Netaji Subhas Open University
Bachelor's Degree Programme (BDP) in Mathematics (EMT)

Syllabus

Programme Objectives: The objective of the programme is to help the learners to acquire the fundamental concept of higher Mathematics. This degree will take learner's understanding of the concepts, theories and applications of mathematics to graduate level, and give them the opportunity to study some statistics, theoretical physics or mathematics education. The syllabus is structured in such a way that a student can acquire the potential of analytical thinking towards solving a real world problem in a mathematical way.

Expected Programme Outcome: After successful completion the students may increase their knowledge with the new tools and techniques of mathematics. A student after completing this course may go for either various government or private jobs or higher studies such as MCA, M.Sc., M.Tech. etc.

Course Structure

1. **Compulsory Subjects : Foundation Course**
   (a) Humanities and Social Science (FHS)   100 Marks/ 8 Credits
   (b) Science and Technology (FST)   100 Marks/8   Credits
   (c) Bengali (FBG)   50 Marks/ 4 Credits
   (d) English (FEG)   50 Marks/ 4 Credits

   300 Marks/ 24   Credits

2. **Elective Subjects : Honours Course (EMT)**
   Course 01 : Differential Calculus and its Geometric Application 50 Marks/ 4 Credits
   Course 02 : Integral Calculus and Differential Equations   50 Marks/ 4 Credits
   Course 03 : Classical Algebra & Abstract Algebra   50 Marks/ 4 Credits
   Course 04 : Vector Algebra & Vector Calculus   50 Marks/ 4 Credits
   Course 05 : Linear Algebra & Transformation   50 Marks/ 4 Credits
   Course 06 : Analytical Geometry   50 Marks/ 4 Credits
   Course 07 : Mathematical Analysis - I   50 Marks/ 4 Credits
   Course 08 : Mathematical Analysis - II   50 Marks/ 4 Credits
   Course 09 : Analytical Dynamics   50 Marks/ 4 Credits
   Course 10 : Analytical Statics   50 Marks/ 4 Credits
   Course 11 : Numerical Analysis   50 Marks/ 4 Credits

Course 12 : Probability Theory   50 Marks/ 4   Credits
Course 13 : Statistics and its Application   50 Marks/ 4   Credits
Course 14 : Linear Programming and Game Theory   50 Marks/ 4   Credits
Course 15 : Complex Analysis and Integral Transform   50 Marks/ 4   Credits
Course 16 : Computer Programming (Practical)   50 Marks/ 4   Credits

800 Marks/ 64   Credits

3. **Subsidiary Course :**
    One subsidiary Course from (SPH, SPS)   300 Marks/ 24   Credits
4. **Application Oriented Course**   **100 Marks/** 8   Credits
     Household Chemistry (AOC-03)
5. **Environmental Studies**   50 Marks/ 4   Credits

Total Credits for the Course = (24+64+24+8+4) = 124 Credits or
Total Marks= 1550 Marks (300+800+300+100+50).
 Evaluation System :
    Internal Assessment : 30%
    Term-end Examinations : 70%

Programme Duration: *Course duration is 3 years*. However, the students have the liberty to complete its course *within 6 years*.

Detailed Syllabus

EMT 01 :

Block 1 : Differential Calculus

Unit-1 : Real numbers and their properties

Unit-2 : One variable function, limit and properties

Unit-3 : Continuity at a point of a function of one variable

Unit-4 : Derivatives of functions of one variable and higher order delrivatives

Unit-5 : Rolle's Th., Meanvalue Ths., L' Hospital's rule

Unit-6 : Taylor's expansion with Semainder and infinite series expansion

Unit-7 : Function of several variables, Limit, Continuity and Partial Derivatives

Reference :

