END SEMESTER EXAMINATION, MARCH-2023

INTRODUCTION TO COMPUTER PROGRAMMING
(CSE 1001)

Programme: B.Tech **Semester: Ist**
Full Marks: 60 **Time: 3 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Ability to state and explain the basic Java programming syntax, semantics, and building blocks.	L1	2(b,c), 3(a,b,c), 5(b,c)	14
Ability to design, write, debug, and test the correctness of programs.	L3	1(a,b,c), 2(a)	8
Ability to develop Java programs using programming constructs like conditional statements, looping, arrays, methods, and class.	L2, L3	8(a,b,c), 9(a,b,c) 10(b)	14
Ability to solve computational problem(s) using programming constructs.	L4	4(a,b,c), 5(a), 10(c)	10
Ability to identify the problem, and identify a solution plan for the problem.	L3, L4	6(a,b,c)	6
Ability to analyze the problem, and improve the efficiency of the solution.	L4	7(a,b,c), 10(a)	8

Bloom's taxonomy levels:** ***Remembering (L1), Understanding (L2), Applying (L3), Analysing (L4), Evaluating (L5), Creating (L6)

Answer all questions. Each question carries equal mark.

1. (a) Find the output of the given code snippet. 2

```
byte y=15,z=(byte) -y;
System.out.println(~y);
System.out.println(~z);
y&= ~y;
System.out.println(y>>2);
byte x = -11;
System.out.println(x>>>28);
```

(b) Find the output of the given code snippet. 2

```
int i = 140;
short s = 23;
byte b = (byte) i;
int x = b + s;
System.out.println("Value of x is " + x);
x=x%2-20;
System.out.println("New value of x is "+x);
```

(c) Find the output of the given code snippet. 2

```
int x=4,y=-8;
if(++x<(y=y-=7)||(x=x+=14)>y){
      System.out.println(x+","+y);
}else{
      System.out.println((x-y)+","+(y-x));
}
```

2. (a) Find the output of the given code snippet. 2

```
int a[]=new int[5];
int sum=0;
for(int i=0;i<a.length;i++){
      a[i]=a[i]+i*2;
      sum=sum+a[i];
      System.out.println(a[i]);
}System.out.println(sum);
```

(b) Amit and ruby are playing with dice. In one turn both of them rolling the dice once. They consider a turn to be good if sum of their number on the dice is greater than 6. Given that a particular turn got X and Y on their respective dice. Find whether the turn was good. Write a java program for the given problem. 2

(c) Write the java statements that take three integer value from command line and print them in ascending order. Use Math.min() and Math.max(). 2

3. (a) Write the Java statements that takes the x-y co-ordinates of a point in the Cartesian plane and print a message telling either on axis the point lies or the quadrant on which it is found. 2

(b) Tom is running after jerry. Jerry is running at a speed of X meter per second while Tom is chasing him at a speed of Y meter per second. Determine whether Tom will able to catch Jerry. Note that initially Jerry is not at the same position as TOM. Write a Java program for the given problem. 2
Constraint 1<=(X,Y)<=100
E.g: Jerry speed=4, Tom speed=1, so can't catch
Jerry speed=3, Tom speed=5, so can catch

(c) Write a java program that prompts the user to enter an integer for today's day of the week (Sunday is 0, Monday is 1... and Saturday is 6). Also prompt the user to enter the number of days after today for a future day and display the future day of the week. 2

4. (a) If "HOUSE" is coded as 35842, and "LEMON" is coded as 12659, then what would be the code for "HELEN"? 2
Write the java statements for the above problem.

