ACADEMIC SUBJECT: MATHEMATICS

Table 1: AS 1 Math Structure for BSc (Ed) (Primary 2 CS Track) AS 1 Math Structure for BSc (Ed) (Secondary)

Year	Course Code	Title	Course Category	No. of AUs	Pre-requisites
1	AAM10A	Linear Algebra I	Core	3	-
	AAM10B	Calculus I	Core	3	-
	AAM10C	Finite Mathematics	Core	3	-
	AAM10D	Number Theory	Core	3	-
2	AAM20A	Linear Algebra II	Core	3	-
	AAM20B	Calculus II	Core	3	-
	AAM20C	Statistics I	Core	3	-
	AAM20D	Computational Mathematics	Core	3	-
	AAM20E	Differential Equations	Core	3	-
	AAM20G	Complex Analysis	Core	3	-
3	**Select any 3 electives**				
	AAM33A	Special Topics in Mathematics I	Pres	3	-
	AAM33C	Statistics II	Pres	3	-
	AAM33D	Real Analysis	Pres	3	-
	AAM33E	Modern Algebra	Pres	3	-
	AAM33G	Modelling with Differential Equations	Pres	3	-
	AAM33H	Statistics III	Pres	3	-
	AAM33J	Combinatorial Analysis	Pres	3	-
4	AAM40A	Academic Exercise: Mathematics	Core	3	-
	Select any 3 electives				
	AAM43A	Special Topics in Mathematics II	Pres	3	-
	AAM43B	Statistical Theory	Pres	3	-
	AAM43C	Applied Statistics	Pres	3	-
	AAM43D	Techniques in Operations Research	Pres	3	-
	AAM43E	Mathematical Programming and Stochastic Processes	Pres	3	-
	AAM43G	Metric Spaces	Pres	3	-
	AAM43H	Galois Theory	Pres	3	-
	AAM43J	Graph Theory	Pres	3	-
	AAM43K	Geometry	Pres	3	-
	AAM43L	Advanced Mathematical Modelling	Pres	3	-
Total AUs for Degree				51	-

Please refer to the NIE Portal for the list of courses offered by semesters

Table 2: AS 1 Math Structure for BA/BSc (Ed) (Primary 3 CS Track)

Year	Course Code	Title	Course Category	No. of AUs	Pre-requisites
1	AAM10A	Linear Algebra I	Core	3	-
	AAM10B	Calculus I	Core	3	-
	AAM10C	Finite Mathematics	Core	3	-
	AAM10D	Number Theory	Core	3	-
2	AAM20A	Linear Algebra II	Core	3	-
	AAM20B	Calculus II	Core	3	-
	AAM20C	Statistics I	Core	3	-
	AAM20D	Computational Mathematics	Core	3	-
	AAM20E	Differential Equations	Core	3	-
	AAM20G	Complex Analysis	Core	3	-
3	**Select any 2 electives**				
	AAM33A	Special Topics in Mathematics I	Pres	3	-
	AAM33C	Statistics II	Pres	3	-
	AAM33D	Real Analysis	Pres	3	-
	AAM33E	Modern Algebra	Pres	3	-
	AAM33G	Modelling with Differential Equations	Pres	3	-
	AAM33H	Statistics III	Pres	3	-
	AAM33J	Combinatorial Analysis	Pres	3	-
4	AAM40A	Academic Exercise: Mathematics	Core	3	-
	Select any 1 elective				
	AAM43A	Special Topics in Mathematics II	Pres	3	-
	AAM43B	Statistical Theory	Pres	3	-
	AAM43C	Applied Statistics	Pres	3	-
	AAM43D	Techniques in Operations Research	Pres	3	-
	AAM43E	Mathematical Programming and Stochastic Processes	Pres	3	-
	AAM43G	Metric Spaces	Pres	3	-
	AAM43H	Galois Theory	Pres	3	-
	AAM43J	Graph Theory	Pres	3	-
	AAM43K	Geometry	Pres	3	-
	AAM43L	Advanced Mathematical Modelling	Pres	3	-
Total AUs for Degree				42	-

Please refer to the NIE Portal for the list of courses offered by semesters.

