DHAKA UNIVERSITY
AFFILIATED COLLEGES

First Year Syllabus
Department of Mathematics

Four Year B S Honours Course
Effective from the Session: 2017–2018

Affiliated Colleges

Subject: Mathematics

Syllabus for Four Year B S Honours Course

Effective from the Session: 2013-2014

Year wise Courses and marks distribution

FIRST YEAR

Subject Code	Title	Marks	Credits
MAT 101	Fundamentals of Mathematics	100	3
MAT 102	Calculus I	100	3
MAT 103	Linear Algebra I	100	3
MAT 104	Analytic and Vector Geometry	100	3
MAT 150	Math Lab I		2
COM 100	History of the Emergence of Independent Bangladesh Bangladesh	100	4

Any Two of the following Minor Subjects :

Physics	6 Credits
Chemistry	6 Credits
Statistics	6 Credits
Economics	6 Credits

Detailed Syllabus

Subject Code	MAT 101	Marks: 100	Credits: 3	Hours: 45
Subject Title:	Fundamentals of Mathematics			

Elements of logic: Mathematical statements, Logical connectives, Conditional and bi-conditional statements, Truth tables and tautologies, Quantifiers, Logical implication and equivalence, Deductive reasoning.
Set Theory : Sets and subsets, Set operations, Cartesian product of two sets, Operations on family of sets, De Morgan's laws.
Relations and functions:. Relations. Order relation. Equivalence relations. Functions. Images and inverse images of sets. Injective, surjective, and bijective functions. Inverse functions.
Real Number System: Field and order properties, Natural numbers, Integers and rational numbers, Absolute value and their properties, Basic inequalities. (Including inequalities of means, powers; inequalities of Cauchy, Chebyshev, Weierstrass).
Complex Number System: Field of Complex numbers, De Moivre's theorem and its applications.
Theory of Equations: Relations between roots and coefficients, Symmetric functions of roots, Sum of the powers of roots, Synthetic division, Des Cartes rule of signs, Multiplicity of roots, Transformation of equation.

Elementary number theory: Divisibility. Fundamental theorem of arithmetic. Congruences (basic properties only).
Summation of series: Summation of algebraic and trigonometric series.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 3 hours): 70 Marks.
Eight questions of equal value will be set, of which any **five** are to be answered.

References:

1. S. Lipschutz, **Set Theory, Schaum's Outline Series**.
2. S. Barnard & J. M. Child, **Higher Algebra**.
3. W.L. Ferrar, **Algebra**.
4. P.R. Halmos, Naive **Set Theory**.
5. H. S. Hall and S. R. Knight, **Higher Algebra**.

Subject Code	MAT 102	Marks: 100	Credits: 3	Hours: 45
Subject Title:	Calculus I			

Functions & **their graphs :** Polynomial and rational functions, logarithmic and exponential functions, trigonometric functions & their inverses, hyperbolic functions & their inverses, combinations of such functions.
Limit and continuity: Definitions and basic theorems on limit and continuity. Limit at infinity & infinite limits, Computation of limits. Indeterminate forms (L'Hospital's rule)
Differentiation: Tangent lines and rates of change. Definition of derivative. One-sided derivatives. Rules of differentiation (proofs and applications). Successive differentiation. Leibnitz's theorem (proof and application). Related rates. Linear approximations and differentials.
Applications of Differentiation: Rolle's theorem, Mean value theorem. Maximum and minimum values of functions and related problems. Concavity and points of inflection. Optimization problems.
Integration: Antiderivatives and indefinite integrals. Techniques of integration. Definite integration using antiderivatives. Fundamental theorems of calculus (proofs and applications). Basic properties of integration. Integration by reduction.

Applications of Integration: Arc lengths. Plane areas. Surfaces of revolution. Volumes of solids of revolution. Volumes by cylindrical shells. Volumes by cross sections.
Graphing in polar coordinates: Tangents to polar curves. Arc length in polar coordinates. Areas in polar coordinates.
Improper integrals : Tests of convergence and their applications. Gamma and Beta functions.
Approximation and Series: Taylor polynomials and series. Convergence of series. Taylor's series. Taylor's theorem and remainders. Differentiation and integration of series. Validity of Taylor expansions and computations with series.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 3 hours): 70 Marks.
Eight questions of equal value will be set, of which any **five** are to be answered.

References:

1. H. Anton, I. C. Bivens and S. Davis, **Calculus: Early Transcendentals**,Wiley.
2. E.W. Swokowski, **Calculus with Analytic Geometry**, Brooks/Cole.
3. G. B. Thomas and R. L. Finney, **Calculus and Analytic Geometry**, Addison Wesley.
4. J. Stewart, **Single Variable Calculus: Early Transcendentals**, Cengage Learning.
5. G. Strang, **Calculus**, Wellesley-Cambridge.
6. R. Larson, R. P. Hostetler, F. H. Edwards and D. E. Heyd, **Calculus with Analytic Geometry**, Houghton Mifflin College Div.