(b) An integer n is divisible by 9 if the sum pf its digits is divisible by 9. Use this concept in your program to determine whether or not the number n is divisible by 9. 2

(c) Write a program that will read the value of n from the user and calculate sum of the following series: 2
$(1/1^2)+(1/2^2)+(1/3^2)+....+(1/n^2)$

5. (a) Write the java statements to find the difference between the sum of the squares of the first 10 natural numbers and the square of the sum. 2
Difference $= (1^2 + 2^2 + ...+10^2) - (1 + 2 + ...+10)^2$

(b) Draw a flow diagram for the given Question no. 5(a) 2

(c) Write the execution pattern for the given Question no. 5(a). 2

6. (a) Write a Java method to count the number of occurrences of a specified character in a string. The method signature is as follows: 2
public static int count(String str ,char c)

(b) Write a java method to check whether a password contains at least two digit and must have at least 8 characters. If it satisfies the conditions then return "Valid Password" otherwise return "Invalid Password". The method signature is as follows: 2
public static String validatePassword(String str)

(c) You are given N fruits. The weight of the fruits is represented by an array A. All those fruits which have the same weight can be sliced in one step. Your task is to determine the number of steps to slice all the fruits. Write the java statements for the given problem. 2
e.g: N=6, A={20,40,30,50,40,20}
1st slice=20, 2nd slice=40, 3rd slice=30, 4th slice= 50
So number of slice=4.

7. (a) Write the Java statements to find the GCD of two number. 2

(b) WAP to enter the first number and second number. Display the prime numbers between the first and second number. 2

(c) Write the java statements to print the given pattern. 2

5
4 4
3 3 3
2 2 2 2
1 1 1 1 1
0 0 0 0 0 0

8. (a) Write a Java method to calculate the sum of digits of a given number until the number is a single digit. 2
e.g: Let n=9294, sum=9+2+9+4=24, sum=2+4=6 so, result is 6.
The method signature is as follows:
public static int sum_Of_Digit(int n)

(b) Write the Java method to check whether a number n is a Neon number or not. e.g: Let n=9, $(9)^2$ =81 , 8+1=9, which is equals to n, so 9 is a Neon Number. The method signature is as follows: 2
public static boolean checkNeon(int n)

(c) Write a Java method to check whether a number n is a spy number or not. e.g Let n=132, sum=1+3+2=6, 2
product=1*3*2=6, sum==product, so 132 is a spy number.
Use single loops. The method signature is a s follows:
public static Boolean checkSpy(int n)

9. (a) Write the java statements to insert an element at specified position of an array. 2

(b) Write a java method to search an element present in the array using linear search. The method signature is as follows. 2
public static Boolean linearSearch(int array[],int element)

(c) Write a java method to find the smallest element present in the array. The method signature is as follows: 2
public static double min(double array[])

10 (a) Write a Java program to read a string and print true if the string is a palindrome otherwise print false. 2
e.g: if string s is "MADAM" print true
e.g: if string s is "MAD" print false

(b) Write a java program to overload the method area() to find area of a circle, rectangle and square. 2

(c) Write a Java method that returns the number of days in a year. 2
The method signature is as follows:
public static int numberOfDaysInAYear(int year)

End of Questions

END SEMESTER EXAMINATION, MARCH-2023
DISCRETE MATHEMATICS (CSE 1002)

Programme: B.Tech **Semester: 1st**
Full Marks: 60 **Time: 3 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Able to analyze and apply rules of logic to distinguish between valid and invalid arguments and use them to prove mathematical statements.	L1, L3, L3, L2, L3, L3	1(a),1(b), 1(c),2(a), 2(b), 2(c)	2,2, 2,2, 2,2
Able to understand sets, their various operations and use them to analyze functions and its various concepts as well as study sequences and summations.	L3, L3, L3	3(a),3(b), 3(c)	2,2, 2
Able to analyze the searching and sorting algorithms and use the growth of functions to study the time complexity of algorithms as well as apply some of the important concepts of number theory to divisibility and modular arithmetic, integer representation of algorithms, congruences and cryptography.	L3, L3, L3, L3, L3, L3	4(a), 4(b), 4(c),5(a), 5(b), 5(c)	2,2, 2,2, 2,2
Able to construct proofs by mathematical induction and analyze and formulate recursive definitions and develop structural induction.	L2, L3, L3	6(a), 6(b), 6(c)	2,2, 2
Able to apply different counting techniques to solve various problems.	L3, L3, L3, L3, L3, L3	7(a), 7(b), 7(c),8(a), 8(b), 8(c)	2,2, 2,2, 2,2
Able to apply relations and their properties to analyze equivalence relations and partial orderings.	L3, L3, L3, L2, L3, L3	9(a), 9(b), 9(c), 10(a), 10(b),10(c)	2,2, 2,2, 2,2

***Bloom's taxonomy levels:** *Remembering (L1), Understanding (L2), Applying (L3), Analysing (L4), Evaluating (L5), Creating (L6)*

Answer all questions. Each question carries equal mark.

