Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Mathematics

(Faculty of Science & Technology)

F.Y.B.Sc. Mathematics (Computer Science)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course : B.Sc. Mathematics (Computer Science)

Preamble:

Savitribai Phule Pune University has decided to change the syllabi of various faculties from June,2019. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects board of studies in mathematics with concern of teachers of mathematics from different colleges affiliated to Savitribai Phule Pune University has prepared the syllabus of F. Y. B.Sc. (Computer Science) Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

(i) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling ,solving and interpreting.
(ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science and technology.
(iii) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills , creative talent and power of communication necessary for various kinds of employment .
(iv) Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:

(i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays , state important facts resulting from their studies.
(ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
(iii) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.
(iv) A student be able to apply their skills and knowledge ,that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Course Outcome:

Upon successful completion of this course, the student will be able to:

i) A students should be able to work with graphs and identify certain parameters and properties of the given graphs.
ii) A students should be able to perform certain algorithms, justify why these algorithms work, and give some estimates of the running times of these algorithms.
iii) A students should be able to solve basic exercises of the type: given a graph with properties *X*, prove that the graph also has property *Y*.
iv) A students should develop an appreciation for the literature on the subject and be able to read and present results from the literature.
v)A students should be able to write cohesive and comprehensive solutions to exercises and be able to defend their arguments.

Structure of the course:-

	Semester - I		Semester -II	
Paper I	**MTC-111**	**Matrix Algebra**	**MTC-121**	**Linear Algebra**
Paper II	**MTC-112**	**Discrete Mathematics**	**MTC-122**	**Graph Theory**
Paper III	**MTC-113**	**Mathematics Practical**	**MTC-123**	**Mathematics Practical**

Proposed Structure of S. Y. B. Sc. Mathematics (Computer Science) Courses:

	Semester - III		Semester -IV	
Paper I	**MT-231**	**Group Theory**	**MT-241**	**Calculus**
Paper II	**MT-232**	**Numerical Analysis**	**MT-242**	**Operations Research**
Paper III	**MT-233**	**Mathematics Practical**	**MT-243**	**Mathematics Practical**

All three above courses are compulsory.

Equivalence of Previous syllabus along with new syllabus:

	Old course	New Course
Paper I	**MTC-101 : Discrete Mathematics**	**MTC-111: Matrix Algebra and MTC-121 : Linear Algebra**

Paper II	**MTC-102 : Algebra and Calculus**	**MTC-112 : Discrete Mathematics and MTC-122 : Graph Theory**
Paper III	**MTC-103 : Mathematics Practical**	**MTC – 113 : Mathematics Practical and MTC – 113 : Mathematics Practical**

Detailed Syllabus:

Semester - I

MTC-111: Matrix Algebra

Unit 1 : Introduction (4 lectures)

1.1 Matrix Operations
1.2 The Inverse of a Matrix
1.3 Characterization of invertible matrices

Unit 2 : Linear Equations in Linear Algebra-I (12 lectures)

2.1 System of Linear equations
2.2 Row reduction and echelon forms
2.3 Vector equations
2.4 The matrix equation Ax=b
2.5 Solution sets of linear systems

Unit 3 : Linear Equations in Linear Algebra -II (12 lectures)

3.1 Partitioned Matrices
3.2 Matrix factorization [Lu decomposition]
3.3 Linear Independence
3.4 Introduction to linear transformation
3.5 The matrix of linear transformation
3.6 Subspaces of R^n
3.7 Dimension and Rank

Unit 4 : Determinants (8 lectures)

4.1 Introduction to determinants
4.2 Properties of determinants

4.3 Cramer's rule, Volume and linear transformations

Text Book : Linear Algebra and its Applications, David C Lay, Steven R. Lay, Judi J. MacDonald Pearson Publication,2016, Fifth Edition.

Unit 1: Chapter 2: Sec. 2.1, 2.2, 2.3
Unit 2: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5
Unit 3: Chapter 2: Sec. 2.4, 2.5,2.8, 2.9, Chapter 1: 1.7, 1.8, 1.9
Unit 4: Chapter 3: Sec. 3.1, 3.2, 3.3

Reference Books :

1. Elementary Linear Algebra with supplemental Applications,Howard Anton and others ,Wiley Student Edition.
2. Matrix and Linear Algebra (aided with MATLAB),KantiBhushanDatta, Eastern Economic Edition.

MTC 112: Discrete Mathematics

UNIT 1 : LOGIC (7 Lectures)

1.1 Revision : Propositional Logic, Propositional Equivalences.
1.2 Rules of Inference : Argument in propositional Logic, Validity Argument(Direct and Indirect methods) Rules of Inference for Propositional Logic, Building Arguments.
1.3 Predicates and Quantifiers : Predicate, n-Place Predicate or ,n-ary Predicate, Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, Logical Equivalences involving Quantifiers.

