UNIT – 1: ELEMENTARY FUNCTIONS OF COMPLEX VARIABLES
10 lectures
1.1 DeMoivre's Theorem.
1.2 $n$th roots of unity.
1.3 Expansion of $\cos n\theta, \sin n\theta$.
1.4 Direct circular functions and hyperbolic functions.
1.5 Relations between circular and hyperbolic functions.
1.6 Some basic properties of hyperbolic functions.
1.7 Inverse circular and hyperbolic functions.
1.8 Examples.

UNIT – 2: MATRICES
10 lectures
2.1 Definitions of Hermitian and Skew Hermitian matrices.
2.2 Rank of a Matrix.
2.3 Eigen values, Eigen vectors and the characteristic equation of a matrix.
2.4 Cayley Hamilton theorem and its use in finding inverse of a matrix.
2.5 System of linear homogeneous equations.
2.6 System of linear non-homogeneous equations.
   1.6.1 Condition for consistency.
   1.6.2 Nature of the general solution.
2.7 Examples.

UNIT - 3 QUADRATIC FORMS AND CONGRUENCE OF MATRICES
10 lectures
3.1 Quadratic form (Definition)
3.2 Matrix of a quadratic form with simple examples
3.3 Quadratic forms corresponding to a symmetric matrix with examples
3.4 Linear transformations
3.5 Congruence of Matrices and Congruence of Quadratic form
3.6 Reduction of Real Quadratic form with examples.

UNIT - 4: GROUPS
10 lectures
4.1 Semigroups, Monoids (Definitions with example)
4.2 Definition of group and example
4.3 Abelian Group, Finite and Infinite Group
4.4 Elementary properties of Group
   If $(G, \cdot)$ is group then
   a) Identity element in $G$ is unique
   b) For every $a \in G$ has unique inverse in $G$
   c) For every $a \in G$, $(a^{-1})^{-1} = a$
   d) For all $a, b \in G, (ab)^{-1} = b^{-1} \cdot a^{-1}$ (Reversal Law)
   e) If $a, b, c \in G$ then
      i) $a \cdot b = a \cdot c \Rightarrow b = c$ (Left Cancellation Law)
      ii) $b \cdot a = c \cdot a \Rightarrow b = c$ (Right Cancellation Law)
REFERENCE BOOKS

2) Algebra for B.Sc. Part - I (Sem-I) - L. G. Kulkarni, Dr. B. P. Jadhav, Kubde, Phadke Prakashan, Kolhapur.
3) Algebra and Complex variables - H. V. Kumbhojkar, Dattar and Bapat, Nirali Prakashan.

Paper – II (CALCULUS)

UNIT – 1: SUCCESSIVE DIFFERENTATION 8 lectures
1.1 $n^{th}$ order derivative of standard functions: $y = (ax + b)^n$, $y = e^{ax}$, $y = a^{mx}$, $y = \frac{1}{ax+b}$, $y = \log(ax + b)$, $y = \sin(ax + b)$, $y = \cos(ax + b)$, $y = e^{ax}\sin(bx + c)$, $y = e^{ax}\cos(bx + c)$.
1.2 Leibnitz's Theorem.
1.3 Examples.

UNIT - 2: SERIES EXPANSIONS AND INDETERMINATE FORMS 10 lectures
2.1 Taylor's Theorem.
2.2 Maclaurin's Theorem.
2.3 Taylor's Series
2.4 Maclaurin's Series
2.5 Series expansions of some standard functions: $e^x$, $\sin x$, $\cos x$, $\tan x$, $(1+x)^n$, $\log (1+x)$.
2.6 Indeterminate forms: $\frac{0}{0}$, $\frac{\infty}{\infty}$, 0, $\infty$.
2.7 L'Hospital's Rule (Statement only).

UNIT – 3: CURVATURE 10 lectures
3.1 Definition of Radius of Curvature.
3.2 Curvature of a circle.
3.3 Radius of Curvature for Intrinsic equations.
3.4 Radius of Curvature for Cartesian equations.
3.5 Radius of Curvature for Parametric equations.
3.6 Radius of Curvature for Polar equations.

UNIT – 4: FUNCTIONS OF TWO VARIABLES 12 lectures
4.1 Functions of two variables.
4.2 Limit of a function of two variables.
4.3 Continuity of a function of two variables.
4.4 Partial derivatives of first order.
4.5 Partial derivatives of Higher order.
4.6 Total derivative
4.7 Composite function.
4.8 Total derivative of Composite function.
4.9 Implicit function.
4.10 Homogeneous functions of two variables.
4.11 Euler's Theorem on Homogeneous functions of two variables.

