MID-SEMESTER EXAMINATION, May-2023
COMPUTER ORGANIZATION AND ARCHITECTURE (EET 2211)

Programme: B. Tech **Semester:4th**
Full Marks: 30 **Time: 2 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
CO-1: Able to explain the concepts that underline the modern Computers evolution, function, and organization.	L2	1	6
CO-2: Able to identify the appropriate organization of a computer for achieving the best performance.	L3	3,4	12
CO-3: Able to analyze and demonstrate the computer function and interconnection.	L2	2	6
CO-6: Able to interpret low level processor operations using a series of computer instructions.	L3	5	6

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) List and define the main structural components of a computer. 2

   (b) Describe the different ARM products. 2

   (c) Explain the cloud services provided by cloud service providers. 2

2. (a) Explain instruction cycle state diagram with interrupt. 2

(b) Describe the three key concepts of Von Neumann Architecture. 2

(c) Discuss the two approach for handling multiple interrupt. 2

3. (a) Summaries the differences among multicore systems, MICs, and GPGPUs. 2

(b) A doctor in a hospital observes that on average 6 patients per hour arrive and there are typically 3 patients in the hospital. Calculate the average length of time each patient spends in the hospital? 2

(c) A benchmark program is run on a 400 MHz processor. The executed program consists of 100,0000 instruction executions, with the following instruction mix and clock cycle count: 2

Instruction Type	Instruction Count	Cycles per Instruction
Integer arithmetic	400000	1
Data transfer	350000	2
Floating point	200000	3
Control transfer	50000	2

Determine the effective CPI, MIPS rate, and execution time for this program.

4. (a) List and briefly define some of the techniques used in contemporary processors to increase speed. 2

(b) Describe Amdahl's law. 2

(c) List the desirable characteristics of a benchmark program. 2

5. (a) Describe the architecture of 8086 processor. 2

(b) Explain indirect addressing along with its advantage. 2

(c) Write an assembly language code to convert 8-bit binary to 8-bit gray code. 2

"End of Questions"

MID SEMESTER EXAMINATION, MAY-2023
ALGORITHM DESIGN-2 (CSE 4131)

Programme: B.Tech.(CSE/CSIT) Semester: 4th

Full Marks: 30 Time: 2 Hours

Course Outcome	*Taxonomy Level	Ques. Nos.	Marks
CO1: understand the network flow problem and apply to real world problems	L3, L4, L5	1(a), 1(b), 1(c), 2(a), 2(b), 2(c)	2+2+2+ 2+2+2
CO2: distinguish between computationally ractable and intractable problems. · define and relate class P, class NP and class P-complete, PSPACE, PSPACE-complete · given a problem in NP, define an ppropriate certificate and the verification algorithm	L3, L4, L5,	3(a), 3(b), 3(c), 4(a), 4(b), 4(c), 5(a), 5(b), 5(c)	2+2+2+ 2+2+2+ 2+2+2
CO3: understand approximation algorithms and apply its concept to solve problems			
CO4: understand local search techniques and apply this concept to solve problems			
CO5: understand randomization and apply this oncept to solve problems			
CO6: identify and apply an appropriate algorithmic pproach to solve a problem and explain the hallenges to solve it			

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

Consider the following network flow G=(V,E), where V = {s, a, b, c, d, t} and capacity of the edges in E are c(s, a) = 8, c(s, b) = 7, c(a, b) = 4, c(b, a) = 2, c(a, c) = 3, c(d, t) = 4, c(c, d) = 2, c(c, t) = 5, c(b, d) = 10, c(b, c) = 7, c(d, b) = 9, where s and t are the source and sink node respectively.

(a) Draw the above flow network. 2

(b) Find all possible cut set of the given graph and then find the minimum cut set of the graph. 2

(c) Let C=(S,V-S) be a minimum cut in a flow network. If we strictly increase the capacity of every edge across C, then the maximum flow of the network must increase. TRUE/FALSE. Justify. 2

2. The department of CSE at ITER is organizing a one-week national level workshop with multiple sessions, each of one hour duration. The department has asked the second-year students to contribute as volunteers for the event. The students are divided into groups of five students and at most one group will be allocated to each session of the workshop. Let's assume there are n groups $g_1, g_2, g_3, \ldots, g_n$ and m sessions in total as $s_1, s_2, s_3, \ldots, s_m$. The classes of the students are rescheduled in such a way that each group is available for some of the sessions and unavailable for others. Each session s_j must be assigned with at most one group. The maximum load given to a group cannot exceed a load limit of l_i. We need to maximize the number of sessions covered by the given groups considering their availability and without exceeding the workloads of the students.

