MATHEMATICS

SYLLABUS

INTERIM JOINT MATRICULATION BOARD EXAMINATION (IJMBE) ADVANCED LEVEL MATHEMATICS SYLLABUS (REVISED 2012)

Introduction:

This one-year course is designed to serve as an intermediate course of study to train students from various colleges to gain insight into basic tools of Mathematics for taking up advanced studies in areas of Pure and Applied Mathematics in Nigerian Universities.

Objective:

The general objective of the course is to train students to gain insight into basic tools of Mathematics for taking up advanced studies in areas of Pure and Applied Mathematics in Nigerian Universities.

Recommendations:

1. Candidates should at least study this syllabus for one (1) years before presenting themselves for A-Level Mathematics examination.

2. Candidates should have credit in O-Level Mathematics before enrolling into the programme. An exposure to further mathematics is an additional advantage.

3. Students must attend lectures and workout some representative exercises from the recommended textbooks.

Examination Structure:

There will be three papers of two hours each.

PAPER I

This will cover Algebra, Trigonometry and Complex Numbers Co-ordinate Geometry – Topics 1 to 15 of the syllabus.

Section A: This will consist of between 5 to 7 short questions drawn from the above three topics and will be worth 20% of the total marks.

Section B: This will consist of three questions on Algebra, each worth 15% of the total marks.

Section C: This will consist of three questions on Trigonometry and Complex Numbers, each worth 15% of the total marks.

PAPER II

This will cover Calculus, Differential Equations, and Vectors – Topics 16- to 20.

Section A: This will consist of between 5 to 7 short questions drawn from the above three topics and will be worth 20% of the total marks.

Section B: This will consist of three questions on Calculus, each worth 15% of the total marks.

Section C: This will consist of three questions on Differential Equations and Vectors, each worth 12% of the total marks.

PAPER III

This will cover Co-ordinate Geometry and Statistics – Topics 21 to 28.

Section A: This will consist of between 5 to 7 short questions drawn from the above two topics and will be worth 20% of the total marks.

Section B: This will consist of three questions on Co-ordinate Geometry, each worth 15% of the total marks.

Section C: This will consist of three questions on Statistics, each worth 15% of the total marks.

NOTE: In each paper, candidates must attempt **ALL** the questions in Section A. They must also attempt **FOUR** questions from Sections B, and C including at least **ONE** question from each of these sections.

Continuous Assessment:

Continuous assessment will be considered for all candidates and will constitute 20% of the final score. The written examination will constitute 80% of the final score. Out of all the tests and assignments undertaken by each candidate, at least **FOUR (4)** may be selected and used for continuous assessment.

DETAILED SYLLABUS

FIRST SEMESTER

S/NO:	TOPICS AND CONTENTS	ACTIVITIES / PRACTICAL GUIDE	DURATION
1.	SET, RELATIONS FUNCTIONS AND OPERATIONS The definition of a set, finite and infinite sets, equality of sets, subsets union, intersection, universal set, complements, empty set, Venn diagram symmetric difference, power sets and De Morgan's laws. Inclusion–exclusion principle. Elements of relations functions and operations	Generate elementary examples of functions. Also form simple example to elucidate inclusion–exclusion principle. De Morgan's laws need to be proved analytically. Proofs by Venn diagram are acceptable	2weeks/12hrs
2.	SOME PROPERTIES OF NUMBER SYSTEM Natural numbers, integers, rationals, irrationals and real numbers. Order relations on the set of real numbers. Open and closed intervals on the number line	Generate examples of rational and irrational numbers. Manipulate the algebraic properties of real numbers by concrete examples. No analytic proof of properties is needed	1week/6hrs
3.	INEQUALITIES Definition of absolute value for modulus of a real number. Solving inequalities involving linear and quadratic functions. Solution sets of inequalities	Generate specific examples of inequalities such as $ax + b > 0$, $ax^2 + bx + c > 0$, $x - a > x - b$ 1, etc. and solve them.	1week/6hrs
4.	PRINCIPLE OF MATHEMATICAL INDUCTION AND ITS APPLICATIONS Intuitive definition of a sequence and a series. Arithmetic and Geometric progressions and means. The sigma notation. Evaluation of Σn, Σn^2 by using mathematical induction	Generate concrete examples of Arithmetic and Geometric progressions. Also evaluate Arithmetic and Geometric means and know their relationships. Only finite cases need to be treated except in Geometric progression where common ratio is less than one	1week/6hrs
5.	QUADRATIC AND OTHER POLYNOMIAL FUNCTIONS Elementary properties of quadratic expressions. Sums and products of roofs of quadratic equations. Applications to symmetric	Master the determination of roots by taking some concrete examples of quadratic equations. Learn to also determine the range of variable in a quadratic expression under given conditions	2weeks/12hrs

