# BANKIM SARDAR COLLEGE

## A College with Potential for Excellence

## Department of Mathematics

## Programme Outcome (PO) - Programme Specific Outcome (PSO) - Course Outcome (CO)

**Programme Outcome (PO)** - It is expected that after learning and completing the Mathematics and Statistics general course for B.Sc., B.Com.(Hons. & Gen), the students will definitely make themselves ready for the following:

- They will able to enter in the job markets in our society like W.B.C.S, various S.S.C., Banking and different financial institutes and of course teaching faculties.
- Students can enter to various engineering and technological courses.
- Students can enter to costing and management courses.
- Students can enter to the various computer related courses and jobs.
- Students can enter to higher learning in mathematics and statistics.
- Students can easily associate themselves with various cognitive tasks involving attention and decision making.

**Programme Specific Outcome (PSO)** - Each unit of this syllabus i.e. course has been formulated for some specific outcomes which are as follows

- It develops a greater global awareness of mathematics and mathematical sciences and prepares to face the problems.
- It develops and provides an effective way of building mental discipline.
- It develops and helps to have analytical thinking which generates to the ability to investigate to know the truth about the world around us.
- Financial mathematics can help the students to create the money in a legal way.
- Geometry, Algebra, Calculus can help the students to understand the most complicated problems of modern scientific worlds.
- It develops the problem-solving skill
- It helps to understand the computer programming and computer technology.

| Semester | Unit | | Topic | Course Outcomes |
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| 1st | Unit-1 | Algebra-I | Complex Numbers | **CO 01**: To express complex numbers in polar form. Use De Moivre's theorem find the roots of complex numbers and representation with Trigonometric, Hyperbolic and logarithmic functions. |
| | | | Polynomials | **CO 02**: Fundamental theorem of algebra and nature and location of roots of an equation. |
| | | | Rank of a matrix | **CO 03**: Consistency and inconsistency of a system of equations. |
| | Unit-2 | Differential Calculus-I | Rational, Irrational and Real numbers | **CO 04**: Various numbering system and their real use in day to day world. |
| | | | Real-valued functions | **CO 05**: Domain and range of different type of functions and limit and continuity of a function. |
| | | | Derivative | **CO 06**: Interpret the derivative of a function at a point the as the rate of change (geometrical and physical). |
| | | | Successive derivative | **CO 07**: To find the nth order derivative of a function and use of Leibnitz's theorem. |
| | | | Functions of two and three variables | **CO 08**: How to develop a function with two or three independent variables. |
| | | | Applications of Differential Calculus | **CO 09**: To analyse the characteristic properties of plain curves. |
| | Unit-3 | Differential Equation-I | Order, degree and solution of an ODE | **CO 10**: Order of a differential equation is the order of the highest order derivative (also known as differential coefficient) present in the equation. The power of the highest order derivative used in the rationalized form in an ODE is its degree. An n-th order differential equation has exactly n linearly independent solution and n-arbitrary constants. |
| | | | First order equations | **CO 11**: To find the solution of exact differential equation. To reduce an equation to exact differential equation. To find I.F. |
| | | | Second order linear equations | **CO 12**: To find the solution of a 2nd order differential equation consisting complementary function and particular integral |
| | | | Second order differential equations | **CO 13**: To find the solution of Cauchy-Euler equation. To find the solution of differential equation by variation of parameters and method of undetermined coefficients. |
| | Unit-4 | Coordinate Geometry | Transformation of Rectangular axes | **CO 14**: The components of transformation also known as rigid motion are translation and rotation. |
| | | | General equation of second degree in x and y | **CO 15**: To reduce the general 2nd degree equation to canonical form by transformation of coordinates. |

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| | | | Pair of straight lines | **CO 16**: To learn the condition under which the general 2nd degree equation represents a pair of straight lines. To find the angle and equation of bisectors of the angles between the straight lines. |
| | | | Equations of pair of tangents from an external point, chord of contact, Poles and polars of general conic | **CO 17**: To learn about the respective outcomes of intersection of a conic and a straight line. |
| | | | Polar equation of straight lines, circles, conic. Equations of tangent and normal | **CO 18**: To learn the equation of straight lines, circle and conic in polar coordinate system under different conditions. To learn about the respective outcomes of intersection of a straight line and a conic. |
| | | | Sphere and its tangent plane | **CO 19**: To find the equation of a sphere under different conditions. To learn about the respective outcomes of intersection of a sphere by a plane, a line or a sphere. |
| | | | Right circular cone | **CO 20**: To find the equation of a right circular cone under different conditions. To learn the outcome of intersection of a cone by a plane. |
| 2nd | Unit-1 | Differential Calculus-II | Sequence of real numbers | **CO 21**: To learn about different types of sequence and its properties |
| | | | Infinite series of constant terms | **CO 22**: To learn about the convergence and divergence of infinite series by different methods. |
| | | | Real-valued functions defined on an interval | **CO 23**: To learn different Mean value theorems and its application. To expand five types of functions using Taylor's and Maclaurin's infinite series |
| | | | Indeterminate Forms | **CO 24**: To evaluate the limits of different types of indeterminate forms using L'Hospital's Rule. |
| | | | Application of Principle of Maxima and Minima for a function of single variable | **CO 25**: To learn the concept of maximum and minimum values of functions of single variable on different intervals and under various situations. |
| | | | Maxima and minima of functions of not more than three variables | **CO 26**: To determine the maxima and minima of functions of n variables (may be connected by m equations (m<n)(n= 2 or 3)) |
| | Unit-2 | Differential Equation-II | Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations | **CO 27**: To find the general solution of second order differential equation by different methods. |
| | | | Order and degree of partial differential equations, concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order | **CO 28**: To formulate different types of partial differential equation. To find the solution of PDE by Lagrange's and Charpit's method |

