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 year 2020-2021

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		
Title of the Course and Course Code	**Applied Algebra (MTC2301)**	**Number of Credits : 02**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define linearly independent and dependent vectors.	
CO2	Discuss the concepts of vector spaces and subspaces.	
CO3	Apply concept of diagonalization (factorization) of a matrix using eigenvalues and eigenvectors.	
CO4	Analyze norm, distance and angle between vectors to check similarities.	
CO5	Determine eigenvalues and eigenvectors of a given matrix.	
CO6	Generate matrix of a general linear transformation by evaluating kernel, range.	

Unit No.	Title of Unit and Contents	No of Lectures
I	**General Vector Spaces** Real vector spaces, Subspaces, Linear independence, Basis and dimensions, Row space, Column space and null space, Rank and Nullity.	**12**
II	**Linear Transformations** General linear transformations, Kernel and range. (Rank nullity theorem without proof.), Inverse linear transformation, Matrix of a general linear transformation.	**8**
III	**Eigen Values and Eigen vectors** Eigen values and Eigen vectors (Definition only), Diagonalization(without proof), Application of Eigen values (Quadratic form).	**8**
IV	**Inner Product Spaces** 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	**8**

References:

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		
Title of the Course and Course Code	**Operations Research (MTC2302)**	**Number of Credits : 02**

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Identify the role of Linear programming problem solving skills in real life business models.
CO2	Distinguish between Transportation Problems and Assignment Problems.
CO3	Demonstrate methods including graphs and linear programming to analyze and solve the Two-person, zero-sum games.
CO4	Relate the theoretical problem solving techniques with their relative applications.
CO5	Validate and apply the techniques constructively to make effective business decisions.
CO6	Develop mathematical and computational modelling of real decision making problems.

Unit No.	Title of Unit and Contents	No of Lectures
I	**Modeling with Linear Programming** Two-Variable LP Model, Graphical LP Solution, Linear Programming Applications, Production Planning and Inventory Control	**4**
II	**The Simplex Method and Duality** 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** Definition: Transportation problem, Initial basic feasible solution by Northwest Corner method, Least cost method, Voggel's approximation method, Optimal solution by MODI method, The Assignment Model, Hungarian Algorithm.	**12**
IV	**Game Theory** Two-person Zero sum game, Algebraic method, Graphical method, Dominance method for mxn game, LPP formation.	**8**

[13]

References:

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		
Title of the Course and Course Code	**Mathematics Practical (MTC2303)**	**Number of Credits : 02**

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Recall basic techniques, concepts of applied algebra and operations research.
CO2	Compute Eigenvalues and Eigenvectors.
CO3	Apply and test different mathematical concepts in python programming.
CO4	Integrate the mathematical conceptual knowledge to write better programs.
CO5	Discriminate different methods of assignment and transportation problems.
CO6	Write programs for different sorting algorithms.

List of practicals (Compulsory 10 + 2 Activity)

Sr No.	List of practicals
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
11	Gram Schmidt process
12	Student activity - I
13	Student activity - II

S.Y. B.Sc. Semester IV		
Title of the Course and Course Code	**Computational Geometry (MTC2401)**	**Number of Credits : 02**

Course Outcomes (COs) **On completion of the course, the students will be able to:**	
CO1	State different types of projections on an object.
CO2	Compute points of standard curves using recursive formulae.
CO3	Demonstrate knowledge of key notions and principles related to 2 dimensional transformations.
CO4	Explain and implement the basic principles and theory of geometric algorithms.
CO5	Evaluate 3D transformations.
CO6	Construct Bezier curves of order 2 and order 3.

Unit No.	Title of Unit and Contents	No of Lectures
I	**Two dimensional transformations** 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** 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** 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.	8
IV	**Space curves** Bezier Curves - Introduction, definition, properties (without proof),	4

	Curve fitting (up to n = 3), equation of the curve in matrix form (up to n = 3), 1st and 2nd Derivative.	

References:

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		
Title of the Course and Course Code	**Multivariable Calculus (MTC2402)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall series expansion of single variable functions.	
CO2	Interpret the properties of continuous, derivable functions and mean value theorems.	
CO3	Apply concepts of double and triple integrals to solve various problems.	
CO4	Explain higher order partial derivatives and their applications.	
CO5	Evaluate limits of multi variable functions.	
CO6	Create optimization algorithms using the gradient and extrema of multi variable functions.	

Unit No.	Title of Unit and Contents	No of Lectures
I	**Partial Differentiation** 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.	**9**
II	**Differentiation** 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.	**9**
III	**Extrema of functions and Vector Field** 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.	**9**
IV	**Double and Triple Integrals** 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.	**9**

References:

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		
Title of the Course and Course Code	**Mathematics Practical (MTC2403)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall 2 dimensional and 3 dimensional transformations.	
CO2	Illustrate the concepts in the vector field.	
CO3	Solve interpolation problems by writing python programs.	
CO4	Analyze and implement all geometric algorithms.	
CO5	Evaluate problems of differentiation, extrema of functions.	
CO6	Generate equidistant points on the boundary of the standard circle/ellipse.	

List of practicals (Compulsory 10 + 2 Activity)

Sr No.	Title of practicals
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