**DEPARTMENT OF MATHEMATICS AND STATISTICS**
**YESHWANT MAHAVIDYALAYA NANDED**
**Mapping of Program Outcomes (POs)and Course Outcomes(COs )**
**COs of Courses Offered in Programmes of B.A. (Mathematics) & B.Sc. (Mathematics)**

**PROGRAMME OUTCOMES (PO):** After the completion of the program, students will able to:

PO1: Pursue logical aspects useful in the society and solve the existing mathematical problems using the knowledge of pure and applied mathematics.

PO2: Acquire the strong foundation of basic concepts which will benefit them to for understanding sciences .

PO3: Apply the concept of mathematical tools to address real life problems

PO4: Gain the knowledge of software which will be useful in Research and Industry

PO5: Qualify various competitive exams like ,CSIR-UGC NET, SET, GATE, MPSC, UPSC, etc

**PROGRAM SPECIFIC OUTCOMES (PSO):**

PSO 1: To imbibe problem-solving and computational skills
PSO 2: To understand the motivation behind the statements and proofs
PSO 3: To enhance self learning and improve own performance.
PSO 4: To inculcate abstract mathematical thinking. Structure of the program: B.A./ B.Sc. Mathematics.

**Name of Programme: B.A./B.Sc- First Year (Semester- I)**
**Name of Course:- Paper 01 :- Differential calculus**

**Course Outcomes:** After successful completion of the course student will be able to
1. Understanding concept of Limit, Continuity of Single and two variable Functions.
2. Find the Higher order derivatives of Product of Functions
3. Expand functions in terms of infinite series.
4. Find Equation of Tangent, Normal and Length of Tangent, Normal, Sub-tangent, Sub-normal.
5. Understanding of Mean Value Theorem concepts.
6. Understand the concept of Partial differentiation.
7. Use the results to solve problems.
8. Differentiate difference between derivative of single variable and Severable Variables.

**Mapping of Cos and POs**

| | PO1 | Po2 | PO3 | PO4 | Po5 |
|---|---|---|---|---|---|
| CO1 | * | * | | | * |
| CO2 | * | * | * | | * |
| CO3 | * | * | * | | * |
| CO4 | * | * | | * | * |
| CO5 | * | * | * | | * |
| CO6 | * | | * | | * |
| CO7 | * | * | * | * | * |
| CO8 | * | * | | | * |

**Name of Programme :** B.A. (Mathematics) & B.Sc. (Mathematics) 1st Year 1st Semester
**Name of Course :** Paper – 02 : Algebra and Trigonometry
**Course Outcomes:** After successful completion of course student will be able to
1.Add, Subtract and Multiply two Matrices.
2.Recognize the different types of Matrices.
3.Find the Inverse of invertible Matrices.
4.Determine the Rank of a Matrix.
5.Transform matrix to Row Echelon form

6. Solve the System of Linear Equations.
7. Find the Characteristic Roots and Characteristic Vectors of a Square Matrix.
8. Check that every square matrix satisfies its own Characteristic Polynomial.

**Mapping of COs to POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ |
| CO2 | ✓ | ✓ | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | | ✓ | ✓ | ✓ |
| CO7 | ✓ | ✓ | ✓ | | ✓ |
| CO8 | ✓ | | ✓ | | ✓ |

**Name of Programme: B.A./B.Sc./ First Year (Semester II)**

**Name of Course: Paper -03 Integral Calculus**

**Course Outcomes:** After successful completion of the course student will be able to

1. Apply method of integration to find the integral of function.
2. Solve examples of definite integrals using Properties definite integrals.
3. Find the area and volume of given shape.
4. Understanding concept of Gamma and Beta Functions.
5. Solve problems on Multiple Integrals

Mapping of COs and Pos

| | **PO1** | **Po2** | **PO3** | **PO4** | **Po5** |
|---|---|---|---|---|---|
| **CO1** | * | * | * | * | * |
| **CO2** | * | * | * | * | * |
| **CO3** | * | * | * | | * |
| **CO4** | * | * | * | * | * |
| **CO5** | * | * | * | | * |

**Name of Programme :** B.A. (Mathematics) & B.Sc. (Mathematics) 1st Year 2nd Semester

**Name of Course :** Paper – 04 : Geometry

**Course Outcomes:** After successful completion of course student will be able to

1. Understanding concepts on Three Dimensional Geometry.
2. Find equations of Right lines, Planes, Spheres, Cones and Cylinders.
3. Find the Direction cosines of any line under the different given conditions.
4. Understand the intersection of any two or three, three dimensional geometrical figures.
5. Transform the equation of a plane to the normal form.
6. Transform equation of line from the unsymmetrical to the symmetrical form.
7. Find the length of perpendicular from a point to a plane.
8. Find the angle of intersection of two spheres.
9. Understanding concepts of plane of contact.

