# B.Sc.MATHEMATICS

# Syllabus

# From the Academic Year

# 2023-2024



Madurai Kamaraj University

# Madurai Kamaraj University

# [University with Potential for Excellence]

# Madurai – 625 021

**NEW INITIATIVE IN MODERNISING UNDER-GRADUATE PROGRAMME**

**IN MATHEMATICS**

**Foundation course (Bridge Mathematics) - Course Learning Outcome**

After completion of this course successfully, the students will be able to

**CLO 1:** Prove the binomial theorem and apply it to find the expansions of any $(x + y)^n$ and also, solve the related problems

**CLO 2:** Find the various sequences and series and solve the problems related to them. Explain the principle of counting.

**CLO 3:** Find the number of permutations and combinations in different cases. Apply the principle of counting to solve the problems on permutations and combinations

**CLO 4:** Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and sub multiple angles, etc. Also, they can solve the problems using the transformations.

**CLO 5:** Find the limit and derivative of a function at a point, the definite and indefinite integral of a function. Find the points of min/max of a function.

Mapping of Course Learning Outcomes (CLOs) with Programme Learning Outcomes (PLOs) and Programme Specific Outcomes (PSOs)

|  | POs | | | | | | | PSOs | |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | … | 1 | 2 | … |
| CLO1 |  |  |  |  |  |  |  |  |  |  |
| CLO2 |  |  |  |  |  |  |  |  |  |  |
| CLO3 |  |  |  |  |  |  |  |  |  |  |
| CLO4 |  |  |  |  |  |  |  |  |  |  |
| CLO5 |  |  |  |  |  |  |  |  |  |  |

**ALGEBRA & TRIGONOMETRY - Course Learning Outcome**

 **(for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Classify and Solve reciprocal equations

**CLO 2:** Find the sum of binomial, exponential and logarithmic series

**CLO 3:** Find Eigen values, eigen vectors, verify Cayley – Hamilton theorem and diagonalize a given matrix

**CLO 4:** Expand the powers and multiples of trigonometric functions in terms of sine and cosine

**CLO 5:** Determine relationship between circular and hyperbolic functions and the summation of trigonometric series

|       | POs |   |   |   |   |   | PSOs |   |   |
|-------|---|---|---|---|---|---|---|---|---|
|       | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1  | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO2  | 2 | 1 | 3 | 1 | - | - | 3 | 2 | 1 |
| CLO3  | 3 | 1 | 3 | 1 | - | - | 3 | 2 | 1 |
| CLO4  | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO5  | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |

**DIFFERENTIAL CALCULUS - Course Learning Outcome**

**(for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Find the nth derivative, form equations involving derivatives and apply Leibnitz formula

**CLO 2:** Find the partial derivative and total derivative coefficient

**CLO 3:** Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers

**CLO 4:** Find the envelope of a given family of curves

**CLO 5:** Find the evolutes and involutes and to find the radius of curvature using polar co-ordinates

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO2 | 2 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO3 | 3 | 2 | 3 | 2 | - | - | 3 | 2 | 1 |
| CLO4 | 3 | 2 | 3 | 2 | 1 | - | 3 | 2 | 1 |
| CLO5 | 3 | 2 | 3 | 2 | 1 | - | 3 | 2 | 1 |

**ANALYTICAL GEOMETRY (Two & Three Dimensions) Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Find pole, polar for conics, diameters, conjugate diameters for ellipse and hyperbola

**CLO 2:** Find the polar equations of straight line and circle, equations of chord, tangent and normal and to find the asymptotes of hyperbola

**CLO 3:** Explain in detail the system of Planes

**CLO 4:** Explain in detail the system of Straight lines

**CLO 5:** Explain in detail the system of Spheres

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 2 | 2 | 2 | 1 | - | - | 3 | 2 | 1 |
| CLO2 | 2 | 2 | 2 | 1 | - | - | 3 | 2 | 1 |
| CLO3 | 3 | 2 | 2 | 1 | - | - | 3 | 2 | 1 |
| CLO4 | 3 | 2 | 3 | 1 | - | - | 3 | 2 | 1 |
| CLO5 | 3 | 2 | 3 | 1 | - | - | 3 | 2 | 1 |

