Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune - 5
Third Year of B.Sc. (Computer Science)
(2023 Course under NEP 2020)

Course Code: 23CsMatU5202
Course Name: Operations Research
Teaching Scheme: TH: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites: Matrices, Graphs, Linear Inequations.

Course Objectives: To study

- Linear Programming Problems.
- Assignment Models.
- Transportation Models.

Course Outcomes:

On completion of the course, student will be able to:-

- Find optimum solution to Linear Programming Problem
- Find IBFS of Transportation Problem
- Find optimum solution of Transportation Problem
- Find optimum solution of Assignment Problem

Course Contents:

Chapter 1	Linear Programming Problem I	8 Hours
	● 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. ● Simplex method, Big-M-method.	
Chapter 2	**Linear Programming Problem II**	**6 Hours**
	● Special cases of LPP: Alternative solution, Unbounded solution, Infeasible solution. ● Duality in Linear Programming, Primal to dual conversion, Examples.	
Chapter 3	**Transportation Models**	**10 Hours**
	● Introduction, Tabular representation. ● Methods of IBFS: North-West rule, Matrix-minima, Vogel's Approximation), Algorithms. ● The Optimality Test of Transportation Model: Modified Distribution method	
Chapter 4	**Assignment Models**	**6 Hours**
	● Assignment Model - Introduction. ● Hungerian method for Assignment problem.	
	Total No. of Hours	**30**

Reference Books:

1) Operation Research (12th Edition), by S. D. Sharma.

2) Operations Research: An Introduction, by Hamdy A. Taha, Pearson (9th Edition), 2014.

3) Operations Research by Gupta and Hira, S. Chand, 2015.

4) Operation Research: Theory and Applications, by J. K. Sharma, 4th Edition, 2017.

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Course Code: 23CsMatU5202
Course Name: Operations Research
Teaching Scheme: PR: 4 Hours/Week **Credit: 02**
Examination Scheme: CIA: 20 Marks **End-Semester: 30 Marks**

Prerequisites: Matrices, Graphs, Linear Inequations.

Course Objectives: To study

- Linear Programming Problems.
- Assignment Models.
- Transportation Models.

Course Outcomes:

On completion of the course, student will be able to:-

- Find optimum solution to Linear Programming Problem
- Find IBFS of Transportation Problem
- Find optimum solution of Transportation Problem
- Find optimum solution of Assignment Problem

Course Contents:

	List of Practicals	60 Hours
Practical 1	Standard and Canonical forms of LPP	
Practical 2	Simplex Method	
Practical 3	Big-M Method	
Practical 4	Special Cases of LPP	
Practical 5	Duality in LPP	
Practical 6	Drawing Feasible region of LPP (Using Python)	
Practical 7	Solution of Linear Programming Problem (Using Python)	
Practical 8	North West Corner Method	
Practical 9	Matrix Minima Method	
Practical 10	Vogel's Approximation Method	
Practical 11	Modified Distribution Method	
Practical 12	Solution of Transportation Problem (Using Python)	
Practical 13	Assignment Problem – I	
Practical 14	Assignment Problem – II (Special Cases)	
Practical 15	Solution of Assignment Problem (Using Python)	

Note: For every batch there will be 4 hours for each practical session per week.

Reference Books:

1) Operation Research (12^{th} Edition), by S. D. Sharma.

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Third Year of B.Sc. (Computer Science)
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Course Code : 23CsMatU5301
Course Name : Applied Sciences -IV (Linear Algebra)
Teaching Scheme: TH: 2 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisites: Vectors, Functions, Polynomials, Matrices, Determinant.

Course Objectives: To study
- System of linear equations
- Vector spaces
- Linear transformations
- Eigenvalues and Eigenvectors.

Course Outcomes: On completion of the course, student will be able to:-
- Identify whether a given set of objects is a vector space or not.
- Solve system of linear equations
- Check whether given set of vectors is linearly independent or not
- Find eigenvalues and eigenvectors of a square matrix.
- Find a matrix of general linear transformation.
- Apply concepts learnt in this course to solve some real world problems arising out as an application of linear algebra.

