

B.A./B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)

Subject : Mathematics

Course : SEC-1 (BMH3SEC11)

(Logic & Sets)

Time: 2 Hours

Full Marks: 40

The questions are of value as indicated in the margin.
Candidates are required to give their answers in their own words
as far as practicable.

1. Answer any five questions:

2×5=10

- (a) Define Cartesian product of two sets. Does it satisfy commutativity? Support your answer.
- (b) For the partition $P = \{\{a\}, \{b, c\}, \{d, e\}\}$, write the corresponding equivalence relation on the set $A = \{a, b, c, d, e\}$.
- (c) Give a relation on a set which is both a partial ordering relation and an equivalence relation.
- (d) Consider the partial ordered set (X, \leq) where $X = \{2, 3, 6, 12, 24, 36\}$ and ' $x \leq y$ if x divides y '. Then find
- the least upper bound and the greatest lower bound of $A = \{2, 3, 6\}$, if exists,
 - all upper bounds of $\{2\}$ and $\{6\}$.
- (e) Using quantifiers, translate the following statements:
- The equation $a + x = b$ has a solution for all values of a and b .
 - There exists an animal which is not a mammal.
- (f) Write the converse and contrapositive statements of the following:
If n is a prime and $n \geq 3$ then $n + 1$ is not a prime.
- (g) If the truth values of A and B are 'True', X and Y are 'False', P and Q are not known, then find the truth values of
- $(Q \Rightarrow B) \Rightarrow (A \Rightarrow Y)$;
 - $(P \wedge Q) \wedge ((\sim A) \vee X)$.
- (h) Rewrite the statement: $(P \Rightarrow (Q \Rightarrow R)) \Leftrightarrow ((P \Rightarrow Q) \Rightarrow R)$, using \sim (Not) and \wedge (And) operators only.

2. Answer any two questions:

5×2=10

- (a) (i) What is a 'contradiction' in logic? Check using truth table whether the following statement is a contradiction or not:
 $(P \Rightarrow Q) \Rightarrow [\sim (Q \wedge R) \Rightarrow \sim (R \wedge P)]$
- (ii) If $S(x)$ represent the statement: ' x is a student'.
 $I(x)$ represent the statement: ' x is intelligent'.
 $H(x)$ represent the statement: ' x is hard worker',
then translate the following logical formula into plain english:

$$(\exists x) \left((S(x) \Rightarrow (I(x) \wedge H(x))) \right)$$

(1+2)+2=5

(b) Let X be the set of all positive divisors of 72. Prove that the relation " \leq " on X defined by $a \leq b$ iff a divides b , for $a, b \in X$, is a partial order relation. Also find out maximal and minimal elements of the poset (X, \leq) , if any. 3+2=5

(c) (i) Let A, B, C be three subsets of a universal set U satisfying $A \Delta B = C$. Prove that $A = B \Delta C$. 3+2=5

(ii) Find the number of symmetric relations on a set of three elements.

(d) (i) Simplify the following statement:

$$(\sim P \wedge (\sim Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R)$$

(ii) Symbolize the following statements:

(I) There is a tree in my garden whose all leaves are green.

(II) A non-empty subset A of the set of real numbers is bounded above if there is an upper bound of A . 3+2=5

3. Answer any two questions: 10x2=20

(a) (i) Let ρ be a relation on a set A . Then prove that ρ is an equivalence relation on A if and only if (I) $\Delta_A \subseteq \rho$, where $\Delta_A = \{(a, a) : a \in A\}$, (II) $\rho = \rho^{-1}$ and (III) $\rho \circ \rho \subseteq \rho$.

(ii) Show that every equivalence relation induces a partition on a set.

(iii) Consider the relation ρ on the set $S = \{2, 4, 5, 10, 12, 20, 25\}$ defined by $a \rho b$ if and only if $a|b$. Show that ρ is a partial order relation on S . Draw the covering diagram of this poset. What are the minimal and maximal elements of this poset? 4+2+(1+2+1)=10

(b) (i) Obtain the disjunctive normal form (DNF) of the given logical formula:

$P \Rightarrow (P \wedge (Q \Rightarrow P))$. Is the formula a tautology? What can you say about the conjunctive normal form (CNF) of the above formula?

(ii) Show that the conjunction of two tautologies is also a tautology.

(iii) Show that $\sim(P \vee (\sim P \wedge Q))$ and $((\sim P) \wedge (\sim Q))$ are logically equivalent statements. (3+1+1)+2+3=10

(c) (i) Let A, B, C be subsets of a universe S . Then, if $A \Delta B = A \Delta C$, prove that $B = C$.