(a) Give a mathematical model of the given problem as the maximum flow problem. Explain the objective and the constraints. 2

(b) How can we solve it using Ford-Fulkerson algorithm? [Show the residual graphs at every stage]. 2

(c) Given an instance of the above problem as follows, find the assignment of the groups to the sessions if the maximum load limit for any group 2

is two hours. Check if any session or group is remaining unassigned.

Groups	Available in sessions
g_1	s_1, s_2, s_4, s_6
g_2	s_1, s_3, s_5, s_7
g_3	s_2, s_4, s_6, s_7

3. (a) Given a decision vertex-cover problem instance $(G=(\{s_1,s_2,s_3,s_4,s_5,s_6,s_7\},\{(s_1,s_2),(s_1,s_6),(s_2,s_3),(s_1,s_7),(s_2,s_7),(s_3,s_4),(s_3,s_7),(s_4,s_5),(s_4,s_7),(s_5,s_6),(s_5,s_7),(s_6,s_7)\}),k=4)$. Find the decision set-cover problem instances. (i.e., U, s_1 to s_m and k). 2

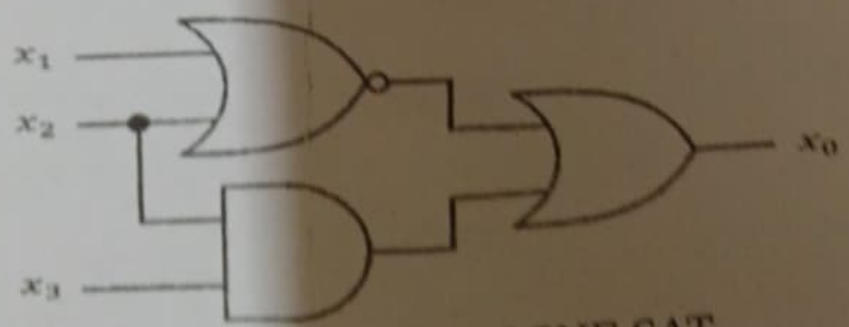
(b) Design a reduction algorithm for Vertex-Cover $\leq_P$ Set-Cover. 2

(or) Find the minimum vertex-cover and maximum set-cover. 2

4. (a) If a problem X can be reduced to a known NP-hard problem, then X must be NP-hard. State TRUE/FALSE with proper reason. 2

(b) $\varphi(x) = (x_1 \vee x_2 \vee x_3) \wedge (x_4 \vee x_5 \vee x_6) \wedge (x_7 \vee x_8 \vee x_9) \wedge (x_{10} \vee x_{11} \vee x_{12})$ 2
Reduce the 3-SAT formula $\varphi(x)$ into independent set and find the maximum independent set.

(or) Given a Boolean circuit as follows. 2



Convert it into an instance of CNF-SAT.

5. (a) Based on the widespread belief, give a pictorial relationship between P, NP, co-NP and PSPACE class of problems. 2

(b) Give the problem statement for decision-competitive-facility-location problem. 2

(c) The decision Quantified-3SAT problem is defined as: "Whether there is a choice for x1, so that for both choices of x2, there is a choice for x3, and so on, so that ϕ is satisfiable?", that is 2

$\exists x_1 \ \forall x_2 \ \exists x_3 \ \ldots \ \exists x_{n-2} \ \forall x_{n-1} \ \exists x_n \ \phi(x_1, x_2, \ldots, x_n)$ is satisfiable?

What transformation in the above definition will make it the original decision 3SAT problem?

