AMBEDKAR COLLEGE OF ARTS & SCIENCE, WANDOOR
(Aided by Govt. of Kerala & Affiliated to University of Calicut)
Run By Indiraji Memorial Society
Ambalapadi, Wandoor, Pin 679328
Phone: 04931-249666 (Office)
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COURSE OUTCOME
DEPARATMENT OF MATHEMATICS
2020 SYLLABUS

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DEPARTMENT OF MATHEMATICS

Program Educational Outcomes (PEOs):

PEO 1: Development of Leadership Qualities.

Graduates will demonstrate leadership qualities by utilizing their full intellectual potential, engaging with their communities, and contributing to the social, cultural, and economic development of society.

PEO 2: Lifelong Learning and Societal Contribution.

Graduates will be equipped with core values and intellectual capabilities, enabling them to pursue lifelong learning and meaningfully contribute to societal well-being through innovative thinking and service.

PEO 3: Entrepreneurial and Global Competence.

Graduates will possess entrepreneurial skills and a global perspective, promoting sustainable national growth through ethical leadership, innovative ventures, and responsible citizenship.

Programme Outcomes (POs):

PO1 - Knowledge Acquisition:

Gain deep understanding of trends and their impact on the chosen field.

PO2 - Communication & Leadership:

Cultivate teamwork, effective communication, and transformative leadership with a focus on inclusivity.

PO3 - Professional Skills:

Develop adaptability and confidence to navigate diverse career paths.

PO4 - Digital Intelligence:

Master digital tools and technologies to efficiently process and analyse information.

PO5 – Scientific awareness & Critical Thinking:

Apply scientific knowledge and critical thinking to solve complex problems and foster sustainable solutions.

PO6 - Ethics & Social Responsibility:

Lead with integrity, upholding ethical values and a commitment to societal and environmental well-being.

PO7 – Research, Innovation & Entrepreneurship:

Drive innovation through research and collaborations with academia, industry, and communities.

PO8 - Lifelong Learning:

Embrace ongoing personal and professional growth by staying current with new knowledge and technologies.

PO9 - Global Perspective:

Understand and engage with global cultural, social, and economic contexts for positive contributions.

PO10 – Democratic Co-existence:

Prepare individuals to work harmoniously in a pluralistic society, nurturing democratic values and interpersonal understanding.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Theoretical and Applied Mathematics Competency

Demonstrate a thorough understanding of core mathematical concepts and theories as outlined in the 2019 Calicut University BSc Mathematics syllabus. Apply these principles to solve complex problems and real-world scenarios, integrating knowledge from various mathematical fields such as algebra, calculus, and statistics. (PO1, PO5)

PSO2: Advanced Analytical and Computational Techniques

Develop and utilize advanced analytical and computational skills in line with the syllabus content, including proficiency in mathematical software tools and techniques for solving complex mathematical problems and data analysis. (PO4, PO3)

PSO3: Mathematical Modeling and Problem-Solving

Develop the ability to construct and analyse mathematical models for complex real-world problems across various domains, such as physical sciences, engineering, economics, and social sciences. Employ problem-solving techniques and strategies learned from the syllabus to provide innovative solutions and insights. (PO1, PO5, PO7)

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B. Sc Mathematics (2020 Syllabus)

Sl. No.	Course Code	Title	Course Outcome
1	MTS1B01	Basic Logic and Number Theory	**CO1**: Recall and explain the fundamental principles of propositional and predicate logic, including quantifiers, logical equivalences, and Boolean expressions. **CO2**: Apply various methods of mathematical proof (direct, indirect, proof by contradiction, induction) to validate mathematical arguments and statements in number theory and logic **CO3**: Analyze the division algorithm, prime numbers, and greatest common divisor (gcd) using algorithms such as Euclid's algorithm, and apply these to solve linear Diophantine equations **CO4**: Evaluate the properties and applications of congruences and modular arithmetic to solve problems involving divisibility, linear congruences, and applications of Wilson's, Fermat's, and Euler's theorems. **CO5**:Formulate recursive functions and mathematical models using logical and number-theoretic principles, and create proofs for number-theoretic propositions, including applications of the Fundamental Theorem of Arithmetic.
2	MTS2B02	Calculus of single variable-1	**CO1**:Recall and understand the fundamental concepts of functions, limits, and continuity, and explain their properties, graphical representations, and behavior at endpoints. **CO2**: Apply differentiation techniques and theorems like

