M. C. E. Society's
Abeda Inamdar Senior College of Arts, Science & Commerce, Pune

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Three-Year B.Sc. Degree Program in Computer Science
(Faculty of Science and Technology)

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

Choice Based Credit System Syllabus
To be implemented from the academic year 2021-2022

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

Aims and Objectives of the Course:

Sr. No.	**Aims**
1.	To give the students sufficient knowledge of fundamental principles, methods, and a clear perception of in numerous power of mathematical ideas and tools and know-how to use them by modeling, solving, and interpreting
2.	To reflect the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science and technology.
3.	To Enhance 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.
4.	To enable students to develop a positive attitude towards mathematics as an the interesting and valuable subject of study.

Sr. No.	**Objectives**
1.	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, and state important facts resulting from their studies.
2.	A student should get a relational understanding of mathematical concepts and concerned structures and should be able to follow the patterns involved, mathematical reasoning
3.	A student should get adequate exposure to global and local concerns that explore many aspects of Mathematical Sciences.
4.	A student must 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 to process the information, and draw the relevant conclusion.
5.	A student should be made aware of the history of mathematics and hence of its past, present, and future role as part of our culture.

Expected Course Specific Learning Outcome

Sr. No.	Objectives
1.	Students will know the basic concepts, properties, and operations of sets and relations and also analyze the proof techniques by mathematical induction and apply the basic principles of counting, permutations, and combinations for solving various practical problems.
2.	Students will learn graph theory, shortest path algorithms, concepts of trees, and minimum spanning tree algorithms; and also implement the learned techniques to realistic problems.
3.	Students will interpret the existence and uniqueness of solutions geometrically, Recognize and use equivalent forms to identify matrices and solve linear systems, Recognize and use equivalent statements regarding invertible matrices, pivot positions, and solutions of homogeneous systems, describe how performing row operations affects the determinant.
4.	Students will study systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality, and diagonalization.

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

Sr. No.	**Courses**		**Continuous Internal Evaluation (CIE) (Internal Marks)**	**End Semester Exam (External Marks)**	**Total Marks**	**Credits**
	Semester-I	**Semester-II**				
1.	21SBCS111M: Matrix Algebra	21SBCS121M: Linear Algebra	20	30	50	2
2.	21SBCS112M: Discrete Mathematics	21SBCS122M: Graph Theory	20	30	50	2
3	21SBCS113M: Maxima Software and Practical Based on Matrix Algebra and Discrete Mathematics	21SBCS123M: Maxima software and Practical Based on Linear Algebra and Graph Theory	20	30	50	1.5

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

Sr. No.	Courses		Continuous Internal Evaluation (CIE) (Internal Marks)	End Semester Exam (External Marks)	Total Marks	Credits
	Semester-I	Semester-II				
1.	21SBCS231M: Groups and Coding Theory	21SBCS241M: Computational Geometry	20	30	50	2
2.	21SBCS232M: Numerical Techniques	21SBCS242M: Operations Research	20	30	50	2
3	21SBCS233M: Mathematics Practical based on Groups and Coding Theory and Numerical Techniques	21SBCS243M: Mathematics Practical based on Computational Geometry and Operations Research	20	30	50	2

For Continuous Internal Evaluation (CIE):

Evaluation will be done continuously. Internal assessment will be of 20 marks for a paper of 50 Marks. These 20 marks are divided as follows:

a) There will be a compulsory Test on Demand MCQ Examination of 20 marks of each subject which would be converted into 5 Marks.
b) Two Class Tests 10 Marks Each. Converted to 5 Marks.
c) Mid-Sem Exam of 20 Marks converted to 05 Marks
d) Participation in two activities at department/ college level 05 Marks
e) In case of students failing to score under category (d), the attendance can be considered to give marks.
f) There will be a compulsory Mock Practical Examination, Viva Voce of subjects mentioned in for 20 Marks.
g) The subject teacher needs to adopt anyone out of the following methods for internal assessment:

Methods of Internal Assessment

Written exam	Quiz
Presentations	Projects
Assignments	Tutorials
Oral examination	Open Book Test and Others

Course/ Paper Title	Matrix Algebra
Course Code	21SBCS111M
Semester	I
No. of Credits	2

Syllabus

Unit No.	Title with Contents	No. of Lectures
Unit I	**Introduction**	**04**
	1. Matrix Operations	1
	2. The Inverse of a Matrix	1
	3. Row reduction and echelon forms	1
	4. Characterization of invertible matrices	1
Unit II	**Linear Equations-I**	**12**
	1. System of Linear equations	1
	2. Solution of Linear system	4
	3. Vectors in $\mathbb{R}^n$	3
	4. Matrix equation Ax=b	4
Unit III	**Linear Equations-II**	**12**
	1. Linear combination of vectors in $\mathbb{R}^n$	2
	2. Null Space and Column Space of a matrix	2
	3. Dimension and Rank	3
	4. Linear Dependence/Independence	3
	5. Linear transformation	2
Unit IV	**Determinants**	**08**
	1. Introduction to determinants	2
	2. Properties of determinants	3
	3. Cramer's rule, Volume, and linear transformations	3

