

SYLLABUS FOR SCI - J154

MATHEMATICS

GENERAL OBJECTIVES:

The general objectives are to:

1. help students in developing interest in Mathematics, hone their skills of mathematical thinking in order to stimulate their intellectual curiosity to provide satisfaction in their learning experience.
2. raise students' consciousness in appreciating Mathematics principles as tools for logical reasoning.
3. sharpen the mathematical skills of students in the applications of Mathematics to real life situations.
4. develop students to approach and solve range of mathematical problems creatively and communicate likewise.
5. build a solid mathematical foundation for students in their chosen future endeavors.

FIRST SEMESTER COURSES

MAT 001: ADVANCED PURE MATHEMATICS (3 Units)

MAT 002: CALCULUS (3 Units)

SECOND SEMESTER COURSES

MAT 003: STATISTICS (3 Units)

MAT 004A: APPLIED MATHEMATICS (3 Units)

MAT 004B: APPLIED BUSINESS MATHEMATICS (3 Units)

NOTE

All Candidates taking Mathematics shall be required to answer questions from **MAT 001, 002 and 003** while **MAT 004** is in two parts of which candidate will be required to choose **one** of the parts.

For MAT 004, candidates will be required to take **ONLY ONE** of either

MAT 004A (APPLIED MATHEMATICS), or

MAT 004B (APPLIED BUSINESS MATHEMATICS).

Candidates interested in degree courses in Sciences, Engineering and Environmental Sciences shall be required to take MAT 004A while candidates interested in studying courses in Management Sciences and Social Sciences are required to take MAT 004B.

COURSE DESCRIPTION

MAT 001: ADVANCED PURE MATHEMATICS

Specific Objectives

At the end of this course, candidates should be able to:

1. identify and perform operations with number system, sequences and series;
2. manipulate in all ramification the different set problems;
3. use trigonometric identities and apply the concept of trigonometry in solving problems;
4. solve conic sections related problems; and
5. find the relationship between real and complex numbers.

Course Content

S/N	TOPICS	SUB-TOPICS	DETAILS & NOTES
1.	Real Numbers	Operations with Real Numbers	Integers, rational and irrational number, mathematical induction, sequence and series (to include Arithmetic, Geometric and Harmonic Progressions), Sum to infinity of Geometric Progression and its convergence, binary operations (simple illustrations of uniqueness of identity and inverse elements)

MAT 004A (APPLIED MATHEMATICS), or

MAT 004B (APPLIED BUSINESS MATHEMATICS).

Candidates interested in degree courses in Sciences, Engineering and Environmental Sciences shall be required to take MAT 004A while candidates interested in studying courses in Management Sciences and Social Sciences are required to take MAT 004B.

COURSE DESCRIPTION

MAT 001: ADVANCED PURE MATHEMATICS

Specific Objectives

At the end of this course, candidates should be able to:

1. identify and perform operations with number system, sequences and series;
2. manipulate in all ramification the different set problems;
3. use trigonometric identities and apply the concept of trigonometry in solving problems;
4. solve conic sections related problems; and
5. find the relationship between real and complex numbers.

Course Content

S/N	TOPICS	SUB-TOPICS	DETAILS & NOTES
1.	Real Numbers	Operations with Real Numbers	Integers, rational and irrational number, mathematical induction, sequence and series (to include Arithmetic, Geometric and Harmonic Progressions), Sum to infinity of Geometric Progression and its convergence, binary operations (simple illustrations of uniqueness of identity and inverse elements)

2.	Algebra	Set Theory	Operations of sets (subset, union, intersection, complements), Algebra of sets (commutative, associative, distributive, idempotent laws), Venn diagram and its applications to word problems.
		Mappings	Compositions of mapping, domain, range, one-to-one, onto mapping, inverse functions and composite functions.
		Theory of Quadratic Equations	The roots of quadratic equations (completing the square, using the discriminant to determine the nature of roots), theory of quadratic equations and functions, relationship between the roots and coefficients of quadratic equations.
		Polynomials	Polynomial as an equation up to degree 3, the Factor theorem and the Remainder theorem. Partial fractions.
		Binomial Theorem	Expansions, Pascal triangles, Binomial theorem and linear approximations.
		Logarithms	The relationship between logarithm and indices, change of base, and the natural logarithm.
		Matrices	Algebra and Determinants of matrices of not more than 3×3 , inverse and its applications to system of linear equations up to three unknowns.
		Inequalities	Linear, quadratic, Simultaneous (one linear, one quadratic) and graphical solution. Absolute value and intervals. The inequalities of the mean.