1. Differential Calculus - Shantinarayan.

2. Differential & Integral Calculus – Courant & John.

3. Advanced Calculus – W. Kaplan

4. Infinitesimal Calculus Vol I. – J. dela Vallece Poussain

Block 2 : Geometric Application

Unit-8 : Tangent, normal and linear asymptote

Unit-9 : Envelope, cusp, node, double point, point of inflection

Unit-10 : Curvature of a curve

Unit-11 : Some typical curves

Unit-12 : Minimum, maximum and stationary values of one variable functions

Unit-13 : Minimum, maximum and stationary values of multivariate functions

Reference :

1. Coordinate Geometry–S. L. Loney

2. Coordinate Geometry of Three Dimensions–J. T. Bell

3. Solid Analytic Geometry–C. Smith

4. Elementary Treatise on Conic Sections – C. Smith

EMT 02 :

Block 1 : Integral Calculus

Unit-1 : Definite Integral

Unit-2 : Different methods of integration

Unit-3 : Reduction Formulas and Integration by Consecutive Reduction

Unit-4 : Improper Integral

Unit-5 : Line Integral and determination of the length of a curved line

Unit-6 : Double Integral, Tripple Integral and Determination of Surface and Volume

Reference :

1. Integral Calculus : Shantinarayan

2. Differetial & Integral Calculus (Vol–I & II)—Courant & John
3. Theory of Integrals & Fourier Series–H. S. Carslaw
4. Differential Equation–Lester R. Ford \ Shepley L. Ross \ H. T. H. Piaggio \ H. B. Phillips
5. Differential Equation with Application & Programme –S. Bala Chandra Rao, M. R. Anuradha
6. Text Book of ordinary Differential Equations – S. G. Deo, V. Lakshmi Kantham & V. Raghavendra

Block 2 : Differential Equations
Unit-7   :   Differential Equation–Genesis, Order and Degree

Unit-8   :   Differential Equations

Unit-9   :   First Order Differential Equations

Unit-10 :   Singular Solution

Unit-11 :   Simultaneous Linear Differential Equations with Constant Coefficients

Unit-12 :   Differential Equations of Second and Higher Order—Methods of Solutions

Reference :
1. An Introductory Course on Ordinary Differential Equations – D. A. Murray
2. Differential Equations–Lester R. Ford
3. Differential Equations–Shepley L. Ross
4. Differential Equations–H. T. H. Piaggio

EMT 03 :
Block 1 : Classical Algebra
Unit-1   :   Inequalities

Unit-2   :   Complex Number, De-moivre's Theorem etc.

Unit-3   :   Function of complex Numbers

Unit-4   :   Polynomials, Roots and Properties of Polynomical Equations

Unit-5   :   Cubic and Bi-quadratic Equations

Unit-6   :   Special Reciprocal Equation

Unit-7   :   Continued Fraction

Unit-8   :   Elementary Theory of Numbers

Reference :
(1) The Theory of Equations (Vol.1)–Burnside & Panton

(2) Higher Algebra—Barnard & Child

Block-2 : Abstract Algebra
Unit-9   :   Sets

Unit-10 :   Relations and Mapping

Unit-11 : Group-Definition and Properties

Unit-12 : Cyclic Group, Normal Subgroup

Unit-13 : Ring

Unit-14 : Field

Reference :

    (1)   Abstract Algebra – N. P. Chaudhuri

    (2)   Elements of Abstract Algebra – Sharma, Gokhroo, Saini

    (3)   First Course in Abstract Algebra–Fraleigh

EMT 04 :

Block 1 : Vector Algebra

Unit-1 : Cartesian Coordinates of Three-Dimensional Geometry, Direction

Cosine etc. Unit-2 : Vector

Unit-3 : Vector Multiplication

Unit-4 : Geometric Application of Vectors

Unit-5 : Other Applications of Vectors

Reference :

    (1)   Vector Analysis – Louis Brand

    (2)   Vector Analysis – Barry Spain

    (3)   Elementary Vector Analysis – C.E. Weather Burn (Vol I & II)

Block 2 : Vector Calculus

Unit-6 : Derivatives of Vector

Unit-7 : Integration of Vectors

Unit-8 : Gradient, Divergence, Curl etc.