Subject Code	MAT 103	**Marks: 100**	**Credits: 3**	**Hours: 45**
Subject Title:	**Linear Algebra I**			

Matrices and Determinants:,
Notion of matrix. Types of matrices. Algebra of matrices. Determinant function. Properties of determinants. Minors, Cofactors, expansion and evaluation of determinants. Elementary row and column operations and row-reduced echelon matrices. Invertible matrices. Different types of matrices, Rank of matrices.
Vectors in R^n and C^n: Review of geometric vectors in R^2 and R^3 spaces. Vectors in R^n and C^n. Inner product. Norm and distance in R^n and C^n.
System of Linear Equations: System of linear equations (homogeneous and non-homogeneous) and their solutions. Application of matrices and determinants for solving system of linear equations. Applications of system of equations in real life problems.
Vector Spaces: Notion of groups and fields. Vector spaces. Subspaces. Linear combination of vectors. Linear dependence of vectors. Basis and dimension of vector spaces. Row and column space of a matrix. Rank of matrices. Solution spaces of systems of linear equations.
Linear Transformation: Linear transformations. Kernel and image of a linear transformation and their properties. Matrix representation of linear transformations. Change of bases.
Eigenvalues and Eigenvectors: Eigenvalues and Eigenvectors. Diagonalization. Cayley-Hamilton theorem and its application.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 3 hours): 70 Marks.
Eight questions of equal value will be set, of which any **five** are to be answered.

Books Recommended :

1. Howard Anton & Chris Rorres – *Elementary Linear Algebra with Application.*
2. Seymour Lipschutz (Schaum's Outline Series)-*Linear Algebra.*
3. Md. Abdur Rahman- *Linear Algebra.*

Subject Code	MAT 104	Marks: 100	Credits: 3	Hours: 45
Subject Title:	Analytic and Vector Geometry			

Two-dimensional Geometry: Transformation of coordinates, Pair of straight lines (homogeneous second degree equations, general second degree equations representing pair of straight lines, angle between pair of straight lines, bisectors of angle between pair of straight lines), General equations of second degree (reduction to standard forms, identifications, properties and tracing of conics).
Three-dimensional Geometry: Coordinates, Distance, Direction cosines and direction ratios, Planes (equation of plane, angle between two planes, distance of a point from a plane), Straight lines (equations of lines, relationship between planes and lines, shortest distance). Spheres. Conicoids (basic properties).
Vector Geometry: Vectors in plane and space. Algebra of vectors. Rectangular Components. Scalar and Vector products. Triple scalar product. Applications of vectors to geometry (vector equations of straight lines and planes, areas and volumes).

Evaluation: Incourse Assessment: 30 marks. Final examination (Theory, 3 hours): 70 Marks.
Eight questions of equal value will be set of which **five** are to be answered. (taking at least one from each group).

References:

1. A.F.M. Abdur Rahman & P.K. Bhattacharjee, **Analytic Geometry and Vector Analysis**.
2. Khosh Mohammad, **Analytic Geometry and Vector Analysis**.
3. J. A. Hummel, **Vector Geometry**.
4. H. Anton, I. C. Bivens and S. Davis, **Calculus: Early Transcendentals**, Wiley.
5. E.W. Swokowski, **Calculus with Analytic Geometry**, Brooks/Cole; Alternate.

Subject Code	MAT 150	Marks: 100	Credits: 2	Hours: 45
Subject Title:	Math Lab 1			

Problem solving in concurrent courses (e.g; Algebra, Calculus, Linear Algebra and Geometry) using MATHEMATICA/MATLAB.

Lab Assignments: There shall be at least 5 lab assignments.

Evaluation: Internal Assessment (Laboratory works) 40 marks
Final Examination (Lab, 3 hours) 60 marks

Mathematics Minor Courses
for
Honours Students of Different Departments of 7 Colleges other than Mathematics

The minor courses in Mathematics is open to Honours students of other departments in the faculty of science. Each students will pursue such courses as are required by her/his parent department

FIRST YEAR

Subject Code	Title	Marks	Credits
MAM 101	Fundamentals of Mathematics	100	2
MAM 102	Calculus I	100	2
MAM 103	Analytic and Vector Geometry	100	2
MAM 104	Linear Algebra	100	2

Detailed Syllabi

Subject Code	MAM 101	**Marks: 100**	**Credits: 2**	**Hours: 30**
Subject Title:	**Fundamentals of Mathematics**			

