Progressive Education Society's

Modern college of Arts, Science and Commerce,

Ganeshkhind,Pune-16

Autonomous

NEP 2020 (1)

(Under Faculty of Science and Technology)

S.Y.B.Sc. (Computer Science)

Mathematics : Minor

Choice Based Credit System Syllabus

To be implemented from Academic Year 2024-2025

Structure of S. Y. B. Sc. Mathematics (Computer Science) Course

For the students having Mathematics as minor subject

Semester - III		Semester - IV		Credits
CMAT23201 **2 Credits** **Theory**	**Linear Algebra**	**CMAT24201** **2 Credits** **Theory**	**Numerical Techniques**	**2**
CMAT23202 **2 Credits** **Practical**	**Effective Problem Solving via algorithms**	**CMAT24202** **2 Credits** **Practical**	**Computational Techniques using Python**	**2**

Medium of Instruction: English

Examination:

A) Pattern of Examination: Semester

B) Each course is of 50 marks (30 marks Final Examination & 20 marks internal examination).

C) Standard of passing : 20 marks out of 50 marks for each paper. But the student should obtain minimum 12 marks out of 30 in the final examination and 8 marks for internal examination out of 20.

D) Pattern of Theory Question Papers.

Q.1 Attempt any 5 out of 7 each of 2 marks [10 marks].

Q.2 Attempt any 3 out of 5 each of 4 marks [12 marks].

Q.3 Attempt any 1 out of 2 each of 8 marks [8 marks].

E) External students: Not Allowed.

Detailed Syllabus

For the students having Mathematics as minor subject

Semester – III

Name of the Paper : Linear Algebra (Theory).

Paper Code : CMAT23201

Total No. of Credits : 2 **Total No. of lectures : 30**

Course Learning Outcomes	
CO1	Students will get equipped with the knowledge of various properties of matrices and how matrices help in solving problems in different dimensions.
CO2	Students will be able to perform certain algorithms, justify why these algorithms work, and give some estimates of the running times of these algorithms.
CO3	Students will be able to solve linear systems by using different methods.
CO4	This course will enhance the abstract thinking .
CO5	Students will be able to write cohesive and comprehensive solutions to exercises and be able to defend their arguments.

Course Contents

Unit 1: System of Linear Equations and Matrices [09 Lectures]

1.1 Matrices and Matrix operations
1.2 Introduction to system of linear equations
1.3 Gaussian Elimination method
1.4 Determinants by cofactor expansion method
1.5 Determinant by row reduction method

Unit 2: General Vector space [11 Lectures]

2.1 Real vector spaces
2.2 Subspaces
2.3Linear Independence
2.4 Basis and Dimension
2.5 Row space, column space, null space, rank and nullity

Unit3: Eigen values and Eigen vectors [5 Lectures]

3.1 Eigen values and Eigen vectors
3.2 Diagonalization

Unit 4: Linear Transformation [5 Lectures]

4.1 Linear Transformation : Definition and examples
4.2 Kernel and range
4.3 Matrix of a Linear Transformation

Text Books:

Elementary Linear Algebra by Howard Anton, Chris Rorres.(Seventh Edition) John Wiley & Sons, Inc.
Unit 1: Chapter 1: 1.1 to 1.4, Chapter 2: 2.1, 2.2,
Unit 2 : Chapter 5: 5.1 to 5.6
Unit 3 : Chapter 7: 7.1,7.2
Unit 4: Chapter 8: 8.1,8.2,8.4

Name of the Paper : Effective problem solving via algorithms (Practical).
Paper Code : CMAT23202
Total No. of Credits : 2 **Total No. of Practical : 15**

List of Practical

1. Matrices, operations and row echelon form
2. Soling system of linear equations by Gaussian Eliminations and LU decomposition method
3. Determinants and Cramer's rule
4. Vector space I
5. Vector space II
6. Eigen values and Eigen vectors
7. Diagonalization
8. Linear Transformation
9. Recurrence relation I
10. Recurrence relation II
11. Introduction to R

12. Diagrammatic and Graphical representation using R
13. 3. Measures using R Commands(for raw data)
14. 4. Correlation and regression using R
15. 5. Small Programs in R.