**INTEGRAL CALCULUS -Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae

**CLO 2:** Evaluate double and triple integrals and problems using change of order of integration

**CLO 3:** Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution

**CLO 4:** Explain beta and gamma functions and to use them in solving problems of integration

**CLO 5:** Explain Geometric and Physical applications of integral calculus

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO2 | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO3 | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO4 | 3 | 1 | 3 | - | - | - | 3 | 2 | 1 |
| CLO5 | 3 | 1 | 3 | - | 2 | 1 | 3 | 2 | 1 |

# VECTOR CALCULUS AND ITS APPLICATIONS -Course Learning Outcome
## (for Mapping with POs and PSOs)

Students will be able to

**CLO 1:** Find the derivative of vector and sum of vectors, product of scalar and vector point function and to Determine derivatives of scalar and vector products

**CLO 2:** Applications of the operator 'del' and to Explain soleonidal and ir-rotational vectors

**CLO 3:** Solve simple line integrals

**CLO 4:** Solve surface integrals and volume integrals

**CLO 5:** Verify the theorems of Gauss, Stoke's and Green's Two Dimension)

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 2 | 3 | 1 | - | - | 3 | 2 | 1 |
| CLO2 | 3 | 2 | 3 | 1 | 2 | - | 3 | 2 | 1 |
| CLO3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 1 |
| CLO4 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 1 |
| CLO5 | 3 | 3 | 3 | 3 | 2 | - | 3 | 3 | 1 |

**DIFFERENTIAL EQUATIONS AND APPLICATIONS-Course Learning Outcome**

**(for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Determine solutions of homogeneous equations, non-homogeneous equations of degree one in two variables, solve Bernoulli's equations and exact differential equations

**CLO 2:** Find the solutions of equations of first order but not of higher degree and to Determine particular integrals of algebraic, exponential, trigonometric functions and their products

**CLO 3:** Find solutions of simultaneous linear differential equations, linear equations of second order and to find solutions using the method of variations of parameters

**CLO 4:** Form a PDE by eliminating arbitrary constants and arbitrary functions,

find complete, singular and general integrals, to solve Lagrange's equations

**CLO 5:** Explain standard forms and Solve Differential equations using Charpit's method

| | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 1 | 3 | 2 | 1 | - | 3 | 2 | 1 |
| CLO2 | 3 | 1 | 3 | 2 | 1 | - | 3 | 2 | 1 |
| CLO3 | 3 | 1 | 3 | 2 | 1 | - | 3 | 3 | 1 |
| CLO4 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 3 | 1 |
| CLO5 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 3 | 1 |

**INDUSTRIAL STATISTICS - INDUSTRIAL STATISTICS PRACTICAL ASSIGNMENT**

- ✓ Construction of control chart for mean using Excel / R /SPSS

- ✓ Control charts for mean using Range in Excel / R /SPSS

- ✓ Control Charts for Mean using Standard Deviation in Excel / R /SPSS

- ✓ Control Charts for Range using Excel / R /SPSS

- ✓ Control Charts for Standard Deviation using Excel / R /SPSS

**Note**:

1. There will be **no practical exam** for Industrial Statistics.

2. The above activity is mainly intended for providing practical knowledge in Industrial Statistics.

3. Instruct the students to submit the above as an **assignment.**

**ELEMENTS OF MATHEMATICAL ANALYSIS- Course Learning Outcome**

**(for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Explain in detail about sets and functions, equivalence and countability and the LUB axiom

**CLO 2:** Explain Sequence and Subsequence of real numbers and to find the limit of sequence to test for convergent, divergent, bounded and monotone sequences

**CLO 3:** Explain the operations on convergent and divergent sequences and to explain the concepts of limit superior and limit inferior and the notion of Cauchy sequences

