AC/24.02.2024/RS1

SIES College of Arts, Science & Commerce (Autonomous)

RISE WITH EDUCATION

NAAC REACCREDITED - 'A' GRADE

SIES College of Arts, Science and Commerce (Autonomous)

Affiliated to University of Mumbai

Syllabus under NEP effective from June 2024

Department of Mathematics

Programme: B.Sc. **Class: SYBSc** **Semester: III**

Vocational Skill Course

Course Name

Option1: Python Through Algorithmic Approach

Option2: Discrete Mathematics

Choice Based Credit System (CBCS)
with effect from the academic year 2024-25

SIES COLLEGE OF ARTS, SCIENCE AND COMMERCE, AUTONOMOUS, SION WEST

This course is offered to students of BSc in semester III, who have chosen Mathematics as Major subject.

Name of Program: Bachelor of Science **Name of Department:** Mathematics
Type of course: Vocational Skill Course – Practical Course
Evaluation Pattern: Continuous Internal Evaluation

Option	Course Name	Course Code	Credits	L/P (per week)	Marks
1	Discrete Mathematics	SIUMTVS211	2	2 P (4L)	50
2	Introduction to Algorithms and Basic Python Programming	SIUMTVS212	2	2 P (4L)	50
1P (Practical) = 2 Hours per week					

Vocational Skill Course

Option 1

Course Name: **Discrete Mathematics** Course Code: **SIUMTVS211**

Credits**: 2** Type**: Practical Course**

Expected Course Outcomes

On completion of this course, students are expected to

1. State the definitions and prove results based on the concept of preliminary and advanced counting, permutations and recurrence relations
2. Apply various definitions and results to solve real life counting problems and problems in geometry.

The following contents will be covered in Practical sessions.

Duration: 30 Practical Sessions of 2 hours per batch, of not more than 30 students.

	Sec 1: Preliminary Counting
	1. Addition and multiplication Principle, counting sets of pairs, two ways counting 2. Stirling numbers of the second kind. Simple recursion formulae satisfied by $S(n, k)$ for $k = 1, 2, \cdots, n-1, n$ 3. Pigeonhole principle- simple and strong form and examples, its applications to geometry.
	Sec 2: Advanced Counting

1. Permutation and combination of sets and multi-sets, circular permutations, emphasis on solving problems.
2. Binomial and Multinomial Theorem, Pascal identity, examples of standard identities such as the following with emphasis on combinatorial arguments:

$$\sum_{k=0}^{r}\left(\frac{m}{k}\right)\left(\frac{n}{r-k}\right)=\left(\frac{m+n}{r}\right) \qquad \sum_{i=0}^{k}\left(\frac{k}{i}\right)^2=\left(\frac{2k}{k}\right)$$

$$\sum_{i=r}^{n}\left(\frac{i}{r}\right)=\left(\frac{n+1}{r+1}\right) \qquad \sum_{i=0}^{n}\left(\frac{n}{i}\right)=2^n$$

3. Non-negative integer solutions of equation $x_1+x_2+\cdots+x_k=n$.

Principal of inclusion and exclusion, its applications, derangements, explicit formula for d_n , Euler's function $\varphi(n)$ and problems.

Sec 3: Permutations and Recurrence relation

1. Permutation of objects, S_n, composition of permutations, results such as every permutation is a product of disjoint cycles, every cycle is a product of transpositions, signature of a permutation, even and odd permutations, cardinality of S_n, A_n.
2. Recurrence Relations, definition of homogeneous, non-homogeneous, linear, non-linear recurrence relation, obtaining recurrence relations of Tower of Hanoi, Fibonacci sequence, etc. in counting problems, solving homogeneous as well as non homogeneous recurrence relations by using iterative methods, solving a homogeneous recurrence relation of second degree using algebraic method using the necessary result.

References:

1. Norman Biggs, Discrete Mathematics, Oxford University Press.
2. Richard Brualdi, Introductory Combinatorics, John Wiley and sons.
3. V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
4. Discrete Mathematics and its Applications, Tata McGraw Hills.
5. Schaum's outline series, Discrete mathematics,
6. Allen Tucker, Applied Combinatorics, John Wiley and Sons.
7. Sharad Sane, Combinatorial Techniques, Springer.