Text Book:

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

Unit I: Chapter 2: Sec. 2.1, 2.2, 2.3

Unit II: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5

Unit III: Chapter 2: Sec. 2.8, 2.9

Chapter 1: Sec. 1.7, 1.8, 1.9

Chapter 4: Sec. 4.2, 4.3

Unit IV: Chapter 3: Sec. 3.1, 3.2, 3.3

References:

1.Book:

1. Elementary Linear Algebra with supplemental Applications, Howard Anton and others, Wiley Student Edition.

2. **Web links:**

1. http://math.mit.edu/~gs/linearalgebra/
2. http://www.freebookcentre.net/maths-books-download/Linear-Algebra-A-free-Linear-Algebra-Textbook-and-Online-Resource.html

Course/ Paper Title	Discrete Mathematics
Course Code	21SBCS112M
Semester	I
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Logic and Mathematical Induction**	**10**
	1. Propositional Logic, Propositional Equivalences	2
	2. Predicate, n-Place Predicate or n-ary Predicate, Quantification and Quantifiers, Logical Equivalences involving Quantifiers	3
	3.Argument in propositional Logic, Validity of an Argument (Direct and Indirect methods),Rules of Inference for Propositional Logic, Building Arguments	3
	4. Mathematical induction	2
Unit II	**Lattices and Boolean Algebra**	**14**
	1. Sets and Relations, Equivalence relations, Digraphs, matrix representation and composition of relations	4
	2. Partial order relation, Poset, Hasse diagram	2
	3. Lattices, Complemented lattice, Bounded lattice, and Distributive lattice	2
	4. Boolean functions: Introduction, Boolean variable, Boolean function of degree n, Boolean identities, Definition of Boolean Algebra	3
	5. Representation of Boolean functions: Disjunctive Normal form, Conjunctive Normal Form	3
Unit III	**Techniques of Counting**	**06**
	1. Basic Counting Principles	1
	2. The Inclusion-Exclusion Principle (Without proof)	2
	3. Permutations and Combinations	2
	4. The Pigeonhole Principle	1
Unit IV	**Recurrence Relations**	**06**
	1. Recurrence Relations: Introduction, Formation	2
	2. Linear Recurrence Relations with constant coefficients	2
	3. Homogeneous Solutions	2

Text Books:

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

Unit I: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5.
Chapter 4: Sec.4.1
Unit II: Chapter 2: Sec. 2.1, 2.2.
Chapter 7: Sec.7.1,7.3,7.5,7.6.
Chapter 10: Sec.10.1,10.2.
Unit III: Chapter 5: Sec. 5.1, 5.2, 5.3, 5.5.
Unit IV: Chapter 6: Sec. 6.1, 6.2.

2.Discrete Mathematical Structures, by Kolman, Busby, Ross, Prentice Hall, Sixth Edition

Unit II: Chapter 4: Sec.4.1, 4.2, 4.4, 4.5, 4.7.

References:

1.Book:

1. Elements of Discrete Mathematics, by C. L. Liu, Tata McGraw Hill.

2.Web links:

1. Discrete Mathematics: An Open Introduction, 3rd edition, Oscar Levin
   http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
2. Lecture Notes on Discrete Mathematics: https://home.iitk.ac.in/~arlal/book/mth202.pdf
3. Problems on Discrete Mathematics: http://www.itk.ilstu.edu/faculty/chungli/DIS300/dis300v1.pdf

Course/ Paper Title	Maxima software and Practical Based on Matrix Algebra and Discrete Mathematics
Course Code	21SBCS113M
Semester	I
No. of Credits	1.5

Syllabus

Sr. No	**Title of the Practical**	**No. of Practical**
1.	Problems on Unit I (Written) from 21SBCS111M.	1
2.	Problems on Unit II (Written) from 21SBCS111M.	1
3.	Problems on Unit III (Written) from 21SBCS111M.	1
4.	Problems on Unit IV (Written) from 21SBCS111M.	1
5.	Problems on Unit I and Unit II from 21SBCS111M using Maxima software.	1
6.	Problems on Unit III and Unit IV from 21SBCS111M using Maxima software.	1
7.	Problems on Unit I (Written) from 21SBCS112M.	1
8.	Problems on Unit II(Written) from 21SBCS112M.	1
9.	Problems on Unit III (Written) from 21SBCS112M.	1
10.	Problems on Unit IV(Written) from 21SBCS112M.	1
11.	Problems on Unit I and Unit II from 21SBCS112M using Maxima software.	1
12.	Problems on Unit III and Unit IV from 21SBCS112M using Maxima software.	1

Course/ Paper Title	Linear Algebra
Course Code	21SBCS121M
Semester	II
No. of Credits	2