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			the Mean Value Theorem to solve real-world problems involving rates of change, optimization, and motion. **CO3**:Analyze the behaviour of functions by examining extrema, concavity, and inflection points using first and second derivative tests, and apply these to sketch curves and optimize functions. **CO4**: : Evaluate the role of definite integrals in determining areas between curves, volumes of solids of revolution, and work done by forces, using different integration techniques. **C05**: Construct solutions to complex real-life problems by integrating calculus concepts, including solving differential equations and finding the center of mass of objects using definite integrals
3	MTS3B03	Calculus of Single variable-2	**CO1**: Explain the fundamental concepts of logarithmic, exponential, inverse trigonometric, and hyperbolic functions, and describe their properties, graphs, and applications in calculus **CO2**:Apply differentiation and integration techniques to solve problems involving natural logarithmic, exponential, and hyperbolic functions, including their use in real-world scenarios. **CO3**:Analyze the convergence and divergence of sequences and series using appropriate tests such as the Integral Test, Comparison Test, and Alternating Series Test, and apply these to solve related mathematical problems. **CO4**: Evaluate improper integrals, limits, and indeterminate forms using l'Hôpital's Rule and techniques for handling infinite discontinuities and intervals, demonstrating the

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			ability to handle complex limit problems **CO5**: Construct mathematical solutions involving parametric and polar equations, vector-valued functions, and surfaces in space, including determining arc lengths, areas, volumes, and curvatures in three-dimensional contexts
4	MTS4B04	Linear Algebra	**CO1**:**Understand and Define** the fundamental concepts of linear equations, matrix operations, and vector spaces, demonstrating knowledge of key terms like augmented matrices, Gaussian elimination, and linear independence. **CO2**:**Apply** matrix transformation techniques and row-reduction methods to solve linear systems, compute inverses, and analyze the consistency of systems in real-world scenarios. **CO3**:**Analyze** the properties of matrices, including diagonalization, eigenvalues, eigenvectors, and inner products, to interpret and manipulate matrix transformations and solve problems involving transformations in R2R^2R2 and R3R^3R3 **CO4**:**Evaluate** the rank, nullity, and fundamental matrix spaces by using concepts like row and column space, orthogonal complement, and matrix operators to assess system solutions and matrix invertibility . **CO5**: **Synthesize** and **Design** solutions using advanced techniques like the Gram-Schmidt Process and orthogonal diagonalization to construct orthonormal bases, diagonalize symmetric matrices, and simplify complex vector space transformations
5	MTS5B05	Abstract Algebra	**C01**:Define the fundamental concepts of groups, including binary operations, subgroups, cyclic groups, and permutation groups, and their structural properties.

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			CO2:Apply the concepts of congruence class modulo nnn to solve problems involving addition, multiplication, and finding multiplicative inverses, as well as analyze equivalence relations and partitions in various mathematical contexts. **CO3**:Analyze the structural properties of groups by studying isomorphism, homeomorphisms, cosets, and automorphisms, and demonstrate the use of the first and second isomorphism theorems in solving group theory problems. **CO4**: Evaluate and construct examples of groups with various properties, such as Abelian groups, cyclic groups, permutation groups, and subgroups of specific orders, while interpreting key theorems like Lagrange's and Cayley's **CO5**: Synthesize the properties of commutative rings, integral domains, and subrings to develop deeper insights into algebraic structures and demonstrate their understanding of divisors of zero and finite integral domains
6	MTS5B06	Basic Analysis	**CO1**:Define key concepts related to finite and infinite sets, real numbers, complex numbers, and sequences, demonstrating an understanding of fundamental properties and definitions such as supremum, infimum . **CO2**:Apply limit theorems and convergence criteria to evaluate the limits of sequences and series, employing tools such as the Squeeze Theorem and Cauchy criterion to determine convergence or divergence in practical examples **CO3**: Will analyze sequences and their limits by investigating the behavior of subsequences, employing the Bolzano-Weierstrass theorem to establish convergence properties and discussing the implications of properly divergent sequences **CO4**: Create complex functions and mappings in the

