

MID-SEMESTER EXAMINATION, April-2024
Computer Science Workshop 2 (CSE 3141)

Programme: B.Tech. (CSE)
Full Marks: 30

Semester: 4th
Time: 2 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Understanding Object-oriented programming, generic and collection class and applying it to solve different problems.	L1, L2, L3	Q.1, Q.2	6+6
Understanding Error handling, garbage collection, string, I/O operation, and file management of java. And apply it to solve related problems.	L1,L2, L3	Q.3, Q.4, Q.5	6+6+6
Learning different data structure and applying it to solve different problems and analyze its effectiveness on different problem-solving. Understanding and applying Lambdas and Functional programming using Java.	L1,L2, L3		
Understanding multithreading and reactive programming of java, and applying it to solve related problems.	L1,L2,L3		
Learning spring and spring MVC of Java and applying it to solve different problems	L1,L2, L3		
Understanding and learning Hibernate and applying it to solve different problems.	L1,L2, L3		

*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) Define an interface named **Shape** with two abstract methods: 2
area() and *perimeter()*.
- (b) Create two classes, **Circle** and **Rectangle**, both of which implement the **Shape** interface. In the Circle class, override the *area()* and *perimeter()* methods to print appropriate messages indicating the area and perimeter for a circle. Similarly, in the Rectangle class, override the same methods to display messages specific to a rectangle's area and perimeter. 2

- (c) Implement method overloading in both classes by providing multiple versions of the `area()` method, each accepting different parameters such as radius. Finally, create a Main class to instantiate objects of both **Circle** and **Rectangle** classes, test their overridden methods, and demonstrate method overloading by invoking different versions of the `area()` method. 2
- Note: Write one program for Q1 a, b, c.*
2. (a) Create a Class **Car** that has modelNo, name, and price as member variables. Add the required constructor and methods to it.
Note: Don't close the Car class keep some space to add some other method to it. 2
- (b) Override the required method, which is used for sorting, and searching car objects according to car price. 2
- (c) Create another class named **CarApp** and create a carShowroom which is an `ArrayList` of car objects. Sort the carShowroom according to price. Search for a particular car object according to price. Display the cars after sorting. 2
- Note: Write one program for Q2 a, b, c.*
3. (a) Write a Java program to create a class named **MyArithmaticException** by extending the required class. Add the required method and member variable to this class. 2
- (b) Create another class **CalculatorApp**. Add the main method to it which reads two integer numbers and performs addition, subtraction, multiplication, and division operations, and prints the results. 2
- (c) Add the required technique which throw and handles the **MyArithmaticException** exception if the the first number is smaller than the second number. Also, add the required technique to handle the divide by zero exception. 2
- Note: Write one program for Q3 a, b, c.*
4. (a) Write a Java program to create an **Employee** class having name, age, and date of birth(dd/mm/yyyy). Add the required method and constructors to it. Add a method to this class that generates a password that takes the last name and year from the date of birth and returns it. 2

Example:

Input: If name is Ramesh Kumar and date of birth is

- 23/07/1993
Output: Password is Kumar1993
- (b) Add a method to the **Employee** class that takes a string that consists of the name, date of birth, and age as its argument create a student object from it and return it. 2
- (c) Add a method to the **Employee** class that prints the details of the student in the below format.
 First name:
 Middle name:
 Last name:
 DOB:dd-mm-yyyy
 Age:
 Invoke the above-created method for execution.
- Note: Write one program for Q4 a, b, c.*
5. (a) Write a Java program that creates an array of integers and reads some elements for the array. Create a static function that takes a number as an argument and checks whether the number is prime or not. 2
- (b) Create a static function that takes a file name and opens the file if it is present otherwise shows a proper message without terminating the program. If the file is present, then it stores all prime numbers present in the array in the file. 2
- (c) Create a static function that takes a file name of the above-created file and opens the file if it is present otherwise shows the proper message without terminating the program. Display the prime numbers which are present in the file. 2

Note: Write one program for Q5 a, b, c.

End of Questions

- (b) What will be the resulting makespan of running this greedy algorithm on a given sequence of $n=m(m-1)+1$ jobs with processing time $t_j=1$ for $1 \leq j \leq n-1$ and $t_n=m$, for $m=4$ identical machines?
- (c) Compare the resulting assignment in Q5(b) with the optimal assignment which can be obtained by assigning the largest job to one of the machines and evenly spreading the remaining jobs over the other $m-1$ machines.