Syllabus

Unit No.	Title with Contents	No. of Lectures
Unit I	**Introduction**	**10**
	1. Vector spaces and subspaces	4
	2. Coordinate systems	2
	3.The dimension of a vector space	2
	4. Rank	2
Unit II	**Eigenvalues and Eigen vectors**	**10**
	1.The characteristic equation	3
	2.Eigenvalues and Eigenvectors	4
	3.Diagonalization	3
Unit III	**Orthogonality and Symmetric Matrices**	**10**
	1.Inner product, length, and orthogonality	2
	2.Orthogonal sets and orthogonal projections	3
	3.Diagonalization of Symmetric Matrices	3
	4.Quadratic forms	2
Unit IV	**The Geometry of vector spaces**	**06**
	1.Affine combinations	2
	2.Affine independence	2
	3.Convex combinations	2

Text Book:

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

Unit I: Chapter 4: Sec.4.1, 4.4, 4.5, 4.6
Unit II: Chapter 5: Sec. 5.1, 5.2, 5.3
Unit III: Chapter 6: Sec. 6.1, 6.2, 6.3, Chapter 7: 7.1, 7.2
Unit IV: Chapter 8: Sec. 8.1, 8.2, 8.3

References:

1.Book:

Elementary Linear Algebra with supplemental Applications, Howard Anton and others, Wiley Student Edition.

2. Weblinks:

1. http://math.mit.edu/~gs/linearalgebra/
2. http://www.freebookcentre.net/maths-books-download/Linear-Algebra-A-free-Linear-Algebra-Textbook-and-Online-Resource.html

Course/ Paper Title	Graph Theory
Course Code	21SBCS122M
Semester	II
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction**	**12**
	1.Graph, properties of the graph	2
	2.Special types of graph and their applications, Operations on graphs	4
	3.Directed graphs, types of directed graphs	2
	4.Matrix representation and Isomorphism of graphs	3
	5.Degree sequence and Havel Hakimi theorem	1
Unit II	**Connected Graph**	**12**
	1.Walk, trail, path, cycle, elementary properties of connectedness	4
	2.Cut edge (Bridge), Cut vertex, cut set, vertex connectivity and edge connectivity	4
	3. Shortest path problem, Dijkstra's algorithm	4
Unit III	**Euler and Hamilton Path**	**06**
	1.The Konigsberg bridge problem, Euler trail, path, circuit and tour, elementary properties and Fleury's algorithm	2
	2.Hamilton path, circuit, elementary properties	2
	3.Applications: Travelling salesman problem, Chinese postman problem	2
Unit IV	**Trees**	**06**
	1.Trees and applications of trees.	2
	2.Weighted graph, spanning tree, shortest spanning-tree, Kruskal's algorithm, Prim's algorithm	2
	3.M-ary tree, binary tree, definitions, and properties, tree traversal, infix, prefix, postfix notations	2

Text Book:

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

Unit I: Chapter 8: Sec. 8.1, 8.2, 8.3.

Unit II: Chapter 8: Sec. 8.4, 8.6.

Unit III: Chapter 8: Sec. 8.5.

Unit IV: Chapter 9: Sec. 9.1, 9.2, 9.3, 9.4, 9.5.

References:

1.Books:

1. John Clark and Derek Holton, A first look at Graph theory, Allied Publishers.
2. Narsingh Deo, 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.

2.Weblinks:

1. Discrete Mathematics: An Open Introduction, 3rd edition, Oscar Levin: http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
2. Textbook of Graph Theory : R Balakrishnan , K. Ranganathan : http://meskc.ac.in/wp-content/uploads/2018/12/A-Textbook-of-Graph-Theory-R.-Balakrishnan-K.-Ranganathan.pdf

Course/ Paper Title	Maxima Software and Practical Based on Linear Algebra and Graph Theory
Course Code	21SBCS123M
Semester	II
No. of Credits	1.5

Syllabus

Sr. No	**Title of the Practical**	**No. of Practical**
1.	Problems on Unit I (Written) from 21SBCS121M.	1
2.	Problems on Unit II (Written) from 21SBCS121M.	1
3.	Problems on Unit III (Written) from 21SBCS121M.	1
4.	Problems on Unit IV (Written) from 21SBCS121M.	1
5.	Problems on Unit I and Unit II from 21SBCS121M using Maxima software.	1
6.	Problems on Unit III and Unit IV from 21SBCS121M using Maxima software.	1
7.	Problems on Unit I (Written) from 21SBCS122M.	1
8.	Problems on Unit II(Written) from 21SBCS122M.	1
9.	Problems on Unit III (Written) from 21SBCS122M.	1
10.	Problems on Unit IV(Written) from 21SBCS122M.	1
11.	Problems on Unit I and Unit II from 21SBCS122M using Maxima software.	1
12.	Problems on Unit III and Unit IV from 21SBCS122M using Maxima software.	1