Progressive Education Society's

Modern college of Arts, Science and Commerce,

Ganeshkhind,Pune-16

www.moderncollegegk.org

Autonomous

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 2022-2023

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

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 touse 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 communicationnecessary for various kinds of employment .
(iv) Enabling students to develop a positive attitude towards mathematics as aninteresting and valuable subject of study.

Objectives:

(i) A student should be able to recall basic facts about mathematics and shouldbe 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 conceptsand 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 thatexplore 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 itspast, present and future role as part of our culture.

Course Outcome:

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

CO1 : A students should be able to work with graphs and identify certain parameters andproperties of the given graphs.
CO2 : A students should be able to perform certain algorithms, justify why these algorithmswork, and give some estimates of the running times of these algorithms.
CO3 : A students should be able to solve basic exercises of the type: given a graph withproperties *X*, prove that the graph also has property *Y*.
CO4 : A students should develop an appreciation for the literature on the subject and beable to read and present results from the literature.
CO5 : A students should be able to write cohesive and comprehensive solutions toexercises and be able to defend their arguments.

Structure of the course

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

	Semester - I		**Semester -II**	
Paper I	**22**-MTC-111	Matrix Algebra	**22**-MTC-121	Linear Algebra
Paper II	**22**-MTC-112	Discrete Mathematics	**22**-MTC-122	Graph Theory
Paper III	**22**-MTC-113	Mathematics Practical	**22**-MTC-123	Mathematics Practical

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

	Semester - III		**Semester -IV**	
Paper I	**23**-MT-231	Groups and Coding Theory	**23**-MT-241	Computational Geometry
Paper II	**23**-MT-232	Numerical Analysis	**23**-MT-242	Operations Research
Paper III	**23**-MT-233	Mathematics Practical	**23**-MT-243	Mathematics Practical

Detailed Syllabus

Semester - I

22-MTC-111: Matrix Algebra

(2 Credits)

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: Students will develop their basics for the course of Linear Algebra of second semester.
CO5: Students will be able to write cohesive and comprehensive solutions to exercises and be able to defend their arguments.

Course Contents

Unit 1 : Introduction **(6 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 **(10 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 Linear Independence

3.2 Introduction to linear transformation
3.3 The matrix of linear transformation
3.4 Subspaces of R^n (column space and null space of a matrix)
3.5 Matrix factorization [Lu decomposition]

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. 2.5,2.8 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 andothers ,Wiley Student Edition.
2. Matrix and Linear Algebra (aided with MATLAB),KantiBhushanDatta, Eastern Economic Edition.

22-MTC 112 : Discrete Mathematics

(2 Credits)

Course Learning Outcomes:

CO1: The logical thinking of student will be developed.
CO2: Student will be able to apply mathematical foundations to design computer based algorithms.
CO3: Enhancement in the ability of student to develop algorithms.
CO4: Student will be able to translate the presented information in mathematical form and draw the relevant conclusion using his mathematical knowledge.
CO5: Help in solving a very wide variety of practical problems.

Course Contents:

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

22-MTC 113: Mathematics Practical
(1.5 Credits)

(Practical based on the applications of articles in **22**-MTC-111 and **22**-MTC-112)

In Semester-I, we should conduct 6 written practicals for each paper **22**-MTC-111 and **22**-MTC-112.

List of Practicals

Practical 1 : Problems on Unit 1 (Written) from 22 MTC-111.
Practical 2 : Problems on Unit 2 (Written) from 22 MTC-111.
Practical 3 : Problems on Unit 3 (Written) from 22 MTC-111.
Practical 4 : Problems on Unit 3 (Written) from 22 MTC111.
Practical 5 : Problems on Unit 4 (Written) from 22 MTC-111.
Practical 6 : Miscellaneous
Practical 7 : Problems on Unit 1 (Written) from 22 MTC-112.
Practical 8 : Problems on Unit 2 (Written) from 22 MTC-112.
Practical 9 : Problems on Unit 2 (Written) from 22 MTC-112.
Practical 10 : Problems on Unit 3 (Written) from 22 MTC112.
Practical 11 : Problems on Unit 4 (Written) from 22 MTC-112.
Practical 12 : Miscellaneous

Semester -II

22-MTC-121 : Linear Algebra

(2 Credits)

Course Learning Outcomes:

CO1: Students will get equipped with the knowledge of various spaces and the functioning on those spaces.
CO2: Students will be able to perform operations on spaces which are different from the usual spaces.
CO3: Students will also learn how linear algebra helps in solving real life problems using computers.
CO4: Students will develop an appreciation for the literature on the subject and be able to read and present results from the literature.
CO5: Students will be able to write cohesive and comprehensive solutions to exercises and be able to defend their arguments.