**CLO 4:** Classify the series of real numbers and the alternating series and their convergence and divergence, the conditional convergence and absolute convergence and solve problems on convergence of the sequences

**CLO 5:** Explain about the metric spaces and functions continuous on a Metric space

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 3 | 2 | 3 | 2 | - | 3 | 2 | 1 |
| CLO2 | 3 | 3 | 2 | 3 | 2 | - | 3 | 2 | 1 |
| CLO3 | 3 | 3 | 3 | 3 | 2 | - | 3 | 2 | 1 |
| CLO4 | 3 | 3 | 3 | 3 | 2 | - | 3 | 2 | 1 |
| CLO5 | 3 | 3 | 2 | 3 | 2 | - | 3 | 2 | 1 |

**ABSTRACT ALGEBRA -Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Explain groups, subgroups and cyclic groups

**CLO 2:** Explain about Normal subgroup, Quotient groups, Homomorphisms and Automorphisms and verify the functions for homomorphism and automorphism properties

**CLO 3:** Explain Permutation groups and apply Cayley's theorem to problems

**CLO 4:** Explain Rings, Ideals and Quotient Rings and examine their structure

**CLO 5:** Discuss about the field of quotient of an integral domain and to Explain in detail about Euclidean Rings

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 3 | 2 | 3 | 1 | - | 3 | 3 | 1 |
| CLO2 | 3 | 3 | 2 | 3 | 1 | - | 3 | 3 | 1 |
| CLO3 | 3 | 3 | 2 | 3 | 2 | - | 3 | 3 | 1 |
| CLO4 | 3 | 3 | 2 | 3 | 1 | - | 3 | 3 | 1 |
| CLO5 | 3 | 3 | 2 | 3 | 2 | - | 3 | 3 | 1 |

**REAL ANALYSIS -Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Explain the concepts of Continuous and Discontinuous functions, open and close sets, Connectedness, Completeness and Compactness

**CLO 2:** Explain the concepts of bounded and totally bounded sets, continuity of inverse functions and Uniform continuity

**CLO 3:** Define the sets of measure zero, to Explain about the existence and properties of Riemann integral

**CLO 4:** Explain the concept of differentiability and to Explain Rolle's theorem, Law of mean, and Fundamental theorem of calculus

**CLO 5:** Explain the point wise and uniform convergence of sequence of function and to derive the Taylor's theorem

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 3 | 1 | 3 | 1 | - | 3 | 1 | 1 |
| CLO2 | 3 | 3 | 1 | 3 | 1 | - | 3 | 1 | 1 |
| CLO3 | 3 | 3 | 1 | 3 | 1 | - | 3 | 1 | 1 |
| CLO4 | 3 | 3 | 1 | 3 | 1 | - | 3 | 1 | 1 |
| CLO5 | 3 | 3 | 1 | 3 | 1 | - | 3 | 1 | 1 |

**MATHEMATICAL MODELLING -Course Learning Outcome**

**(for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Explain simple situations requiring Mathematical Modelling and to Determine the characteristics of such models

**CLO 2:** Model using differential equations in-terms of linear growth and Decay models

**CLO 3:** Model using systems of ordinary differential equations of first order, to discuss about various models under the categories 'Epidemics' and 'Medicine'

**CLO 4:** Explain in detail about difference equations

**CLO 5:** Model using difference equations

|      | POs | | | | | | PSOs | | |
|------|---|---|---|---|---|---|---|---|---|
|      | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |
| CLO2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |
| CLO3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |
| CLO4 | 3 | 2 | 2 | 2 | - | 1 | 2 | 3 | 2 |
| CLO5 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 |

**LINEAR ALGEBRA -Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Acquire a detailed knowledge about vector spaces and subspaces

