University of Pune
Board of Studies in Mathematics

S.Y.B.Sc. (Comp. Sc.)
Syllabus of Mathematics

	Semester – I		Semester – II	
Paper I	Linear Algebra	(MTC:211)	Computational Geometry	(MTC : 221)
Paper II	Numerical Analysis	(MTC:212)	Operations Research	(MTC:222)
Paper III	Practical			(MTC:223)

Paper I- (Semester I) :
Linear Algebra (MTC:211)

1. Linear Equations and Matrices

Linear systems
Matrices
Dot Product and Matrix Multiplication
Matrix Transformations
Solutions of Linear Systems of Equations
LU- Factorization. (12 lectures)

2. Real Vector spaces

Vector Spaces
Subspaces
Linear Independence
Basis and Dimension
Homogeneous Systems
The Rank of a Matrix and Applications
Coordinates and Change of Basis
Orthonormal Bases in R^n (20 lectures)

3. Eigenvalues, Eigenvectors and diagonalization

Eigenvalues and Eigenvectors
Diagonalization
Cayley Hamilton theorem (Statement only) (10 lectures)

4. Linear Transformations and Matrices

Definitions and Examples
The Kernel and Range of a Linear transformation
The Matrix of a Linear Transformation (6 lectures)

Text Book

B. Kolman , D. Hill, Introductory Linear Algebra, An Applied First Course, Pearson Edn; 8th Edn; (2008)
Chapters : 1, 6, 8, 10(Only Arts. 10.1, 10.2, 10.3)

Reference Book: H.Anton, Chris Rorres, Linear Algebra with Applns., Wiley, 7th Edn; (1994)

Paper I- Semester II :
Computational Geometry (MTC:221)

1. **Two dimensional transformations -** (16 Lectures)

a) Introduction.
b) Representation of points.
c) Transformations and matrices.
d) Transformation of points.
e) Transformation of straight lines.
f) Midpoint transformation.
g) Transformation of parallel lines.
h) Transformation of intersecting lines.
i) Transformation: rotations, reflections, scaling, shearing.
j) Combined transformations.
k) Transformation of a unit square.
l) Solid body transformations.
m) Transformation and homogeneous coordinates. Translation.
n) Rotation about an arbitrary point.
o) Reflection through an arbitrary line.
p) Projection – a geometric interpretation of homogeneous coordinates.
q) Overall Scaling.
r) Point at infinity.

2. **Three dimensional transformations** (16 Lectures)

a) Introduction.
b) Three dimensional – Scaling, shearing, rotation, reflection, translation.
c) Multiple transformations.
d) Rotation about – an axis parallel to coordinate axes, an arbitrary axis in space.
e) Reflection through – coordinate planes, planes parallel to coordinate planes, arbitrary planes.
f) Affine and perspective transformations.
g) Orthographic projections.
h) Axonometric projections.
i) Oblique projections.
j) Single point perspective transformations.
k) Vanishing points.

3. Plane Curves (10 Lectures)

a) Introduction.
b) Curve representation.
c) Non – parametric curves.
d) Parametric curves.
d) Parametric representation of a circle and generation of circle.
e) Parametric representation of an ellipse and generation of ellipse.
f) Parametric representation of a parabola and generation of parabolic segment.
g) Parametric representation of a hyperbola and generation of hyperbolic segment.

5. **Space curves** (6 Lectures)

a) Bezier Curves – Introduction, definition, properties(without proof), curve fitting (up to n = 3), equation of the curve in matrix form (upto n = 3)

TextBook :

D. F. Rogers, J. A. Adams, Mathematical elements for Computer graphics, Mc Graw Hill Intnl Edition.

References :

- Schaum Series, Computer Graphics.
- M. E. Mortenson, Computer Graphics Handbook, Industrial Pres Inc.

Paper II- Semester I :
Numerical Analysis (MTC:212)

1. Errors: [4 lectures]

(1) Rounding off numbers to n significant digits, to n decimal places.
(2) Absolute, relative and percentage errors.

2. Solution of Equations: [14 lectures]

(1) Location of roots.
(2) Descartes' Rules.
(3) Sturm's theorem (without proof).
(4) Bisection Method
(5) Regula Falsi
(6) Newton- Raphson Method.
(7) Gauss-Seidel Method.

3. Interpolation: [14 lectures]

(1) Operator Δ, ∇, E and their relations.
(2) Fundamental theorem of difference calculus.
(3) Newton's Interpolation Formulae (Forward and Backward).
(4) Lagrange's Interpolation Formula.
(5) Divided difference and Newton's divided difference formula.
(6) Central Difference and Average operators.

4. Numerical Differentiation: [3 lectures]

5. Numerical Integration: [7 lectures]

(1) General quadrature formula.
(2) Trapezoidal rule.
(3) Simpsons's $\frac{1}{3}^{rd}$ rule.
(4) Simpsons's $\frac{3}{8}^{th}$ rule.

