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

**Choice Based Credit System Syllabus**
**To be implemented from the Academic Year 2022-2023**

## 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 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 develop 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 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 and 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. | **Outcomes** |
|---|---|
| 1. | • Students will know the basic concepts from abstract algebra, especially the notion of a group.<br>• Students will have encountered some of the most important examples of groups, as well as developing some far-reaching theory "from the ground up", gaining an insight into powerful ideas and learning techniques that are applicable across a wide range of mathematics and science.<br>• Students will develop methods that allow detecting /correcting errors caused when information is transmitted through noisy channels. |
| 2. | • The students will be familiarized with the ways of solving complicated mathematical problems numerically.<br>• The students will be able to analyze and solve several errors and approximations in numerical methods.<br>• Compare the viability of different approaches to the numerical solution of problems arising in roots of solution of non-linear equations, interpolation, and approximation, numerical differentiation, and integration, solution of linear systems. |
| 3. | • Students will be able to apply algorithms for transformation or generation of points.<br>• Students will be able to apply geometric techniques to real-world problems in graphics. |
| 4. | • Students will be ready to formulate a real-world problem as a mathematical programming model and to apply the appropriate method to find an optimal solution.<br>• Students will understand the theoretical workings of the simplex/dual-simplex method for linear programming and perform iterations of it by hand. |

**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-III | Semester-IV | | | | |
| 1. | 21SBCS231M: Groups and Coding Theory | 21SBCS241M: Computational Geometry | 20 | 30 | 50 | 2 |
| 2. | 21SBCS232M: Numerical Methods | 21SBCS242M: Operations Research | 20 | 30 | 50 | 2 |
| 3. | 21SBCS233M: Numerical Methods using Scilab | 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 |

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|---|---|
| **Course/ Paper Title** | Groups and Coding Theory |
| **Course Code** | 21SBCS231M |
| **Semester** | III |
| **No. of Credits** | 2 |

**Syllabus**

| Unit No. | Title with Contents | No. of Lectures |
|---|---|---|
| **Unit I** | **Integers** | **06** |
| | 1. Division algorithm (without proof) | 1 |
| | 2. G.C.D. using Division Algorithm and expressing it as a linear combination, Euclid's lemma | 2 |
| | 3. Equivalence relation (revision) | 1 |
| | 4. Congruence relation on a set of integers | 1 |
| | 5. Equivalence class, Partition | 1 |
| **Unit II** | **Groups** | **06** |
| | 1. Binary operation | 1 |
| | 2. Group: Definition and Examples | 3 |
| | 3. Elementary Properties of Groups | 2 |
| **Unit III** | **Finite Groups and Subgroups** | **12** |
| | 1. Order of a Group, Order of an element | 2 |
| | 2. Subgroup definition, Finite Subgroup Test, Subgroups of $\mathbb{Z}_n$, examples | 4 |
| | 3. Generator, Cyclic group, Finding generators of $\mathbb{Z}_n$ | 3 |
| | 4. Permutation group: Composition of two permutations, representation as a product of disjoint cycles, inverse and order of a permutation, even/ odd permutation | 3 |
| **Unit IV** | **Coding Theory** | **12** |
| | 1. Coding of Binary Information and Error Detection | 3 |
| | 2. Decoding and Error Correction | 4 |
| | 3. Public Key Cryptography | 5 |

**Text Books:**

1. **Contemporary Abstract Algebra By J. A, Gallian (7th Edition)**
   Unit I: Chapter 0
   Unit II: Chapter 2
   Unit III: Chapter 3
   Chapter 4
   Chapter 5
   Chapter 7
2. **Discrete Mathematical Structures By Bernard Kolman, Robert C. Busby and Sharon Ross (6th Edition) Pearson Education Publication**
   Unit IV: Chapter 11

**References:**

**1. Book:**

**1) Basic Abstract Algebra By P.B.Bhattacharya, S.K.Jain, S.R.Nagpaul (2nd Edition), Cambridge University Press**

**2. Weblinks:**

1) https://www.researchgate.net/publication/340062621_LECTURE_NOTE_ON_ABSTRACT_ALGEBRA_I
2) https://nptel.ac.in/courses/111/106/111106113/

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|---|---|
| **Course/ Paper Title** | Numerical Methods |
| **Course Code** | 21SBCS232M |
| **Semester** | III |
| **No. of Credits** | 2 |