*** End of Questions ***

2141020001

MID-SEMESTER EXAMINATION, May-2023
Computer Science Workshop 2 (CSE3141)

Programme: B.Tech(CSE/CSIT) **Semester:4th**
Full Marks: 30 **Time: 2 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Analysis algorithm using time and space complexity	L4	Q.1	6
Understanding and effectively use ADT, java collection, sorting and searching	L4	Q.2,Q Q.3,Q .4,Q. 5	24
Applying linkedlist, stack, queue on different problem solving			
Applying priority queue, graph on problem solving			
Understanding algorithm design tchniques			
Applying design techniques on problem solving			

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Write a program to create a class **ArrayApp**, add a method to the class which takes two increasing order integer arrays as argument and find maximum sum by choosing few consecutive elements from one array then few elements from other. The element switching can happen at transition point only when element value is same in both the array. Find the time complexity of the function using the step count method. 2

(b) Create another method which takes an integer array as argument. and return the smallest positive missing number. 2

(c) Create and add a recursive method to **ArrayApp** class which takes an integer as its argument and returns the hexadecimal form Create a main method to invoke the above method for execution. 2

Note: Write as a single program for Q.1a, Q.1b, Q.1c

2 (a) Write a program to create a class **AttendanceApp** having registration number, name and number of classes attended as instance member variables and total no. of classes as static member and calculate the percentages of attendance of each student. 2

(b) Create a table to store the registration number and the percentage of attendance. Use appropriate collection class to store it. 2

(c) Display the table. Find and display the student having attendance less than 75% and remove them from the table. Count the number of students having attendance more than or equals to 75%. 2

Note: Write as a single program for Q.2a, Q.2b, Q.2c

3 (a) Write a program to sort elements of a given array using quick sort. 2

(b) Show and justify how quick sort is not a stable sorting algorithm with an example. 2

(c) Find the best, worst, and average case time complexity. 2

4 (a) Create a class **SortApp**, add a method to it which takes an array of positive elements as its argument and perform the reduction operation. In each reduction operation the smallest positive element value is picked, and all the elements are subtracted by that value. The function prints the number of elements left after each reduction process. 2

(b) Add a method to the **SortApp** class which takes two arrays as its argument and sort the first array according to the order defined in second array. 2

(c) Add a method to the **SortApp** class to invoke the above method and calculate the time complexity of the above two methods. 2

Note: Write as a single program for Q.4a, Q.4b, Q.4c

5 (a) Create a class **SearchApp**, add a method to this class which takes argument an array of integer in which all the elements appear even number of times except two, which appear odd number of times. The function find which elements appear odd number of times in $O(n)$ time complexity and $O(1)$ space complexity. 2

(b) Add a method to the **SearchApp**, class which takes an array of integers as its argument and find a triplet whose sum is equal to a given value. Calculate its time complexity. 2

(c) Add a method to **SearchApp** class which takes an array as its argument and find the majority element., which appear more than $n/2$ times. Return 0 in case there is no majority element. Add the required method to execute the above created methods. 2

Note: Write as a single program for Q.5a, Q.5b, Q.5c

"End of Questions"

2 (a) Write a program to create a class **AttendanceApp** having registration number, name and number of classes attended as instance member variables and total no. of classes as static member and calculate the percentages of attendance of each student. 2

(b) Create a table to store the registration number and the percentage of attendance. Use appropriate collection class to store it. 2

(c) Display the table. Find and display the student having attendance less than 75% and remove them from the table. Count the number of students having attendance more than or equals to 75%. 2

Note: Write as a single program for Q.2a, Q.2b, Q.2c

3. (a) Write a program to sort elements of a given array using quick sort. 2

(b) Show and justify how quick sort is not a stable sorting algorithm with an example. 2

(c) Find the best, worst, and average case time complexity. 2

4. (a) Create a class **SortApp,** add a method to it which takes an array of positive elements as its argument and perform the reduction operation. In each reduction operation the smallest positive element value is picked, and all the elements are subtracted by that value. The function prints the number of elements left after each reduction process. 2

(b) Add a method to the **SortApp** class which takes two arrays as its argument and sort the first array according to the order defined in second array. 2

(c) Add a method to the **SortApp** class to invoke the above method and calculate the time complexity of the above two methods. 2