Unit-9 : Gauss and Stoke's Theorem

Unit-10 : Applications of Vector Calculus

Reference :

    (1)   Vector Analysis – Spiegel (Schaum)

    (2)   Vector Calculus – C. E. Weatherburn

EMT 05 :

Block 1 : Linear Algebra

Unit-1 : Introduction to Matrix Algebra, Its Properties & Application From Classical Approach

Unit-2 : Determinant

Unit-3 : Solution of Linear Equations of Three Variables, Cramer's Rule

Unit-4 : Vector Space or Linear Space

Unit-5 : Basis and Dimension

Unit-6 : Three Elementary Operations and Elementary Matrices
Unit-7 : Rank of a matrix
Unit-8 : System of Linear Equations and its Solution
Reference :
  (1) Linear Algebra – B. C. Chatterjee
  (2) Introduction to Linear Algebra with Applications – Kolman Bernard
  (3) Elementary Linear Algebra – Anton Howard (4)
  Elements of Linear Algebra – N. C. Mazumdar (5)

Block 2 : Linear Transformation
Unit-9 : Inner Product Space
Unit-10 : Linear Transformation / Mapping
Unit-11 : Linear Transformation in the form of a Matrix
Unit-12 : Eigen Vector
Unit-13 : Quadratic Form
Unit-14 : Geometric Applications
Reference :
  (1) Linear Algebra – G. Hadley
  (2) Linear Algebra—Schaum's Outline Series
  (3) Linear Algebra with Application – H. G. Campbell
  (4) Higher Algebra – S. K. Mapa

EMT 06 :
  Block 1 : Analytical Geometry (2 & 3 Dimensions)
  Unit-1 : Transformation of Coordinates and Invariant
  Unit-2 : Pair of Straight Lines
  Unit-3 : Common Quadratic Equations : Classification
  Unit-4 : Tangent, Normal, Diameter
  Unit-5 : Polar Equation of Conics
  Reference :
      (1) Coordinate Geometry – S. L. Loney
      (2) Coordinate Geometry of Three Dimensions – J. T. Bell
      (3) Elementary Treatise on Conic Sections – C. Smith
      (4) Solid Analytic Geometry – C. Smith
  Block 2 : Three Dimensional Geometry
  Unit-6 : Coordinates and Transformartion
  Unit-7 : Plane
  Unit-8 : Straight Line
  Unit-9 : Rotational Plane, Generating Line

Unit-10 : Sphere
Unit-11 : Cone, Cylinder
Unit-12 : Quadratic Surface
Unit-13 : Tangent, Normal, Diameter
Unit-14 : General Equation of 2nd degree : Classification

Reference :
(1) M. C. Chaki — Analytical Co-ordinate Geometry
(2) J. G. Chakravorty & P. R. Ghosh — Advanced Analytic Geometry,
U.N. Dhar Pub., Kolkata.

EMT 07 :
Block 1 : Mathematical Analysis - I
Unit-1 : Sets of Real Numbers and Properties
Unit-2 : Limit Point Properties and Heine Borel Properties of Sets of Real Numbers
Unit-3 : Infinite Sequences of Real Numbers
Unit-4 : Infinite Series of Real Numbers
Unit-5 : Sufficient Conditions of Convergence of Sequence of Real Numbers and Examples
Unit-6 : Sufficient Condition for Convergence of Infinite Series

Reference :
(1) Mathematical Analysis – Par Zynski
(2) Mathematical Analysis – Shantinarayan

Block 2 : Mathematical Analysis - I
Unit-7 : Properties of Functions Continuous in a Closed Interval
Unit-8 : Monotonic Increasing and Decreasing Functions of Bounded Variation and Their Properties
Unit-9 : Inverse Functions : Conditions of Existence, Trigonometric Inverse Functions : e^x, $\log_e x$, a^x.
Unit-10 : Convergence of Series of Functions and Power Series.
Unit-11 : Uniform Convergence of Sequences and Series of Functions.
Unit-12 : Theorems Concerning Limit, Continuity, Partial Derivatives of Function of Several Variables.
Unit-13 : Implicit Function Theory for Function of Single Variable, Jacobians etc.