**Syllabus**

| Unit No | Title with Contents | No. of Lectures |
|---|---|---|
| **Unit I** | **Algebraic and Transcendental Equations** | **4** |
| | 1. Errors | 1 |
| | 2. Algebraic and Transcendental Equations | 1 |
| | 3. False Position Method/Regula Falsi Method | 1 |
| | 4. Newton-Raphson's Method | 1 |
| **Unit II** | **Calculus of Finite Differences and Interpolation** | **16** |
| | 1. Differences<br>i. Forward Differences<br>ii. Backward Differences<br>iii. Central Differences<br>iv. Other Differences (δ, μ operators) | 4 |
| | 2. Properties of Operators | 1 |
| | 3. Relation between Operators | 1 |
| | 4. Newton's Gregory Formula for forward Difference Interpolation | 2 |
| | 5. Newton's Gregory Formula for Backward Difference Interpolation | 2 |
| | 6. Lagrange's Interpolation Formula | 2 |
| | 7. Divided Difference | 2 |
| | 8. Newton's Divided Difference Interpolation Formula | 2 |
| **Unit III** | **Numerical Integration** | **08** |
| | 1. General Quadrature Formula | 2 |
| | 2. Trapezoidal Rule | 2 |
| | 3. Simpson's one-third Rule | 2 |
| | 4. Simpson's three-eight Rule | 2 |
| **Unit IV** | **Numerical Solution of Ordinary Differential Equation** | **08** |
| | 1. Euler's Method | 2 |
| | 2. Euler's Modified Method | 2 |
| | 3. Runge-Kutta's Second-order Method | 2 |
| | 4. Runge-Kutta's Fourth order Method | 2 |

**Text Book:**

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

Unit I: Chapter 2: Sec. 2.1, 2.5, 2.7
Unit II: Chapter 3: Sec. 3.1, 3.2, 3.4, 3.5
Chapter 4: Sec. 4.1, 4.2, 4.3,
Chapter 5: Sec. 5.1, 5.2, 5.4, 5.5
Unit III: Chapter 6: Sec. 6.1, 6.3, 6.4, 6.5, 6.6, 6.7
Unit IV: Chapter 7: Sec. 7.1, 7.4, 7.5, 7.6

**References:**

**1. Books:**


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


**2. Weblink:**

https://nptel.ac.in/courses/111/106/111106101/

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|---|---|
| **Course/ Paper Title** | Numerical Methods using Scilab |
| **Course Code** | 21SBCS233M |
| **Semester** | III |
| **No. of Credits** | 2 |

**Syllabus**

| Sr. No | Title of the Practical | No. of Practical |
|---|---|---|
| **1** | **Introduction to Scilab** | 2 |
| | 1. Installation of the software Scilab<br>2. Basic syntax<br>3. Mathematical Operators<br>4. Complex numbers<br>5. Polynomials<br>6. Built-in functions | |
| **2** | **Operations on Matrices** | 4 |
| | 1. Matrix construction<br>2. Algebraic operations on Matrices<br>3. Accessing rows and columns<br>4. Determinant and inverse of a matrix<br>5. Reduced row echelon form, Rank of a matrix<br>6. Solving systems of linear equations<br>7. Eigenvalues and Eigenvectors | |
| **3** | **User-defined functions** | 1 |
| | 1. 'deff' command | |
| **4** | **Plotting graphs using Scilab** | 1 |
| | 1. 2-D graph<br>2. 3-D graph | |
| **5** | **Iterations & conditional statements in Scilab** | 1 |
| | 1. for statement<br>2. while statement<br>3. if statement | |
| **6** | **Finding roots of an equation using Scilab** | 1 |
| | 1. False Position (Regula Falsi) Method<br>2. Newton-Raphson Method | |
| **7** | **Numerical Integration using Scilab** | 1 |
| | 1. Trapezoidal Rule<br>2. Simpson's 1/3rd Rule<br>3. Simpson's 3/8th Rule | |
| **8** | **Numerical Differentiation using Scilab** | 1 |
| | 1. Euler's Method<br>2. Runge-Kutta Method | |

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|---|---|
| **Course/ Paper Title** | Computational Geometry |
| **Course Code** | 21SBCS241M |
| **Semester** | IV |
| **No. of Credits** | 2 |

**Syllabus**

| Unit No. | Title with Contents | No. of Lectures |
|---|---|---|
| **Unit I** | **Two Dimensional Transformation** | **12** |
| | 1. Introduction | 01 |
| | 2. Representation of points | 01 |
| | 3. Transformations and matrices | 01 |
| | 4. Transformation of straight lines | 02 |
| | i. Midpoint Transformation | |
| | ii. Transformation of parallel lines | |
| | iii. Transformation of intersecting line | |
| | 5. Rotation, reflection, scaling, shearing | 01 |
| | 6. Combined transformations/ Concatenation | 01 |
| | 7. Transformation of a unit square | 01 |
| | 8. Solid-body transformations | 01 |
| | 9. Translations and homogeneous coordinates | 01 |
| | 10. Rotation about an arbitrary point | 01 |
| | 11. Reflection through an arbitrary line | 01 |
| **Unit II** | **Three Dimensional Transformation** | **08** |
| | 1. Three dimensional: Scaling, shearing, rotation, reflection, translation | 02 |
| | 2. Multiple transformations/Concatenation | 02 |
| | 3. Rotation: | 02 |
| | i. about an axis parallel to coordinate axes | |
| | ii. about an arbitrary line | |
| | 4. Reflection : | 02 |
| | i. through coordinate planes | |
| | ii. through planes parallel to coordinate planes | |
| | iii. through an arbitrary plane | |
| **Unit III** | **Projection** | **08** |
| | 1. Orthographic projections | 02 |
| | 2. Axonometric projections | 02 |
| | 3. Oblique projections | 02 |
| | 4. Single point perspective projection | 02 |
| **Unit IV** | **Plane and Space Curves:** | **08** |
| | 1. Introduction | 01 |
| | 2. Curve representation | 01 |

| | | |
|---|---|---|
| | 3. Parametric curves<br>4. Parametric representation of a circle and generation of circle<br>5. Bezier Curves:<br>i. Introduction<br>ii. properties (without proof)<br>iii. Curve fitting (up to n = 3)<br>iv. Equation of the curve in matrix form (up to n = 3) | 01<br>03<br><br>02 |

