LATEST EDITION

MATHEMATICS

JUPEB SYLLABUS

SYLLABUS FOR SCI - J154

MATHEMATICS

GENERAL OBJECTIVES

At the end of the series of courses, candidates should be able to:

1. identify and solve problems in general algebra which includes set, real number system, trigonometry, complex numbers, and coordinate geometry;
2. solve problems on calculus which involve the different rules of differentiation and integration of various functions. Solve problems on ordinary differential equation of first and second order using different techniques;
3. manipulate the problems in Mechanics through the understanding of vectors, kinematics of motion, Forces, Newtonian laws, inclined plane, motion of particles in a plane, equilibrium of rigid bodies;
4. evaluate the general analysis of statistical data, deal with random variables using different probability density functions such as Bernoulli, Binomial, Geometric and Poisson random variable; and
5. model data using the Normal Distribution and the use of the Normal standard tables, Hypothesis testing, Correlation and Regression.

FIRST SEMESTER COURSES

MAT 001 ADVANCED PURE MATHEMATICS (3 UNITS)
MAT 002 CALCULUS (3 UNITS)

SECOND SEMESTER COURSES

MAT 003 APPLIED MATHEMATICS (3 UNITS)
MAT 004 STATISTICS (3 UNITS)

COURSE DESCRIPTION

MAT 001: Advanced Pure Mathematics (3 Units)

Specific Objectives

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

1. manipulate in all ramification the different set problems;
2. identify and perform operations with number system, sequences and series;
3. solve problems on circular functions; and
4. use trigonometric identities and apply the concept of trigonometry in solving problems.

Course Contents

S/N	TOPIC	SUB-TOPICS	DETAILS
1.	Real Numbers	Real Numbers	Integers, rational and irrational numbers, Mathematical induction, real sequence, and series (AP and GP), Sum to infinity of Geometric Progression and its convergence, and binary operations
2.	Algebra	Set Theory	Elementary set theory, subset, union, intersection, complements, Venn diagram and its applications to word problems.
		Mapping	Compositions of mapping, domain, range, one-to-one, onto mapping, inverse functions and composite functions.
		Theory of Quadratics	The roots of quadratic (completing the square, using the discriminant to determine the roots), theory of quadratic equations.
		Polynomials	Polynomial as an equation up to degree 3, the Factor theorem and the Remainder theorem. Partial fractions.
		Binomial Theorem	Binomial theorem, Pascal triangle.
		Logarithms Functions	The relationship between logarithm and indices, change of base, and the natural logarithm.
		Matrices and Determinants	Matrices and Determinants of not more than 3 x 3, inverse, addition, subtraction, multiplication and its applications to system of equations up to three unknowns.
		Inequalities	Linear, quadratic, Simultaneous (one linear, one quadratic) and graphical solution. Absolute value and intervals.
3	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.
4.	Trigonometry	Circular Measure	Radians and Degrees conversion, length of an arc, area of a sector, area of the segment of a circle.

		Trigonometric Functions	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.
5.	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.
		Other Conic Equations	Circles, parabola, ellipse, hyperbola and their properties (e.g. tangents and normal).

MAT 002: Calculus (3 Units)

Specific Objectives

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

1. solve problems on limits;
2. differentiate various functions including algebraic, logarithmic, exponential, and implicit functions;
3. apply the technique of differentiation in solving practical problems; and
4. use the technique of integration in solving practical problem.

Course Content

S/N	TOPIC	SUB-TOPICS	DETAILS
1.	Differentiation	Differentiation	Functions of a real variable, graphs, limits and notion of continuity, differentiation from first principle, differentiation of : algebraic functions and trigonometric functions. Composite functions: chain rule, product rule, and quotient rule. Derivatives of implicit and parametric functions. Higher order derivatives.
		Applications of Differentiation	Rectilinear motion, tangent and normal to a curve, maximum and minimum, rate of change and curve sketching. Maclaurin and Taylor series.
2.	Exponential Functions	Exponential Functions	The graph of exponential function (a^x), limit and derivative of the function (a^x). The exponential function (e^x), the graph, limit and derivative of the exponential functions (e^x).
3.	Logarithm Function	Logarithm Function	The relationship between logarithmic and exponential functions, the graph, limit and derivative of the logarithmic function ($\log_e x$).
4.	Integration	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.
5.	Differential Equations	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.
6.	Second Order Differential Equations	Second Order Differential Equations	Homogeneous second order differential equations with constant coefficients.
		Geometric Applications	The exponential growth and decay problems.