(ii) Prove that

(I) $\bigcup_{n=1}^{\infty} (0, \frac{1}{n}) = (0, 1)$ and

(II) $\bigcap_{n=1}^{\infty} (0, \frac{1}{n}) = \phi$. 4+6

(d) (i) Let R and S be relations defined on the set $\{1, 3, 5\}$ defined by " xRy iff $y = x + 2$ " and " xSy iff $fx \leq y$ ". Then find the relations $R \circ S$ and $S \circ R$.

(ii) If $T = \{1, 2, 3, 4, 5\}$, then how many subsets of T have less than 4 elements?

(iii) Let (Z^+, \leq) be a partially ordered set where Z^+ is the set of all positive integers and " $a \leq b$ iff $a|b$ ". Find the greatest lower bound and the least upper bound of the sets $\{3, 9, 12\}$ and $\{1, 2, 4, 5, 10\}$.

(iv) Give an example of a poset that has 3 maximal elements. (2+2)+1+3+2

B.A./B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)

Subject : Mathematics

Course : SEC-1 (OR) [BMH3SEC12]

(Computer Graphics)

Time: 2 Hours

Full Marks: 40

*The questions are of value as indicated in the margin.
Candidates are required to give their answers in their own words
as far as practicable.*

1. Answer *any five* questions: 2×5=10
 - (a) Define computer graphics.
 - (b) What do you mean by Raster Scan?
 - (c) What is a pixel?
 - (d) What do you mean by 4-connected neighbours?
 - (e) What do you mean by view port?
 - (f) What is a pivot point w.r.t. scaling?
 - (g) What is the disadvantage of DDA line drawing algorithm over Bresenham algorithm?
 - (h) What do you mean by true color?

2. Answer *any two* questions: 5×2=10
 - (a) (i) Discuss the characteristics of boundary fill method.
(ii) Briefly discuss the boundary fill algorithm. 1+4=5
 - (b) What do you mean by CRT? Discuss any one color display technique for monitor. 1+4=5
 - (c) Discuss DDA line drawing algorithm in brief. Why don't we use $y = mx + c$ equation directly for line drawing? 4+1=5
 - (d) What do you mean by translation? Develop the mathematical formula for two dimensional rotation. 1+4=5

3. Answer *any two* questions: 10×2=20
 - (a) (i) What do you mean by 8-symmetry property of a circle?
(ii) Discuss Bresenham's algorithm for circle drawing in brief. 2+8=10
 - (b) (i) What do you mean by line clipping?
(ii) Briefly discuss Cohen-Sutherland line clipping algorithm. 2+8=10
 - (c) (i) What do you mean by homogeneous coordinate systems?
(ii) Briefly discuss translation and scaling (in 2D) in the context of homogeneous coordinate systems. 2+(4+4)=10
 - (d) (i) Briefly discuss mid-point ellipse generation algorithm.
(ii) Discuss the role of decision parameter in the context of mid-point ellipse generation algorithm. 8+2=10

B.A./B.Sc. 3rd Semester (Honours) Examination, 2022 (CBCS)

Subject : Mathematics

**Course : SEC-1 (OR) [BMH3SEC13]
(Object Oriented Programming in C++)**

Full Marks: 40

Time: 2 Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.*

Notations and symbols have their usual meaning.

2×5=10

1. Answer any five questions:

- (a) Explain the benefits of object-oriented approach.
- (b) What are the steps involved in executing a C++ program.
- (c) Define local and global variables with examples.
- (d) What is a relational expression? Give an example.
- (e) Differentiate between built-in-functions and user-defined-functions.
- (f) What do you mean by dimensionality of an array? Explain the syntax of declaring a one dimensional array with an example.
- (g) Mention the differences between structure and class.
- (h) What is operator overloading? What is the necessity of it?

5×2=10

2. Answer any two questions:

- (a) (i) What is the necessity of 'friend functions' in operator overloading? Explain with an example.
- (ii) What is function templates with multiple parameters?
- (b) Explain overloading of an operator with non-member function with an example.
- (c) What is the significance of logical operators? Mention three logical operators in C++ with examples.
- (d) Write a program in C++ to find the largest of three numbers using conditional operator.

3+2=5

10×2=20

3. Answer any two questions:

- (a) (i) Write a program in C++ to generate all the integers in the range 10 and 100 divisible by the integer 3.
- (ii) Differentiate between 'while' loop and 'do-while' loop with examples.
- (iii) What is the necessity of nest loops?
- (b) (i) Write a program to find the reverse of an integer 6782 using a function.
- (ii) Write a program to transpose a matrix of order 4×3.
- (c) (i) Write a class template by name vector and find the smallest of the elements in the vector with user defined size.
- (ii) What is constructor? What is the necessity of it? Explain with example.
- (d) (i) Write a program to find the union of two arrays a and b with size m and n respectively.
- (ii) Write a program to calculate nC_r using a function for the calculation of factorial of a non-negative integer number.

5+3+2=10

5+5=10

5+(3+2)=10

5+5=10