1. (a) Write the negation of the following proposition. 2
'*The summer in Maine is hot and sunny.*"

(b) Determine whether $\neg p \rightarrow \neg q$ is logically equivalent to $p \rightarrow q$ or $q \rightarrow p$. 2

(c) Prove by the method of contraposition that if n is an integer and $n^3 + 5$ is odd, then n is even. 2

2. (a) Translate the following statement into a logical expression using predicates, quantifiers and logical connectives. 2
'*Every student in this class has studied calculus.*'

(b) Determine whether $(p \rightarrow q) \wedge (q \rightarrow r) \rightarrow (p \rightarrow r)$ is a tautology or not. 2

(c) Show that the premises '*No man is an island.*' and '*Manhattan is an island.*' imply the conclusion '*Manhattan is not a man.*' 2

3. (a) Show that if A and B are sets, then $A - B \subseteq A$. 2

(b) Let f and g be functions from the set of integers to the set of integers defined by $f(x) = 2x + 3$ and $g(x) = 3x + 2$. Find $f \circ g$ and $g \circ f$. 2

(c) What is the missing number in the following sequence? 2
2, 12, 60, 240, 720, 1440, ------, 0

4. (a) Use the bubble sort algorithm to sort the list 3, 5, 4, 1, 2 in increasing order showing the lists obtained at each step. 2

(b) Show that $x^4 + 9x^3 + 4x + 7$ is $O(x^4)$. 2

(c) Determine whether $f(x) = \lfloor x \rfloor$ is $\Omega(x)$. 2

5. (a) Use the linear congruential generator 2

$$x_{n+1} = (7x_n + 4) \pmod 9$$

with seed $x_0 = 3$ to generate a sequence of pseudorandom numbers.

(b) What is the value of $3^{51} \bmod 5$? 2

(c) Solve the congruence $3x \equiv 4 \pmod 7$. 2

6. (a) Give recursive definition of the sequence $\{a_n\}, n = 1, 2, 3, \ldots$ if 2

(i) $a_n = 6n$ and (ii) $a_n = 5$.

(b) Use mathematical induction to prove that 3 divides $n^3 + 2n$, whenever n is a positive integer. 2

(c) Use strong induction to prove that every amount of postage of 18 cents or more can be formed using just 3-cent and 10-cent stamps. 2

7. (a) How many positive integers between 100 and 999 inclusive are divisible by 3 or 4? 2

(b) Show that among any $n+1$ positive integers not exceeding $2n$ there must be an integer that divides one of the other integers. 2

(c) If a department contains 10 men and 15 women, then how many ways are there to form a committee with six members if it must have the same number of men and women? 2

8. (a) How many ways are there for eight men and five women to stand in a line so that no two women stand next to each other? 2

(b) What is the coefficient of $x^8 y^9$ in the expansion of $(3x+2y)^{17}$? 2

(c) How many ways are there to select five unordered elements from a set with three elements when repetition is allowed? 2

9. (a) Determine whether the relation R on the set of all real numbers is reflexive, symmetric, antisymmetric and/or transitive where $(x,y) \in R$ if and only if $x+y=0$. 2

(b) Let R be the relation $R = \{(a,b) \mid a \text{ divides } b\}$ on the set of positive integers. Find (i) R^{-1} and (ii) $\overline{R}$. 2

(c) Let R be the relation represented by the matrix 2

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

Find the matrix representing R^2.

10 (a) Give a description of each of the congruence classes modulo 6. 2

(b) Draw the Hasse diagram and find the maximal and minimal elements for the poset ({2, 4, 5, 10, 12, 20, 25}, |). 2

(c) Answer the following questions for the poset ({2, 4, 6, 9, 12, 18, 27, 36, 48, 60, 72}, |). 2

(i) Find all the upper bounds of {2,9}.