Reference :
(1) Problems in Mathematical Analysis–B. P. Demidovich
(2) Problems in Mathematical Analysis – Berman

EMT 08 :

Block 1 : Mathematical Analysis - II

Unit-1 : Riemann Integral of Bounded Functions of one Variable.

Unit-2 : Darboux's Theorem on Integration

Unit-3 : Properties of Riemann Integral

Unit-4 : Riemann Integrable Functions

Unit-5 : Meanvalue Theorem of Riemann Integrals

Unit-6 : Riemann Integral of Functions of Several Variables

Unit-7 : Differentiation and Integration of Functions of Several Variables

Reference :

(1) Elements of Real Analysis (2nd Edition, John Wiley)—Robert G. Bartle

(2) A Course of Analysis – Phillips

(3) Mathematical Analysis – Shantinarayan

Block 2 : Mathematical Analysis - II

Unit-8 : Improper Riemann Integration

Unit-9 : Differentiation and Integration of an Infinite integral w.r.t. a Parameter

Unit-10 : Beta / Gamma Functions and other Related Improper Integrals

Unit-11 : Convergence of Series by term Integration and Differentiation of Power Series

Unit-12 : Fourier Series of Bounded, Integrable and Periodic Functions.

Unit-13 : Different types of Fourier Series, such as Cosine, Sine Series etc. and other Applicable Examples.

Reference :

(1) Advanced Calculus – David V. Widder

(2) Methods of Real Analysis – Richard R. Goldberg

(3) Introductions to the Theory of Fourier Series and Integrals – H. S. Carslaw

(4) Mathematical Analysis – Malik and Arora

(5) A Course of Mathematical Analysis – Shantinarayan

EMT 09 :

Block 1 : Particle Dynamics

Unit-1 : Introduction : Galilean System – Kinematics I

Unit-2 : Kinematics II

Unit-3 : Newton's Laws of Motion and Different Principles of Conservation (Impulsive Motion)

Unit-4 : Motion in a Straight Line – SHM and Other Forced Motions

Unit-5 : Motion of a Particle in a Plane (Friction with Elastic Bodies)

Unit-6 : Central Forces and Stability of Orbits

Unit-7 : Motion under Inverse Square Law : Planetary Motion

Unit-8 : Change of Elliptical Path due to Disturbance

Unit-9 : Motion of a Particle in Resisting Medium (Planar)

Unit-10 : Constrained Motion

Unit-11 : Motion of a Particle of Varying Mass

Reference :

    (1) Dynamics of a Particle and of Rigid Bodies – S. L. Loney.

    (2) Hydrostatics – A. S. Ramsay.

Block 2 : Rigid Dynamics

Unit-12 : Motion of a Rigid body ; Motion of Centre of Gravity, motion with respect to Centre of Gravity, Conservation of Momentum & Angular Momentum.

Unit-13 : Kinematics of a Rigid body.

Unit-14 : Moment of Inertia of Rigid body

Unit-15 : D'Alembert's Equations of Motion and its Application in laws of Motions of

        Rigid Bodies

Unit-16 : Principles of Conservation of Motions of Rigid Bodies.

Unit-17 : Two Dimensional Motion of Rigid Bodies (Under limiting Force)

Unit-18 : Impulsive Motion of rigid bodies

Unit-19 : Motion of Rigid Bodies about a fixed Axis.

Unit-20 : Different Examples and Exercises on Motion of Broad Cylinder and Spheres with two Dimensional Motion

Reference :

    (1) An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies – S. L. Loney.