Course Contents

Unit 1: Vector Spaces **(12 lectures)**

1.1 Vector spaces and subspaces
1.2 Null spaces, column spaces and linear transformations.
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:Orthogonal and Orthonormal sets **(08 lectures)**

3.1 Inner product, length and orthogonality
3.2 Orthogonal sets
3.3 Orthogonal Projections
3.4 Gram Schmidt Process
3.5

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, 6.4
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.

22-MTC-122: Graph Theory

(2 Credits)

Course Learning Outcomes:

CO1: Able to work with graphs and identify certain parameters.
CO2: Develop the skill of converting mathematical problem graphically and vice-versa.
CO3: Motivates to solve real life problems.
CO4: Develop suitable techniques of analysis of problems.
CO5: Enable students to develop a positive attitude towards mathematics as an interesting and valuable subject to study.

Course Contents

Unit 1: Graph and operations on Graphs (12 lectures)

1.1. Definitions, Graph models, Handshaking lemma

1.2. Special types of graphs, properties and examples, directed graphs, types of digraphs

1.3. Matrix representation (Adjacency and Incidence matrix) and elementary results, Isomorphism of graphs.
1.4. Subgraph, vertex induced subgraph, edge induced subgraph, vertex deleted subgraph, edge deleted subgraph
1.5. Union, intersection and ring sum of two graphs, Fusion of two vertices, complement of a graph.
1.6. Isomorphism of graphs, self complementary graph

Unit 2: Connected graph (8 lectures)

2.1. Walk, trail, path, cycle, elementary properties of connectedness.

2.2. Center radius and dimeter of a graph
2.3. Cut edge (Bridge), Cut vertex, cut set, vertex connectivity, edge connectivity, and properties.
2.4. Shortest path problem, Dijkstra's algorithm.

Unit 3. Euler and Hamilton path. (6 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.

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. Narsingh Deo, Graph Theory with applications to computer science and engineering,

3. Prentice Hall.
4. C.L.Liu, Elements of Discrete Mathematics, Tata McGraw Hill, Fourth edition
5. Douglas B. West, Introduction to Graph Theory, Pearson Education, second edition.

22-MTC 123: Mathematics Practical

(1.5 Credits)

(Practical based on the applications of articles in **22**-MTC-121 and **22**-MTC-122)

In Semester-II, we should conduct 6 written practicals for each paper **22**-MTC-121 and **22**-MTC-122.

List of Practicals

Practical 1 : Problems on Unit 1 (Written) from 22 MTC-121.
Practical 2 : Problems on Unit 1 (Written) from 22 MTC-121.
Practical 3 : Problems on Unit 2 (Written) from 22 MTC-121.
Practical 4 : Problems on Unit 3 (Written) from 22 MTC121.
Practical 5 : Problems on Unit 4 (Written) from 22 MTC-121.
Practical 6 : Miscellaneous
Practical 7 : Problems on Unit 1 (Written) from 22 MTC-122.
Practical 8 : Problems on Unit 1 (Written) from 22 MTC-122.
Practical 9 : Problems on Unit 2 (Written) from 22 MTC-122.
Practical 10 : Problems on Unit 3 (Written) from 22 MTC122.
Practical 11 : Problems on Unit 4 (Written) from 22 MTC-122.
Practical 12 : Miscellaneous

Modalities for conducting practicals and practical examination:

1) There will be one 3 hour practical session per 15 students batch per week.
2) A question bank consisting of 50 problems in all for each semester, distributed in two sections (25 questions on paper I and 25 on paperII) will be the course work for this paper. Question bank will be prepared by the individual subject teacher and the problems included should be changed every year.
3) Each student will maintain a journal to be provided by the college.
4) The internal 15 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practicals.

5) Practical examination will consist of written examination of 30 marks and oral examination 5 marks. The pattern for the practical written examination will be as follows:

Q.1)	**A)**	Any 1 out of 2 worth 7 marks on paper I
	B)	Any 2 out of 3 worth 4 marks on paper I
Q.2)	**A)**	Any 1 out of 2 worth 7 marks on paper II
	B)	Any 2 out of 3 worth 4 marks on paper II

6) Study tours may be arranged at places having important mathematical institutes or historical places.
7) **Special Instruction**:
   a) Before starting each practical necessary introduction, basic definitions and prerequisites must be discussed.
   b) Examiners should set separate question papers, solutions and scheme of marking for each batch and claim the remuneration as per rule.

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