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| | Unit-3 | Vector Algebra | Addition of vectors, Multiplication of a vector by a scalar. Collinear and Coplanar vectors. Scalar and vector products of two and three vectors. Simple applications to problems of geometry. Vector equation of plane and straight line. Volume of tetrahedron. Applications to problems of Mechanics (Work done and Moment) | **CO 29**: Use of different operations in vector algebra and how to evaluate dot and cross products in vector algebra and its properties. |
| | Unit-4 | Discrete Mathematics | Integers | **CO 30**: Learn properties of natural numbers, integers and prime numbers and Diophantine equation. |
| | | | Congruences | **CO 31**: To test the divisibility of integers on using arithmetic of remainders |
| | | | Application of Congruences | **CO 32**: To determine the validity of ISBN, UPC, credit card numbers. To make a schedule of a round robin tournament, |
| | | | Congruence Classes | **CO 33**: Idea about congruence classes of any integer and their properties. |
| | | | Boolean Algebra | **CO 34**: It's an algebraic structure and used in designing computers and switching circuits etc. |
| 3rd | Unit-1 | Integral Calculus | Evaluation of definite integrals | **CO 35**: To know that the connection between primitives and integrals is represented by the Fundamental Theorem of Integral Calculus. To evaluate a definite integral, arbitrary constant need not be added in the value of the corresponding indefinite integral. |
| | | | Integration as the limit of a sum | **CO 36**: To evaluate the limits of the sums of certain series, when the number of terms tends to infinity by identifying them with some definite integrals. |
| | | | Reduction formulae | **CO 37**: To learn Reduction Formula involving one, two and three parameters. |
| | | | Definition of Improper Integrals. Use of Beta and Gamma Functions | **CO 38**: To learn three types of improper integrals and the condition of convergence and divergence using different methods. To learn about Beta and Gamma functions. |
| | | | Working knowledge of double integral | **CO 39**: To know that every double integral can be evaluated in stages, using the single-integration methods. |
| | | | Applications: Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only. | **CO 40**: To find length of an arc of a curve. To find the area bounded by one or more curves. To learn the concept of volume of revolution and surface of revolution. |
| | Unit-2 | Numerical Methods | Approximate numbers, Significant figures, Rounding off numbers. Error: Absolute, Relative and percentage. | **CO 41**: To learn the concepts of approximate numbers, significant figures, rounding-off rule and different types of error. |

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| | | | Three types of Operators (Definitions and some relations among them). | **CO 42**: To learn about forward difference, backward difference and shift operators and properties and relation among them. To estimate missing entries of a table when the arguments of a function are known. |
| | | | Interpolation | **CO 43**: To compute an approximate value of an entry of a table when the arguments of a function are known for equally and unequally spaced arguments. |
| | | | Numerical Integration | **CO 44**: To find the Quadrature formula by Trapezoidal Rule and Simpson's one-third formula. |
| | | | Solution of Numerical Equation | **CO 45**: To find rough approximation to a real root by graphical method, method of tabulation. To find the solution of an equation by bisection and Newton-Raphson methods. |
| | Unit-3 | Linear Programming Problem | Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S. | **CO 46**: To optimize of a linear objective function, subject to linear equality and linear inequality constraints. To find the solution of LPP using different properties and concepts of matrix. To learn about convex set, convex hull, Hyperplane, Extreme points, convex polyhedron and degenerate and non-degenerate BFS |
| | | | The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. | **CO 47**: To learn about different properties of the set of all feasible solutions of an LPP |
| | | | Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions. | **CO 48**: To find the set of all feasible solutions with the help of graph. To find the solution of L.P.P. by simplex method. To learn the concepts of primal and dual problems. To solve a transportation problem using initial basic feasible solutions (by five different methods). Assignment problems deal with corresponding or matching an element of one set to an element of another set so that total value for entire correspondence is optimum. |

