RAIGANJ UNIVERSITY
DEPARTMENT OF MATHEMATICS

SYLLABUS FOR MATHEMATICS
B. Sc. (General)

CBCS FORMAT
w.e.f. the academic session 2017 - 2018

RAIGANJ UNIVERSITY
Raiganj, Uttar Dinajpur
West Bengal, India

Contents

SEMESTER 1

Chapter 1

SEMESTER 1

1.1 BSCPMATH101 [Credit 6]

Analytical Geometry of Two and Three Dimensions and Vector Algebra [CORE]

1.1.1 Analytical Geometry of Two Dimensions

1. Transformations of Rectangular axes: translation, rotation and their combinations.

2. General equation of second degree in x and y: Reduction to canonical forms. Classification of conics.

3. Pair of straight lines: condition that the general equation of second degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of pair of straight lines joining the origin to the points in which a line meets a conic.

4. Equations of pair of tangents from an external point, chord of contact, poles and polars in case of general conic, in particular for Circle, Parabola, Ellipse, Hyperbola.

5. Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equation of chord joining two points. Equations of tangent and normal.

1.1.2 Analytical Geometry of Three Dimensions:

1. Rectangular Cartesian co-ordinates. Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line.

2. Equation of plane: General equation of a plane. Intercept and normal forms. Angle between two planes. Distance of a point from a plane and distance

between two parallel planes. Bisectors of angles between two intersecting planes.

3. Equation of a straight line: General and symmetric form. Angle between two straight lines. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew lines.

4. Sphere and its tangent plane.

1.1.3 Vector Algebra

Collinear and coplanar vectors. Scalar and vector products of three vectors. Simple applications to problems of Geometry. Vector equations of plane and straight line. Volume of a tetrahedron. Applications to problems of Mechanics (Work done and Moment).

1.2 AECC101 [Credit 4]

ENVIRONMENTAL STUDIES [AECC]

SEMESTER 2

Chapter 2

SEMESTER 2

2.1 BSCPMATH201 [Credit 6]

Algebra [CORE]

2.1.1 Classical Algebra

1. **Complex Numbers:** De-Moivre's theorem and its applications. Exponential, sine, cosine and logarithm of a complex number. Inverse circular and hyperbolic functions.

2. **Theory of Equations (polynomials with real coefficients):** Fundamental theorem of Classical Algebra(statement only). Polynomials with real coefficients. The n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surds or complex roots occur in pairs). If the polynomial $f(x)$ has opposite signs for two real values of x, then the equations $f(x) = 0$ has an odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no root or an even number of roots lie between a and b. Rolle's theorem ,Descartes' rule of signs and their direct applications. Relation between roots and co-efficients. Symmetric functions of the roots, transformations of equations, Cardan's method of solving a cubic equation.

3. Determinants: Basic properties and operations. Symmetric and skew symmetric determinants. Solutions of a system of linear equations with not more than three variables.

4. Matrices: Basic properties and operations of Matrices. Orthogonal matrix. Rank of a matrix. Determination of rank of a matrix. Solutions of a system of linear equations with three variables by matrix method.

2.1.2 Modern and Linear Algebra

1. Basic concepts and properties of sets, operations on sets. Different kinds and compositions of mappings. Binary operations. Identity element. Inverse element.

2. Definitions and examples of Groups. Elementary properties using definition of Group, its identity and inverse. Definition and examples of Subgroups. Statement of necessary and sufficient conditions for a subset of a Group to be a Subgroup and its applications.

3. Definitions and examples of Rings, Fields, Subrings and Subfields. Basic theorems and simple problems.

4. Definitions and examples of Vector Space over a Field. Linear combinations, linear dependence and independence of a finite set of vectors. Subspace. Generators and basis of a finite-dimensional Vector Space. Problems on formation of basis of a Vector Space (proof is not required).

5. Real Quadratic Form involving not more than three variables (problems only).

2.2 AECC201 [Credit 2]

ENGLISH/MIL COMMUNICATIONS [AECC]

SEMESTER 3

Chapter 3

SEMESTER 3

3.1 BSCPMATH301 [Credit 6]

Differential Calculus and Integral Calculus [CORE]

3.1.1 Differential Calculus

1. Rational numbers. Geometrical representations. Irrational numbers. Real number represented as point on a line. Linear continuum. Basic properties of real numbers (no deduction or proof)

2. Sequence: Definition of bounds of a sequence and monotone sequence. Limit of a sequence. Statements of limit theorems. Concepts of convergence and divergence of monotone sequences, relevant theorems and their applications. Statements of Sandwich theorem and Cauchy's general principle of convergence and their applications.