Unit 2 : Lattices and Boolean Algebra (13 Lectures)

2.1 Relations, types of relations, equivalence relations, Partial ordering relations
2.2 Digraphs of relations, matrix representation and composition of relations.
2.3 Transitive closure and Warshall's Algorithm
2.3 Poset, Hasse diagram.
2.4 Lattices, Complemented lattice, Bounded lattice and Distributive lattice.
2.5 Boolean Functions : Introduction, Boolean variable, Boolean Function of degree n, Boolean identities, Definition of Boolean Algebra.
2.6 Representation of Boolean Functions : Minterm, Maxterm Disjunctive normal form, Conjunctive normal Form.

Unit 3 : Counting Principles (7 Lectures)

3.1 Cardinality of Set : Cardinality of a finite set.
3.2 Basics of Counting : The Product Rule, The Sum Rule, The Inclusion- Exclusion Principle.
3.3 The Pigeonhole Principle: Statement, the Generalized Pigeonhole Principle, Its Applications.

3.4 Generalized Permutations and Combinations : Permutation and
3.5 Combination with Repetitions, Permutations with Indistinguishable Objects

Unit 4: Recurrence Relations (9 Lectures)

4.1 Recurrence Relations: Introduction, Formation.
4.2 Linear Recurrence Relations with constant coefficients.
4.3 Homogeneous Solutions.
4.4 Particular Solutions.
4.5 Total Solutions.

TextBooks:
1. Discrete Mathematics and its applications, by Kenneth Rosen, Tata McGraw Hill, Seventh Edition.
2. Discrete Mathematical Structures, by Kolman, Busby, Ross, Rehman, Prentice Hall,
3. Elements of Discrete Mathematics, by C. L. Liu, Tata McGraw Hill,

Unit 1: Text Book 1: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5
Unit 2: Text Book 2: Chapter 6: Sec. 6.1, 6.2, 6.3, 6.4, 6.5
Unit 3: Text Book 1: Chapter 2: Sec. 2.1, Chapter 5: Sec.5.1, 5.2, 5.3
Unit 4: Text Book 3: Chapter 10: Sec. 10.1, 10.2, 10.3, 10.4, 10.5, 10.6

MTC 113: Mathematics Practical

(Practical based on the applications of articles in MTC-111 and MTC - 112)

In Semester-I, we should conduct 3 written practical and 3 practical on maxima software for each paper MTC -111 and MTC -112.

List of Practical

Practical 1 : Problems on Unit 1 and 2 (Written) from MTC-111.
Practical 2 : Problems on Unit 3 (Written) from MTC-111.
Practical 3 : Problems on Unit 4 (Written) from MTC-111.
Practical 4 :Introduction to maxima software for MTC-111.
Practical 5 : Problems on unit 1 and unit 2 from MTC-111using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MTC-111using maxima software.
Practical 7: Problems on Unit 1 and Unit 2(Written) from MTC-112.
Practical 8 : Problems on Unit 3 (Written) from MTC-112.
Practical 9 : Problems on Unit 4(Written) from MTC-112.
Practical 10 :Introduction to maxima software for MTC-112.
Practical 11 : Problems on unit 1 and unit 2 from MTC-112 using maxima software.
Practical 12 : Problems on Unit 3 and Unit 4 from MTC-112 using maxima software.

Note:

1. The soft copy of practical on maxima software will be prepared and provided by the Board of Studies in mathematics.
2. Practical on maxima software can be performed on computer and android mobiles.
3. Android mobiles are allowed for practical examination on maxima software.
4.Practical examination of 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

Semester -II

MTC-121: Linear Algebra

Unit 1: Vector Spaces **(10 lectures)**

1.1 Vector spaces and subspaces
1.2 Null spaces, column spaces and linear tranformations.
1.3 Linearly independent sets : Bases
1.4 Coordinate systems
1.5 The dimension of a vector space
1.6 Rank

Unit 2: Eigen values and Eigen vectors **(10 lectures)**

2.1 Eigen values and Eigen vectors
2.2 The characteristic equation
2.3 Diagonalization
2.4 Eigen vectors and Linear transformations

Unit 3:Orthogonality and Symmetric Matrices **(10 lectures)**

3.1 Inner product, length and orthogonality
3.2 Orthogonal sets
3.3 Orthogonal Projections
3.4 Diagonalization of Symmetric Matrices
3.5 Quadratic forms

Unit 4: The Geometry of vector spaces **(6lectures)**

4.1 Affine combinations
4.2 Affine independence
4.3 Convex combinations

Text Book :

Linear Algebra and its Applications (5th Edition) David C Lay, Steven R. Lay, Judi J. MacDonaldPearson Publication, Fifth Edition, 2016.

Unit 1:Chapter 4: Sec.4.1, 4.2, 4.3,4.4, 4.5, 4.6
Unit 2: Chapter 5: Sec. 5.1, 5.2, 5.3, 5.4
Unit 3: Chapter 6: Sec. 6.1, 6.2, 6.3, Chapter 7: 7.1,7.2
Unit 4: Chapter 8:Sec. 8.1, 8.2*,8.3
*From section 8.2 omit Barycentric coordinates.