**CLO 2:** Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis

**CLO 3:** Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces

**CLO 4:** Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation

**CLO5:** Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces

|      | POs | | | | | | PSOs | | |
|------|-----|-----|-----|-----|-----|-----|------|-----|-----|
|      | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 3 | 2 | 3 | - | - | 3 | 3 | 1 |
| CLO2 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 1 |
| CLO3 | 3 | 3 | 2 | 3 | 1 | - | 3 | 3 | 1 |
| CLO4 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 1 |
| CLO5 | 3 | 3 | 3 | 3 | 1 | - | 3 | 3 | 1 |

**COMPLEX ANALYSIS -Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

**CLO 1:** Explain about analytic functions, their differentiation and continuity and to verify the Harmonic functions using analyticity conditions

**CLO 2:** Explain the concept of Conformal mappings and mappings by linear transformations and linear fractional transformations

**CLO 3:** Explain about the integrations of functions over simply and multiply connected domains and to derive the Cauchy integral formula, Liouvlle's theorem, Fundamental theorem of Algebra and Maximum Module Principle

**CLO 4:** Find the convergence the sequences and series, to derive Taylor's and Laurent's series

**CLO 5:** Find the nature of singularities, to find the residue of a given function at a given singular point, to Explain about zeros and poles and to evaluate real improper integrals (Excluding poles on the real axis)

| | POs | | | | | | PSOs | | |
|------|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 3 | 3 | 2 | 1 | - | 3 | 3 | 2 |
| CLO2 | 3 | 3 | 3 | 2 | 1 | - | 3 | 3 | 2 |
| CLO3 | 3 | 3 | 3 | 2 | 1 | - | 3 | 3 | 2 |
| CLO4 | 3 | 3 | 3 | 2 | 1 | - | 3 | 3 | 2 |
| CLO5 | 3 | 3 | 3 | 2 | 1 | - | 3 | 3 | 2 |

**MECHANICS -Course Learning Outcome (for Mapping with POs and PSOs)**

Students will able to

**CLO 1:** Define Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Equilibrium of a Particle, Limiting equilibrium of a particle on an inclined plane.

**CLO 2:** Define Moment of a force and Couple with examples. Define Parallel Forces and Forces acting along a Triangle, Solve problems on frictional forces

**CLO 3:** Define work, energy, power, rectilinear motions under varying forces. Define Simple Harmonic Motion and find its Geometrical representation.

**CLO 4:** Define Projectile, impulse, impact and laws of impact. Prove that the path of a projectile is a parabola. Find the direct and oblique impact of smooth elastic spheres

**CLO 5:** Define central orbits, explain conic as centered orbits and solve problems related to central orbits

|  | POs | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|
|  | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 |
| CLO1 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 2 |
| CLO2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 2 |
| CLO3 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 2 |
| CLO4 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 2 |
| CLO5 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 3 | 2 |

# Internship / Industrial Training

**OBJECTIVES:**

- To make students acquire practical knowledge by going to a company and learn in a live environment
- To make students learn teamwork and work ethics
- To make students to know the recent trends in the area relevant to their study
- To make students analyse their skills and interests
- To help students examine academic and career goals

**OUTCOME:**

At the end of this internship programme the students will be able to

- ✓ Apply theory to real life
- ✓ work as a part of team
- ✓ learn from the company experts
- ✓ learn latest trending technologies
- ✓ come out with a high morale
- ✓ enrich CV

**About the internship programme:** The internship programme provides students with practical, real-world experience and a valuable complement to their academic training. It enhances the students' skills in problem solving by making him/her work in a live environment in which systematic problem solving methods are practiced.

**Duration:** Internship requires students to spend a minimum of 15days (during vacation) employed, full-time, as trainees **during vacation at the end of fourth semester**. During this period, they are engaged in work of direct relevance to their programme of study.

**Areas**: Some of the fields that are open to students include:

- Industries
- Companies
- Market Research
- Web designing
- Any other field related to / Mathematics / Statistics / IT /Applications.

**Certificate:** A certificate is to be obtained from the organization in which the student undergoes internship programme. This certificate is to be submitted to the college within fifteen days after the college reopens for the next semester.

**Credits:** The Internship programme does not carry any credit.