(ii) Find the least upper bound of {2,9} if it exists.

End of Questions

END SEMESTER EXAMINATION, MARCH-2023
UNIVERSITY PHYSICS MECHANICS (PHY-1001)

Programme: B. Tech **Semester: 1st**
Full Marks: 60 **Time: 3 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
PHY/ a,e	L_1, L_2, L_3	1	6
PHY/ a,e	L_1, L_2, L_3	2	6
PHY/ a,e,g	L_1, L_2, L_3	3	6
PHY/ a,e,g	L_1, L_2, L_3	4	6
PHY/ a,e	L_1, L_2, L_3	5	6
PHY/ a,e	L_1, L_2, L_3	6	6
PHY/ a,e,g	L_1, L_2, L_3	7	6
PHY/ a,e,g	L_1, L_2, L_3	8	6
PHY/ a,e,g	L_1, L_2, L_3	9	6
PHY/ a,e,g	L_1, L_2, L_3	10	6

*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) $\vec{A}$ and $\vec{B}$ are two vectors in x-y plane. Write their scalar and vector product in component form. 2

   (b) Find the angle between the vectors $\vec{A}=2\hat{i}+3\hat{j}+\hat{k}$ and $\vec{B}=-4\hat{i}+2\hat{j}-\hat{k}$ 2

   (c) Vector $\vec{A}$ has magnitude 2 and vector $\vec{B}$ has magnitude 3. The angle ϕ between $\vec{A}$ and $\vec{B}$ is known to be 0°, 90°, or 180°. For each of the following situations, state what the value of ϕ must be. (In each situation there may be more than one correct answer.) (a) $\vec{A}.\vec{B}=0$ (b) $\vec{A}\times\vec{B}=0$ (c) $\vec{A}.\vec{B}=6$ (d) $|\vec{A}\times\vec{B}|=6$. 2

2. (a) Deduce the relation $x-x_0=v_{0x}t+\frac{1}{2}a_xt^2$. The notations have its usual meaning. 2

1.08×10^{-4}

(b) You throw a ball vertically upward from the roof of a tall building. The ball leaves your hand at a point even with the roof railing with an upward speed of 15.0 m/s; the ball is then in free fall. On its way back down, it just misses the railing. Find the ball's position and velocity 4.0 s after leaving your hand. 2

(c) A stone is thrown up vertically with a velocity of *72 Km/h*. Find out the instances at which the magnitudes of its kinetic energy will be half its initial value ($g = 10\ m/s^2$). 2

3. (a) Derive an expression for the maximum height that can be attained by a projectile. 2

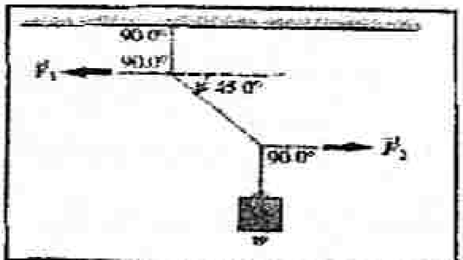
(b) A batter hits a baseball so that it leaves the bat at speed $v_0 = 37$ m/s, at an angle $\alpha_0 = 53.1^0$, at a location where $g = 9.8\ m/s^2$. Find the position of the ball and its velocity at $t = 2.0$ s. 2

(c) An airplane's compass indicates that it is headed due north, and its airspeed indicator shows that it is moving through the air at *240 km/h*. If there is a *100 km/h* wind from west to east, what is the velocity of the airplane relative to the earth? 2

4. (a) A passenger on a Ferries wheel moves in a vertical circle of radius R with constant speed v. The seat remains upright during the motion. Find expressions for the force the seat exerts on the passenger at the top of the circle and at the bottom. 2

(b) A 2.49×10^4 N Rolls-Royce Phantom travelling in the $+x$-direction makes an emergency stop; the x-component of the net force acting on it is -1.83×10^4N. What is its acceleration? 2

(c) In the given figure the weight w is 60.0 N. What is the tension in the diagonal string? 2



5. (a) Derive work–energy theorem for a straight-line motion enacted by a constant force. 2

(b) A 50.0-kg marathon runner runs up the stairs to the top of Chicago's 443-m-tall Willis Tower, the tallest building in the United States. To lift herself to the top in 15.0 minutes, what must be her average 2 power output? Express your answer in watts, and in horsepower.