1. Sets and subsets. Set operations. Family of Sets. De Morgan's laws. Relations and functions: Cartesian product of sets. Relations. Equivalence relations. Functions. Images and inverse images of sets. Injective, surjective, and bijective functions. Inverse functions.
2. The Real number system: Field and order properties. Natural numbers, integers and rational numbers. Absolute value. Basic inequalities. (including inequalities involving means, powers; inequalities of Cauchy, Chebyshev, Weierstrass).
3. The Complex number system: Geometrical representation Polar form. De Moivre's theorem and its applications. Elementary number theory: Divisibility. Fundamental theorem of arithmetic. Congruences (basic properties only).
4. Summation of finite series: Arithmetic-geometric series. Method of difference. Successive differences.
5. Theory of equations: Synthetic division. Number of roots of polynomial equations. Relations between roots and coefficients. Multiplicity of roots. Symmetric functions of roots. Transformationof equations.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 2 ½ hours): 70 Marks
Eight questions of equal value will be set, of which any **five** are to be answered.

References

1. S. Lipschutz, Set Theory, Schaum's Outline Series.
2. S. Barnard & J. M. Child, Higher Algebra.
3. W.L. Ferrar, Algebra.
4. P.R. Halmos, Naive Set Theory.

Subject Code	MAM 102	Marks: 100	Credits: 2	Hours: 30
Subject Title:	Calculus I			

A. Differential Calculus

1. Functions and their graphs (polynomial and rational functions, logarithmic and exponential functions, trigonometric functions and their inverses, hyperbolic functions and their inverses, combination of such functions). Limits of Functions: definition. Basic limit theorems (without proofs).
2. Limit at infinity and infinite limits. Continuous functions. Properties Continuous functions on closed and boundary intervals (no proofs required).
3. Differentiation: Tangent lines and rates of change. Definition of derivative. One-sided derivatives. Rules of differentiation (with applications). Linear approximations and differentials. Successive differentiation. Leibnitz theorem. Rolle's theorem: Lagrange's mean value theorems. Extrema of functions, problems involving maxima and minima.

B. Integral Calculus

4. Integrals: Antiderivatives and indefinite integrals. Techniques of integration. Definite integration using antiderivatives.
5. Definite integral as a limit of a sum. The fundamental theorem of calculus. Integration by reduction.
6. Application of integration: Plane areas. Solids of revolution. Volumes by cylindrical shells. Volumes by cross-sections. Arc length and surface of revolution.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 2 ½ hours): 70 Marks
Eight questions of equal value will be set, of which any **five** are to be answered.

References

1. H. Anton et al, Calculus with Analytic Geometry.
2. E.W. Swokowski, Calculus with Analytic Geometry.
3. L. Bers & P. Karal, Calculus.
4. S. Lang, A First Course in Calculus.

Subject Code	MAM 103	Marks: 100	Credits: 2	Hours: 30
Subject Title:	Analytic and Vector Geometry			

Two-dimensional geometry

1. Coordinates in two dimension. Transformations of coordinates.
2. Reduction of second degree equations to standard forms. Pairs of straight lines. Identifications of conics. Equations of conics in polar coordinates.

Three-dimensional geometry

3. Coordinates in three dimensions. Direction cosines, and direction ratios.
4. Planes, straight lines and conicoids (basic definitions and properties only)

Vector geometry

5. Vectors in plane and space. Algebra of vectors. Scalar and vector products. Triple scalar products. Applications to Geometry.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 2 ½ hours): 70 Marks
Eight questions of equal value will be set, of which any **five** are to be answered.

References

1. A.F.M. Abdur Rahman & P.K. Bhattacharjee, Analytic Geometry and Vector Analysis.
2. Khosh Mohammad, Analytic Geometry and Vector Analysis.
3. J. A. Hummel, Vector Geometry.

Subject Code	MAM 104	**Marks: 100**	**Credits: 2**	**Hours: 30**
Subject Title:	**Linear Algebra**			

1. Matrices and Determinants:

Notion of matrix. Types of matrices. Matrix operations, laws of matrix Algebra. Determinant function. Properties of determinants. Minors, Cofactors, expansion and evaluation of determinants. Elementary row and column operations and row-reduced echelon matrices. Invertible matrices. Block matrices.

2. System of Linear Equations:

Linear equations. System of linear equations (homogeneous and non-homogeneous)and their solutions. Application of matrices and determinants for solving system of linear equations.

3. Vector Spaces:

Vectors in R^n and C^n:
Review of geometric vectors in R^2 and R^3 space. Vectors in R^n and C^n . Inner product. Norm and distance in R^n and C^n. Abstract vector space over R and C. Subspace. Sum and direct sum of sub spaces. Linear independence of vectors; basis and dimension of vector spaces. Row and column space of a matrix; rank of matrices. Solution spaces of systems of linear equation.

