DHAKA UNIVERSITY
AFFILIATED COLLEGES

Second Year Syllabus
Department of Mathematics

Four Year B S Honours Course
Effective from the Session: 2018–2019

Affiliated Colleges
Subject: Mathematics
Syllabus for Four Year B S Honours Course

Effective from the Session: 2018-2019

Year wise Courses and marks distribution

SECOND YEAR

Subject Code	Title	Marks	Credits
MAT 201	Calculus II	100	3
MAT 202	Ordinary Differential Equations I	100	3
MAT 203	Numerical Analysis I	100	3
MAT 204	Programming Fundamentals (Fortran)	100	3
MAT 250	Math Lab II (Fortran)	100	2
MAT 299	Viva Voce	100	2

Any Two of the following Minor Subjects :

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

Detailed Syllabi

Subject Code	MAT 201	Marks: 100	Credits: 3	Hours: 45
Subject Title:	Calculus II			

A. Differential Calculus

1. Vector-valued functions of a single variable: Limits, derivatives and integrals of vector valued functions.
2. Tangent lines to graphs of vector-valued functions . Arc length from vector view point. Arc length parametrization.
3. Curvature of plane and space curves: Curvature from intrinsic equations, Cartesian equations and parametric equations. Radius of curvature. Centre of curvature,
4. Partial Differentiation: Functions of several variables. Graphs of functions of two variables. Limits and continuity. Partial derivatives. Differentiability, linearization and differentials. The Chain rule. Partial derivatives with constrained variables. Directional derivatives; gradient vectors and tangent planes.
5. Extrema of functions of several variables, Lagrange multipliers. Taylor's formula.

B. Integral Calculus

1. Multiple integrals: Double integrals and iterated integrals. Area as a double integral. Double integrals in polar form.
2. Triple integrals and iterated integrals. Volume as a triple integral. Triple integral in cylindrical and spherical polar coordinates.
3. General multiple integrals. Change of variables in multiple integrals. Jacobians.

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 et al, Calculus with Analytic Geometry.
2. E. Swokowski, Calculus with Analytic Geometry.
3. L. Bers & P. Karal, Calculus with Analytic Geometry.
4. S. Lang, Calculus of Several Variables.

Subject Code	MAT 202	Marks: 100	Credits: 3	Hours: 45
Subject Title:	Ordinary Differential Equations I			

1. Ordinary differential equations and their solutions: Classification of differential equations. Solutions: Implicit solutions. Singular solutions. Initial value problems. Boundary value problems. Basic existence and uniqueness theorems (statement and illustration only). Direction fields. Phase line.
2. Solution of first order equations: Separable equations and equations reducible to this form. Linear equations, Exact equations, Special integrating factors, Substitutions and transformations,
3. Modelling with first order differential equations: Construction of differential equations as mathematical models (exponential growth and decay, heating and cooling, mixture of solutions, series circuit, logistic growth, chemical reaction, falling bodies). Model solutions and interpretation of results. Orthogonal and oblique trajectories.
4. Solution of higher order linear differential equations: Linear differential operators. Basic theory of linear differential equations. Solution space of homogeneous linear equations. Fundamental solutions of homogeneous systems. Reduction of order. Homogeneous linear equations with constant coefficients. Nonhomogeneous equation. Method of undetermined coefficients. variation of parameters. Euler-Cauchy differential equations.
5. Modelling with second-order equations: Vibration of a mass on a spring, free and undamped motion; free and damped motion; forced motion; resonance phenomena; electric circuit problems, motion of a rocket.

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. L. Ross, Differential Equation.
2. D. G. Zill, A First Course in Differential Equations with Applications.
3. F. Braner & J. A. Nohel, Differential Equations.
4. H.J.H. Piaggio, An Elementary Treatise on Differential Equations.