**Textbook:**

1. **D. F. Rogers, J. A. Adams, Mathematical Elements for Computer graphics, McGraw Hill Intnl Edition.**
   Unit I: Chapter 2: Sec. 2.1 to 2.17
   Unit II: Chapter 3: Sec. 3.1 to 3.10,
   Unit III: Chapter 3: Sec. 3.12 to 3.14
   Unit IV: Chapter 4: Sec. 4.1, 4.2, 4.5, Chapter 5: Sec. 5.1, 5.8

**References:**

**1. Books:**


1. Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4th Edition)
2. Computer Graphics, Schaum Series.


**2. Weblinks:**

1. https://www.youtube.com/watch?v=DPcVMEBDpAY

2. https://www.youtube.com/watch?v=55JDox30_Fk

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|---|---|
| **Course/ Paper Title** | Operations Research |
| **Course Code** | 21SBCS242M |
| **Semester** | IV |
| **No. of Credits** | 2 |

**Syllabus**

| Unit No | Title with Contents | No. of Lectures |
|---|---|---|
| **Unit I** | **Linear Programming Problem I** | **12** |
| | 1. Introduction, Definition and Examples | 2 |
| | 2. Problem-solving using Graphical method | 2 |
| | 3. Theory of Linear Programming, Slack and Surplus variables, Standard form of LPP, Some important definitions, Assumptions in LPP, Limitations of Linear programming, Applications of Linear programming, Advantages of Linear programming Techniques | 4 |
| | 4. Simplex method, Big- M-method | 4 |
| **Unit II** | **Linear Programming Problem II** | **6** |
| | 1. Special cases of LPP: Alternative solution, Unbounded solution, Infeasible solution | 3 |
| | 2. Duality in Linear Programming, Primal to dual conversion, Examples | 3 |
| **Unit III** | **Transportation Models** | **12** |
| | 1. Introduction, Tabular representation | 3 |
| | 2. Methods of IBFS (North-West Corner rule, Matrix- Minima, Vogel's Approximation), Algorithms | 4 |
| | 3. The Optimality Test of Transportation Model (MODI method only) | 5 |
| **Unit IV** | **Assignment Models** | **6** |
| | 1. Introduction | 2 |
| | 2. The Hungarian method for the Assignment problem | 4 |

**Text Book:**

1. **Operations Research Theory and Applications (2nd Edition), by J.K.Sharma.**
   Unit I: Chapter 2: Sec. 2.1 to 2.8
   Chapter 3: Sec. 3.1, 3.2, 3.3
   Chapter 4: Sec.4.1 to 4.4
   Unit II: Chapter 4: Sec.4.5, 4.6
   Chapter 5: Sec. 5.1, 5.2
   Unit III: Chapter 9: Sec. 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7
   Unit IV: Chapter 10: 10.1, 10.2, 10.3, 10.4

**References:**

**1. Books:**


1. Operations Research by H. A. Taha, Pearson Education India
2. Operations Research by R. Panneerselvam, Prentice Hall of India
3. Principles of Operations Research by H. M. Wagner, Prentice Hall of India
4. Operations Research by P.K.Gupta and D.S.Hira, S.Chand Publication


**2. Weblink:**

https://nptel.ac.in/courses/110/106/110106062/

| | |
|---|---|
| **Course/ Paper Title** | Mathematics Practical based on Computational Geometry and Operations Research |
| **Course Code** | 21SBCS243M |
| **Semester** | IV |
| **No. of Credits** | 2 |

**Syllabus**

| Sr. No | Title with Contents | No. of Practical |
|---|---|---|
| **1** | **C programming** | **4** |
| | 1. Finding the greatest common divisor and the least common multiple<br>2. Sorting of points with respect to given line and rectangle<br>3. Finding pair of points with nearest/farthest distance from a given set<br>4. Generation of n points on a circle and an ellipse | |
| **2** | **Written Practical** | **8** |
| | 5. Problems on Unit I from 21SBCS241M<br>6. Problems on Unit II from 21SBCS241M<br>7. Problems on Unit III from 21SBCS241M<br>8. Problems on Unit IV from 21SBCS241M<br>9. Problems on Unit I from 21SBCS242M<br>10. Problems on Unit II from 21SBCS242M<br>11. Problems on Unit III from 21SBCS242M<br>12. Problems on Unit IV from 21SBCS242M | |