*** End of Questions ***

MID SEMESTER EXAMINATION, APRIL-2024
ALGORITHM DESIGN-2 (CSE 4131)

Programme: B.Tech.(CSE/CSIT/CDS/CIOT/CAIML/CCS)

Semester: 4th Full Marks: 30

Time: 2 Hours

Course Outcome	Taxonomy Level	Ques. Nos.	Marks
CO1: understand the network flow problem and apply it to real-world problems.	L3, L4, L5	1(a), 1(b), 1(c)	2+2+2
CO2: - distinguish between computationally tractable and intractable problems. - define and relate class-P, class-NP and class NP-complete, PSPACE, PSPACE-complete. - given a problem in NP, define an appropriate certificate and the verification algorithm.	L3, L4, L5,	2(a), 2(b), 2(c), 3(a), 3(b), 3(c), 4(a), 4(b), 4(c).	2+2+2+2+2+2
CO3: understand approximation algorithms and apply this concept to solve problems.	L4, L5, L6	5(a), 5(b), 5(c)	2+2+2
CO4: understand local search techniques and apply this concept to solve problems.			
CO5: understand randomization and apply this concept to solve problems.			
CO6: identify and apply an appropriate algorithmic approach to solve a problem and explain the challenges to solve it.			

*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. Consider a flow-network $G(V, E)$, where $V = \{s, a, b, c, d, e, f, g, h, i, t\}$ and capacities of the edges in E are $c(s,a)=2$, $c(s,b)=3$, $c(s,c)=2$, $c(a,d)=2$, $c(b,d)=1$, $c(b,e)=1$, $c(c,e)=2$, $c(c,f)=1$, $c(d,g)=3$, $c(e,h)=2$, $c(f,i)=1$, $c(g,t)=2$, $c(h,t)=3$, $c(i,t)=2$ where s and t are the source and sink node respectively.
- (a) Compute the maximum flow from s to t of the above graph using Ford-Fulkerson algorithm. 2
- (b) Show the minimum-cut and find the capacity of minimum cuts. 2

- (c) A bipartite graph $G = (V, E)$ has the sets $V = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ of vertices and $E = \{(0, 9), (1, 5), (1, 7), (2, 6), (2, 8), (3, 5), (3, 6), (3, 9), (4, 6), (4, 7)\}$ of edges. Given a maximal matching $M_o = \{(0, 9), (1, 7), (2, 8), (3, 6)\}$ of the four pairs of vertices, find a maximum matching of all five pairs of vertices as follows: "Select two possible augmenting paths P_1 and P_2 for M_o and justify your selection." 2

- 2
 (a) Give a simple reduction algorithm to reduce Sorting problem to Convex-Hull problem.
- (b) Define the class NP-Hard. How does it differ from NP-Complete? Provide examples of NP-Hard problems that are not necessarily in NP. Explain why they are classified as NP-Hard. 2
- (c) Given clauses : $C_1 = x_1 \vee 0 \vee 0$, $C_2 = x_2 \vee 0 \vee 0$, $C_3 = x'_1 \vee x'_2 \vee 0$
 (i) Is $C_2 \wedge C_3$ satisfiable ?
 (ii) Is $C_1 \wedge C_2 \wedge C_3$ satisfiable ? 2

3. (a) Give the formal problem statement for both decision and optimization version of "Set-Cover" problem. 2
- (b) Give a reduction algorithm for $\text{Vertex-Cover} \leq_p \text{Set-Cover}$. 2
- (c) Given a graph $G(V, E)$ where V is the set of vertices and set of all edges $E = \{(v1, v2), (v1, v9), (v2, v3), (v2, v8), (v3, v5), (v4, v5), (v5, v6), (v6, v7), (v7, v8), (v7, v9)\}$, can a Vertex Cover of size 4 possible for the given graph? Justify your answer. 2

4. (a) Give a proper example scenario where we can solve a NP-Complete problem by sacrificing one of its 2

features, i.e.-"solve arbitrary instances of the given problem".

- (b) Give a formal problem statement for decision-quantified-satisfiable problem. How it is different from the 3-satisfiable problem? 2
- (c) Consider the problem of "Given a 3×3 board with 8 tiles (every tile has one number from 1 to 8) and one empty space. The objective is to place the numbers on tiles to match the final configuration using the empty space. The primary challenge of the 8-puzzle problem lies in starting from a given initial state and finding a sequence of moves that leads to the goal state". Model this problem as a planning problem. (Hint: set of conditions, initial state, goal state, set of operators etc.) 2

5.

```

Greedy-Load-Balance (n,m,t[1...n]) {
    start with no jobs assigned
    set  $T_i = 0$  and  $A(i) = \emptyset$  for all machines  $M_i$ 
    for  $j = 1, \dots, n$  do {
        let  $M_i$  be a machine with the minimum  $\min_k T_k$ 
        assign job  $j$  to machine  $M_i$ 
        set  $A(i) \leftarrow A(i) \cup \{j\}$ 
        set  $T_i \leftarrow T_i + t_j$ 
    }
    return  $A[1], A[2], \dots, A[m]$ 
}
  