Table 3: AS2 Math Structure for BSc(Ed) (Secondary)

Year	Course Code	Title	Course Category	No. of AUs	Pre-requisites
1	AAM10A	Linear Algebra I	Core	3	-
	AAM10B	Calculus I	Core	3	-
	AAM10C	Finite Mathematics	Core	3	-
	AAM10D	Number Theory	Core	3	-
Total AUs for Degree				12	-

Please refer to the NIE Portal for the list of courses offered by semesters.

AAM10A Linear Algebra I

Introduction to set theory. Linear systems and methods of solving linear systems. Matrix algebra, determinant function. Vectors in R^2 and R^3, dot product, cross product and geometric applications. Euclidean n-space, linear transformations.

AAM10B Calculus I

Functions: domain, codomain, range, composition of functions, graphs. Limits and continuity. Differentiation and applications of differentiation. Integration and applications of integration.

AAM10C Finite Mathematics

Basic principles of counting. Permutations and combinations. Generalized permutations and combinations. Binomial theorem and combinatorial identities. The Pigeonhole principle. Sample space and probability distributions. Conditional probability. Independent events.

AAM10D Number Theory

Divisibility. Greatest common divisor. The Euclidean algorithm. Prime numbers. The Fundamental Theorem of Arithmetic. Linear Diophantine equations. Congruences. The Chinese Remainder Theorem. The Euler's Phi function. The sum and number of divisors. Euler's Theorem. Quadratic residues. The Law of Quadratic Reciprocity. Primitive roots and indices. Real-life applications such as check digits, cryptography.

AAM20A Linear Algebra II

Introduction to propositional logic. Methods of proof. General vectors spaces, bases and dimensions. Linear transformations between general vector spaces, matrices of linear transformations. Eigenvalues and eigenvectors, diagonalization. Orthogonality in n-space, diagonalisation of quadratic forms, conic sections. Applications.

AAM20B Calculus II

Sequence and series. Power series. Partial derivatives for functions of two or more variables, differentiability and chain rules for functions of two variables, directional derivatives and gradients for functions of two variables, tangent planes and normal lines, maxima and minima of functions of two variables, generalization of the concepts to functions of more than two variables. Double integrals and triple integrals.

AAM20C Statistics I

Descriptive statistics. Discrete and continuous distributions. Mathematical expectations. Sampling distributions and Central Limit Theorem. Estimation and confidence intervals: one sample for mean, proportion and variance and two samples for means and proportions.

AAM20D Computational Mathematics

Introduction to computational methods and computing tools. Use of computing techniques to solve problems in mathematics, science and other disciplines. Examples may be drawn from problems involving numerical solutions of equations in one variable, approximation of functions, solving systems of linear equations, and numerical simulations.

AAM20E Differential Equations

Separable, linear and exact first order ordinary differential equations (ODEs). Existence and uniqueness of solutions. Modelling with first order ODEs. Second order ODEs: fundamental solutions, Wronskian, linear dependence. Applications and approaches in modelling, solving and interpreting physical problems with second order ODEs. Laplace transform method for initial value problems.

AAM20G Complex Analysis

Complex numbers, complex functions. Complex differentiation, analytic functions, the Cauchy-Riemann equations. Complex integration over paths. Cauchy integral theorem, Cauchy integral formula. Fundamental theorem of algebra. Taylor series. Residues and poles. Laurent series, the residue theorem, evaluation of real definite integrals.

AAM33A Special Topics in Mathematics I

This course aims to cover some selected topics in mathematics that are not included in the regular course offerings. The contents and pre-requisites of this course may vary.

AAM33C Statistics II

Hypothesis testing: one and two samples for means, proportions and variances. Confidence interval for ratio of two variances. Chi-square tests and contingency tables. Simple linear regression: least squares estimation and inference (including diagnostic checking).

AAM33D Real Analysis

The Completeness Axiom. The Archimedean Property. Density of rational and irrationals. The limit of a sequence, limit theorems. The limit of a function, the continuity of a function. The Intermediate Value Theorem. The Bolzano-Weierstrass Theorem. Extreme Value Theorem. Differentiation. Mean Value

Theorem. Riemann Integration. The Fundamental Theorem of Calculus.