3.	Trigonometry	Trigonometric Functions	Radians and Degrees conversion, trigonometric functions of angles of any magnitude and simple trigonometric equations, graphs of trigonometric functions (sine, cosine, and tangent). Inverse of trigonometric functions. Use of trigonometric identities.
4.	Coordinate Geometry	Straight Line	Length, gradient and mid-point of straight line. Equation of straight line (coordinate of two points and one point, and their gradients). Association between the gradients of parallel and perpendicular lines.
		Conic Sections	Circles, parabola, ellipse, hyperbola and their properties (e.g. tangents and normal).
5.	Complex Numbers	Complex Numbers	Basic complex numbers, Algebra of complex numbers, the Argand diagram, complex numbers in polar form, De-Moivre's theorem with proof, nth root of unity and loci problems.

MAT 002: CALCULUS

Specific Objectives

At the end of this course, candidates should be able to:

1. solve problems on limits;
2. obtain the derivatives of elementary and implicit functions;
3. apply the techniques of differentiation and integration in solving practical problems; and
4. formulate and solve problems on first and second order differential equations and their applications.

Course Content

S/N	TOPIC	SUB-TOPICS	DETAILS & NOTES
1.	Differential Calculus	Functions	Functions of a real variable, types of functions (elementary: algebraic, exponential, logarithmic, trigonometric; absolute value, etc), inverse of elementary functions, graphs of functions.
		Limits and Continuity	Definition of limits of function, properties of limits of functions, evaluation of limits of functions. L'Hospital's rule. Notion of continuity.
		Differentiation	Gradients, differentiation from the first principle, differentiation of elementary functions. Techniques of differentiation: chain rule, product rule, and quotient rule. Derivatives of implicit and parametric functions. Higher order derivatives. Partial Differentiation not more than two variables.
		Applications of Differentiation	Tangent and normal to a curve, maximum and minimum, rate of change, asymptotes and curve sketching. Maclaurin and Taylor series. Rectilinear motion.
2.	Integral Calculus	Integration	Standard integrals, integration as inverse of differentiation, definite integrals, techniques of integration (substitution method, inverse trigonometric function, integration by parts, use of partial fraction and reduction formula).
		Applications of Integration	Areas, volumes, numerical methods of integration: Trapezoidal and Simpson rules.

3.	Ordinary Differential Equations	First order Ordinary Differential Equations	Formulation of simple first order differential equations, solution when the variables are separable, solution when the equation is homogenous and solution when the equation is linear (Bernoulli equation) and use of an initial condition.
		Second Order Differential Equations	Homogeneous second order differential equations with constant coefficients.
		Applications	Geometric, exponential growth and decay problems.

MAT 003: STATISTICS

Specific Objectives

At the end of this course, candidates should be able to:

1. analyze data sets using descriptive measure and pictorial analysis;
2. solve problems using probability theory;
3. classify random variable and evaluate Probability Density and Probability Distribution Functions;
4. apply Normal and Student t distributions to test hypotheses; and
5. solve problems on Regression and Correlation.

Course Content

S/N	TOPIC	SUB-TOPICS	DETAILS & NOTES
1.	Introduction to Statistics	Description of Data set	Definition of Statistics, types of data, sources of data, population and sample, graphical representation of data (frequency table, histogram, bar chart, pie chart, stem-and-leaf display, box plot, frequency distribution, frequency polygon and Ogive).
2.	Different Measures	Measures of location and dispersion	Measure of central tendency for grouped and ungrouped data (mean, median and mode), Quartiles (1^{st} , 2^{nd} and 3^{rd}) and percentiles, Measure of dispersion for grouped and ungrouped data (mean deviation, standard deviation and variance), interquartile range, coefficient of variation, Skewness and Kurtosis.
3.	Combinatorics	Mathematics of Counting and introduction to probability	Permutation and Combination, fundamental principles of probability theory (union of events, mutually exclusive events, independent events and conditional events), simple practical probability problems using venn diagram.
4.	Random Variables	Probability	Discrete and continuous random variables, Probability Density Function (Normal distribution) and Probability Distribution Functions (Bernoulli, Binomial, Geometric and Poisson)
		Discrete Random Variables	Find the mean and variance from a probability distribution table and the linear properties of expectation and variance.
		Discrete Probability Density Function, Expectation and Variance	Expectation and variance of the following distributions: Bernoulli, Binomial, Geometric and Poisson. Use of the Binomial and Poisson tables.