REFERENCE BOOKS

2) Calculus for B.Sc. Part - I (Sem – I) - L. G. Kulkarni, Dr. B. P. Jadhav, Kubde, Phadke Prakashan, Kolhapur.
3) Calculus and Differential equations - H. V. Kumbhojkar, Dattar and Bapat, Nirali Prakashan.
5) Differential Calculus - Shanti Narayan
MATHEMATICS
B.Sc. Part –I (SEMESTER –II)
Paper – III (GEOMETRY)

UNIT – 1: CHANGE OF AXIS  
1.1 Translation.
1.2 Rotation.
1.3 Translation and Rotation.
1.4 Rotation and then Translation.
1.5 Invariants, Basic Theorems.

UNIT – 2: POLAR COORDINATES  
2.1 Relation between Cartesian and Polar coordinates.
2.2 Distance formula and area of a triangle.
2.3 Polar equations of a straight line:
   2.3.1 Joining two lines.
   2.3.2 Normal form.
   2.3.3 Line parallel and perpendicular to the initial line.
   2.3.4 General equation.
2.4 Polar equations of a circle :
   2.4.1 Centre – Radius form.
   2.4.2 Centre at the pole.
   2.4.3 Passing through the pole and touching the polar axis at
       the pole.
   2.4.4 Passing through the pole and with centre on the initial
       line.
   2.4.5 Passing through the pole and the diameter through pole
       making an angle with initial line.
2.5 Equation of chord, tangent and normal to the circle
   \[ r = 2a \cos \theta. \]
2.6 Polar equations of a conic in the form \[ \frac{1}{r} = 1 \pm \frac{\cos \theta}{a}. \]
2.7 Polar equations of a conic in the form \[ \frac{1}{r} = 1 \pm \frac{\cos(\theta - \alpha)}{a}. \]
2.8 Chord, Tangent and normal of a conic.

UNIT – 3: THE SPHERE  
3.1 Equations in different forms.
   3.1.1 Centre – Radius form.
   3.1.2 General form.
   3.1.3 Diameter form.
   3.1.4 Intercept form.
3.2 Intersection of a sphere with straight line and a plane.
3.3 Power of a point and radical plane.
3.4 Tangent plane and condition of tangency.
3.5 Equations of a circle.
3.6 Intersection of (i) two sphere, (ii) a sphere and plane.
3.7 Orthogonality of two spheres

UNIT – 4: CONE  
4.1 Definitions of Cone, Vertex, Generator.
4.2 Equation of a Cone with vertex at a point \((x_1, y_1, z_1).\)
4.3 Equation of a Cone with vertex at origin.
4.4 Right circular cone and equation of a right circular cone.
4.5 Enveloping cone and equation of an enveloping cone.
4.6 Equation of a tangent plane.
4.7 Condition of tangency.

REFERENCE BOOKS -
2) Geometry for B.Sc. Part – I (Sem II) - L. G. Kulkarni, Dr. B. P. Jadhav, Kubde, Phadke Prakashan, Kolhapur.
3) Algebra and Complex variables - H. V. Kumbhojkar, Dattar and Bapat, Nirali Prakashan.
4) A Text Book of Algebra and Geometry - J. D. Yadhav, S. A. Alandkar, N. I. Dhanshetti, Published by Shivaji University mathematics Society (SUMS), 2003

Paper – IV (DIFFERENTIAL EQUATIONS)

UNIT – 1: DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE
10 lectures
1.1 Introduction.
1.2 Exact differential equations.
  1.2.1 Necessary and sufficient condition for exactness.
1.3 Integration factors with Rules.
1.4 Linear Equation \( \frac{dx}{dy} + Py = Q \)
1.5 Bernoulli’s Equation \( \frac{dy}{dx} + Py = Q y^n \)
1.6 Orthogonal Trajectories.
  1.6.1 Definition of trajectory of the given family.
  1.6.2 Definition of orthogonal trajectory.
  1.6.3 Rule for finding the orthogonal trajectory to a given family of curves when its equation is given in 1) Cartesian 2) Polar coordinates
  1.6.4 Examples

UNIT – 2: LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS \( f(D)y = X \)
18 lectures
2.1 Introduction \( f(D)y = X \).
2.2 General (Complete) Solution of \( f(D)y = X \).
2.3 Solution of \( f(D)y = 0 \).
2.4 Solution of Auxiliary equation with real and non – repeated roots.
2.5 Solution of Auxiliary equation with real and repeated roots.
2.6 Solution of Auxiliary equation with imaginary (non – repeated & repeated) roots.
2.7 Solution of \((D) y = x\), where \(x\) is of the form.

