M.Sc. 3rd Semester Examination, 2023

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

(*Discrete Mathematics*)

PAPER – MTM-304(New&Old)(CBCS)

Full Marks : 50

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

1. Attempt any *four* questions out of *six* questions : 2×4

(*a*) State De-Morgan's law for three variables. Using truth table, verify it.

(*b*) What is Exclusive-OR Gate ?

(*c*) Define the k-regular graph. Draw a 3-regular graph with 4 vertices.

(*d*) Prove that the maximum number of edges in a connected simple graph with n vertices is $n(n-1)/2$.

(*e*) Define the greatest element of a Poset with an example.

(*f*) What is a semi-lattice ? Give an example.

2. Attempt any *two* questions out of *six* questions : 4×4

(*a*) Draw Karnaugh map and simplify the following Boolean expressions :

(*i*) $AB + A\bar{B} + \bar{A}\bar{B}$

(*ii*) $AB + A\bar{B}C + ABC$.

(*b*) Solve the recurrence relation of the Fibonacci numbers $f_n = f_{n-1} + f_{n-2}$, $n \geq 2$ with the initial conditions $f_0 = 1, f_1 = 1$, by the method of characteristic roots.

(*c*) Draw a graph with 9 vertices having degree sequence 1,2,5,7,8,10.

(*d*) Define bipartite graph and complete bipartite graph. Is a subgraph of a bipartite graph bipartite ?

(*e*) Give the two definitions of lattice in connection with Poset and binary compositions, and show that they are equivalent.

(*f*) Define sub-lattice with an example. Show that union of two sublattices is not a sublattice.

3. Attempt any *two* questions out of *four* questions : 8×2

(*a*) (*i*) Write down the axioms of Boolean algebra. What are the main differences between Boolean algebra and algebra of real numbers.

(*ii*) What is a Full Adder ? Write down the truth table and block diagram of it. Also, develop its logic circuit.

(*b*) Show that the maximum possible height of a strictly binary tree on $2n + 1$ vertices in n.

(*c*) (*i*) Define finite-state machine with explanation.

(*ii*) Let M be the finite-state machine with state table appearning in the following :

(*a*) Find the input set Σ, the state set S, the output set O, and the initial state of M.

(*b*) Draw the state diagram of M.

(*c*) Find the output string for the input string *aabbcc*.

	f			g		
S \ Σ	a	b	c	a	b	c
s_0	s_0	s_1	s_2	0	1	0
s_1	s_1	s_1	s_0	1	1	1
s_2	s_2	s_1	s_0	1	0	0

(*d*) (*i*) Using mathematical induction, prove that for any integer $n > 1$.

$$\frac{1}{1.2}+\frac{1}{2.3}+....+\frac{1}{n(n+1)}=\frac{n}{n+1}$$

(*ii*) Define the cardinality of a set. What is the difference between relation and mapping ? Explain all with examples.

[Internal Assessment — 10 Marks]