3. Infinite series of constant terms. Concepts of convergence and divergence . Cauchy's principle as applied to infinite series (application only). Series of positive terms. Statements of Comparison test, D' Alembert's ratio test and Cauchy's root test and their applications. Alternating series. Statement of Leibnitz's test and its applications.

4. Acquaintance with the important properties of continuous functions on closed intervals (no proof). Statement of existence of inverse function of a strictly monotone function and its continuity.

5. Differentiation-its geometrical and physical interpretations. Relation between continuity and derivability. Differential- application in finding approximation.

6. Successive differentiation. Leibnitz's theorem and its applications.

7. Statement and proof of Rolle's theorem and its geometrical interpretation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and

Maclaurin's theorems with Lagrange's and Cauchy's form of reminders. Taylor's and Maclaurin's infinite series for functions like e^x, $\sin x$, $\cos x$, $(1+x)^n$, $\log(1+x)$ (with restrictions whenever necessary).

8. Indeterminate forms. L' Hospital's rule: statement and problems only.

9. Functions of two variables: Their geometrical representations. Limit and continuity (definitions only) for functions of two variables. Partial derivatives: knowledge and use of chain rule. Exact differentials (emphasis on solving of problems only). Successive partial derivatives: Statements of Schwartz's and Young's theorems on commutativity of mixed partial derivatives. Euler's theorem on homogeneous function of two variables. Maxima and minima of functions of two variables. Rectilinear Asymptotes (Cartesian only), Curvature of a plane curve, Envelope of family of straight lines and of curves (problems only).

3.1.2 Integral Calculus

1. Evaluation of Definite Integrals.

2. Integration as the limit of a sum (with equally spaced as well as unequal intervals)

3. Reduction formulae and associated problems.

4. Definition of Improper integrals: Statements of

   (i) μ-test,

   (ii) comparison test (limit form excluded) simple problems only. Use of Beta and Gamma functions(convergence and important relations being assumed).

5. Working knowledge of Double integral.

6. Applications: rectification, quadrature, volume and surface areas of solids formed by revolution of plane curve and areas (problems only).

3.2 MATHSEC301 [Credit 2]

3.2.1 Ordinary Differential Equations [SEC-1]

1. Order, degree and solution of an Ordinary Differential Equation (ODE) in presence of arbitrary constants. Formation of ODE.

2. First-order Differential Equation:

   (i) Variables separable.

   (ii) Homogeneous equations and equations reducible to homogeneous forms.

   (iii) Exact equations and those reducible to such equations.

(iv) Euler's and Bernoulli's equations (linear).

(v) Clairaut's equation: General and Singular solutions.

3. Higher order Linear Differential Equation (LDE): Higher order LDE (upto 4-th order) with constant coefficients. Euler's homogeneous equations.

4. Simple applications: Orthogonal trajectories.

SEMESTER 4

Chapter 4

SEMESTER 4

4.1 BSCPMATH401 [Credit 6]

Analytical Dynamics and Numerical Analysis [CORE]

4.1.1 Analytical Dynamics

1. Motion in straight line under variable acceleration. Simple Harmonic Motion.
2. Expressions for velocity and acceleration of a particle moving on a plane in Cartesian and Polar coordinates. Motion of a particle moving on a plane with reference to a set of rotating axes.
3. Central force and central orbit.
4. Tangential and normal accelerations. Circular motion.
5. Motion of a particle in a plane under different laws of resistance. Motion of a projectile in a resisting medium. Trajectories in a resisting medium where resistance varies as some integral power of velocity. Terminal velocity.

4.1.2 Numerical Analysis

1. Approximate numbers. Significant figures. Rounding off numbers. Errors- Absolute, Relative and Percentage.
2. Operators- Δ, ∇ and E (definitions and some relations among them).
3. Interpolation: The problem of interpolation. Equispaced arguments. Difference tables. Deduction of Newton's Forward and Backward Interpolation formulae with remainder term. Lagrange's Interpolation formula(statement only). Simple numerical problems on Interpolation with both equally and unequally spaced arguments.
4. Numerical Integration: Deduction of Trapezoidal and Simpson's $\frac{1}{3}$ formulae. Geometrical interpretations. Simple problems on Numerical Integration.

5. Solution of Numerical Equation: Location of root(tabular method), Bisection method, Newton-Raphson method with geometrical significance. Simple problems.

4.2 MATHSEC401 [Credit 2]

4.2.1 Complex Analysis [SEC-2]

Complex functions. Continuity and Differentiation of complex functions. Analytic function. Cauchy-Riemann equations. Harmonic function.