4. Linear transformations. Kernel and image of a linear transformation and their properties. Matrix representation of linear transformations. Change of bases.

5. Eigenvalues and eigenvectors. Diagonalization. Cayley Hamiton theorem. Applications.

Evaluation: Incourse Assessment: 30 Marks. Final examination (Theory, 2 ½ hours): 70 Marks
Eight questions of equal value will be set, of which any **five** are to be answered.

References

1. H. Anton, and C.Rorres, Linear Algebra with Applications, 7^{th} Edition,
2. S. Lipshutz, Linear Algebra, Schaum's Outline Series.
3. W. Greub, Linear Algebra.

ECO 101: Principles of Microeconomics (3 credits)

1. Introduction: The economic way of thinking. Microeconomics and Macroeconomics. The basic problems of economic organization. Production and exchange- the Production-Possibility Frontier, the market mechanism.

2. Demand and consumer behaviour. Choice and utility theory. The Paradox of value. Law of diminishing marginal utility. Why the demand curve slopes downward. Consumer surplus. Normal inferior and Giffen goods. From individual to market demand. Basic elements of demand and supply. The demand curve; movement along the curve vs. shifts of thecurve. The supply curve: movement along the curves. shift of the curve. Equilibrium with supply and demand curve.

3. Applications of demand and supply. Elasticity of demand and supply. Price, cross and income elasticity. The paradox of the bumper harvest. Impact of a tax/subsidy on price and quantity; price floors and ceilings the minimum wage controversy. Theory of production. The production function. Fixed factors vs. variable factors of production. Short-run and long-run. Total, average and marginal product. The law of diminishing returns. Returns to scale. Technological change.

4. Analysis of costs and profit. Fixed and variable costs. Total average and marginal costs. The link between production and costs. Marginal product and the least-cost rule. Opportunity costs. Accounting profitives. economic profit. Profit-maximizing conditions. Perfect Competition: Profits, losses, break-even andshut-down condition. The firm's supply curve. Industry supply curve. Short-run-and long-run equilibrium. Efficiency of perfect competition.

5. Monopoly: Sources of market imperfections. Monopoly equilibrium. Price discrimination. Natural monopoly andits regulation deadweight loss due to monopoly. Monopolistic competition and oligopoly; game theory. Market failures. Risk and uncertainty. Moral hazard and a diverse selection.

6. Public goods and externalities. Coarse theorem. The labour market. The demand for and supply of labour. Equilibrium in a competitive labour marketMonopsony. Bilateral monopsony. The distribution of income and wealth. The Lorenz curve.

7. International trade: Comparative advantage and the gains from trade. Protectionism.

Textbook

1. Samuelson, P.A. and Nordhaus, W D., Economics
2. Lipsey, R., Positive Economics
3. Baunol, W. and Blinder, A., Economics: Principles and Policy

ECO 102: Principles ofMacroeconomics (3 Credits)

1. Introduction to macroeconomics, Inflation, unemployment, the natural rate of unemployment, nominal and real GDP, business cycles, budget deficit and international deficit.

2. Measuring aggregate output and; the price level. Circular flow of income; injections and Leakages. Three alternative ways of measuring GDP. The accuracy inmeasured GDP. The CPI and the GDP deflator. Aggregate demand and aggregate supply. Short-run and long run aggregate supply. Shifts in aggregate demand and aggregate supply curves. Macroeconomic equilibrium.

3. Aggregate expenditure decisions. Private consumption, private investment, government purchases of goods and services, net exports. Autonomous and induced expenditure. Equilibrium expenditure and output. The autonomous expenditure multiplier. Relationship between the aggregate expenditure and aggregate demand curves; derivation of the aggregate demand curve.

4. Money and banking, Definitions and functions of money. The economic functions of financial intermediaries. How banks create money. The simple money multiplier. The central Bank and open market operations. The money multiplier. Interest rate determination. The demand for money. Interest rates and bond prices. Money market equilibrium.

5. Aggregate demand fluctuation. Monetary and fiscal policy transmission mechanisms. Time lags. Crowding out, international crowding out. Relative effectiveness of monetary and fiscal policy.

6. The labour market and aggregate supply. The flexible wage theory. The sticky wage theory. The long run and short-run aggregate supply curves.

7. Expectations and inflation. Anticipated and unanticipated inflation. Costs of inflating. Demand, pull and cost-push inflation. Adaptive expectations, rational expectations and their policy implications. The short-run and long-run phillips curves. Hysteresis Stabilising the economy: Macroeconomic policy targets and instruments. Conflicts between objectives. Fixed rules vs. feedback rules.

Textbook

1. Parking, M., Macroeconomics.
2. Samuelson, P.A. and Nordhaus, W.D. Economics.