EMT 10 :

Block 1 : Analytical Statics

Unit-1 : Force and Other Ideas

Unit-2 : Concurrent Forces, Resultant and Equilibrium

Unit-3 : Forces, Their Resultant, Moment of Forces and Couple

Unit-4 : Statistical Equivalence of Force Systems

Unit-5 : Equilibrium of Force Systems

Unit-6 : Force of Friction

Unit-7 : Centre of Gravity

Unit-8 : Beam, Wire and Chain

Unit-9 : Work, Principle of Virtual Work.

Unit-10 : Stability of Equilibrium

Reference :

    (1) Analytical Statics – S. L. Loney

Block 2 : Fluid Statics

Unit-11 : Applied force and Its Effect

Unit-12 : Liquid Pressure

Unit-13 : Centre of Pressure on a Plane Area

Unit-14 : Thrust, Couple etc.

Unit-15 : Equilibrium of Rotating Fluid

Unit-16 : Principles of Archimedes, Equilibrium of Floating & Emersed Bodies

Unit-17 : Stability of Equilibrium of Floating Bodies & Metacentre

Unit-18 : Equilibrium in Atmosphere

Reference :

   (1)   Hydrostatics for Degree Classes–J. M. Kar (The Globe library, Kolkata, 1972)

   (2)

EMT 11 :

Block 1 : Numerical Analysis

Unit-1 : Introduction, Errors in Numerical Computation

Unit-2 : Different types of Differences and Divided Differences

Unit-3 : Deduction of Newtons forward and Backward Interpolation Formulae (with errors)

Unit-4 : Deduction of Lagrange's Interpolation Formulae, Error terms and Newton's General Interpolation Formula

Unit-5 : Statements of Starlings and Bessel's Interpolation Formulae

Unit-6 : Inverse Interpolation

Unit-7 : Numerical Differentiation and Numerical Integration

Unit-8 : Different Methods of Integration (Trapezoidal, Simpson's and Weddle's rule)

Reference :

   (1) Numerical Analysis and Computational Procedures – S. A. Mollah

   (2) Introduction to Numerical Analysis – F. B. Hildebrand

Block 2 : Numerical Analysis

Unit-9 : Numerical Solution of Equations – I

Unit-10 : Numerical solution of Equations - II

Unit-11 : Numerical Solution of Equations - III

Unit-12 : Determination of Inverse Matrix of a Square Matrix

Unit-13 : Eigenvalues and Eigenvectors of Matrices

Unit-14 : Solution of Systems of Linear Equations - I

Unit-15 : Solution of Systems of Linear Equations - II

Unit-16 : Numerical Solution of Ordinary Differential Equations

Reference :

    (1)   Numerical Analysis–J. Scarborough

    (2)   Introduction to Numerical Analysis – Carl Erik Froberg

    (3)   Numerical Methods – E. Balaguruswamy

    (4)   Numerical Methods for Science and Engineering–R. G. Stantois

EMT 12 :

Block 1 : Probability Theory

Unit-1   : Event Spaces

Unit-2   : Historical Background

Unit-3   : Axioms of Mathematical Probability

Unit-4   : Conditional Probability

Unit-5   : Compound Experiments

Unit-6   : Probability Distributions

Unit-7   : Transformation of Random Variables and Mathematical Expectations

Unit-8   : Characteristics of Distributions.

Reference :

    (1)   The Elements of Probability Theory and some of its Applications – H. Cramer

    (2)   An Introduction to Probability theory and its Application (Vol I)—W. Feller

    (3)   Theory of Probability – B. V. Gnedenko

    (4)   Mathematical Probability – J. V. Uspensky

Block 2 :

Unit-9   : Two-dimensional Distributions

Unit-10 : Conditional Distributions and two-dimensional transformation

Unit-11 : Expectation and Characteristics of two-dimensional Distributions

Unit-12 : Expectation and Characteristics for Independent Random Variables

Unit-13 : Conditional expectation and regression

Unit-14 : Some Special distributions

Unit-15 : Convergence in Probability

Unit-16 : Theorems on limit.