6. Numerical solution of first order ordinary differential equations: [6 lectures]

(1) Euler's method.
(2) Modified Euler's methods.
(3) Runge - Kutta Methods.

Text Books :

(1) S.S. Sastry; Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India, 1999.

(2) H.C. Saxena; Finite differences and Numerical Analysis, S. Chand and Company.

Reference Books:

(1) K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications.

(2) Balguruswamy; Numerical Analysis.

Paper II- Semester II :
Operations Research (MTC:222)

1. Linear Programming Problem (20 Lectures)

a) Definition, terminology, advantage and limitations.
b) Formulation of LPP and Graphical Method.
c) Feasible solution, basic solution, optimal solution.
d) Solution by Simplex method : All types of objective functions, all types of constraints.(Only non – degenerate problems)
e) Duality : Concept, relation between primal and dual, advantages and interpretation of dual.

2. Transportation and assignment problems (18 Lectures)

a) Introduction to transportation problem, illustrations.
b) Initial solution by North west corner rule, Matrix Minima method and VAM.
c) Optimal solution by MODI method.
d) Assignment problem (Hungarian Method)

3. Theory of games (10 Lectures)

a) Two person zero sum game, pure and mixed strategies, statement of min – max theorem.
b) Graphical method for solving $2 \times m$ and $n \times 2$ games.
c) Subgames.
d) Solution of 2x2 game by arithmetic and algebraic methods.
e) Principle of dominance and solving some simple games.
f) Presentation of game problem as L.P.P.

Text Book: S. D. Sharma, Operations Research.
Reference Books:

1) R. Panneerselvam, Operations Research – Prentice Hall of India.

2) H. M. Wagner, Principles of Operations Research – Prentice Hall of India.

3) H. A. Taha, Operations Research.

4) Gupta and Hira, Operations Research.

Paper III : (MTC:223)
Practical Course

Experiment No.	TITLE
	Section – I : (Semester – I)
1.	System of linear equations : (a) Gaussian elimination method, (b) Gauss-Jordan Elimination method
2.	Gram-Schmidt Process (consider only Euclidean inner product space R^n)
3.	Eigenvalues and Eigenvectors of a matrix, Diagonalization
	Section – II : <u>Computer Sessions</u>
4.	Introduction of Scilab
5.	Computing with Scilab Part – I : Problems on each of the following topics are to be solved by using Scilab : (a)Solve system of linear equations, (b) Determinant and inverse of the matrix, (c) Eigenvalues and Eigenvectors (compute characteristic polynomial, eigenvalues, eigenvectors and diagonalization)
6.	C-Programs of Numerical methods Part – I : (a) Bisection Method (b) Regula-Falsi Method (c) Newton-Raphson Method
7.	Computing with Scilab Part – II : (a) Bisection Method. (b) Regula-Falsi Method. (c) Newton-Raphson Method
8.	C-Programs of Numerical methods Part – I : (a) Numerical Integration by Trapezoidal method, (b) Numerical Integration by Simpson's $(1/3)^{rd}$ Rule, (c) Numerical Integration by Simpson's $(3/8)^{th}$ Rule,

	Section – I : (Semester – II)
9.	Two-dimensional Transformations
10.	Three-dimensional Transformations
11.	Generation of Plane Curves and Bezier curve
12.	Simplex method
13.	Transportation and Assignment Problems
	Section – II : <u>C- Programs</u>
14.	Utility – I : (a) Sorting a set of points in a plane with respect to a line, (b) Sorting a set of points in a plane with respect to rectangle with sides parallel to coordinate axes (c) Sorting a set of points in a plane with respect to a given convex polygon.
15.	Utility – II : (a) Given set of points in the plane, find the pair that is farthest apart and with least mutual distance, (b) Find nearest neighbor of each point in a given set of points in the plane.
16.	Utility – III : Sorting a set of points in 3-dimensional space with respect to a rectangular box with sides parallel to coordinate axes.
17.	Utility – IV : (a) Generation of plane curves: (i) Circle (ii) Ellipse

Instructions :

(1) The annual examination is of 80 marks and 20 marks are based on internal evaluation (journal, viva-voce etc.).

(2) The annual examination is of 80 marks and of 3 hours duration. It has two parts : (i) Question paper solving, (ii) Computer Session.

(3) The maximum marks for the question paper is 50 and is of 2 hours duration. There are three questions; each of 25 marks and a student has to solve any two questions out of 3 questions. There is no internal option. Each question will have three sub questions of marks 10, 10 and 5 respectively.

(4) Computer session is of 1 hour duration. It consists of one question on writing C-program, which is of 20 marks and one question of 10 marks for solving problems using Scilab.

(5) The slips for the questions on C-programs and problem solving by Scilab should be prepared and can be used in annual examination at least for 3 years.