Practical Sessions	
Practical	Topic
01	Counting Principles, two way counting
02	Stirling numbers of second kind, pigeon hole principle
03	Multinomial theorem, identities, permutation and combination of multi-set
04	Inclusion and Exclusion principle, Euler's Phi function
05	Composition of permutations, signature of a permutation, inverse of permutation
06	Recurrence relation

Option 2

Course Name: **Python Through Algorithmic Approach** Course Code: SIUMTVS212

Credits**: 2** Type**: Practical Course**

Expected Course Outcomes

On completion of this course, students are expected to

Apply the knowledge of algorithms to develop basic programs in Python

The following contents will be covered in Practical sessions.

Duration: 30 Practical Sessions of 2 hours per batch, of not more than 30 students.

i) **Introduction to Algorithms:**

A.	Definition of an algorithm, characteristics of an algorithm, Selection and iterative constructs in pseudocode, simple examples such as (a) Exchanging values of variables(Swapping), (b) Sum of n given numbers
B.	Searching and sorting algorithms using conditional and loop constructs including the following: (a) Finding maximum and/or minimum element in a finite sequence of integers, (b) The linear search and binary search algorithms of an integer x in a finite sequence of distinct integers, (c) Sorting of a finite sequence of integers in ascending order, selection sort.
C.	Algorithms on integers: (a) Modular exponent,

	(b) Euclidean algorithm to find the g.c.d of two non-zero integers. (c) Checking if an integer is prime
D.	Arrays(one dimensional)
E.	Complexity of algorithm: Big O notation, Growth of functions, Time complexity, Best case, Average case, Worst Case complexity. Using big O notation to express the best, average and worst case behaviour for sorting and searching algorithms.

Reference:
Chapter 3 of

Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, 07th Edition, McGraw Hill

ii) **Introduction to Python Programming**

A.	Variables, expressions and statements, datatypes like string, numeric, sequence, etc Variables: assignment statements, printing variable values, types of variables.
B.	Operators, operands and precedence:+, -, /, *, **, % PEMDAS(Rules of precedence)
C.	String operations: + : Concatenation, * : Repetition
D.	Boolean, Comparison and Logical operators: Boolean operator: == Comparison operators: ==, !=, >, <, >=, <= Logical operators: and, or, not
E.	Mathematical functions: sin, cos, tan, log, sqrt, etc.
F.	Keyboard input: input() statement
G.	Conditional and alternative statements, Chained and Nested Conditionals: if, if-else, if-elif-else, nested if, nested if-else, looping statements such as while, for, etc

References:

1. Lambert K. A., *Fundamentals of Python - First Programs*, 2nd Edition, Cengage Learning India, 2015.
2. Downey, A. et al., *How to think like a Computer Scientist: Learning with Python*, John Wiley, 2015.
3. Online resources: https://www.w3schools.com/python/

Practical Sessions

Practical	Topic
01	Basic Python Programs demonstrating different data types and arithmetic operations, Mathematical Functions
02	Algorithms based on divisibility.
03	Algorithms based on primes.
04	Use of conditional statements, multiple if and nested if
05	Algorithms for Swapping and Searching.
06	Algorithms for Sorting and Merging, Complexity
07	Algorithms based on recursion
08	User defined functions

6. Teaching Pattern

This is a practical course of 2 credits- 4 hours per week. The Practicals shall be conducted in batches formed as per the University circular. The Practical session shall consist of discussion between the teacher and the students in which students should participate actively. The students should maintain a journal for practicals which should be submitted for checking regularly and at the end of the semester.

7. Scheme of Evaluation

There will be continuous internal assessment throughout the semester.
A practical examination will be conducted at the end of the semester.
Students will have to submit the certified journal at the time of practical examination.

1. Project and Viva/ Assignment	10
2. Journal	15
3. Attendance and participation	05
4. Practical Examination	20
Total Marks	**50**

****