MAT 003: Applied Mathematics (3 Units)

Specific Objectives

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

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

Course Content

S/N	TOPIC	SUB-TOPICS	DETAILS
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

		Rectilinear motion Motion in a plane	velocity Rectilinear motion with uniform acceleration, motion under gravity, and graphical method. Rectangular components of velocity and acceleration, resultant velocity, relative velocity and relative path.
3.	Newtonian Mechanics	Newtonian Mechanics Force and Motion	Energy, work and power (simple cases). Force and motion, momentum, Newton's laws of motion, different kinds of forces (gravitational reactions, tension, and thrust), motion of connected particles, the Atwood's machine (simple cases) and motion of a particle on an inclined plane.
4.	Forces and Equilibrium	Forces and Equilibrium Frictional forces and centre of mass	Forces acting at various points of a rigid body, parallel forces, couple, moment and application of vectors in statics (simple cases). 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 004: Statistics (3 Units)

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. evaluate Random variable by apply Probability Density Function and Probability Distribution Function;
4. test hypotheses by applying Normal distribution, Student t, and Normal standard table; and
5. solve problems on Regression and Correlation.

S/N	TOPIC	SUB-TOPICS	DETAILS
1.	Description of Data Set	Data Set	Population and sample, random variables and graphical representation of data (histogram, bar chart, pie chart, Ogive and frequency polygon). Measure of central tendency for grouped and ungrouped data (mean, median and mode). Measure of dispersion for grouped and ungrouped data (mean deviation, standard deviation and variance). Skewness and Kurtosis.
2.	Mathematics of Counting	Mathematics of Counting	Permutation and Combination, fundamental principles of probability theory, discrete and continuous random variables.
3.	Random Variables	Probability Discrete Random Variables Discrete Probability Density Function, Expectation and Variance	Probability Density Function and Probability Distribution Function. Find the mean and variance from a probability distribution table and the linear properties of expectation and variance. Expectation and variance of the following distributions: Bernoulli, Binomial, Geometric and Poisson. Use of the Binomial and Poisson tables.
4.	Normal Random Variables	Normal Table Significance Testing	Use of Standard Normal table, Normal distribution as a model for data and its applications to real life problems. 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.
5.	Regression and Correlation	Simple Regression and Correlation	Types of correlation, simple correlation and simple linear regression.
6.	Basic Sampling Techniques	Types of Sampling Techniques	Simple sampling techniques, finite and infinite sampling sizes.

RECOMMENDED TEXTS

1. Adamu Muminu, (2006). *Understanding Basic Statistics,* Lagos, Nile Ventures.
2. Barnett, R. (2011). *College Algebra with Trigonometry,* New York, McGraw.
3. Bunday M. (2014). *Pure Mathematics for Advanced Level*
4. University of Lagos, *Department of Mathematics* (2014). A First Course in Statistics, Lagos, Nile Ventures.
5. University of Lagos, *Department of Mathematics* (2014). Elementary Mathematics, Lagos, Tonniichristo Concepts.
6. University of Lagos, *Department of Mathematics* (2014). Introduction Calculus, Lagos, Nile Ventures.
7. Department of Mathematics (2014). *Introduction Mechanics,* Lagos, Tonniichristo Concepts.
8. Dugopolski, M. (2011). *College Algebra,* Addison-Wesley.
9. Goetz, B.S. and Tobey, J. (2011). *Basic Mathematics,* Pearson, Boston.
10. Graham, A. (2003). *Statistics,* London, Hodder Education.
11. Humphrew and Topping (1980). *Intermediate Mathematics,* London, Longman group.
12. Nwagbogwu D.C. and Akinfenwa O.A. (2012). *Fundamentals of Mathematics,* Lagos, S. S. Stephen's Nig. Ltd.
13. Okunuga, S.A., (2009) *Elementary Mathematical Methods,* Lagos, WIM Publication.
14. Okunuga, S.A., (2006) *Understanding Calculus,* Lagos, WIM Publication
15. Riley, K.F., Hobson M.P and Bence, S.J., (2016). *Mathematical methods for Physics and Engineering.*
16. Stroud K. A., (2006). *Advanced Engineering Mathematics,* New York, Palgrave Macmillan.
17. Young, C. Y. (2010). *Algebra and Trigonometry,* New Jersey, John Wiley and Sons.

SCHAUM'S OUTLINES SERIES

18 Murray R., Spiegel, S., *College Algebra*
19 Murray R., Spiegel, S., *Statistics*
20 Frank Ayres, Jr., *Trigonometry*
21 Frank Ayres, Jr., *Statistics*