Modalities for conducting practicals and practical Examination :

1. There will be one 4 hours (240 minutes) practical session for each of batch of 20 students per week for each practical course.
2. External examiner shall be appointed by the college for Mathematics Practical Examination.
3. The duration of practical examination is 3 hours.
4. The practical examination is of 30 marks which consist of written examination of 20 marks & 10 marks on R programming. The slips for the questions on programming and problem solving shall be prepared by the examiner.
5. The internal 20 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical .
6. Study tours may be arranged at place having important mathematical institutes or historical places

Semester – IV

Name of the Paper : Numerical Techniques (Theory).

Paper Code : CMAT24201

Total No. of Credits : 2 **Total No. of Lectures : 30**

Course Learning Outcomes	
CO1	Student will learn to apply the various numerical techniques for solving real life problems.
CO2	Student will be able to solve the integration problems which cannot be solved by usual formulae and methods using numerical techniques.
CO3	Student will learn curve fitting to the data using 3 different methods of interpolation.
CO4	Student will be able to find approximate solutions to differential equations occurring in engineering science.

Course Contents

Unit 1: Algebraic and Transcendental Equation [04 Lectures]

1.1 Introduction to Errors
1.2 False Position Method
1.3 Newton-Raphson Method

Unit 2: Calculus of Finite Differences and Interpolation [16 Lectures]

1.1 Differences
- 1.1.1 Forward Differences
- 1.1.2 Backward Differences
- 1.1.3 Central Differences
- 1.1.4 Other Differences (δ, μ operators)

1.2 Properties of Operators
1.3 Relation between Operators
1.4 Properties of Operators
1.5 Relation between Operators
1.6 Newton's Gregory Formula for Forward Interpolation
1.7 Newton's Gregory Formula for Backward Interpolation
1.8 Lagrange's Interpolation Formula
1.9 Divided Difference
1.10 Newton's Divided Difference Formula

Unit 3: Numerical Integration [08 Lectures]

3.1 General Quadrature Formula
3.2 Trapezoidal Rule
3.3 Simpson's one-Third Rule
3.4 Simpson's Three-Eight Rule

Unit 4: Numerical Solution of Ordinary Differential Equation

[08 Lectures]

a. Euler's Method
b. Euler's Modified Method
c. Runge-Kutta Methods

Text Book:-

A textbook of Computer Based Numerical and Statistical Techniques, by A. K. Jaiswal and Anju Khandelwal. New Age International Publishers.

Chapter 1:2.1, 2.5, 2.7
Chapter 2:3.1, 3.2, 3.4, 3.5,4.1, 4.2, 4.3, 5.1, 5.2, 5.4, 5.5
Chapter 3:6.1, 6.3, 6.4, 6.5, 6.6, 6.7
Chapter 4:7.1, 7.4, 7.5, 7.6

Reference Books

1. S.S. Sastry; Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India, 1999.
2. H.C. Saxena; Finite differences and Numerical Analysis, S. Chand and Company.
3. K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications.
4. Balguruswamy; Numerical Analysis.

Name of the Paper : Computational Techniques using Python (Practical).
Paper Code : CMAT24202
Total No. of Credits : 2 **Total No. of Practical : 15**

Course Learning Outcomes	
CO1	Student will understand how Python is useful scripting language for developers.
CO2	Student will be able to use lists, tuples & dictionaries in Python programs.
CO3	Student will acquire programming skills in core Python.
CO4	Student will learn to solve Linear Algebra problems using Python.
CO5	Student will learn to write program for Numerical methods.

