operating systems fundamentals and multimedia network fundamentals

CO3: Understand multimedia synchronization aspects, SAS factors, issues on dealing with multiple data formats, encryption/decryption techniques

CO4: Understanding of multimedia databases, multimedia storage and retrieval

7a



Figures (a), (b) and (c) show aspect ratio of a TV/Monitor? Which is the correct aspect ratio? (Name the figure number). Also, what is the definition of aspect ratio and value of aspect ratio followed in India?

3

CO1

2

CO1

7b

Explain one colour model (RGB/YUV)

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR**Odd Semester Mid-Term Examination, 2023-24****Course Code:** CS0743**Full Marks:** 25**Course Name:** Computer Networks**Time:** 90 Minutes

Instructions: Answer all the questions. Clearly mention your assumptions where necessary. Answer questions in sequence. This should be strictly followed. Leave space to answer a question later.

Q. No.		Marks	Mapped CO
A1.	Assume that the distance between the sender and the receiver is 1000km and propagation speed of the signal is $2.3 \times 10^8 \text{ms}^{-1}$. Calculate the time required to send 100 packets, where each packet is of size 1KB and data-rate is 10Kbps.	2	CO2
A2.	What is the minimum required bandwidth of a low-pass channel if we need to send 2Mbps by using baseband transmission? What is the required bandwidth if we use the first, third and the fifth harmonics?	2+1=3	CO2
A3.	Consider a signal of 1KHz, that is sampled at regular intervals and then coded using 8 signal levels. What is the sender data-rate? Now if the BER is 10^{-4} , packet size is 100bytes, and number of packets to be sent is 1000, what is the achievable throughput without any ARQ mechanism in place?	2+2=4	CO2
A4.	Assume that the channel has a bandwidth of 25kHz and uses three harmonics. The system uses 00 to encode a 0 and 11 to encode a 1. What is the maximum data-rate that can be achieved?	2	CO2
A5.	A sender uses the stop and wait ARQ protocol for reliable transmission of frames. Frames are of size 100 bytes and the transmission rate at the sender is 20Kbps. Size of an acknowledgement is 10bytes and the transmission rate at the receiver is 8Kbps. The one-way propagation delay is 10 msec. Assuming no frame is lost, what is the sender throughput?	3	CO3
A6.	Consider a packet switched network that divides a message of size 200kB into smaller packets of size 'k' and adds a header of 20 bytes to each packet. If the packets are transmitted over 4 hops, what should be value of k that minimizes the delay?	3	CO3
A7.	Consider that the message 1010001101 is to be transmitted using the generator polynomial $x^5+x^4+x^2+1$. What is the CRC for this message?	3	CO2
A8.	Suppose that a radio system uses a 9600bps channels for sending call setup request messages to a base station. Suppose that packets are 120 bits long, that the timeout is 20ms, and that the back-off is uniformly distributed between 1 and 7. What is the maximum throughput possible with ALOHA and slotted ALOHA? Compare the average delay in ALOHA and slotted ALOHA when the load is 40% of the maximum possible throughput of the ALOHA system.	2+3=5	CO3

Course Outcomes

CO1: Understand the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.

CO2: Comprehend the fundamentals of Physical layer, and will apply them in real time applications.

CO3: Identify data link layer concepts, design issues, and protocols.

CO4: Classify the routing protocols and analyze how to assign the IP addresses for the given network.

CO5: Acquire knowledge of Application layer and Presentation layer paradigms and protocols.