**Mapping of COs to POs**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|
| **CO1** | ✓ | ✓ | | | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| **CO2** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO3** | ✓ | | ✓ | | |
| **CO4** | ✓ | ✓ | ✓ | | ✓ |
| **CO5** | ✓ | ✓ | ✓ | | ✓ |
| **CO6** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO7** | ✓ | ✓ | | | ✓ |
| **CO8** | ✓ | ✓ | | ✓ | ✓ |
| **CO9** | ✓ | ✓ | | | |

**Name of Programme :** B.A. (Mathematics) & B.Sc. (Mathematics) 1st Year
**Name of Course :** Paper – 05 : Practical on MATLAB
**Course Outcomes**: After successful completion of the course students will be able to

CO1 : Understand the basic tools of MATLAB.
CO2 : Student can use MATLAB to solve the linear equations .
CO3 : Students are able to use MATLAB for the findings of Eigenvalues and Eigen vectors.
CO4 : Students are able to plot the two dimensional and three dimensional graphs .
CO5 : Students are able to use for solving Differential Equations.

**Mapping of COs to POs**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|
| **CO1** | ✓ | ✓ | ✓ | ✓ | |
| **CO2** | ✓ | ✓ | ✓ | ✓ | |
| **CO3** | ✓ | ✓ | ✓ | ✓ | |
| **CO4** | ✓ | ✓ | ✓ | ✓ | |
| **CO5** | ✓ | ✓ | ✓ | ✓ | |

**Name of Programme: B.A./B.Sc /Second-Year (Semester- III)**
**Name of Course: Paper 06 :- Real Analysis-I**
**Course Outcomes**: After successful completion of the course students will be able to
**(1).** Understand basic concepts of sets and their properties**.**
**(2).** Understand concept of Neighborhood of a point , interior [point of a set, open sets
**(3).** Understand concept of limit point of a set , closed sets , closure **of a** set dense set**.**
**(4).**Understand basic concepts of sequences , subsequences, bounds of sequences , limit point of sequences and subsequences**.**
**(5).** Understand the concept of Cauchy sequence and general principle of convergences. and different types of sequences..
**(6).** Understand concept of infinite series Different types of series , general principle of convergences of series some standard tests for convergence of series**.**
**(7).** Understand the application of sequences and series to physical sciences such as Fourier's series.

**Mappings of COs and POs**

| | **PO1** | **Po2** | **PO3** | **PO4** | **Po5** |
|---|---|---|---|---|---|
| **CO1** | * | * | | * | * |
| **CO2** | * | * | * | * | * |
| **CO3** | * | * | * | | * |
| **CO4** | * | * | | * | * |
| **CO5** | * | * | * | | * |

| | | | | | |
|---|---|---|---|---|---|
| **CO6** | * | | * | * | * |
| **CO7** | * | * | * | * | * |

**Name of Programme :** B.A. (Mathematics) & B.Sc. (Mathematics) 2nd Year 3rd Semester
**Name of Course :** Paper – 07 : Group Theory
**Course Outcomes:** After successful completion of course student will be able to

CO1 : Understand the concepts on an equivalence relation.

CO2 : Find the examples of equivalence relation.

CO3 : Check whether the given set is a group with respect to given operation or not.

CO4 : Understand general properties of groups.

CO5 : Solve problems on groups.

CO6 : Understand the concepts on cyclic group.

CO7 : Use Lagrange's theorem to solve the problems in number theory.

CO8 : Form a quotient group.