Reference :

    (1)   Theory of Probability – B. V. Gnedenko

    (2)   An introduction to Probability theory and its Application (Vol I)–W. Feller

EMT 13 :

Block 1 : Statistics and Its Application

Unit-1   : Preliminary Discussion, Presentation of Data

Unit-2   : Measures of Central Tendencies–AM, GM, HM ; Mean, Median, Mode.

Unit-3   : Measures of Dispersion

Unit-4 : Bivariate and Multivariate Correlation

Unit-5 : Sampling and Random Sampling Techniques

Unit-6 : Sampling Distribution and Statistic

Unit-7 : Sampling Average and Variation

Unit-8 : Normal Distribution : Sampling and Distributions Collected there from.

Block 2 :

Unit-9 : Point Estimation and its Techniques

Unit-10 : Different Characteristics of Point Estimation, Interval Estimation

Unit-11 : Standard Normal Distribution, Critical Region

Unit-12 : Test of Hypothesis Relating to Statistics Simple Hypothesis and its test, (In case of distributions derived from the Normal)

Unit-13 : Null Hypothesis and its tests in case of Normal Distribution

Unit-14 : Chi-Square test.

Reference :

 (1) Mathematical Methods and Statistics – H. Cramer

 (2) Statistics – N. G. Das

 (3) Statistics – Sen and Dey

EMT 14 :

Block 1 : Linear Programming and Game Theory

Unit-1 : Preliminary Discussions (Relating to Application)

Unit-2 : Problems of Linear Programming

Unit-3 : Graphical Solution of Bivariant L.P.P. and Idea of Sets

Unit-4 : Algebric form of L. P. Model Vector Space, convex set and Related Properties

Unit-5 : Feasible Solutions and there Properties

Unit-6 : Principle theorems Related to Solution of L. P. P.

Unit-7 : Simplex Method of Solution of L. P. P.

Unit-8 : Different Steps of Simplex Method

Unit-9 : Set of Bounded, Feasible Solutions,

  Unbounded set of Solution, Multiple set of Solutions, Discussion of Degeneracy in set of Solutions (Through Simplex Method).

Reference :

 (1) Linear Programming – Ghosh & Chakraborty

 (2) Linear Programming : Method and Application–S. I. Gass

 (3) Linear Programming – G. Hadley

 (4) An Introduction to Linear Programming and Theory of Games – S. Vajda

Block 2 : Linear Programming

Unit-10 : Duality in L. P. P.

Unit-11 : Transportation Model as L. P. P.

Unit-12 : Application of Different Methods in Transportation Model

Unit-13 : Assignment Problem

Unit-14 : Game Theory - Saddle Point

Unit-15 : Mixed Strategies and Two-Person Zero-sum

Game. Unit-16 : Solution of Game Problem as L. P. P.

Referencs :

(1) Linear Programming : Method and Application–S. I. Gass

(2) Linear Programming – G. Hadley

(3) An Introduction to Linear Programming and Theory of Games – S. Vajda

EMT- 15 :

Block 1: **Complex Analysis**

Unit 1 : Complex Numbers

Unit 2 : Functions of Complex Variable

Unit 3 : Limit, Continuity and Differentiability

Unit 4 : Bilinear Transformation

Block 2: **Laplace Transformation**

Unit 1 : Properties of Laplace Transform

Unit 2 : Laplace Transforms of derivatives and integrals

Unit 3 : Differentiation and Integration of Laplace transform

Unit 4 : Convolution Theorem

Unit 5 : Inverse Laplace Transform

Unit 6 : Application of Laplace Transform to Ordinary Differential Equation

EMT – 16:

Block 1: **Computer Programming in C(Practical Paper)**

Unit 1 : Evolution of Computer

Unit 2 : Representation of Data

Unit 3 : Programming

Language Unit 4 : Algorithm

and Flow Chart

Unit 5 : Elements of ANSI C

Unit 6 : C- Programming for problems of Numerical Analysis and Statistics

Block 2: **Computer Programming for Numerical and Statistical Problem**

Unit 1: Problems of Numerical Analysis

Unit 2: Problems of Statistics

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