Course Contents:

Chapter 1	**System of linear equations**	06 hours
	• Row reduction and echelon form of a matrix • The matrix equation Ax=b • Solution sets of Linear systems (Gauss elimination method, Gauss –Jordan elimination method)	
Chapter 2	**Euclidean Vector Spaces**	10 hours
	• Real Vector Spaces. **(**$R, R^2, R^3, \ldots\ldots, R^n$**)** • Subspaces. • Linear Independence. • Basis and Dimension. • Row Space, Column Space and Null space. • Rank and Nullity.	

chapter 3	**Linear Transformations**	06 hours
	● General Linear Transformations. ● Kernel and Range (Rank Nullity Theorem). ● Matrix of general Linear Transformations.	
Chapter 4	**Eigenvalues and Eigenvectors**	08 hours
	● Eigenvalues and Eigenvectors. ● Diagonalization. ● Quadratic Forms.	
	Total No. of Hours	**30**

Reference Books:

1) Elementary Linear Algebra (Applications Version) by Howard Anton, Chriss Rorres, John Wiley and Sons Inc.(Ninth edition), 2010 .
2) Linear Algebra and Its Applications by David Lay, Steven Lay and Judi McDonald, Pearson, Fifth edition.
3) Introduction to Linear Algebra, S. Lang, Springer-Verlag (Second edition), 1986.
4) Linear Algebra by K. Hoffmann and R. Kunze, Prentice Hall of India (Second edition), 1998.

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Course Code : 23CsMatU5301
Course Name : Applied Sciences -IV (Linear Algebra)
Teaching Scheme: PR: 4 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisites: Vectors, Functions, Polynomials, Matrices, Determinant.

Course Objectives: To study
- System of linear equations
- Vector spaces
- Linear transformations
- Eigenvalues and Eigenvectors.

Course Outcomes: On completion of the course, student will be able to:-
- Identify whether a given set of objects is a vector space or not.
- Solve system of linear equations
- Check whether given set of vectors is linearly independent or not
- Find eigenvalues and eigenvectors of a square matrix.
- Find a matrix of general linear transformation.
- Apply concepts learnt in this course to solve some real world problems arising out as an application of linear algebra.

Course Contents:

	List of Practicals	60 Hours
Practical 1	Introduction to Scilab	
Practical 2	Determinant	
Practical 3	Determinants (using Scilab)	
Practical 4	System of linear equation	
Practical 5	System of linear equations (using Scilab)	
Practical 6	Vector Space: Linear independence, dependance	
Practical 7	Row space, column space and null space	
Practical 8	Linear transformation	
Practical 9	Kernel and Range of linear transformation	
Practical 10	Matrix of a linear transformation	

Practical 11	Rank and Nullity based problems	
Practical 12	Eigenvalues and eigenvector	
Practical 13	Diagonalization	
Practical 14	Eigenvalues, Eigenvectors & Diagonalization (using Scilab)	
Practical 15	Quadratic forms	

Note: For every batch there will be 4 hours for each practical session per week.

Reference Books:

1) Elementary Linear Algebra (Applications Version) by Howard Anton, Chriss Rorres, John Wiley and Sons Inc.(Ninth edition), 2010 .
2) Linear Algebra and Its Applications by David Lay, Steven Lay and Judi McDonald, Pearson, Fifth edition.
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Course Code : 23CsMatU6202
Course Name : Computational Geometry
Teaching Scheme: TH: 2 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisites: Euclidean Geometry, Trigonometry, Matrices, Algebra of Equations.

Course Objectives: To study

- Mathematical techniques required for Computer graphic applications, especially principles of geometry and transformations.
- Parametric representation and generation of Conic sections and Space curves.

Course Outcomes:

On completion of the course, student will be able to:-

- Apply various transformations to the object (which can be created using computer graphics software) in order to manipulate (render) the object.
- Analytically represent and generate two dimensional curves (Conic sections).
- Apply Curve fitting technique for given data points.

