# Deccan Education Society's
# FERGUSSON COLLEGE (AUTONOMOUS), PUNE

Syllabus

for

# S.Y.B.Sc.

# (Computer Science_Mathematics)

[Pattern 2019]

*(B.Sc. Semester-III and Semester-IV)*

From Academic Year

# 2020-2021

Deccan Education Society's
Fergusson College (Autonomous), Pune

# S.Y. B.Sc. Computer Science_Mathematics (Pattern 2019)

From academic year2020-2021

| Particulars | Name of Paper | Paper Code | Title of Paper | No. of Credits |
|---|---|---|---|---|
| S.Y. B.Sc. Semester III | Theory Paper - 1 | MTC2301 | Applied Algebra | 2 |
| | Theory Paper - 2 | MTC2302 | Operations Research | 2 |
| | Practical Paper - 1 | MTC2303 | Mathematics Practical -III | 2 |
| S.Y. B.Sc. Semester IV | Theory Paper - 3 | MTC2401 | Computational Geometry | 2 |
| | Theory Paper - 4 | MTC2402 | Multivariable Calculus | 2 |
| | Practical Paper - 2 | MTC2403 | Mathematics Practical -IV | 2 |

# S.Y. B.Sc. Semester III

## Subject: Mathematics Theory Paper -1(MTC2301): Applied Algebra

**[Credits-2]**

**Course Outcomes**

At the end of this course, students will be able to

**CO1** Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.

**CO2** Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations.

**CO3** Learn properties of inner product spaces and determine orthogonality in inner product spaces.

| Unit | Details | Lectures |
|---|---|---|
| I | **General Vector Spaces**<br>Real vector spaces, Subspaces, Linear independence, Basis and dimensions, Row space, Column space and null space, Rank and Nullity. | [12] |
| II | **Linear Transformations**<br>General linear transformations, Kernel and range. (Rank nullity theorem without proof.), Inverse linear transformation, Matrix of a general linear transformation. | [08] |
| III | **Eigen Values and Eigen vectors**<br>Eigen values and Eigen vectors (Definition only), Diagonalization(without proof), Application of Eigen values (Quadratic form). | [08] |
| IV | **Inner Product Spaces**<br>Definition and elementary results, Length, distance and angle in Inner product spaces, Cauchy Schwarz Inequality, Orthonormal bases, Gram-Schmidt process, Orthogonal matrix and its equivalent conditions | [08] |

**Books-**


1. S. Lang, Introduction to Linear Algebra, Second Ed. Springer-Verlag, New Yark, (1986).
2. David C. Lay, Linear Algebra and its Applications, Addison – Wesley Publishing Company.
3. M. Artin, Algebra, Prentice Hall of India , New Delhi, (1994).
4. K. Hoffmann and R. Kunze Linear Algebra, Second Ed. Prentice Hall of India New Delhi, (1998).
5. G. Strang, Linear Algebra and its Applications. Third Ed. Harcourt BraceJovanovich, Orlando, (1988).

# S.Y. B.Sc. Semester III

## Subject: Mathematics Theory Paper -2 (MTC2302):Operations Research

**[Credits-2]**

**Course Outcomes**

At the end of this course, students will be able to

**CO1** Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.

**CO2** Analyze and solve linear programming models of real life situations.

**CO3** Understand the theory of the Simplex method. Know about the relationships between the primal and dual problems

**CO4** Solve the transportation, assignment and two-person zero-sum game problems.

| Unit | Details | Lectures |
|---|---|---|
| I | **Modeling with Linear Programming**<br>Two-Variable LP Model, Graphical LP Solution, Linear Programming Applications, Production Planning and Inventory Control | **[04]** |
| II | **The Simplex Method and Duality**<br>LP Model in Equation Form, Transition from Graphical to Algebraic Solution, The Simplex Method, Big M-Method, Special Cases in Simplex Method, Dual formation, Primal Dual relation. | **[12]** |
| III | **Transportation Model and Assignment Model**<br>Definition: Transportation problem, Initial basic feasible solution by North West Corner method, Least cost method, Voggel's approximation method, Optimal solution by MODI method, The Assignment Model, Hungarian Algorithm. | **[12]**<br>[13] |
| IV | **Game Theory**<br>Two person Zero sum game, Algebraic method, Graphical method, Dominance method for mxn game, LPP formation. | **[08]** |

**Books-**

1. Hira and Gupta, Operations Research.
2. S. D. Sharma, Operations Research.
3. R. Panneerselvam, Operations Research, Prentice Hall of India.