(c) A bullet of 50g and travelling at 80 m/s, hit a sand bag, penetrates it and gets stopped after passing through a distance of 10 cm. Find the force exerted by the sand bag on the bullet. 2

6. (a) Calculate the work done if a spring is elongated by a distance 'x'. 2

(b) A puck with coordinates x and y slides on a level, frictionless air hockey table. It is acted on by a conservative force described by the potential-energy function $U(x,y) = \frac{1}{2}k(x^2 + y^2)$. Find a vector expression for the force acting on the puck, and find an expression for the magnitude of the force. 2

(c) A force of 800 N stretches a certain spring a distance of 0.200 m. What is the potential energy of the spring when it is stretched 0.200 m? 2

7. (a) What is elastic collision? Write general expressions for conservation of kinetic energy and momentum when a body had 1-dimensional elastic collision with another body at rest. 2

(b) A spring-loaded toy sits at rest on a horizontal, frictionless surface. When the spring releases, the toy breaks into three equal mass pieces, A, B, and C, which slide along the surface. Piece A moves off in the negative x-direction, while piece B moves off in the negative y-direction. What are the signs of the velocity components of piece C? 2

(c) One 110-kg football lineman is running to the right at 2.75 m/s while another 125-kg lineman is running directly toward him at 2.6 m/s. What are the magnitude and direction of the net momentum of these two athletes? 2

8. (a) Analyze static and kinetic friction. 2

(b) You are trying to move a 500 N crate across a floor. To start the crate moving, you have to pull with a 230 N horizontal force. Once the crate starts to move, you can keep it moving at constant velocity with only 200 N. What are the coefficients of static and kinetic friction. 2

(c) The flywheel of an engine has moment of inertia 2.50 kg.m^2 about its rotation axis. What constant torque is required to bring it up to an angular speed of 400 rev/min in 8.00 s, starting from rest? 2

END SEMESTER EXAMINATION, MARCH -2023
CALCULUS-A (MTH-1101)

Programme: B.Tech **Semester: 1st**
Full Marks: 60 **Time: 3 Hours**

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Use limit laws to evaluate the limit of a function and demonstrate the existence of limit and continuity of functions.	L1,L3	1.a,c	2.2
Compute slope of tangent lines and derivatives by different techniques and apply the concept of derivatives for linearizion of functions and solve various physical and Engineering problems.	L1 L1,L1,L1	1.b 2.a,b,c	2 2,2,2
Discuss the Mean Value Theorems and study maximum and minimum values of a function as well as apply L' Hospital's rule to evaluate limits of functions and sketch curves of functions	L1,L1,L1 L1,L1,L1	3.a,b,c 4.a,b,c	2,2,2 2,2,2
Compute indefinite integrals using techniques of integration and apply it to physical and Engineering problems	L1,L1 L1,L4 L4	5.a,b 6.b,c 7.c	2,2 2,2 2
Apply the concept of integration to find volume, work done, surface area and average value of an integral and study numerical integration using different methods.	L3 L1 L1, L4 L3	5.c 6.a 7.a,b 9.c	2 2 2,2 2
Apply the principles of calculus to study and calculate areas, arc lengths etc. of parametric and polar curves.	L1,L1,L2 L1,L2	8.a,b,c 9.a,b	2,2,2 2,2
Analyze infinite series and sequences and discuss their convergences using comparison test, root test and ratio test	L1,L3,L3	10.a,b, c	2,2,2

Bloom's taxonomy levels:** ***Remembering (L1), Understanding (L2), Applying (L3), Analysing (L4), Evaluating (L5), Creating (L6)

Answer all questions. Each question carries equal mark.