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7			complex plane, utilizing polar coordinates and de Moivre's theorem to derive results regarding powers and roots of complex numbers, while also illustrating these concepts through graphical representations. **CO5**:Evaluate properties of open and closed sets in R\mathbb{R}R and the complex plane, using definitions and theorems to characterize sets, identify cluster points, and discuss implications of the Cantor set and its properties in terms of measure and topology.
7	MTS5B07	Numerical Analysis	**CO1**: Explain key concepts in numerical methods, such as the bisection method, fixed-point iteration, and the Newton-Raphson method, along with related terminologies like 'round-off error' and 'rate of convergence' **CO2**: Apply various numerical techniques to solve equations in one variable, employing methods such as Newton's method and the secant method while analyzing their convergence properties and error behaviors. **CO3**: Analyze and compare different interpolation methods, including Lagrange interpolation and Neville's method, assessing their effectiveness in polynomial approximation and understanding the implications of divided differences on computational accuracy. **CO4**:Synthesize knowledge from numerical differentiation and integration to construct and evaluate numerical quadrature methods like the Trapezoidal Rule and Simpson's Rule, including composite rules and Gaussian quadrature for arbitrary intervals. **CO5**: Evaluate initial-value problems for ordinary differential equations using techniques such as Euler's

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			method and Runge-Kutta methods, assessing their accuracy and stability while recommending appropriate methods based on specific problem requirements.
8	MTS5B08	Linear Programming	**CO1**: Understanding Linear Programming Basics. **CO2**: Formulation of Linear Programming Problems. **CO3**: Implementation of the Simplex Method. **CO4**: Application of Duality Theory. **CO5**: Evaluation and Application of Transportation and Assignment Problems.
9	MTS5B09	Introduction to Geometry and Theory of Equations	**CO1**:Define and describe conic sections, including parabolas, ellipses, and hyperbolas, as well as their standard forms and properties such as focal distances and reflection laws. **CO2**:Apply the properties of conics to solve problems involving tangents, normals, and the identification of conics from their general equations, demonstrating proficiency in recognizing different conic types based on their characteristics **CO3**:Analyze affine transformations and their properties, distinguishing between isometries and affine transformations, and applying the fundamental theorem of affine geometry to various geometric problems. **CO4**:Synthesize knowledge from polynomial theory, employing methods such as synthetic division, Taylor expansion, and the Fundamental Theorem of Algebra to derive and factor polynomials, determining the nature and multiplicity of their roots. **CO5**:Evaluate the roots of polynomial equations using various methods, including Descartes' rule of signs and Rolle's theorem, assessing the implications of root behavior

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			and multiplicity within defined intervals
10	MTS5 D04	Mathematics for decision making	**CO1**: Understand and Describe Fundamental Concepts of Decision Making in Mathematics. **CO2**: Apply Mathematical Techniques to Solve Decision-Making Problems. **CO3**: Analyze Decision-Making Scenarios Using Quantitative Methods. **CO4**: Evaluate the Effectiveness of Mathematical Models in Decision Making. **CO5**: Create and Develop Strategic Decision-Making Models Using Mathematical Tools.
11	MTS6B10	Real Analysis	**CO1**: Define continuous functions, identify criteria for continuity and discontinuity, and provide examples of both types of functions, including specific cases such as Dirichlet and Thomae *functions.* **CO2**: Apply theorems related to continuous functions on intervals, such as the Maximum-Minimum Theorem and Bolzano's Intermediate Value Theorem, to solve problems involving the existence of roots and the boundedness of functions. **CO3**: Analyze concepts of uniform continuity, differentiating between uniform and nonuniform continuity, and employing the Weierstrass Approximation Theorem to approximate continuous functions using step functions and piecewise linear functions. **CO4**: Synthesize knowledge from Riemann integration, employing the Fundamental Theorem of Calculus, substitution, and integration by parts, to evaluate integrals and understand the properties of Riemann integrable functions.