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| 4th | Unit-1 | Algebra-II | Introduction of Group Theory | **CO 49**: To study an algebraic structure of a non-empty set and one binary operation defined on it and a set of axioms, which are imposed on the operation. |
| | | | Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. | **CO 50**: To learn three algebraic structures (ring, integral domains and fields) with two binary operations satisfying some specific properties. |
| | | | Concept of Vector space over a Field: Examples, Concepts of Linear combinations, Linear dependence and independence of a finite number of vectors, Sub- space, Concepts of generators and basis of a finite-finite dimensional<br>vector space. Problems on formation of basis of a vector space (No proof required). | **CO 51**: General properties of vector space. Linear dependence and independence of a finite set of vectors. Sub space, generators and basis of a finite dimensional vector space. |
| | | | Real Quadratic Form involving not more than three variables (problems only). | **CO 52**: To determine the value class by different methods |
| | | | Characteristic equation of square matrix of order not more than three. Determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem. | **CO 53**: Concept of characteristic matrix, polynomial equation of a square matrix. Eigen value and Eigen vectors |
| | Unit-2 | Computer Science & Programming | Computer Science and Programming: Historical Development, Computer Generation, Computer Anatomy- Different Components of a computer system. Operating System, hardware and Software. | **CO 54**: Be aware the evolution of computer and what is its necessity and how it's used in the modern-day world. What are the various entities of the computer and what are their functions. |
| | | | Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data-ASCII, etc. | **CO 55**: Be aware various numbering system and its relation and what is the use in the computing world. |
| | | | Programming Language: Machine language, Assembly language and High-level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc. | **CO 56**: Will know various languages of computer (such as machines languages, assembly languages) and how computer communicate across various entities. Also, will be aware what is the use of various languages and when to leverage which languages. They will also know the merits and demerits of various languages. |

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| | | | Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algorithm.<br>Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions. | **CO 57**: It will develop reasoning capability and the flow of reason or logic. Also, how to develop a solution of a complex problem leveraging various computer languages. Computer will execute the solution leveraging language compilers. |
| | Unit-3 | Probability & Statistics | Elements of probability Theory: Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Conditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathematical expectation. Joint distribution of two random variables. | **CO 58**: To know that the theory of probability deals with laws governing the chances of occurrences of phenomena which are unpredictable in nature. To learn about the concepts of random experiment, outcome, event, conditional probabilities and mathematical expectation. |
| | | | Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. | **CO 59**: To understand difference between discrete and continuous probability distribution. To learn different types of distributions and their properties. To learn the theorems of probability and mathematical expectation. |
| | | | Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Frequency<br>curve, Measures of Central tendencies. Averages: AM, GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis. | **CO 60**: To learn the concepts of different types of statistical data and their presentation in various forms. To learn different types of measures of central tendency in different cases. To learn about two types of measures of dispersion, namely absolute and relative measures. To learn the relation between raw moment, central moment and moments about an arbitrary constant. To learn about the concepts of skewness and kurtosis. |

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| | | | Sampling Theory: Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: (i) standard Normal Distribution, (ii) Chi-square distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. | **CO 61**: To learn the main objects of sampling. To learn about the concepts of sampling error, bias, standard error, simple random sampling with or without replacement, point estimation, interval estimation, statistical hypothesis, level of significance, critical region. |
| | | | Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Regression lines. | **CO 62**: To learn about bivariate data, scatter diagram. To learn about correlation co-efficient and its properties. To find the regression lines by different methods. |
| 5th | DSE-A | Particle Dynamics | Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. | **CO 63**: To learn expressions of velocity and acceleration in cartesian and polar coordinates for a particle moving in a plane under different conditions. To learn expressions for the tangential and normal components of velocity and acceleration of a particle describing a plane curve. |
| | | | Concept of Force: Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane. | **CO 64**: To find expressions for acceleration, velocity and displacement of the moving particle at any time or position. To learn the concept of work involving two factors namely force and displacement caused by the force. To learn relation between Force, Power and velocity and their properties. |
| | | | Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. | **CO 65**: To find solution of a SHM under any initial conditions, compositions of two SHM in the same straight line. To find solution of horizontal and vertical oscillation of an elastic string. To find solutions of damped oscillations and forced oscillations. |

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| | | | Motion in two dimensions: Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. | **CO 66**: To find expressions for velocity and displacement of the moving particle at any time or position in a resisting medium, generally proportional to some integral power of the velocity of the particle. To find expressions for velocity and acceleration of the moving particle under forces varying as distance from fixed point. |
| | | | Central orbit. Kepler's laws of motion. Motion under inverse square law. | **CO 67**: To learn the concepts of central orbit, central force and centre of force. To find the path of a particle under Inverse Square Law. |
| 6th | DSE-B | Advanced Calculus | Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions . Simple problems. | **CO 68**: To learn about different types of Sequences and Series and their properties. |