1.	(a)	Find $\lim_{x\to\infty}\frac{e^{3x}-e^{-3x}}{e^{3x}+e^{-3x}}$ or show that the limit does not exist.	2
	(b)	A particle moves along a straight line with equation of motion $s=f(t)=100+50t-4.9t^2$, where s is measured in meters and t in seconds. Find the velocity and speed when $t=5$.	2
	(c)	Show that the function $f(x)=\|x\|$ is differentiable for all $x<0$, as well as for all $x>0$.	2
2.	(a)	Find the points on the curve $y=1-12x+3x^2+2x^3$ where the tangent line is horizontal.	2
	(b)	If $h(2)=4$ and $h'(2)=-3$, find $\frac{d}{dx}\left(\frac{h(x)}{x}\right)$ at $x=2$.	2
	(c)	Find the equation of the tangent line to the curve $y=\sin(\sin x)$ at the point $(\pi,0)$.	2
3.	(a)	Find $\frac{dy}{dx}$ if $y^x=x^y$.	2
	(b)	A freshly brewed cup of coffee has temperature 95^0 C in a 20^{0}C room. When its temperature is 70^{0}C, it is cooling at a rate of 1^{0}C per minute. When does this occur?	2
	(c)	Find the critical numbers of the function $h(p)=\frac{p-1}{p^2+4}$.	2
4.	(a)	Find the minimum value of the function $f(t)=t^3-3t^2-24t+100$ in the interval $[-3,3]$.	2
	(b)	Find the interval on which the function $f(x)=x^2\ln x$ is increasing or decreasing.	2
	(c)	The sum of two positive numbers is 16. What is the smallest possible value of the sum of their squares?	2
5.	(a)	Use Newton's method to find a root of the equation $3\cos x=x+1$ correct to 2 decimal places.	2
	(b)	Evaluate the upper and lower sums for $f(x)=2+\sin x, 0\le x\le\pi$, with $n=4$.	2
	(c)	Find the derivative of the function $g(x)=\int_{1-2x}^{1+2x} t\sin t\,dt$.	2

6.	(a)	Evaluate the indefinite integral $\int \sqrt{x}\sin(1+x^{\frac{3}{2}})dx$.	2
	(b)	Find the volume of the solid obtained by rotating the region bounded by the curves $x=y^2, x=2y$; about y-axis.	2
	(c)	Find the average value of the function $f(x)=\sin 4x$ on the interval $[-\pi,\pi]$.	2
7.	(a)	Evaluate $\int (\tan^5 x\sec^3 x dx$.	2
	(b)	Evaluate $\int \frac{t}{t-6}dt$.	2
	(c)	Determine whether the integral $\int_e^{\infty}\frac{dx}{x(\ln x)^3}$ is convergent or divergent and if it is convergent then evaluate it.	2
8.	(a)	Use Simpson's rule with $n=10$ to estimate the arc length of the curve $y=x\sin x, 0\le x\le 2\pi$.	2
	(b)	Eliminate the parameter t from the parametric equation $x=1-t^2, y=t-2, -2\le t\le 2$ to find its Cartesian form.	2
	(c)	Describe the motion of the particle with position $(x,y)=(2\sin t, 4+\cos t)$ as t varies in $0\le t\le {}^{3\pi}\!/_{2}$.	2
9.	(a)	Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ of the curve $x=e^t, y=te^{-t}$.	2
	(b)	Find the points on the curve $x=t^3-3t, y=t^3-3t^2$ where the tangent line is horizontal or vertical.	2
	(c)	Find a formula for the general term a_n of the sequence $\left\{1,-\frac{1}{3},\frac{1}{9},-\frac{1}{27},\frac{1}{81},\ldots\right\}$, assuming that the pattern of the first few terms continues.	2
10	(a)	Determine whether the geometric series $2+0.5+0.125+0.03125+\ldots$ is convergent or divergent. If it is convergent, find the sum.	2

$\frac{\pi}{2}+\frac{\pi}{4}=\frac{2\pi+\pi}{4}$ $\frac{3\pi}{4}$

	(b)	Express the number $2.\overline{516}$ as a ratio of integers.	2
	(c)	Find the Maclaurin series for $f(x) = e^{-2x}$ using the definition of the Maclaurin series.	2
		End of Questions	