# S.Y. B.Sc. Semester III

**Subject: Mathematics Practical Paper -1 (MTC2303): Mathematics Practical**

**[Credits-2]**

**Course Outcomes**

At the end of this course, students will be able to

**CO1** Perform basic commands in python.

**CO2** Compute exercises of Simplex method, transportation problems, assignment models.

**List of practicals (Compulsory 10 + 2 Activity)**

1. Introduction to computations using Python-I
2. Introduction to computations using Python-II
3. Sorting of points with respect to standard rectangle/rectangular block
4. Finding pairs of points having least and greatest mutual distance
5. Sorting of points with respect to a line and with respect to a convex polygon
6. Simplex Method
7. Transportation Problem
8. Assignment Problem
9. Eigen values and Eigen vectors
10. Gram Schmidt process
11. Student activity - I
12. Student activity - II

# S.Y. B.Sc. Semester IV

**Subject: Mathematics Theory Paper -3 (MTC2401): Computational Geometry**

**[Credits-2]**

**Course Outcomes**

At the end of this course, students will be able to

- **CO1** Get the idea about basic 2D and 3D transformations like scaling, shearing, reflection, rotation, and translation.
- **CO2** Understand the concept of different types of projections(from 3 dim to 2 dim)
- **CO3** Generate plane curves like circle, ellipse , hyperbola and parabola
- **CO4** Explore properties of Bezier curves of degree 2 and 3.

| Unit | Details | Lectures |
|---|---|---|
| I | **Two dimensional transformations**<br>Introduction, Representation of points, Transformations and matrices, Transformation of points, Transformation of straight lines, Midpoint transformation, Transformation of parallel lines, Transformation of intersecting lines, Transformation: rotations, reflections, scaling, shearing, Concatenation of transformations, Solid body transformations, homogeneous coordinates, Translation, Rotation about an arbitrary point, Reflection through an arbitrary line, Overall Scaling, Point at infinity. | [12] |
| II | **Three dimensional transformations and Projections**<br>Three dimensional transformations – Scaling, shearing, rotation, reflection, translation, Multiple transformations, Rotation about – an axis parallel to coordinate axes, an arbitrary axis in space, Reflection through – coordinate planes, planes parallel to coordinate planes, arbitrary planes, Affine and perspective transformations, Orthographic projections, Axonometric projections, Oblique projections, Single point perspective transformations, Vanishing points. | [12] |
| III | **Plane Curves**<br>Introduction, Curve representation, Non - parametric curves, Parametric curves, Parametric representation of a circle and generation of circle, Parametric representation of an ellipse and generation of ellipse, Parametric representation of a parabola and generation of parabolic Segment, Parametric representation of a hyperbola and generation of hyperbolic segment. | [08] |

| | | |
|---|---|---|
| **IV** | **Space curves**<br>Bezier Curves - Introduction, definition, properties (without proof), Curve fitting (up to n = 3), equation of the curve in matrix form (up to n = 3), $1^{st}$ and $2^{nd}$ Derivative. | **[04]** |

**Books-**

1. D. F. Rogers, j. a. Adams, Mathematical elements for Computer Graphics, McGraw Hill Edition.
2. Schaum Series, Computer Graphics.
3. M. E. Mortenson, Computer Graphics Handbook, Industrial Pres Inc.
4. D.Marsh, Applied Geometry and CAD.

# S.Y. B.Sc. Semester IV

## Subject: Mathematics Theory Paper - 4 (MTC2402): Multivariable Calculus

**[Credits-2]**

**Course Outcomes**

At the end of this course, students will be able to

**CO1** Learn conceptual variations while advancing from one variable to several variables in calculus.

**CO2** Apply multivariable calculus in optimization problems.

| Unit | Details | Lectures |
|---|---|---|
| I | **Partial Differentiation**<br>Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Tangent planes, Chain rule, Directional derivatives, The gradient, Maximal and normal properties of the gradient, Tangent planes and normal lines. | [09] |
| II | **Differentiation**<br>Higher order partial derivatives, Total differentiation and differentiability, Jacobians, Change of variables, Euler's theorem for homogenous functions, Taylor's theorem for functions of two variables and more variables. | [09] |
| III | **Extrema of functions and Vector Field**<br>Extrema of functions of two and more variables, Method of Lagrange multipliers, Constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identities. | [09] |
| IV | **Double and Triple Integrals**<br>Double integration over rectangular and non rectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals, Dirichlet integrals. | [09] |

**Books-**

1. Jerrold Marsden, Anthony J. Tromba and Alan Weinstein, Basic Multivariable Calculus, Springer India Pvt. Limited (2009).
2. James Stewart, Multivariable Calculus Brooks / Cole. Cengage (2012).

# S.Y. B.Sc. Semester IV

**Subject: Mathematics Practical Paper -2 (MTC2403):Mathematics Practical**

**[Credits-2]**

**Course Outcomes**

At the end of this course, students will be able to

**CO1** Perform interpolation methods in python.

**CO2** Compute exercises of 2 D and 3 D transformations.

**List of practicals (Compulsory 10 + 2 Activity)**

1. Newton forward Interpolation
2. Newton backward Interpolation
3. Newton divided difference method
4. Lagrange's method for interpolation
5. 2-D Transformations
6. Generation of equidistant points on boundary of standard circle / ellipse
7. 3-D Transformations
8. Differentiation
9. Extrema of functions and Vector Field
10. Plane curves and Be'zier curves
11. Student activity - I
12. Student activity - II