5.	Normal Random Variables	Normal distribution	Use of Standard Normal table, Normal distribution as a model for data and its applications to real life problems.
		Significance Testing	Test of hypothesis, errors in hypothesis testing, significance tests using Normal distribution and Student t-distribution, Chi-square test (goodness of fit test and contingency table), one sample mean test, difference of mean, one sample proportion test.
6.	Correlation and Regression	Correlation and Simple Regression	Types of correlation, simple correlation, correlation coefficients (Pearson product-moment and Spearman's rank), simple real life problems. simple linear regression.
7.	Basic Sampling Techniques	Types of Sampling Techniques	Simple sampling techniques, finite and infinite sampling sizes.

Course MAT 004

MAT 004 is in two parts. Candidates will take only one of either MAT 004A (APPLIED MATHEMATICS) OR MAT 004B (APPLIED BUSINESS MATHEMATICS). Candidates interested in degree courses in Engineering and Sciences shall be required to take MAT 004A while candidates interested in studying courses in Management and social sciences are required to take MAT 004B.

MAT 004A: APPLIED MATHEMATICS

Specific Objectives

At the end of this course, candidates should be able to:

1. evaluate the various operations of vectors;
2. state and apply Newton's laws of motion;
3. interpret and solve problems of particle on an inclined plane;
4. solve problems of forces in equilibrium and equilibrium of rigid bodies; and

5. represent motion diagrammatically and apply equations of motion to practical problems.

Course Content

S/N	TOPIC	SUB-TOPICS	DETAILS & NOTES
1.	Vectors	Vectors	Scalar and vector quantities, types of vectors, representation and naming of vectors.
		Algebra of Vectors	Addition, subtraction and scalar multiplication, commutativity and associativity, linear dependence and co-linearity of vectors, perpendicularity of vectors and the angles between two vectors.
		Vector Equations	Vector equation of lines and planes, application to geometry, vectors in three dimensions, and the rectangular unit vectors i , j , and k . Representation of vectors in terms of rectangular coordinates, scalar and vector functions.
		Vector Functions	Differentiation of vector functions, integration of vector functions (one integral and differential operators of at most order 3).
2.	Kinematics of Motion in a Straight Line	Motion in a straight line	Unit vectors, position vectors, speed, velocity, acceleration and displacement in simple cases. Area under a velocity-time graph representing displacement, and gradient of velocity-time graph representing acceleration. Gradient of a displacement-time graph representing velocity.
		Rectilinear motion	Rectilinear motion with uniform acceleration, motion under gravity, and graphical method.
		Motion in a plane	Rectangular components of velocity and acceleration, resultant velocity, relative velocity and relative path.

3.	Newtonian Mechanics	Newtonian Mechanics	Energy, work and power (simple cases).
		Force and Motion	Force and motion, momentum, Newton's laws of motion, different kinds of forces (gravitational reactions, tension, and thrust), motion of connected particles and motion of a particle on an inclined plane.
4.	Forces and Equilibrium	Forces and Equilibrium	Forces acting at various points of a rigid body, parallel forces, couple, moment and application of vectors in statics (simple cases).
		Frictional forces and centre of mass	Friction, smooth bodies, tension and thrust, bodies in equilibrium (rough, horizontal and inclined planes). Centre of gravity (simple cases).
5.	Equilibrium of a Rigid Body	Equilibrium of a Rigid Body	Moment of inertia, radius of gyration, parallel and perpendicular axes theorems, kinetic energy of a body rotating about a fixed axis (simple cases).

MAT 004B: APPLIED BUSINESS MATHEMATICS

Specific Objectives

At the end of this course, candidates should be able to:

1. select and evaluate financial topics relevant to their area of study;
2. elucidate various options in financial decision;
3. explain the basic terms in the area of business and finance;
4. solve practical business problems.