Subject Code	**MAT 203**	**Marks: 100**	**Credits: 3**	**Hours: 45**
Subject Title:	**Numerical Analysis I**			

1. Solution of equation in one variable: Bisection algorithm, Method of false position. Fixed point iteration, Newton-Raphson method, Error Analysis for iterative method, Accelerating limit of convergence.
2. Interpolation and polynomial approximation: Taylor polynomials, Interpolation and Lagrange polynomial, Iterated interpolation, Extrapolation.
3. Differentiation and Integration: Numerical differentiation, Richardson's extrapolation, Elements of Numerical Integration, Adaptive quadrature method, Romberg's integration, Gaussian quadrature.
4. Solutions of linear systems: Gaussian elimination and backward substitution, pivoting strategies, LU decomposition method.

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. R.L. Burden & J.D. Faires, Numerical Analysis.
2. M.A.Celia & W.G. Gray,Numerical Methods for Differential Equations.
3. L.W. Johson & R.D. Riess,Numerical Analysis.

Subject Code	**MAT 204**	**Marks: 100**	**Credits: 3**	**Hours: 45**
Subject Title:	**Programming Fundamentals (FORTRAN)**			

1. Brief Introduction to Computer: Computer system, Information Processing Cycle, Operating System, Data representation in Computer
2. Program Design: Algorithm, Flowchart, Conditional Branching, Loop
3. Programming Language: Fortran and its History
4. Basic Elements of Fortran: Character set, Structure of Fortran statement, Program Structure, Data type, Constants, Variables, Operators and Operations, Intrinsic Functions, List directed I/O
5. Control Structures: Branches, Loops
6. Arrays: One dimensional array, Two dimensional array
7. Input/Output concept: Formatted I/O, File Handling
8. Subprogram: Subroutine, User defined function
9. Implementation: Construction of Fortran program for problems drawn from mathematics and sciences including root finding problem for equation of one variable, IVP.

Classes: Theory (2 hours/week), Lab (At least 5 assignments).

Evaluation:
Internal Assessment (Lab / Incourse Examination) 30 Marks
Final examination (Theory, 3 hours) 70 Marks

References

1. Introduction to Fortran 90/95 for Scientists and Engineers by Stephen J. Chapman.
2. Modern Fortran Explained. Michael Metcalf, John Reid and Malcolm Cohen.
3. Gordon B. Davis & Thomas R. Hoffmann, FORTRAN 77: A Structured, Disciplined Style.

Subject Code	MAT 250	**Marks: 100**	**Credits: 2**	**Hours: 45**
Subject Title:	Math Lab II (Fortran)			

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

Subject Code	MAT 299	**Marks: 100**	**Credits: 2**	
Subject Title:	**Viva Voce**			

Viva Voce on courses taught in the First Year and Second Year

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

SECOND YEAR

Subject Code	Title	Marks	Credits
MAM 201	**Calculus II**	**100**	**2**
MAM 202	**Ordinary Differential Equations**	**100**	**2**
MAM 203	**Numerical Analysis**	**100**	**2**
MAM 204	**Mathematical Methods**	**100**	**2**

Detailed Syllabi

Subject Code	**MAM 201**	**Marks: 100**	**Credits: 2**	**Hours: 30**
Subject Title:	**Calculus II**			

A. Differential Calculus

1. Vector-valued functions of a single variable: Limits, derivatives and integrals of vector valued functions. Tangent lines to graphs of vector-valued functions . Curvature of plane and space curves:

2. Partial Differentiation: Functions of several variables. Limits and continuity. Partial derivatives. Differentiability, linearization and differentials. The Chain rule. Partial derivatives with constrained variables. Directional derivatives; gradient vectors and tangent planes.
3. Taylor's formula (in one and in several variables). Extrema of functions of several variables, Lagrange multiplier.

B. Integral Calculus

4. Multiple integrals: Double and triple integrals; and iterated integrals. Area as a double integral. Double integrals in polar form. Volume as a triple integral. Triple integral in cylindrical and spherical polar coordinates.
5. General multiple integrals. Change of variables in multiple integrals. Jacobians.
6. Gradient, divergence, curl. Green's theorem, Gauss's theorem, Stoke's theorem.

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

4. H. Anton et al, Calculus with Analytic Geometry.
5. E. Swokowski, Calculus with Analytic Geometry.
6. L. Bers & P. Karal, Calculus with Analytic Geometry.
4. S. Lang, Calculus of Several Variables.