CO9 : Find the kernel of a group homomorphism**.**

**Mapping of COs to POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | ✓ | ✓ | | | ✓ |
| **CO2** | ✓ | ✓ | ✓ | | ✓ |
| **CO3** | ✓ | ✓ | ✓ | | ✓ |
| **CO4** | ✓ | ✓ | ✓ | | ✓ |
| **CO5** | ✓ | | | ✓ | ✓ |
| **CO6** | ✓ | ✓ | ✓ | | ✓ |
| **CO7** | | ✓ | ✓ | | ✓ |
| **CO8** | ✓ | ✓ | ✓ | | ✓ |
| **CO9** | ✓ | ✓ | ✓ | | ✓ |

**Name of Programme: B.A./B.Sc. Second Year (Semester III)**
**Name of Course: Paper :- 08 Ordinary differential Equations**

**Outcomes:** After successful completion of the course student will be able to
1. Understanding concept of solution of differential equations, order and degree.
2. Transform the equations into variable separable form.
3. Transform first-order non-homogeneous equation in x and y to homogeneous equation in x and y and solve it.
4. Find the equations that can be resolved into components equation and solve it.
5. Solve Clairaut's equation.
6. Find the solutions when the auxiliary equations are equal, different, repeated, and imaginary roots.
7. Find the solution of the exact differential equation, rules of finding the integrating factor.
8. Transform non-linear equation to linear equation and solve it.

9. Find integral corresponding to a term of the form e ax, xm, sin ax or cos ax, e axV, xV, x2V in the second member.
10. Find the solution of linear equation with variable coefficients.
11. Transform the equations to the homogeneous linear form.
12. Transform the homogeneous linear equation with constant coefficient by changing the independent variable x to z by putting x = e z or Z = log x.

**Mappings of COs and POs**

| | PO1 | Po2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | * | * | | | * |
| **CO2** | * | * | * | | * |
| **CO3** | * | * | * | | * |
| **CO4** | * | * | | * | * |
| **CO5** | * | * | * | | * |
| **CO6** | * | | * | | * |
| **CO7** | * | * | * | * | * |
| **CO8** | * | * | * | | * |
| **CO9** | * | | | * | * |
| **CO10** | * | * | * | | * |
| **CO11** | * | | | | * |
| **CO12** | * | * | * | * | * |

**Name of Programme: B.A./B.Sc. Second Year (Semester IV)**
**Name of Course: Paper :- 09:- Real Analysis-II**
**Course Outcomes:** After successful completion of the course student will be able to
1. Understand meaning of interval, subinterval, partitions and their refinement.
2. Understanding basic concept of upper integral and lower integral and Riemann integral.
3. Understanding difference between upper sum, lower sum and Riemann sum
4. Acquire the idea about Riemann Inerrability and Riemann Integration
5. Understand various theorems associated with Riemann Integration
6. Develop a knowledge about Riemann Integration and applies into problems
7. Understand the meaning of improper integral.
8. Determine convergence of improper integrals with discontinuities in their domain or infinite limits of integration.
9. Develop skill in checking the convergence of improper integral using various tests of convergence
10. Understanding distinguishes between convergence and absolute convergence of improper integral.
11. Use comparison test with a corresponding improper integral with other improper integral to decide whether improper integral converge or diverge
12. Use the results to solve some problems.

Mappings of COs and POs

| | PO1 | Po2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | * | * | | | * |
| **CO2** | * | * | * | | * |
| **CO3** | * | * | * | | * |
| **CO4** | * | * | | * | * |
| **CO5** | * | * | * | | * |
| **CO6** | * | | * | | * |
| **CO7** | * | * | * | * | * |
| **CO8** | * | * | * | | * |
| **CO9** | * | | | * | * |
| **CO10** | * | * | * | | * |
| **CO11** | * | | | | * |
| **CO12** | * | * | * | * | * |

**Name of Programme :** **B.A. & B.Sc. : Second Year (Semester- IV)**
**Name of Course:** **Paper – 10 : Ring Theory**

**Course Outcomes:** After successful completion of course student will be able to
Understand given algebraic structure is a Ring or not.
Construct the examples of ring with known examples of ring.
Differentiate between zero-divisors and non zero-divisors in a given ring.
Check whether given two rings are isomorphic or not.
Check whether given ideal of a ring is a principal ideal or not.
Understand the concepts on principal ideal ring.
Understand concepts on Euclidean rings.

