| Semester: I | | | |
|---|---|---|---|
| **Course Title** | Mathematics-I for Computer Science & Engineering Stream | **CIE Marks** | 50 |
| **Course Code** | BCSMAT101 | **SEE Marks** | 50 |
| **Course Type** | Integrated | **Total Marks** | 100 |
| **Course Category** | ASC | **SEE Duration** | 03 hrs |
| **Hours Per Week** | 2L: 2T: 2P | **SEE Type** | Written |
| **Total Hours** | 40 hrs of theory + 18-20 hrs of practical sessions | **Credits** | 04 |

| **Course Learning Objectives** |
|---|
| This course will enable the students to: |
| • Familiarize the importance of concepts of calculus associated with one variable and multivariable for computer science and Engineering. |
| • Analyze Computer science and Engineering problems using Ordinary Differential Equations. |
| • Apply the knowledge of modular arithmetic to computer algorithms. |
| • Develop the knowledge of applying Linear Algebra referring to matrices. |
| **Pre-Requisites** |
| • Fundamentals and concepts of calculus, matrices, number system and ODE's. |

| **Module-1: Calculus** | **(8 hrs)** |
|---|---|
| **Polar Coordinates and Curvature**<br>Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms - Problems.<br>**Self-study:** Center and circle of curvature, evolutes and involutes.<br>**Applications:** Computer graphics, Image processing. | |
| **Module-2: Series Expansion and Multivariable Calculus** | **(8 hrs)** |
| **Series expansion and Partial differentiation**<br>Taylor's and Maclaurin's series expansion for one variable (Statement only) - Problems.<br>Partial differentiation, total derivative - differentiation of composite functions. Jacobian and problems. Maxima and minima for a function of two variables - Problems. Computing errors and approximations.<br>**Self-study:** Euler's theorem and Problems. Method of Lagrange's undetermined multipliers with single constraint. Indeterminate forms – L 'Hospital's rule - Problems. **Applications:** Series expansion in computer programming. | |
| **Module- 3: Ordinary Differential Equations (ODEs) of First Order** | **(8 hrs)** |
| **First-order Ordinary Differential Equations**<br>Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations - Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$. Orthogonal trajectories, L-R circuits - Problems.<br>**Non-linear Differential Equations:** Introduction to general and singular solutions, Solvable for p only.<br>**Self-Study:** Solvable for x and y. Clairaut's equations, reducible to Clairaut's equations. Problems.<br>**Applications of Ordinary Differential Equations:** Rate of Growth or Decay, Conduction of heat. | |

| Module-4: Modular Arithmetic | (8 hrs) |
|---|---|

**Introduction of Modular Arithmetic and its applications**

Introduction to Congruences, Linear Congruences, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruences, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruences - RSA algorithm.

**Self-Study:** Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic.

**Applications:** Cryptography, encoding and decoding, RSA applications in public key encryption.

| Module-5: Linear Algebra | (8 hrs) |
|---|---|

**Introduction of Linear algebra**

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigen values and Eigen vectors, Rayleigh's power method to find the dominant Eigen value and Eigen vector.

**Self-Study:** Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.

**Applications:** Boolean matrix, Network Analysis, Markov Analysis, Critical point of a network system. Optimum solution.

**Practical Components**

| Sl. No. | Programs for Implementation |
|---|---|
| 1. | 2D plots for Cartesian and polar curves |
| 2. | Finding angle between polar curves, curvature and radius of curvature of a given curve |
| 3. | Finding partial derivatives and Jacobian |
| 4. | Applications to Maxima and Minima of two variables |
| 5. | Solution of first-order ordinary differential equation and plotting the solution curves |
| 6. | Finding GCD using Euclid's Algorithm |
| 7. | Solving linear congruences $\boldsymbol{ax \equiv b\ (mod\ m)}$ |
| 8. | Numerical solution of system of linear equations, test for consistency and graphical representation |
| 9. | Solution of system of linear equations using Gauss-Seidel iteration |
| 10. | Compute Eigen values and Eigenvectors and find the largest and smallest Eigen value by Rayleigh power method. |

***Programs should be implemented using programming language - Python.**


| **Text Books:** | |
|---|---|
| 1. | "Higher Engineering Mathematics" by B. S. Grewal, 44th Edition, Khanna Publishers, 2021. |
| 2. | "Advanced Engineering Mathematics" by E. Kreyszig, 10th Edition., John Wiley & Sons, 2018. |
| 3. | "Elementary Number Theory" by David M Burton, 7th Edition, Mc Graw Hill, 2017. |
| **Reference Books:** | |
| 1. | "Higher Engineering Mathematics" by V. Ramana, 11th Edition, McGraw-Hill Education, 2017. |
| 2. | "Engineering Mathematics" by Srimanta Pal & Subodh C.Bhunia, 3rd Edition, Oxford University Press, 2016. |
| 3. | "A Textbook of Engineering Mathematics" by N.P Bali and Manish Goyal, 10th Edition, Laxmi Publications, 2022. |
| 4. | "Advanced Engineering Mathematics" by C. Ray Wylie,Louis C. Barrett, 6th Edition Mc Graw Hill, |

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|---|---|
| | 2017. |
| 5. | "Engineering Mathematic for Semester I and II" by Gupta C.B, Singh S.R and Mukesh Kumar, Mc Graw Hill, 2015. |
| 6. | "Higher Engineering Mathematics" by H. K. Dass and Er. Rajnish Verma, 3rd Edition, S. Chand Publication, 2014. |
| 7. | "Engineering Mathematics" by Dr. K S Chandrashekar, Sudha Publications, 2023-24. |
| 8. | "Calculus" by James Stewart, 7th Edition, Cengage Publications, 2019. |
| 9. | "Linear Algebra and its Applications" by David C Lay, 4th Edition, Pearson Publishers, 2018. |
| 10. | "Linear Algebra with Applications" by Gareth Williams, 6th Edition, Jones Bartlett, 2017 |
| 11. | "Cryptography and Network Security" by William Stallings, 6th Edition, Pearson Prentice Hall, 2013 |


| **Course Outcome Statements:** After the successful completion of the course, the student will be able to | |
|---|---|
| **CO1** | Explain the basic concepts of Calculus for functions with single and multi-variables, Ordinary Differential Equations, Modular Arithmetic and Linear Algebra. |
| **CO2** | Apply the techniques of Calculus, Modular Arithmetic and Linear Algebra to solve Engineering problems. |
| **CO3** | Analyze the variations associated with oscillations, errors, accuracy and precision, Maxima and Minima using multi variable Calculus. |
| **CO4** | Use modern tool to solve/visualize Engineering problems by applying principles of Calculus, Differential Equations, Modular Arithmetic and Linear Algebra. |

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | 1 |
| **CO2** | 3 | 2 | - | - | - | - | - | - | - | - | - | 1 |
| **CO3** | 3 | 2 | - | - | - | - | - | - | - | - | - | 1 |
| **CO4** | - | - | - | - | 2 | - | - | - | - | - | - | 2 |
| **Avg.** | **3** | **2** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **1.25** |

**3: High, 2: Medium, 1: Low**