Subject Code	MAM 202	Marks: 100	Credits: 2	Hours: 30
Subject Title:	Ordinary Differential Equations			

1. Ordinary differential equations and their solutions: Initial value problems. Boundary value problems. Basic existence and uniqueness theorems (statement and illustration only).
2. Solution of first order equations: Separable equations and equations reducible to this form. Linear equations, Exact equations, Special integrating factors, Substitutions and transformations,
3. Solution of higher order linear differential equations: Solution space of homogeneous linear equations. Fundamental solutions of homogeneous systems. Reduction of order. Homogeneous linear equations with constant coefficients. Nonhomogeneous equations.
4. Method of undetermined coefficients. variation of parameters. Euler-Cauchy differential equations.
5. Systems of differential equations, Linear system, Fundamental matix. Solutions of linear systems, with constant coefficient.

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. L. Ross, Differential Equation.
2. D. G. Zill, A First Course in Differential Equations with Applications.
3. F. Braner & J. A. Nohel, Differential Equations.
4. H.J.H. Piaggio, An Elementary Treatise on Differential Equations.

Subject Code	MAM 203	Marks: 100	Credits: 2	Hours: 30
Subject Title:	Numerical Analysis			

1. Solution of equation in one variable: Bisection algorithm, Method of false position. Fixed point iteration, Newton-Raphson method, Error Analysis for iterative method, Acceleration of convergence.
2. Interpolation and polynomial approximation: Taylor polynomials, Interpolation and Lagrange polynomial, Iterated interpolation, Extrapolation.
3. Differentiation and Integration: Numerical differentiation, Richardson's extrapolation, Elements of Numerical Integration, Adaptive quadrature method, Romberg's integration, Gaussian quadrature.
4. Solutions of linear systems: Gaussian elimination and backward substitution, pivoting strategies, Matrix inversion; LU decomposition method.

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. R.L. Burden & J.D. Faires, Numerical Analysis.
2. M.A.Celia & W.G. Gray, Numerical Methods for Differential Equations.
3. L.W. Johson & R.D. Riess, Numerical Analysis.

Subject Code	MAM 204	Marks: 100	Credits: 2	Hours: 30
Subject Title:	Mathematical Methods			

1. **Fourier Series:** Fourier Series, Fourier sine and cosine series. Properties of Fourier series. Operations on Fourier series. Complex form.
2. Solution of differential equations in infinite series. Equations of Legendre, Bessel, Hermite and Laguerre. Special functions: Legendre, Hermite and Laguerre polynomials; Bessel functions. Generating functiions and recurrene relations.
3. Beta and Gamma functions.
4. **Laplace transforms:** Basic definitions and properties, Existence theorem.. Laplace transforms of

periodic functions. Transforms of convolutions. Inverse transform. Use of Lablace transforms in solving initial value problems.

5. Functions of a complex variable, analytic functions. Complex integration; Cauchy's theorem and Cauchy's integral formula. Singularities and residues. Cauchy's residue theorem. Evaluation of real integrals using contour integration.

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. W.N. Lebedev & R.A. Silverman, Special Functions and their Applications.
2. E. Kreyszig, Advanced Engineering Mathematics.
3. M. R. Spiegel, Laplace Transforms, Schaum's Outline Series.
4. R.V. Churchill & J. W. Brown, Complex Variables and Applications.

Subject Code	**ECO 201**	**Marks: 100**	**Credits: 3**	**Hours: 45**
Subject Title:	**Mathematical Economics**			