Course Contents:

Chapter 1	**Two Dimensional Transformations**	**12 Hours**
	● Introduction. ● Representation of points. ● Transformation and Matrices. ● Transformation of Points. ● Transformation of Straight Lines. ● Midpoint Transformation. ● Transformation of Parallel Lines. ● Transformation of Intersecting Lines. ● Transformations: Rotations, Reflections, Scaling, Shearing. ● Combined Transformations. ● Transformation of the Unit Square. ● Solid Body Transformations. ● Translations and Homogeneous Coordinates. ● Rotation about an Arbitrary Point. ● Reflection through an Arbitrary Line.	

	• Projection – A Geometric Interpretation of Homogeneous Coordinates. • Overall Scaling. • Points at Infinity.	
Chapter 2	**Three Dimensional Transformations**	**10 Hours**
	• Introduction. • Three Dimensional – Scaling, Shearing, Rotation, Reflection, Translation. • Multiple Transformations. • Rotation about an Axis Parallel to a Coordinate Axis. • Rotation about an Arbitrary Axis in Space. • Reflection through an Arbitrary Plane. • Affine and Perspective Geometry. • Orthographic Projections. • Axonometric Projections. • Oblique Projections. • Single Point Perspective Transformations.	
Chapter 3	**Plane Curves**	**04 Hours**
	• Introduction. • Curve Representation. • Nonparametric Curves. • Parametric Curves. • Parametric Representation of a Circle and Generation of Circle. • Parametric Representation of an Ellipse and Generation of Ellipse.	
Chapter 4	**Space Curves**	**04 Hours**
	• Introduction. • Representation of Space Curves. • B*é*zier Curves – Introduction, Definition, Properties, Curve fitting (upto n = 3), Equation of the Curve in Matrix form (upto n = 3).	
	Total No. of Hours	**30**

Reference Books:

1) Mathematical Elements for Computer Graphics by D. F. Rogers and J. A. Adams, Tata McGraw Hill (Second edition), 2002.
2) Schaum's Outlines, Computer Graphics, Tata McGraw Hill Publisher (Second edition), 2015.
3) Applied Geometry for Computer Graphics and CAD by Ducan Marsh, Springer (Second edition), 2005.
4) Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4^{th} Edition).

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Course Code : 23CsMatU6202
Course Name : Computational Geometry
Teaching Scheme: PR: 4 Hours/Week **Credit : 02**
Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisites: Euclidean Geometry, Trigonometry, Matrices, Algebra of Equations.

Course Objectives: To study

- Mathematical techniques required for Computer graphic applications, especially principles of geometry and transformations.
- Parametric representation and generation of Conic sections and Space curves.

Course Outcomes:

On completion of the course, student will be able to:-

- Apply various transformations to the object (which can be created using computer graphics software) in order to manipulate (render) the object.
- Analytically represent and generate two dimensional curves (Conic sections).
- Apply Curve fitting technique for given data points.

Course Contents:

	List of Practicals	**60 Hours**
Practical 1	Two dimensional Transformations I (scaling, shearing, reflection, rotation)	
Practical 2	Combined Transformations	
Practical 3	Two dimensional Transformations II (translation, rotation about arbitrary point, reflection through arbitrary line)	
Practical 4	Two dimensional transformations (using Python)	
Practical 5	Three dimensional Transformations I (scaling, shearing, reflection, rotation)	
Practical 6	Combined Transformations	
Practical 7	Three dimensional Transformations II (translation, rotation about arbitrary line, reflection through plane parallel to coordinate plane)	
Practical 8	Three dimensional transformations (using Python)	

Practical 9	Projections (orthographic, axonometric, oblique)	
Practical 10	Projections (using Python)	
Practical 11	Generation of Circle	
Practical 12	Generation of Ellipse	
Practical 13	Generation of Plane Curves (using Python)	
Practical 14	Bezier Curve (for control points 2 and 3)	
Practical 15	Bezier Curve (using Python)	

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1) Mathematical Elements for Computer Graphics by D. F. Rogers and J. A. Adams, Tata McGraw Hill (Second edition), 2002.
2) Schaum's Outlines, Computer Graphics, Tata McGraw Hill Publisher (Second edition), 2015.
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