2.7.1 \(e^{ax}\), \(a\) is constant.

2.7.2 \(\sin(ax)\) and \(\cos(ax)\).

2.7.3 \(x^m\), \(m\) is positive integer.

2.7.4 \(e^{ax}, V\), \(V\) is a function of \(x\).

2.7.5 \(x^m, V\), \(V\) is a function of \(x\).

UNIT – 3: EQUATIONS OF FIRST ORDER BUT NOT OF FIRST DEGREE

3.1 Equations that can be factorized.

3.1.1 Equations solvable for \(y\).

3.2 Equations that cannot be factorized.

3.2.1 Equations solvable for \(x\).

3.2.2 Equations solvable for \(y\).

UNIT – 4: CLAIRAUT’S EQUATION

4.1 Clairaut’s form.

4.2 Method of solution.

4.3 Equations reducible to Clairaut’s form.

4.4 Special forms reducible to Clairaut’s form.

REFERENCE BOOKS

1) Differential equations for B.Sc. Part – I (Sem II) - Dr. S. B.


3) Differential equations for B.Sc. Part – I (Sem II) - L. G. Kulkarni, Dr. B. P. Jadhav, Kubde, Phadke Prakashan, Kolhapur.

4) Calculus and Differential equations - H. V. Kumbhojkar, Dattar and Bapat, Nirali Prakashan.


MATHEMATICS PRACTICAL

B.Sc. - I (Sem. I & Sem II)

Computational Mathematics Laboratory I (CML- I)

<table>
<thead>
<tr>
<th>EXP. No.</th>
<th>Name of experiment</th>
<th>No. Of Practicals</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Inverse of matrix by Cayley Hamilton Method</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Eigen values and Eigen vectors of matrix</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>a)Solution of system of linear homogeneous equations in n unknowns</td>
<td>1</td>
</tr>
</tbody>
</table>
b) Solution of system of \( n \) linear nonhomogeneous equations in \( n \) unknowns.

4 Matrix - Linear dependence and independence 1

5 Matrix – Quadratic forms 1

6 Successive Differentiation 1

7 Radius of curvature for Cartesian equations 1

8 Radius of curvature for Parametric equations 1

9 Radius of curvature for Polar equations 1

10 Euler’s Theorem on homogeneous fuctions 1

11 Translation and Rotation 1

12 Cartesian and Polar Coordinates, Distance formula, Area of a triangle 1

13 Polar Equation of a circle in different forms, centre and radius of a circle 1

14 Equation of a Sphere in different forms, centre and radius of a Sphere 1

15 Touching Sphere 1

16 Orthogonal Trajectories (Cartesian Coordinates) 1

17 Orthogonal Trajectories (Polar Coordinates) 1

18 Mechanical Applications of Differential equations (Kepler’s Law Of Motion) 1

19 Electrical Applications of differential equation 1

20 Simple Harmonic Motion 1

Reference books:-

1) Mathematics paper I – Algebra By Dr. S. B. Kalyanshetti, Dr. S.D. Thikane, S.R. Bhosale, N. I. Dhansheti, S. R. Patil (Shradha prakashan, Solapur)

2) Mathematics paper I – Algebra By L. G. Kulkarni, Dr. B. P. Jadhav, Kubde (Phadke Prakashan, Kolhapur)

3) Maths paper II – Calculus By Dr. S. B. Kalyanshetti, Dr. S.D. Thikane, S.R. Bhosale, N. I. Dhansheti, S. R. Patil (Shradha prakashan, Solapur)

4) Mathematics paper II – Calculus By L. G. Kulkarni, Dr. B. P. Jadhav, Kubde (Phadke Prakashan, Kolhapur)

5) Engineering Mathematics I-By G.V.kumbhojkar (C.Jamanadas co.)

7) Geometry for B.Sc. Part - I Sem II - L. G. Kulkarni, Dr. B. P. Jadhav, Kubde, Phadke Prakashan, Kolhapur. Exp. No. 11 to 15