	functions. Polynomial functions of 3rd and 4th degrees that can be reduced to quadratic ones. Remainder and factor theorems		
6.	INDICES AND LOGARITHMIC FUNCTIONS Index notation, multiplying and dividing expressions involving indices. Negative and fractional indices. Laws of logarithms. Solutions of simple exponential and logarithmic equations	To demonstrate the application of various bases of logarithms, e.g. $\log_a b = \frac{\log_c b}{\log_c a}$ Proofs of various laws of logarithms be given	1week/6hrs
7.	PARTIAL FRACTIONS Types of partial fractions. Applications of partial fractions in summation of series and expansion of rational functions	Master the techniques to resolve functions such as $\frac{A}{(x-\alpha)(x+\beta)}$, $\frac{A}{x^2+bx+c}$, $\frac{A}{(x+\alpha)(x^2+bx+c)}$, etc.	1week/6hrs
8.	DETERMINANTS AND MATRICES Definition and properties of second and third order determinants. Applications of determinants to solve simultaneous linear equations using Cramer's rule. Algebraic operations, addition, subtraction and multiplication of matrices. Multiplication of a matrix by a scalar. Restricted to 3 x 3 matrices	Need to work out several concrete examples of determinants and matrices. Not to go beyond Cramer's rule	2weeks/12hrs
9.	BINOMIAL THEOREM Binomial expressions. Pascal's triangular array. The expansion of $(a + x)^n$, where n is a positive integer, and its use where n is a rational index. Determination of the interval of x for which a given Binomial expansion is valid. Approximation and errors	Generate examples to demonstrate the use of Binomial expansion in calculating errors. Confine to expression involving two terms only	2weeks/12hrs
10.	PERMUTATIONS AND COMBINATIONS Factorial notation, ${}^nP_r$, ${}^nC_r$ and simple examples	Generate concrete examples to illustrate how to apply the formulae of ${}^nP_r$ and ${}^nC_r$. Only simple cases need to be treated	1week/6hrs
11.	CIRCULAR MEASURES Functions and their graphs. Odd,	Generate examples of trigonometric functions and determine the periods,	

	even and periodic functions. Trigonometric ratios of angles of any magnitude. Inverse trigonometric functions. Graphs of trigonometric functions	amplitude, phase etc.	2weeks/12hrs
12.	COMPOUND ANGLE FORMULAE TRIGONOMETRIC EQUATIONS The formulae sin (A + B), cos (A + B), tan (A + B) and their proofs. Multiple and half angles. Simple identities. The solution of simple trigonometric equations, e.g. $a\cos\theta + b\sin\theta = R\cos(\theta \forall \alpha)$. Factor formulae	Master the methods of proof involving half and multiple angles in particular. Workout various examples of trigonometric equations	2weeks/12hrs
13.	SINE AND COSINE RULES Application of sine and cosine rules to the solution of triangles. Heights and distance	Master various methods of solutions of triangles excluding ambiguous case	1week/6hrs
14.	PLANE AND POLAR CO-ORDINATES Relations between Polar and Cartesian coordinates. Plotting and sketching of simple curves whose polar equations are known	Master the sketch of simple polar graphs, e.g. $r = a + b\cos\theta$. Only linear cases are to be treated	2weeks/12hrs
15.	COMPLEX NUMBERS Definition of a complex number, addition, subtraction, multiplication and division of complex numbers. Modulus, conjugation argument. Geometric interpretation. Polar representation. De Moivre's theorem. Nth roots of Unity	Generate various examples of complex numbers to find their magnitudes and arguments. To determine nth roots of a given complex quality, e.g. $(1 + i)^{1/3}$, $i^{1/5}$. No proof of De Moivre's theorem for fractional index is needed	2weeks/12hrs
16.	LIMITS AND CONTINUITY OF FUNCTIONS Definition of limit and continuity of functions with simple examples. Proof of $\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$. Asymptotes (parallel to the axes only) in graph sketching. Graphs of algebraic functions (polynomials and simple rational functions), trigonometric functions.	Generate examples to find limits and test continuity at a given point. No analytic proofs are needed	2weeks/12hrs

	Exponential and logarithmic functions to various bases. Knowledge of the series expansion of e^x for all **x** and **ln** $(1 + x)$, for $-1 < x < 1$.		

Total 150hr

SECOND SEMESTER

1.	DIFFERENTIATION Differentiation from the first principle. Meaning of derivative and interpretation as a rate of change. Differentiation of elementary functions. Differentiation of sums, differences, products and quotients The chain rule. Implicit differentiation. Higher derivatives. Differentiation of inverse trigonometric functions, logarithmic and exponential functions. Application to curve sketching. Maxima and minima. Newton's approximation and errors	Generate examples of Implicit, inverse trigonometric, logarithmic and exponential functions and find their derivatives. First and second order derivatives only	3weeks/18hrs
2.	INTEGRATION Definite integral and its representation as an area. Integration as the inverse of differentiation. Integration of elementary functions. Techniques of integration (by partial fractions, by substitution and by parts). Integration using identities and standard formulae. Applications of integration to areas and volumes	Master various methods of integration. Application of definite integral to determine area under the curves for simple cases. Only proper integrals need to be treated	2weeks/12hrs
3.	DIFFERENTIAL EQUATIONS First order differential equations only	Generate some simple examples of first order differential equations and integrate them. Only intuitive understanding of the concept need to be given	1week/6hrs
4.	VECTORS Notion of a vector, position vector, modulus of a vector. Scalar product of vectors. Representation as a directed line segment. Equal, unit, zero and parallel vectors. Position vector of a point dividing a line in a	Master the representation and determination of magnitude and direction cosine of vectors. Need to concentrate on concrete and simple examples	