**Mappings of COs and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | | ✓ |
| CO2 | ✓ | ✓ | ✓ | | ✓ |
| CO3 | ✓ | ✓ | | | ✓ |
| CO4 | ✓ | ✓ | | | ✓ |
| CO5 | ✓ | ✓ | | | ✓ |
| CO6 | ✓ | ✓ | | | ✓ |
| CO7 | ✓ | ✓ | ✓ | | ✓ |

**Name of Programme :** **B.A. & B.Sc. : Second Year (Semester- IV)**
**Name of Course: Paper – 11 : Partial Differential Equations**

**Outcomes:** After successful completion of the course student will be able to
1. Classification of PDE.
2. Solve linear as well as non-linear PDE of first and second order.
3. Apply PDE techniques to predict the behavior of certain phenomena.
4. Solve real problems by identifying them approximately from the perspective of PDE.
5. Mathematical formation of real problem precisely.
6. Solve problem using boundary conditions.

**Mappings of COs and POs**

| | PO1 | Po2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | * | * | | | * |
| CO2 | * | * | * | | * |
| CO3 | * | * | * | | * |
| CO4 | * | * | | * | * |
| CO5 | * | * | * | | * |
| CO6 | * | | * | | * |

**Name of Programme: B.A./B.Sc:-Third Year (Semester V)**
**Name of Course: Paper No 12 :- Metric Spaces**

**Course Outcomes:** After completion of this course student can understand
1. How the various types distances are to be define on a same set.
2. Student can understand the concepts of open sphere and closed sphere.
3. Student can understand the concept of open and closed sets.
4. Student can understand the concepts of subspaces.

5. Student can understand the concepts of positions of a point in the space i.e. Adherent point, limit point, Boundary point , Interior of a set and exterior of a sets 6. Student can understand the concepts of convergences and completeness.
7.Student can understand the concept of fixed point and Banach principle. .
8.Student can understand the concepts of continuity and uniform continuity
9. Student can understand the concept of compact and non compact sets.
10. Various properties of compact sets,
11. Student can understand the concepts of connectedness of sets.
12. After completion of this course student can aware with basic concepts of functional analysis.

Mappings of COs and POs

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | * | * | | | * |
| **CO2** | * | * | * | * | * |
| **CO3** | * | | * | | * |
| **CO4** | * | * | | * | * |
| **CO5** | * | * | * | | * |
| **CO6** | * | | * | | * |
| **CO7** | * | * | * | * | * |
| **CO8** | * | * | * | | * |
| **CO9** | * | * | | * | * |
| **CO10** | * | * | * | | * |
| **CO11** | * | | | | * |
| **CO12** | * | * | * | * | * |

**Name of Programme :** **B.A. & B.Sc. : Third Year (Semester- V)**
**Name of Course:** **Paper – 13 : Linear Algebra**

**Course Outcomes:** After successful completion of course student will be able to

1. Define a vector space.
2. Check subsets for being subspaces.
3. Decide whether the given vectors are linearly dependent or independent.
4. Find dimension of the given vector space.
5. Find basis of the given vector space.
6. Construct orthonormal basis from given basis.
7. Find lengths of vectors and decide about their orthogonality.
8. Apply linear transformations through matrix approach.

**Mappings of COs and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | ✓ | ✓ | | | ✓ |
| **CO2** | ✓ | ✓ | ✓ | | ✓ |
| **CO3** | ✓ | ✓ | ✓ | | ✓ |
| **CO4** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO5** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **CO6** | ✓ | ✓ | | | ✓ |
| **CO7** | ✓ | ✓ | ✓ | | ✓ |
| **CO8** | ✓ | ✓ | ✓ | ✓ | ✓ |

**Name of Programme :** **B.A. & B.Sc. : Third Year (Semester- VI)**
**Name of Course:** **Paper – 14 : Numerical Analysis**

**Course Outcomes:** After successful completion of course student will be able to

1. Know the various forward and backward operators
2. Understand the difference between equal and unequal differences
3. Concepts of central differences
4. Understand the process of numerical differences.
5. Understand the process of numerical Integrations
6. Understand how to solve the differential equations numerically
7. Process of errors in the solutions.
8. Students can understand the difference between the continuous and discrete processes.