SEMESTER 5

Chapter 5

SEMESTER 5

5.1 MATHSEC501 [Credit 2]

Probability [SEC- 3]

1. Poisson trials. Random variables. Probability distribution. Distribution function. Discrete and continuous distributions: Binomial, Poisson, Gamma, Uniform and Normal distribution.

2. Two dimensional probability distributions. Discrete and continuous distributions in two dimensions. Conditional distributions (definition only).

3. Mathematical expectation. Mean, variance, moments and central moments. Measures of location, dispersion, skewness and kurtosis. Median, mode, quartiles. Two dimensional expectation. Covariance, Correlation co-efficient. Multiplication rule for mathematical expectations. Regression curves. Least square regression lines and parabolas.

5.2 MATHDSE501 [Credit 6]

A Course of Calculus [DSE-1]

5.2.1 A Course of Calculus

1. Uniform Convergence of Sequence and Series of Functions: Sequence of functions. Convergence of sequence of functions. Cauchy's Criterion for uniform convergence, test for uniform convergence. Convergence of series of functions. Cauchy's Criterion for convergence of series of functions. Weierstrass M-test. Uniform convergence and continuity. Uniform convergence and integration. Uniform convergence and differentiation.

2. Determination of radius of convergence of power series. Statement and properties of continuity of sum function of power series, term by term integration and differentiation of power series. Statements of Abel's theorems on power series, convergence of power series. Expansion of elementary functions such as $e^x,\ \sin x,\ \log(1+x),\ (1+x)^n$. Simple problems.

3. Fourier Series: Trigonometric series. Periodic function. Fourier coefficients. Statement of Dirichlet's conditions for convergence. Fourier sine and cosine series.

4. Differential equations of second order. Method of variation of parameters, method of undetermined coefficients, simple eigen value problems.

5. Simultaneous linear differential equations with constant coefficients.

6. Laplace Transform and its applications in ordinary differential equations. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its inverse. Elementary properties of derivatives and integrals. Convolution theorem (statement only) and applications.

7. Partial Differential Equation (PDE): Introduction, formation of PDE, solutions of PDE, Lagrange's method of solution.

SEMESTER 6

Chapter 6

SEMESTER 6

6.1 MATHSEC601 [Credit 2]

Linear Programming and Optimization [SEC- 4]

1. Statement of Linear Programming Problem (L. P. P). Formation of L. P. P. Slack and Surplus variables. L. P. P in Matrix form. Convex set. Hyperplane. Extreme Points. Convex polyhedron. Basic Solution (B. S.), Feasible Solution (F. S.) and Basic Feasible Solution (B.F.S). Degenerate and Non Degenerate B.F.S.

2. 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 point 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.

3. Fundamental theorem of L. P. P.(statement only). Reduction of a F. S. to B. F. S. Standard form of an L. P. P. Solution by Graphical Method (for two variables), Simplex Method and Method of Penalty.

4. Concept of Duality. Duality theory. The dual of the dual is primal. Relation between the objective values of dual and primal problems. Dual problems with at most one unrestricted variable, one constraint of equality.

5. Transportation and Assignment problems and their optimal solutions.

6.2 MATHDSE601 [Credit 6]

Computer Science, Programming and Discrete Mathematics [DSE-2]

6.2.1 Computer Science and Programming

1. **Computer Fundamentals:** Historical development, computer generations, computer anatomy- different components of a computer system. Operating

system. Hardware and software. 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 data- ASCII, EBCDIC, etc. Programming languages: Machine language, Assembly language and High level language. Compiler and Interpreter. Object program and source program. Algorithms and Flow charts and their utilities and important features, ideas about the complexities of an algorithm. Applications in simple problems.

2. **Programming in C:** Character set in $ANSI\ C$. Key words: if, while, do, for, int, float, etc. Data type: character, integer, floating point, etc. Variables, operators: $=, ==, !!, <, >$ etc. (arithmetic, assignment, relational, logical, increment, etc.). Expressions: eg. $(a == b)!!(b == c)$.Statements: eg. if $(a < b)$ $small = a$; else $small = b$; Standard input/output. Use of while, if else, for, do while, switch, continue, etc. Arrays, strings, library functions and user defined functions. Header file. construction of simple C programs.

6.2.2 Discrete Mathematics

1. **Integers:** First and Second principles of mathematical induction, equivalence of these two principles (statement only). Proof of some simple mathematical results by induction. The division theorem(or algorithm). The greatest common divisor (g.c.d.) of two integers a and b. [This number is denoted by the symbol (a, b)]. Existence and uniqueness of (a, b). Relatively prime integers. The equation $ax + by = c$ has integral solution iff (a, b) divides c (a, b, c are integers). Prime integers. Euclid's first theorem: If some prime p divides ab, then p divides either a or b. Euclid's second theorem: There are infinitely many prime integers. Unique factorization theorem. The greatest integer function.