```

- (a) For the above given approximation algorithm, one possible lower bound on the optimal assignment is – "one of the m machines must do atleast the amount of work same as the maximum processing time of any job". Provide a critical view on this lower bound. 2

MID-SEMESTER EXAMINATION, April-2024
Applied Linear Algebra (MTH 3003)

Programme: B.Tech.(All Except ME)
Full Marks: 30

Semester: 4th
Time: 2 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Concept of column picture to understand the geometrical meaning of the solution of the system of equations, Gaussian elimination method and singular system. Also, explain the role of elementary matrices to convert a matrix into upper triangular form.	L4,L4, L3,	1. a, b, c	2, 2, 2
Explain the concepts of triangular factorization, matrix inverse using Gauss Jordan method.	L5, L4,L3, L4,L5, L4	2. a, b, c 3. a, b, c	2, 2, 2 2, 2, 2
Explain the concept vector space, subspaces, column space and null space, echelon form to find the rank.	L3, L3	4. a, b	2, 2
Explain the concepts of row reduced echelon form of matrices, linear independence and dependence of vectors, basis and dimension.	L3, L4,L3	4. c, 5. a	2, 2
Explain the concepts of four fundamental subspaces, left-inverse, right inverse of a matrix and the concept of linear transformation.	L4, L5	5. b, c	2, 2

*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) Explain the column picture for the equations

$$\begin{aligned}x - 2y &= 0 \\x + y &= 6.\end{aligned}$$

2

- (b) Discuss the relations between b_1 and b_2 and the number of 2 solutions of the corresponding system
 $3x - 2y = b_1$
 $6x - 4y = b_2$
- (c) Solve the following system using Gaussian elimination method.
 $u + v = 0$
 $u + 2v + w = 1$
 $2u - v - 3w = 3$
2. (a) Elaborate skew-symmetric matrix with an example of a 3×3 matrix
(b) Factorize the matrix 'A' as $A = LDU$ form, where L is the lower triangular matrix, D is the diagonal matrix and U is the upper triangular matrix.
 $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
- (c) Determine the inverse of the following matrix using Gauss-Jordan method.
 $A = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$
3. (a) Explain about singular matrix. For which three values of c the following matrix is singular.
 $\begin{bmatrix} 2 & c & c \\ c & c & c \\ 8 & 7 & c \end{bmatrix}$
- (b) Design three elementary matrices multiplying which the following matrix is upper triangular.
 $\begin{bmatrix} 2 & 1 & 1 \\ 4 & -6 & 0 \\ -2 & 7 & 2 \end{bmatrix}$
- (c) Explain permanent breakdown of elimination process with proper examples.

4. (a) Discuss about the column space and the null space of the following matrix. 2
 $A = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix}$
- (b) Reduce the following matrix into its echelon form and find its rank. 2
 $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$
- (c) Determine the complete solution the following system. 2
 $\begin{bmatrix} 1 & 2 & 2 \\ 2 & 5 & 7 \end{bmatrix} \begin{bmatrix} u \\ v \\ w \end{bmatrix} = \begin{bmatrix} 1 \\ 4 \end{bmatrix}$
5. (a) Examine whether the given vectors $(1,2,3)$, $(2,1,3)$ and $(3,2,1)$ form a basis for \mathbb{R}^3 ? Justify your answer. 2
(b) Determine the dimensions of the four fundamental spaces of the given matrix.
 $A = \begin{bmatrix} 1 & 3 & 3 & 2 \\ 2 & 6 & 9 & 5 \\ -1 & -3 & 3 & 0 \end{bmatrix}$
- (c) Construct a the basis and of each of the four fundamental subspaces for the following matrix. 2
 $A = \begin{bmatrix} 1 & 2 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 2 & 0 & 1 \end{bmatrix}$

End of Questions

MID-SEMESTER EXAMINATION, April-2024
Computer Organization and Architecture (EET2211)

Programme: B.Tech.(CSE/CSIT)
Full Marks: 30

Semester: 4th
Time: 2 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Able to explain the concepts that underline the modern computer's evolution, function, and organization.	L1	1	6
Able to identify the appropriate organization of a computer for achieving the best performance.	L2	2	6
Able to analyze and demonstrate the computer function and interconnection.	L2	3	6
Able to understand and analyze the computer memory system.	L2	4	6
Able to interpret low-level processor operations using a series of computer instructions.	L4	5	6

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

Answer all questions. Each question carries an equal mark.