1. **Functions, Limit, Continuity and their Economic Application**: Functions and their Domain and Range, Elementary Functions. Convexity, Quasiconvexity. Definition of Limit, Limit of a Sequence, Present Value Calculations, Compounding, Discounting. Continuity of Functions; Applications of Continuous and Discontinuous Functions in Economics, Intermediate-Value Theorem and the Existence of Equilibrium.
2. **Derivatives and its Uses in Economics (Single Variable Case)** : Derivatives, Differential, Conditions of Differentiability, Application of the Derivatives in Economics, Derivative of the Logarithmic Function and Elasticity, L'Hospital's Rule, Optimization of Functions of One Variable, Maximum and Minimum Functions, Inflection Point, Optimization of Economic Function.
3. **Derivatives and its Uses in Economics (Multivariable Case)** : Partial Differentiation, Implicit Differentiation Level Curves and Level Sets, Marginal Rate of Substitution and Marginal Rate of Technical Substitution, Homogeneous Functions, Elasticity of Substitution, Multiproduct Monopoly, price Discriminations, Second-Order Condition using the Hessian, Constrained Optimization with Lagrange Multiplier, Second– Order Condition using Bordered Hessian.
4. **Comparative Static Analysis**: The Meaning of Equilibrium, Partial Market Equilibrium (Linear and Non-Linear Model), General Market Equilibrium, Equilibrium in the National Income Analysis, Comparative Static Analysis in IS-LM Model.
5. **System of Linear Equations:** Solving System of Linear Equations-Graphing Solutions, Solution by Substitution and Elimination, Solution by Row Operations, Matrices, Solving Equations with Inverse Matrix and Cramer's Rule, Input- Output Analysis.
6. **Integrations and their Economic Applications** : Indefinite Integral, Rules of Integration, Definite Integral, Properties of Integrals, Area under a Curve, Consumer Surplus, Producer Surplus, Improper Integrals, the Substitution Rule of Integration, Integration by Parts.

Reference

1. Hoy, M, et al (2011). Mathematics for Economics, 3rd Edition. The MIT Press Cambridge Massachusetts (Text).
2. Simon, C.P and L. Bloom (1994). Mathematics for Economists, W.W. Norton and Company (Text).
3. Dixit, A. K. (1990). Optimization in Economics Theory, 2nd Edition Oxford University Press, Oxford.
4. Dowling, E. T. (2001). Theory and Problems of Introduction to Mathematical Economics Schaum's Outline Series, McGraw-Hill, 3rd Editions.

5. Chiang, A C. and K. Wainwright (2005). Fundamental Methods of Mathematical Economics, McGraw-Hill, 4th Editions.

Subject Code	ECO 202	Marks: 100	Credits: 3	Hours: 45
Subject Title:	Economy of Bangladesh			

1. **Introduction :** Economical History of Pre-British Period, Economic History of British Period, Economic History of Pakistan Period, Economic Performance of Bangladesh under Different Political Regimes.
2. **Growth and Structural Change :** Population Growth, Labour Force and its Distribution, Growth in GDP and Per Capital Income, Structure and Composition of GDP, Macroeconomic Changes Since Independence.
3. **Agriculture Sector :** Definition, Structure and Growth of Agriculture and its Importance in the National Economy, The Resource Base and the Production Organization, Factors Behind Growth, Agricultural Asset Distribution, Agricultural Credit Performance, Co-Operative Strategies for Development, Changes in Agricultural Policies.
4. **Industrialization :** Defination, Structure and Growth of Industries, Category of Industries: Large, Small and Cottage industries, A Comparison of Different Industries, The public and private Sectors, Experiences with Nationalization, Denationalization and privatization, The Liberalization Regime, Foreign Exchange Regimes and Industrial Growth, problems and prospects of Foreign Direct Investment (FDI).

References:

1. Khan. A. R and M. Hossain, eds. (1989), *The Strategy of Development in Bangladesh*, Macmillan, London.
2. Centre for policy Dialogue, *Independent Review of Bangladesh Development* (IRBD), (different issues from 1995 to 2001), University press Limited, Dhaka.
3. Islam, S., eds. (1992). *History of Bangladesh: 1704-1971, vol. 2, (Economic History)*, Asiatic Society of Bangladesh, Dhaka.
4. Abdullah, A., eds. (2001). *Bangladesh Economy 2000: Selected Issues*, BIDS, Dhaka.
5. Bayes, A. and A. Muhammad, eds. (1998). *Bangladesh at 25: An Analytical Discourse on Development*, University press Ltd., Dhaka.