2. **Congruences:** Definition and properties. Euler's ϕ function. Multiplicative property of Euler's ϕ function. Fermat's theorem, Euler's theorem, Wilson's theorem. Solutions of Linear Congruence equations. Statement of Chinese Remainder theorem and simple problems. Primitive Roots. Divisibility tests. Checkdigits in ISBN, UPC and Credit Cards. Theorem regarding error detecting capability.

3. **Boolean Algebra:** Huntington postulates for Boolean Algebra. Algebra of sets and Switching Algebra as examples of Boolean Algebra. Duality. Boolean functions. Normal forms. Karnaugh maps. Design of simple switching circuits.

Books for reference in Mathematics B. Sc. (General)

Chapter 7

Books for reference in Mathematics B. Sc. (General)

Books on Algebra:

1. Higher Algebra: R. K. Ghosh and K. C. Maity (New Central Book Agency)
2. Higher Algebra- Classical: S. K. Mapa (Sarat Book House)
3. Higher Algebra- Abstract and Linear: S. K. Mapa (Sarat Book House)
4. Algebra: R. M. Khan (New Central Book Agency)
5. Higher Algebra: J. G. Chakravorty and P. R. Ghosh (U. N. Dhur and Sons)
6. University Algebra: Gopala Krishnan, N. S. (New Age International)

Books on Analysis and Calculus:

7. Differential Calculus: B. C. Das and B. N. Mukherjee (U. N. Dhur and Sons)
8. Differential Calculus: Dhami, H. S. (New Age International)
9. Integral Calculus: B. C. Das and B. N. Mukherjee (U. N. Dhur and Sons)
10. A Course Of Calculus: Das, A. N. (New Central Book Agency)
11. Complex Variables: M. R. Spiegel (McGraw Hill)
12. Theory of functions of A Complex Variable: Shanti Narayan and P. K. Mittal (S. Chand and Co.)

Books on Coordinate Geometry and Vector Algebra:

13. Analytical Geometry: N. Datta, R. N. Jana (Shreedhar Prakashani)
14. Analytical Geometry and Vector Algebra: R. M. Khan (New Central Book Agency)
15. Analytical Geometry and Vector Analysis: J. G. Chakravorty and P. R. Ghosh (U. N. Dhur and Sons)

16. Vector Analysis: R. K. Ghosh and K. C. Maity (New Central Book Agency)

Books on Differential Equation:

17. Differential Equations: J. G. Chakravorty and P. R. Ghosh (U. N. Dhur and Sons)
18. An Introduction to Differential Equations: R. K. Ghosh and K. C. Maity (New Central Book Agency)

Books on Linear Programming:

19. Linear Programming: J. G. Chakraborty and P. R. Ghosh (Moulik Library)
20. Introduction to Linear Programming: D. C. Sanyal and K. Das (U. N. Dhur and Sons)
21. Linear Programming: P. M. Karak (New Central Book Agency)

Books on Probability and Statistics:

22. Statistical Methods- part I and II: N. G. Das (M. Das and Co.)
23. Fundamentals of Mathematical Statistics: S. C. Gupta and V. K. Kapoor (Sultan Chand and Sons)
24. Mathematical Probability: A. Banerjee, S. K. De, S. Sen (U. N. Dhur and Sons)

Books on Analytical Dynamics:

25. Analytical Dynamics of a Particle: S. Ganguly and S. Saha (New Central Book Agency)
26. Analytical Dynamics: J. G. Chakravorty and P. R. Ghosh (U. N. Dhur and Sons)

Books on Discrete Mathematics:

27. Discrete Mathematics: B. S. Vasta, S. Vasta (New Age International)
28. Discrete Mathematics: J. K. Sharma (Macmillan)

Books on Numerical Analysis, Computer Science and Programming:

29. Introductory Numerical Analysis: N. Datta, R. N. Jana (ShreedharPrakashani)
30. Numerical Analysis: Das, A. N. (New Central Book Agency)
31. Fundamentals of Computers: E. Balagurusamy (Tata McGraw Hill)

32. Programming in ANSI C: E. Balagurusamy (Tata McGraw Hill)

33. Let us C: Yashwant Kanetkar (BPB Publications)

General Reading:

34. Mathematics for Science: S. M. Uppal and H. M. Humphreys (New Age International)

35. Objective Mathematics: Das, A. N. (Books And Allied)

36. Objective Mathematics: J. K. Goyal (A. S. Prakashan, Meerut)

37. What is Mathematics: R. Courant and H. Robbins (Oxford University Press)

THE END OF MATHS B. Sc. (GEN) SYLLABUS