1. (a) List and briefly define the main structural components of the single-processor computer. 2
(b) What is the difference between a microprocessor and a microcontroller? Also, draw a block diagram to indicate the microcontroller chip elements. 2
(c) Briefly explain the different services provided by cloud computing 2

2. (a) Explain the possible approaches to increase processor speed, as well as the obstacles to doing so. 2
(b) Let a program have 30 percent of its code enhanced to run 2.5 times faster. What will be the overall system speedup? 2

- (c) Consider the execution of a program that result in the execution of 2 million instructions on a 400-MHz processor. The instruction mix and the CPI for each instruction type are given below, based on the result of a program trace experiment. Then determine the effective CPI and MIPS rate.

Instruction Type	CPI	Instruction Mix (%)
Arithmetic/logic	1	50
Load/store	2	20
Branch	4	10
Memory reference	8	20

3. (a) Briefly describe the instruction cycle state diagram. 2
 (b) Explain the memory module of a computer. Also, find out the maximum memory capacity if the width of the address bus is 20 lines and the data bus is 8 lines. 2
 (c) Consider a 32-bit microprocessor whose bus cycle is the same duration as that of a 16-bit microprocessor. Assume that, on average, 30% of the operands and instructions are 32 bits long, 30% are 16 bits long, and 40% are only 8 bits long. Calculate the improvement achieved when fetching instructions and operands with the 32-bit microprocessor. 2
4. (a) Explain the performance parameters: Access time, Memory cycle time, and Transfer rate of memory. 2
 (b) Explain the cache read operation through a flowchart. 2
 (c) Consider a machine with a byte-addressable main memory of 64KB and a block size of 8 bytes. Assume that a direct mapped cache consisting of 32 lines is used with the machine. Then, how is a 16-bit memory address divided into tag, line number, and byte number, and show the format of how the processor's addresses are interpreted? 2
5. (a) Explain the different addressing modes of the 8086 microprocessor with suitable examples. 2
 (b) Determine the output memory location (data location) and the content of that location for the following code: 2

```

MOV AX, 23F0H
MOV BX, AX
MOV [BX], AX
MOV CX, 503FH
MOV AX, CX
SUB AX, [BX]
INC BX
INC BX
MOV [BX], AX
HLT
  
```

- (c) Write an assembly language program using assembler directive in 8086 to find the smallest number among an array of 8-bit data. 2

End of Questions

MID-SEMESTER EXAMINATION, April-2024
Universal Human Values (GEN 1972)

Programme: B.Tech.(Common to All Branches)
Full Marks: 30

Semester: 4th
Time: 2 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Understand the Need, Basic Guidelines Content, and Process for Value Education with experiential validation through the mechanism of self-exploration	L2 L3 L4 L2 L3 L4	1(a) 1(b) 1(c) 2(a) 2(b) 2(c)	12
Understand the harmony in Human Beings leading to the identification of basic aspirations, and exploring the content of imagination, with feelings of self-regulation, prosperity, and health.	L2 L3 L4 L2 L3 L4	3(a) 3(b) 3(c) 4(a) 4(b) 4(c)	12
Understand harmony in the Family and Society at large by fulfilling foundational values of relationship and by effectively contributing as members/leaders in team dynamics.	L2 L3 L4	5(a) 5(b) 5(c)	06

*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) Discuss the basic guidelines for Value Education with their need.	2
	(b) Demonstrate with the help of a suitable pictorial model the role of human beings in a larger order.	2
	(c) "Holistic development is the process of transformation from animal consciousness to the human consciousness." Analyze the statement using appropriate model graphically.	2
2.	(a) Discuss the societal impact of living with human consciousness.	2
	(b) "For human beings, the path of right understanding with physical facility leads to mutual prosperity". Examine the statement with suitable example.	2
	(c) "Consumption of junk food and enjoying favorable sensations provides you continuous happiness." Analyze the statement through the process of self-exploration.	2
3.	(a) Discuss in which situation human conduct is definite.	2
	(b) Consider the list of activities such as (Thinking, Running, Heartbeat, and Blood circulation) from morning till night. Examine your observations on the above activities: Case-1: The activities of the Self which do not involve the Body. Case-2: Activities of the Body. Case-3: Activities that involve both the Self as well as the Body.	2
	(c) Analyze why assuming that a human being is to be only the body is a gross misunderstanding.	2
4.	(a) Discuss the qualitative/quantitative difference between the needs of the Self and those of the Body.	2
	(b) Outline the different program for nurturing the body (for good health) with suitable examples.	2
	(c) "Body is the Seer, Doer, and Enjoyer, and Self is only an instrument." As a human being, will you agree with this? Analyze with a suitable example.	2
5.	(a) State all the feelings that are naturally acceptable to you in your relationship with other human beings.	2
	(b) In relationship, respect or disrespect is naturally acceptable to you. Identify your role for mutual	2

Page 2 of 4

	happiness if someone disrespects you (Hint: in that conversation, you have no mistakes).	
	(c) Relationship is between oneself and another self. Analyze with a suitable example.	2
	End of Questions	



page 3 of 4