AAM33E Modern Algebra

Permutations and permutation groups. Groups, Lagrange's Theorem. Symmetry groups of plane figures. Quotient groups, Cauchy's theorem. Group homomorphisms and the Fundamental homomorphism theorems. Rings and fields, ring homomorphism. Ideals, quotient rings. Rings of polynomials.

AAM33G Modelling with Differential Equations

The solution of ordinary differential equations (ODEs), including system of ODEs. Phase-plane, trajectories and fixed points. Stability and classification of fixed points. Sketching solutions in the phase-plane. Examples will include mass/spring systems, pendulum motions and predator/prey models. Numerical solution of ordinary differential equations: initial value problems, Euler's method. Runge-Kutta method. Applications of numerical techniques.

AAM33H Statistics III

Analysis of variance: completely randomized design, randomized block design, factorial designs. Non-parametric tests including sign test, Wilcoxon tests, rank correlation test.

AAM33J Combinatorial Analysis

Combinatorial techniques in proving. The principle of Inclusion and Exclusion and the general principle of Inclusion and Exclusion. The generating function of a sequence of numbers.

AAM40A Academic Exercise: Mathematics

The Academic Exercise provides student teachers an opportunity to engage in independent learning and research under the guidance of an academic staff. It gives student teachers a chance to explore topics that may not be covered in the regular curriculum, and to investigate and solve mathematical problems related to those topics. This Academic Exercise enables student teachers to further hone their problem solving and communication skills.

AAM43A Special Topics in Mathematics II

This course aims to cover some selected advanced topics in mathematics that are not included in the regular course offerings. The contents and pre-requisites of this course may vary.

AAM43B Statistical Theory

Further univariate distributions. Bivariate distributions. Moment generating functions and proof of Central Limit Theorem. Sampling distributions: t-, F-, and chi-square distributions. Selected topics from estimation theory and hypothesis testing theory.

AAM43C Applied Statistics

Selected topics from multiple regression models, design of experiments.

AAM43D Techniques in Operations Research

Topics from the theory of networks: minimal spanning trees, shortest paths, maximal flows, critical path analysis. Topics from the advanced theory of networks: least cost flows, transportation problem, travelling salesman problem, dynamic programming.

AAM43E Mathematical Programming and Stochastic Processes

Selected topics from the theory of linear programming: the simplex algorithm, introduction to duality, sensitivity analysis, dual simplex algorithm, integer programming, non-linear programming. Selected topics from the theory of stochastic processes: queueing theory, probabilistic inventory models, project scheduling under uncertainty.

AAM43G Metric Spaces

Topology in R. Metric spaces. Open sets and closed sets. Convergence and completeness. Continuity and compactness. Equicontinuity, Arzela-Ascoli Theorem. Topological spaces.

AAM43H Galois Theory

Field extensions, simple, finite and algebraic extensions, constructions with straight-edge and compass, splitting fields, normal and separable extensions, primitive elements, finite fields, Galois groups, Galois extensions, The Fundamental Theorem of Galois Theory, solvability by radicals.

AAM43J Graph Theory

Graphs. Euler tours, Hamiltonian cycles, representations of graphs, isomorphisms of graphs, planar graphs. Trees and applications.
Selected topics from:
Connectivity and matching: Hall's theorem, transversals, Konig's theorem, vertex and edge cuts, Menger's theorem.
Colouring: vertex colouring, Brook's theorem, chromatic polynomials, map colouring and the four colour problem, edge colouring, Vizing's theorem.
Planarity: planar graphs, Kuratowski's theorem, Euler's formula, dual graphs.
Ramsey theory, extremal graphs.

AAM43K Geometry

The axiomatic approaches to various geometries, including finite geometries, Euclidean geometry, hyperbolic geometry and spherical geometry. Geometric transformations of the Euclidean plane, symmetries and isometries. Brief excursions to the classical projective geometry and the modern geometry of fractal.

AAM43L Advanced Mathematical Modelling

Introduction to partial differential equations (PDEs) and classification into elliptic, parabolic and hyperbolic PDEs. Analytical and numerical solutions of PDEs. Explicit and implicit finite difference techniques for time-dependent PDEs, such as the unsteady diffusion equation. Direct and iterative methods for solving systems of algebraic equations. Application of numerical techniques for solving PDEs to industrial problems.