**Mappings of COs and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | * | * | | | * |
| CO2 | * | * | * | * | * |
| CO3 | * | | * | | * |
| CO4 | * | * | | * | * |
| CO5 | * | * | * | | * |
| CO6 | * | | * | | * |
| CO7 | * | * | * | * | * |
| CO8 | * | * | * | | * |

**Name of Programme:** **B.A./B.ScThird Year (Semester –VI)**
**Name of Course:** **Paper –15 Complex Analysis**

**Course Outcomes:** After successful completion of the course student will be able to

1 Understand difference between real number system and complex number system.
2. Understand various forms of complex number system
3. Understand the concepts of limit, and derivative of functions of complex variables.
4 Understand the Sufficient condition for Differentiability.
5. Understand the Concepts of Analytic functions and harmonic functions,
6 . Understand the concepts of , Exponential and Logarithmic functions.
7. .Understand the concept of Trigonometric and hyperbolic functions.

**Mappings of COs and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | * | * | | | * |
| CO2 | * | * | * | * | * |
| CO3 | * | | * | | * |
| CO4 | * | * | | * | * |
| CO5 | * | * | * | | * |
| CO6 | * | | * | | * |
| CO7 | * | * | * | * | * |

**Name of Programme :** **B.A. & B.Sc. : Third Year (Semester- VI)**
**Name of Course:** **Paper – 16 : Integral Transforms**

**Course Outcomes:** After successful completion of course student will be able to

1. Know the way integral transforms are defined.
2. Understand the applicability and utility of integral transforms.
3. Find Laplace transforms for standard and general functions.
4. Find Laplace transforms of derivatives, integrals, multiples and of periodic functions
5. Find inverse Laplace transforms of functions.
6. Apply shifting properties.
7. Solve individual differential equations and their systems with initial conditions.
8. Find Fourier Complex, Fourier sine and Fourier cosine transforms for functions.

**Mappings of COs and POs**

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | | ✓ |
| CO2 | ✓ | ✓ | ✓ | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | ✓ |
| CO5 | ✓ | ✓ | ✓ | | ✓ |
| CO6 | ✓ | | ✓ | | ✓ |
| CO7 | ✓ | | ✓ | ✓ | ✓ |
| CO8 | ✓ | ✓ | ✓ | | ✓ |

**Name of Programme:** **B.A./B.Sc./ Third Year (Semester- VI)**
**Name of Course:** **Paper 17 (A) Topology / Mechanics**

**Course Outcomes:** After successful completion of the course student will be able to
1 Understand Concept of Topological spaces ,
2Understand Topological Properties of Sets.
3.Understand the concept of order Topology and product topology
4. Understand concept of Subspace topology.
5. Understand Concept of Closed sets limit points .
6. Understand of continuity .
7. Understand the separation properties like Hausdroff Spaces.
8 Understand Concept of Connected Spaces and compact Spaces.

Mappings of COs and POs

| | PO1 | Po2 | PO3 | PO4 | Po5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | | ✓ | | ✓ |
| CO4 | ✓ | ✓ | | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | | ✓ |
| CO6 | ✓ | | ✓ | ✓ | ✓ |
| CO7 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO8 | ✓ | ✓ | ✓ | ✓ | ✓ |

## Evaluation of Attainment of COs of Courses Offered in Programmes

**Name of Programme :** B.Sc. (Mathematics) 2022-23

(3 Point Scale)

### Evaluation of Attainments of COs

| Course Paper | Course Outcomes (COs) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 | CO7 | CO8 | CO9 | CO10 | CO11 | CO12 |
| **1** | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | NA | NA | NA | NA |
| **2** | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | NA | NA | NA | NA |
| **3** | 1 | 1 | 2 | 1 | 1 | NA | NA | NA | NA | NA | NA | NA |
| **4** | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | NA | NA | NA |
| **5** | 3 | 3 | 3 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **6** | 2 | 3 | 2 | 2 | 1 | 2 | 2 | NA | NA | NA | NA | NA |
| **7** | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | NA | NA | NA |
| **8** | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **9** | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 |
| **10** | 1 | 1 | 1 | 2 | 1 | 1 | 1 | NA | NA | NA | NA | NA |
| **11** | 1 | 1 | 2 | 1 | 1 | 1 | NA | NA | NA | NA | NA | NA |
| **12** | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | NA | NA |
| **13** | 2 | 2 | 2 | 2 | 2 | 2 | NA | NA | NA | NA | NA | NA |
| **14** | 1 | 1 | 2 | 1 | 1 | 1 | NA | NA | NA | NA | NA | NA |
| **15** | 1 | 2 | 1 | 1 | 1 | 1 | NA | NA | NA | NA | NA | NA |
| **16** | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | NA | NA | NA | NA |
| **17** | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | NA | NA | NA |