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			CO5:Evaluate series of functions, assessing convergence through tests for uniform convergence, including the Weierstrass M-Test, and determining the conditions for the existence of improper Riemann integrals using the Cauchy Principal Value and other criteria.
12	MTS6B11	Complex Analysis	**CO1**: Define and understand the concepts of limits and continuity for complex functions, including the properties of bounded functions, branches, and branch cuts. **CO2**: Apply the Cauchy-Riemann equations to determine the analyticity of complex functions, differentiating between analytic and non-analytic functions, and recognize harmonic functions and their properties. **CO3**: Analyze integration in the complex plane, evaluating complex integrals using the Cauchy-Goursat theorem and understanding the independence of path in contour integrals, along with the implications of Cauchy's integral formulas. **CO4**: Synthesize knowledge from sequences and series, including convergence tests and the formulation of Taylor and Laurent series, enabling them to express complex functions in series form and analyze their properties **CO5**: Evaluate residues using the residue theorem, applying it to compute complex integrals and derive consequences for real trigonometric integrals, thereby solidifying their understanding of singularities and the behavior of functions near them.
13	MTS6B12	Calculus of	**CO1**: Define and explain concepts related to functions of

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		Multi variable	multiple variables, including limits, continuity, partial derivatives, and differentiability, along with their geometric interpretations. **CO2**: Apply techniques such as the chain rule, directional derivatives, and Lagrange multipliers to find extrema and optimize functions of several variables, demonstrating proficiency in solving real-world problems involving constraints. **CO3**: Analyze double and triple integrals, including evaluating iterated integrals and changing the order of integration, as well as applying multiple integrals to compute volumes, areas, and other physical properties of solids **CO4**:Synthesize their understanding of vector calculus, employing line integrals and surface integrals to calculate work done by vector fields and fluid flow, while interpreting results through the lens of conservative vector fields and potential functions. **CO5**: Evaluate the implications of Green's Theorem, the Divergence Theorem, and Stokes' Theorem in connecting line and surface integrals to volume integrals, thereby enhancing their ability to interpret physical phenomena in a mathematical context.
14	MTS6B13	Differential Equations	**CO1**: Identify and classify different types of differential equations, including first-order linear and nonlinear equations, and understand basic mathematical models and their significance in various applications **CO2**: Apply methods such as integrating factors, separation of variables, and the method of undetermined coefficients to

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			solve first-order and second-order differential equations, demonstrating proficiency in both theoretical and practical aspects of differential equations. **CO3**: Analyze solutions of homogeneous and nonhomogeneous linear differential equations, utilizing techniques such as the Wronskian and reduction of order, to understand the nature of solutions in terms of stability and behavior over time. **CO4**:Synthesize knowledge of Laplace transforms to solve initial value problems and analyze step and impulse functions, integrating this knowledge to tackle real-world problems in engineering and physics. **CO5**: Evaluate boundary value problems and apply Fourier series to solve partial differential equations, interpreting results in the context of physical phenomena such as heat conduction and vibrations, while assessing the convergence of Fourier series in different scenarios.
15	MTS6B14(E01)	Graph Theory	**CO1**: Define fundamental concepts in graph theory, including vertices, edges, subgraphs, and vertex degrees, while understanding their significance in modeling real-world phenomena. **CO2**: Apply graph representations and properties to analyze various types of graphs, including the identification of paths, cycles, bridges, and connectivity, demonstrating the ability to construct and manipulate graphs for problem-solving. **CO3**: Analyze Eulerian and Hamiltonian graphs,

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			identifying necessary conditions for the existence of Euler tours and Hamiltonian cycles, and evaluate their implications in network design and optimization **CO4**: Synthesize knowledge of planar graphs and Euler's formula to solve problems involving graph drawing and representation, gaining insights into graph embedding and topological properties **CO5**: Evaluate the connectivity of graphs and the significance of spanning trees and cut vertices, using theoretical frameworks to assess graph robustness and reliability in various applications.
16	MTS6P15(PR)	Project Viva	**CO1**: Understand and Describe Project Concepts and Methodologies. **CO2**: Apply Mathematical Techniques to Real-World Problems. **CO3**: Analyze Results and Interpret Findings. **CO4**: Evaluate the Quality and Validity of the Project Work. **CO5**: Create and Present a Comprehensive Project Report and Oral Presentation.

Complimentary – Computer Science (2019 Syllabus)

Sl No.	Course Code	Title	Course Outcome
1	CSC1C01	Computer Fundamentals	CO1: Understand the knowledge of number systems and data representations. CO2: Apply Boolean Algebra to Simplify Logical Expressions. CO3: Analyze CPU Performance Metrics and Their Impact on System Efficiency.