Course Content

S/N	TOPIC	SUB-TOPICS	DETAILS & NOTES
1.	Mathematics of Finance	Interest Application	Simple interest, accumulated value of simple interest loan, compound interest, continuous compound interest, time value concept (payback period, net present value, internal rate of return), future of a single sum.
		Annuities and Perpetuity	Annuity: Ordinary annuity, deferred annuity, present value of an annuity due. Perpetuity: present value of a level perpetuity, present value of a growing perpetuity.
		Sinking fund and loan amortization	Computation of due date/terminal value, amount and future value, loan amortization schedule.
		Inventory and turnover	Techniques of inventory control (average cost, First in first out, Last in first out), computing inventory at the lower of cost (market value), estimating inventory value, computing inventory turnover.
2.	Application of Differential Calculus to Business	Marginal Concept	Marginal productivity, marginal profit, marginal cost and average cost, marginal revenue, marginal demand, price and income elasticity of demand, cross price elasticity.

3.	Application of Integral Calculus to Business	Production and Cost Functions	Total cost, total revenue, average cost, average revenue, breakeven point.
		Consumer Surplus and Producer Surplus	Demand function, supply function, equilibrium price and quantity, marginal propensity to consume and save, calculation of consumer surplus and producer surplus,
		Second Order Differential Equations	Homogeneous second order differential equations with constant coefficients.
		Applications	Geometric, exponential growth and decay problems.
4.	Optimization	Maximization and Minimization Problems	Constrained problems (treating Cobb-douglas and other production functions), Lagrange optimization.
		Linear Programming	Graphical representation of simple linear programming.

RECOMMENDED TEXTS

1. Adamu M. (2006). *Understanding Basic Statistics*. Lagos, Nile Ventures.
2. Barnett, R. (2011). *College Algebra with Trigonometry*. New York, McGraw.
3. Bunday B.D., & (1983) Mulholland M. *Pure Mathematics for Advanced Level*.
4. Crawshaw, J., & Chambers, J. (2002). *A concise course in A-level statistics*. United Kingdom, Nelson Thomas Ltd.
5. Daas H. K., (2010) *Advance Engineering Mathematics*, New Delhi, S. Chand & Company Ltd.

6. Dowling, E. T. , *Introduction to Mathematical Economics*.
7. Dugopolski, M. (2011). *College Algebra*, Addison-Wesley.
8. Frank Ayres, Jr., *Trigonometry*. Schaum's Outlines Series
9. Frank Ayres, Jr., *Statistics*. Schaum's Outlines Series
10. Goetz, B.S., & Tobey, J. (2011). *Basic Mathematics*, Pearson, Boston.
11. Graham, A. (2003). *Statistics*, London, Hodder Education.
12. Humphrew, D., and Topping, J (1980). *Intermediate Mathematics*, London, Longman group.
13. Murray R., Spiegel, S., *College Algebra*. Schaum's Outlines Series
14. Murray R., Spiegel, S., *Statistics*. Schaum's Outlines Series
15. Nwagbogwu D.C. and Akinfenwa O.A. (2006). *Fundamentals of Mathematics 1*, Lagos, S. S. Stephen's Nig. Ltd.
16. Nwagbogwu D.C. and Akinfenwa O.A. (2006). *Fundamentals of Mathematics 2: Application to Business*, Lagos, S. S. Stephen's Nig. Ltd.
17. Okunuga, S.A., (2006) *Understanding Calculus*, Lagos, WIM Publication
18. Okunuga, S.A., (2009) *Elementary Mathematical Methods*, Lagos, WIM Publication.
19. Riley, K.F., Hobson M. P., & Bence, S.J., (2016). *Mathematical methods for Physics and Engineering*.
20. Stroud K. A. & Dexter J. B (2001). *Engineering Mathematics*, New York, Palgrave Macmillian.
21. Stroud K. A., (2006). *Advanced Engineering Mathematics*, New York, Palgrave Macmillan.
22. University of Lagos, Department of Mathematics (2014). *A First Course in Statistics*. Lagos, Nile Ventures.

23. University of Lagos, Department of Mathematics (2014). *Elementary Mathematics*. Lagos, Tonniichristo Concepts.
24. University of Lagos, Department of Mathematics (2014). *Introduction Calculus*, Lagos, Nile Ventures.
25. University of Lagos, Department of Mathematics (2014). *Introduction Mechanics*, Lagos, Tonniichristo Concepts.
26. Young, C. Y. (2010). *Algebra and Trigonometry*, New Jersey, John Wiley and Sons.
27. Stafford, L. W. T. (1989). *Business Mathematics*, Great Britain, Macdonald and Evans Ltd.
28. Olaniyi, E. (2020). *University Mathematics*, Lagos, Hevanz International. Volume 1 and Volume 2.