Reference Books:

1. Elementary Linear Algebra with supplemental Applications, by Howard Anton and others,Wiley Student Edition, Fourth edition.
2. Matrix and Linear Algebra (aided with MATLAB), byKantiBhushanDatta, Eastern Economic Edition, Fourth edition.

MTC-122: Graph Theory

Unit 1: An Introduction to graph (10 lectures)

1.1. Definitions, Basic terminologies and properties of graph, Graph models.
1.2. Special types of graphs, basic terminologies, properties and examples of directed graphs .Types of diagraphs.
1.3. Some applications of special types of graph.
1.4. Matrix representation and elementary results, Isomorphism of graphs.

Unit 2: Connected graph (8 lectures)

2.1. Walk, trail, path, cycle, elementary properties of connectedness. Counting paths between vertices (by Warshall's algorithm).
2.2. Cut edge (Bridge), Cut vertex, cut set, vertex connectivity, edge connectivity, and Properties.
2.3. Shortest path problem, Dijkstra's algorithm.

Unit 3. Euler and Hamilton path. (8 lectures)

3.1. The Konigsberg bridge problem, Euler trail, path, circuit and tour, elementary properties and Fleury's algorithm.
3.2. Hamilton path, circuit, elementary properties and examples.
3.3. Introduction of Travelling salesman problem, Chinese postman problem.

Unit 4. Trees (10 lectures)

4.1. Definitions, basic terminologies, properties and applications of trees.
4.2. Weighted graph, definition and properties of spanning tree, shortest spanning tree, Kruskal's algorithm, Prim's algorithm.

4.3. M-ary tree, binary tree, definitions and properties, tree traversal: preorder, inorder, postorder, infix, prefix, postfix notations and examples.

Text Book:

Kenneth Rosen, Discrete Mathematics and its applications, Tata McGraw Hill, Seventh Edition.

Unit 1: Chapter 8: Sec. 8.1, 8.2, 8.3
Unit 2: Chapter 8: Sec. 8.4
Unit 3: Chapter 8: Sec. 8.5, 8.6
Unit 4: Chapter 9: Sec. 9.1,9.2,9.3,9.4,9.5.

Reference Books:

1. John Clark and Derek Holton, A first look at Graph theory, Allied Publishers.
2. NarsinghDeo, Graph Theory with applications to computer science and engineering, Prentice Hall.
3. C.L.Liu, Elements of Discrete Mathematics, Tata McGraw Hill, Fourth edition
4. Douglas B. West, Introduction to Graph Theory, Pearson Education, second edition.

MTC 123: Mathematics Practical

(Practical based on the applications of articles in MTC- 121 and MTC- 122)

In Semester- II, we should conduct 4 written practical and 2 practical on maxima software for each paper MTC-121 and MTC-122.

List of Practical

Practical 1 : Problems on Unit 1 (Written) from MTC-121.
Practical 2 : Problems on Unit 2 (Written) from MTC-121.
Practical 3 : Problems on Unit 3(Written) from MTC-121.
Practical 4 :Problems on Unit 4(Written) from MTC-121.
Practical 5 : Problems on unit 1 and unit 2 from MTC-121using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MTC-121using maxima software.
Practical 7: Problems on Unit 1 (Written) from MTC-122.
Practical 8 : Problems on Unit 2 (Written) from MTC-122.
Practical 9 : Problems on Unit 3 (Written) from MTC-122.
Practical 10 :Problems on Unit 4 (Written) from MTC-122.
Practical 11 : Problems on unit 1 and Unit 2 from MTC-122 using maxima software.
Practical 12: Problems on Unit 3 and Unit 4 from MTC-122 using maxima software.

Note:

1 The soft copy of practical on maxima software will be prepared and provided by the Board of Studies in mathematics.
2. Practical on maxima software can be performed on computer and android mobiles.
3. Android mobiles are allowed for practical examination on maxima software.
4.Practical examination 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

Modalities For Conducting The Practical and The Practical Examination:

1) There will be one 3 hour practical session for each batch of 15 students per week.

2) The College will conduct the Practical Examination at least 15 days before the commencement of the Main Theory Examination. The practical examination will consist of written examination of 20 marks, 10 marks on maxima software and oral examination of 05 marks.
3) There will be no external examiner, the practical exam will be of the duration of 3 hours.
4) The subject teacher will set a question paper based on pattern as follows:

Q1. Any 2 out of 4 each question of 5 marks on paper - I.
Q2.Any 2 out of 4 each question of 5 marks on paper - II.
Q3. (a) Any 1 out of 2 each question of 5 marks on maxima software from paper – I.
(b) Any 1 out of 2 each question of 5 marks on maxima software from paper – II.

5) Each student will maintain a journal to be provided by the college.
7) The internal 15 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical.

8) It is recommended that concept may be illustrated using computer software maxima andgraphing calculators wherever possible.
9) Study tours may be arranged at places having important mathematical institutes or historical places.

10) **Special Instruction:**

a) There should be well equipped mathematics practical laboratory of size 20 X 20 sq. fts containing at least 10 computers.
b) Examiners should set separate question papers, solutions and scheme of marking for each batch and claim the remuneration as per rule.
c) Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed**.**