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			CO4: Evaluate I/O Systems and Their Impact on Overall Computer Performance. CO5: Create and Develop Algorithms and Corresponding Flowcharts for Real-World Problems.
2	CSC2C02	Fundamentals of System Software, Networks and DBMS	CO1: Understand and Describe the Fundamental Concepts of System Software, networks and dbms. CO2: Apply Networking Protocols and Standards to Configure Network Devices. CO3: Analyze Database Design Principles and Normalization Techniques. CO4: Evaluate Complex SQL Queries for Data Retrieval. CO5: Create and Develop Web Pages Using HTML.
3	CSC3C03	Problem Solving Using C programming	CO1: Understand and Describe the Basics of the C Programming Language. CO2: Apply C Programming Constructs to Solve Simple Problems. CO3: Analyze and Debug C Programs for Errors and Efficiency. CO4: Evaluate and Use Functions, Pointers, and Arrays in C Programming. CO5: Create and Develop Comprehensive C Programs for Real-World Applications.
4	CSC4C04	Data Structure Using C programming	CO1: Understand and Describe Fundamental Data Structures. C02: Apply C Programming Constructs to Implement Data Structures. CO3: Analyze the Efficiency of Data Structure Operations. CO4: Evaluate Algorithmic Approaches for Data Structure Manipulation. CO5: Create and Develop Advanced Data Structure Applications Using C.
5	CSC4C05	Programming Lab: C and Data structure	CO1: Understand and Describe Basic C Programming Concepts. CO2: Apply C Programming to Implement Basic Data Structures. CO3: Analyze and Debug Programs for Data

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			Structure Implementation. CO4: Evaluate the Performance of Data Structures through Practical Experiments. CO5: Create and Develop Comprehensive Programs Utilizing Advanced Data Structures.

Complimentary – Statistics (2019 Syllabus)

Sl No.	Course Code	Title	Course Outcome
1	STA1C01	Introductory Statistics	**CO1**: Describe the functions of various statistical organizations in India, including the CSO and NSSO. **CO2**: Explain the different types of data (nominal, ordinal, time series, discrete, and continuous) and their significance in statistical analysis **CO3**: Apply measures of central tendency and dispersion, including mean, median, mode, and standard deviation, to summarize and interpret real-world data sets. **CO4**: Analyze relationships between variables by constructing and interpreting scatter plots, regression lines, and correlation coefficients **CO5**: Evaluate time series data using methods like moving averages and seasonal component estimation to make informed decisions based on trends.
2	STA2C02	Probability Theory	**CO1**: Define basic probability terms such as random experiments, sample space, events, and different types of probability **CO2**: Explain the properties and applications of probability mass functions (PMF) and probability density functions (PDF) for both discrete and

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			continuous random variables **CO3**: Calculate mathematical expectations (mean, variance) for univariate distributions and apply moment generation functions to derive properties of distributions **CO4**: Analyze the relationships between bivariate random variables by calculating joint, marginal, and conditional probabilities and interpreting the results **CO5**: Evaluate the independence of random variables using joint probability distributions and covariance, applying statistical techniques such as Karl Pearson's correlation coefficient.
3	STA3C03	Probability Distributions and Sampling Theory	**CO1**: Describe various standard probability distributions including Bernoulli, Binomial, Poisson, and Normal distributions, along with their key properties **CO2**: Apply the Central Limit Theorem to solve problems involving sample means and variances, including situations where the theorem's assumptions are met. **CO3**: Analyze sampling methods, including simple random sampling, stratified sampling, and cluster sampling, and **compare** their applicability to different real-world scenarios. **CO4**: Evaluate the convergence of random variables using Chebyshev's inequality and the Law of Large Numbers in both independent and identically distributed (iid) cases. **CO5**: Explain the relationships between sampling distributions such as the chi-square, t-distribution, and F-distribution and **use** them in hypothesis testing.