Course Contents

1. Introduction to Python

1.1. Installation of Python
1.2. Values and types: int, float and str,
1.3. Variables: assignment statements, printing variable values, types of variables.
1.4. Operators, operands and precedence:+, -, /, *, **, % PEMDAS(Rules of precedence)
1.5. String operations: + : Concatenation, * : Repetition
1.6. Boolean operator:
  1.6.1.Comparison operators: ==, !=, >, =, <=
  1.6.2.Logical operators: and, or, not
1.7. Mathematical functions from math, cmath modules.
1.8. Keyboard input: input() statement

2. String, list, tuple

2.1. Strings:
  2.1.1.Length (Len function)
  2.1.2.String traversal: Using while statement, Using for statement
  2.1.3.String slice
  2.1.4.Comparison operators (>, <, ==)

2.2. Lists:
- 2.2.1.List operations
- 2.2.2.Use of range function
- 2.2.3.Accessing list elements
- 2.2.4.List membership and for loop
- 2.2.5.List operations
- 2.2.6.Updating list: addition, removal or updating of elements of a list

2.3. Tuples:
- 2.3.1.Defining a tuple,
- 2.3.2.Index operator,
- 2.3.3.Slice operator,
- 2.3.4.Tuple assignment,
- 2.3.5.Tuple as a return value

3. Iterations and Conditional statements

3.1. Conditional and alternative statements, Chained and Nested Conditionals: if, if-else, if-elif-else, nested if, nested if-else

3.2. Looping statements such as while, for etc, Tables using while.

3.3. Functions:
- 3.3.1.Calling functions: type, id
- 3.3.2.Type conversion: int, float, str
- 3.3.3.Composition of functions
- 3.3.4.User defined functions, Parameters and arguments

4. Linear Algebra

4.1. Matrix construct, eye(n), zeros(n,m) matrices

4.2. Addition, Subtraction, Multiplication of matrices, powers and invers of a matrix.

4.3. Accessing Rows and Columns, Deleting and Inserting Rows and Columns

4.4. Determinant, reduced row echelon form, nullspace, columnspace, rank

4.5. Eigenvalues, Eigenvectors, and Diagonalization

5. Numerical methods in Python

5.1. Simple Iterations Method
- 5.1.1 Bisection Method
- 5.1.2 Newton-Raphson Method
- 5.1.3 False Position (Regula Falsi) Mehtod

5.2 Numerical Integration:
- 5.2.1 Trapezoidal Rule,
- 5.2.2 Simpson's 1/3 Rule,
- 5.2.3 Simpson's 3/8 Rule

Text Books

1. **Downey, A. et al., How to think like a Computer Scientist: Learning with Python, John Wiley, 2015.**
Sections: 1, 2, 3

2. **Robert Johansson, Introduction to Scientific Computing in Python**
   Section: 4

Reference Books

1. Lambert K. A., Fundamentals of Python - First Programs, Cengage Learning India, 2015.
2. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India.
3. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015.
4. Zelle, J., Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates Inc.
5. Sandro Tosi, Matplotlib for Python Developers, Packt Publishing Ltd.(2009)

List of Practicals

Practical 1: Introduction to Python, Python data type-I (Unit 1)

Practical 2: Python data type-II (Unit 2)

Practical 3: Iterations & conditional statements (Unit-3 – 3.1,3.2)

Practical 4: Iterations & conditional statements (Unit 3 – 3.3)

Practical 5: Application : Matrices (Unit 4 – 4.1,4.2,4.3)

Practical 6: Application : Matrices (Unit 4 – 4.4,4.5)

Practical 7: Application : System of equations (Unit 4 – 4.5)

Practical 8: Application : Eigenvalues,Eigenvectors (Unit 4 – 4.6)

Practical 9: Application : Roots of equations (Unit 5 – 5.1)

Practical 10: Application: Numerical Integration. (Unit 5-5.2)

Practical 11 : Probability calulations using R

Practical 12: Plotting of Probability graphs using R

Practical 13:. Simulation using R

Practical 14: Tests using R

Practical 15:. Non Parametric tests using R

Modalities for conducting practical and practical Examination :

1.There will be one 4 hours (240 minutes) practical session for each of batch of 20 students per week for each practical course.
2.External examiner shall be appointed by the college for Mathematics Practical Examination.
3.The duration of practical examination is 3 hours.
4.The practical examination is of 30 marks. The slips for the questions on programming and problem solving shall be prepared by the examiner.
5.The internal 20 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical .
6.Study tours may be arranged at place having important mathematical institutes or historical places