Note: Write as a single program for Q.4a, Q.4b, Q.4c

5. (a) Create a class **SearchApp,** add a method to this class which takes argument an array of integer in which all the elements appear even number of times except two, which appear odd number of times. The function find which elements appear odd number of times in $O(n)$ time complexity and $O(1)$ space complexity. 2

(b) Add a method to the **SearchApp**, class which takes an array of integers as its argument and find a triplet whose sum is equal to a given value. Calculate its time complexity. 2

(c) Add a method to **SearchApp** class which takes an array as its argument and find the majority element., which appear more than n/2 times. Return 0 in case there is no majority element. Add the required method to execute the abive created methods. 2

Note: Write as a single program for Q.5a, Q.5b, Q.5c

End of Questions

MID-SEMESTER EXAMINATION, May 2023
APPLIED LINEAR ALGEBRA (MTH-3003)

Programme: B. Tech **Semester: 4th**
Full Marks: 30 **Time: 2 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Concept of row picture to understand the geometrical meaning of the solution of the system of equations, Gaussian elimination method and singular system.	L3, L3, L5	1. a, b, c	2, 2, 2
Explains to understand the concept of matrix construction and matrix multiplication. Also, explains the role of elementary matrices to convert a matrix into upper triangular form.	L3, L3, L5	2. a, b, c	2, 2, 2
Explains the concept of triangular factorization, matrix inverse using Gauss Jordan method.	L5, L3, L3	3. a, b, c	2, 2, 2
Explains the concept vector space, subspaces, column space and nullspace, echelon form to find the rank.	L4, L3, L3	4. a, b, c	2, 2, 2
Explains the concept of reduced row echelon form of matrices, linear independence and dependence of vectors, basis and dimension. Orthogonality and Orthogonal projections.	L3, L5, L3	5. a, b, c	2, 2, 2

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Sketch the column picture and decide the number of solutions for the following system. [2]

$$2x - y = 1$$
$$x + y = 5$$

(b) Apply Gaussian elimination to solve the following system. [2]

$$u + v + w = 3$$
$$u + 3w = 4$$
$$u + v + 7w = 9$$

(c) Discuss the values of α for which the elimination breaks down [2]
(a) permanently (b) temporarily.

$$\alpha x + 3y = -3$$

$$4x + 6y = 6$$

2. (a) Determine the value of α for which the system is singular and [2]
the value of β for which the system has infinitely many solutions.

$$x + 4y - 2z = 1$$

$$x + 7y - 6z = 6$$

$$3y + \alpha z = \beta$$

(b) Determine the three elementary matrices that put the following [2]
matrix into upper triangular form.

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 2 & 2 \\ 3 & 4 & 5 \end{bmatrix}.$$

(c) Discuss symmetric matrix and skew-symmetric matrix giving [2]
examples 3rd order.

3. (a) Design an example with AB=AC but $B \neq C$. [2]

(b) Determine the three elementary matrices that put the following [2]
matrix into upper triangular form.

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 2 & 2 \\ 3 & 4 & 5 \end{bmatrix}.$$

(c) Discuss symmetric matrix and skew-symmetric matrix giving [2]
examples 3rd order.

4. (a) Categorize whether the following set is a subspace of R^2 or not. [2]
Justify your answer.

$V=\{(b_1,b_2): b_1>0, b_2>0 \text{ and } b_1 \in R, b_2 \in R\}$

(b) Describe the column space and the null space of the matrix [2]

$$A=\begin{bmatrix}1 & 0\\ 2 & 0\\ 0 & 0\end{bmatrix}.$$

(c) Compute the rank of the matrix. [2]

$$A=\begin{bmatrix}1 & 3 & 3 & 2\\ 2 & 6 & 9 & 7\\ -1 & -3 & 3 & 4\end{bmatrix}$$

5. (a) Project the vector b onto the line through a. Check that e =b-p is [2]
perpendicular to a. Where b = (1, 2, 2) & a = (1, 1, 1).

(b) Decide the dependence or independence of the vectors (1,2,3), [2]
(2,3,1), (3,2,1).

(c) Determine a basis and calculate the dimension of the vector space [2]
$x+2y-3z-t=0$ in R^4.

End of Questions