	given ratio. Commutative, distributive, associative and parallelogram laws. Components of a vector. Resolution of vectors into orthogonal components. Resultant of coplanar. Vector products of vectors. Perpendicular vectors. Scalar product of parallel vectors. Subtraction of a vector as the addition of its additive inverse. Angle between two? Vector equation of a line. Direction vector. Direction ratios and cosines. Distance of a point from a line. Linear dependence and independence of vectors		2weeks/12hrs
5.	CO-ORDINATE GEOMETRY OF LINES AND CIRCLES Gradient of a line. Distance between two points. Equation of a linear graph from the gradient and the y-intercept. Division of a line in a given ratio. Equation of a line from two points on the line. Midpoints equation of a line (including the gradient and intercept forms). Point of intersection of two lines. Equation of a line through the point of intersection of two given lines. Equation of a line from a given point and the gradient. Angle between two lines. Parallel and perpendicular lines. Distance of a point from a line. Equation of a circle with a given Centre and radius; with a given diameter. Equation of tangent to a circle.	Construct concrete examples of equations of lines. Find out the equations of tangents and normals. Only standard forms need to be considered	3weeks/18hrs
6.	CONIC SECTIONS Properties of Parabola, Ellipse, Hyperbola, Rectangular hyperbola, their Cartesian and Parametric equations. Problems involving elimination of Parameters. Equations of tangents and normals. General	Only standard forms of conics should be considered	2weeks/12hrs

	equation of second degree and conditions under which it represents a pair of lines, circles and other conics		
7.	STATISTICAL MEASURES AND GRAPHS Measures of control tendency and variation: Mean, Median, Mode, ranges, variation and standard deviation. Histograms and cumulative frequency polygons	Construct concrete examples of the two measures. Also draw inferences from graphs and interpret. Simple cases only	2weeks/12hrs
8.	PROBABILITY Axiomatic definition of probability. Discrete sample space. Events. Frequency interpretation. Sum and product laws. Conditional probability. Dependent and independent events. Tree diagrams	Perform illustrations with coin and dice throwing experiments. Some simple examples of probability trees should be also constructed	2weeks/12hrs
9.	RANDOM VARIABLES Types of random variables. Probability density function. Cumulative distribution function. Expectation, standard deviation and variance	Use concrete examples of both discrete and continuous random variable. Also calculate and interprete expected values and standard deviation of discrete random variable.	1week/6hrs
10.	PROBABILITY DISTRIBUTIONS Binomial, poison and normal distributions; their means and variances	Concrete examples of these distributions should be constructed. Derivations of these distributions are not required	2weeks/12hrs
11.	REGRESSION Scatter diagrams. Regression line and its characteristics. Linear regression equation and curves. Fitting of regression lines by the method of least squares. The meaning of regression coefficient and its estimation from graphs. The use of regression lines	Some simple concrete examples should be constructed. No exponential or multiple regression is required	2weeks 12hrs
12.	CORRELATION COEFFICIENT Product moment correlation coefficient and Spearman's rank correlation coefficients	Simple examples of these coefficients should be constructed	2weeks/12hrs
13.	**Revision**		1week/6hrs

Total 144hrs

Recommended Texts / Reference Materials:

1. K.A Stroud: Engineering mathematics 6th Edition. Palgrave Macmillan Houndmills; 2007.
2. Backhouse J. K., : Pure Mathematics. Volume's 1 & 2.. Longman. Group Limited 1990 Bostoch L. and Chandler S.: Core Mathematics For A-Level. Volume's 1& 2 Stainley Thornes Ltd., Cheltenham, England; 1990.
3. Israel H. R.: College mathematics. Volume's 1& 2.John Wiley and Sons, Inc 1959.
4. Tuttuh. M.R., Sivasubramaniam S., and Adegoke R. Further Mathematics projects 1, 2 and 3.NPS Education Publishers Limited; 1997.
5. Murray R. S.,:Schaum's outline series Probability and Statistics Mcgraw-Hill Book Company; 1980.
6. Godman A., Talbert J. F., and Ogum G. E O: Additional Mathematics for west Africa, Longman Group Limited 1994
7. R.E. Walpole: Introduction to Statistics, 3rd Edition. Macmillan, London; 1982.