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4	STA4C04	Statistical inference and quality control	**CO1**: Explain the core concepts of estimation theory, including unbiasedness, consistency, efficiency, and sufficiency, and how they relate to point estimation. **CO2**: Apply maximum likelihood and moment estimation methods to estimate parameters of probability distributions and evaluate their efficiency using Cramer-Rao inequality. **CO3**: Analyze various hypothesis testing procedures, such as the Neyman-Pearson Lemma and large sample tests and interpret the outcomes of these tests in practical scenarios. **CO4**: Evaluate non-parametric testing methods like the Mann-Whitney U test, Kruskal-Wallis test, and Median test for different types of data where parametric assumptions are violated. **CO5**: Design and implement quality control charts (X-bar, R-chart, p-chart) to monitor and improve the quality of manufacturing processes, identifying causes of variation and suggesting corrective actions.

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LEARNING OUTCOMES-BASED CURRICULUM FRAME WORK FOR UNDERGRADUATE AND POST GRADUATE EDUCATION

FILE DESCRIPTION

We are pleased to present the Learning Outcome Based Curriculum Framework for Under Graduation and Post Graduation programmes offered by various departments of Ambedkar College of Arts and Science, Wandoor. This document embodies our institution's Vision and Mission, guiding us towards academic excellence and ensuring our commitment to provide comprehensive and insightful education.

The vision of Ambedkar College of Arts and Science, Wandoor is to 'change lives through education'. We aim to provide high-quality, accessible learning experiences that empower students to achieve their full potential.

The departments responsible for the programme establish Programme Outcomes (POs), Course Outcomes (COs), and Programme Specific Outcomes (PSOs) in strict adherence to Outcome-Based Education (OBE) objectives. This process involves thorough consultations with faculty and stakeholders. The outcomes are widely disseminated through various channels, including the college website, circulars, faculty and HOD meetings, Bridge Course and Orientation programs.

The syllabi for various programs are showcased on the college website, clearly accompanied by the corresponding Programme Outcomes and Course Outcomes. Additionally, printed copies of the program syllabi are made available in each department for the reference of both teachers and students.

At the beginning of each academic programme, students are introduced to the Programme Outcomes during orientation sessions conducted at both the college and department levels. Teachers play a crucial role by effectively communicating the course outcomes to students at the onset of each course. They employ various assessment instruments to evaluate students' progress toward these outcomes, guided by a detailed semester plan.

Furthermore, a comprehensive college handbook is provided to both staff and students, containing pertinent details about the programmes offered. This holistic approach ensures that all stakeholders are well-informed and aligned with the educational objectives, fostering an environment that supports student learning and success.

Heads of Departments (HoDs) play a crucial role in raising awareness among students regarding Program Outcomes (POs), Program Specific Outcomes (PSOs), and Course Outcomes (COs). This communication is reinforced by faculty members, class teachers, mentors, course coordinators, and programme coordinators, all of whom emphasize the significance of achieving these outcomes. PSOs delineate specific skill requirements and achievements that students are expected to meet by the end of their programs.

The Board of Studies (BOS), which consists of HoDs and subject experts, is responsible for discussing and approving PSOs after receiving endorsement from the principal. POs serve as broad statements that articulate the professional accomplishments students should achieve upon completing their programmes, while COs provide direct statements that outline the essential and lasting disciplinary knowledge and skills students are expected to acquire upon completing a course.

Each course establishes a set of COs, along with corresponding evaluation criteria. These COs are directly mapped to POs, offering a quantitative measure of the achievement of program outcomes. Students' performance in examinations throughout each semester is used to assess the level of attainment for both POs and PSOs by mapping COs to these broader outcomes. The program coordinator, in collaboration with faculty members, develops the mapping of COs to POs and PSOs for all courses within the programme.

Assessment of CO attainment employs both direct and indirect methods. The direct method includes mid-term and end-semester examinations, while lab courses require the outcomes of practical sessions align with one or more defined program outcomes. This alignment demonstrates the knowledge, skills, and values that students should acquire upon completing each course.

Courses contributing to POs are clearly identified and evaluated through their respective COs. This evaluation utilizes a combination of internal assessments (20% weightage) and external examinations (80% weightage), alongside indirect assessments such as end-of-course surveys.

The results from the assessments of POs are then compared with expected attainment levels. A PO is deemed satisfied when the expected level of achievement is reached, ensuring that the educational objectives are met. This systematic approach not only facilitates clear communication of expectations to students but also supports continuous improvement in program delivery and outcomes. By actively engaging in this process, faculty and coordinators create a robust educational environment that fosters student success and alignment with professional standards.