FURTHER METHODS FOR ADVANCED MATHEMATICS, FP2 (4756) A2

Objectives

To build on and extend students' knowledge of Pure Mathematics and associated techniques.

Assessment

Examination: (72 marks)
1 hour 30 minutes.
The examination paper has two sections.

Section A: All questions are compulsory.
three questions each worth about 18 marks.
One or two of the questions may be divided into independent parts on different topics in the specification.
Section Total: 54 marks.

Section B: One question to be chosen from two both worth 18 marks.
Section Total: 18 marks.

Assumed Knowledge

Candidates are expected to know the content for *C1, C2, C3, C4* and *FP1*.

Subject Criteria

Both this unit and *FP1* are required for Advanced Further Mathematics.
The Units *C1, C2, C3* and *C4* are required for Advanced GCE Mathematics.

Calculators

In the MEI Structured Mathematics specification, no calculator is allowed in the examination for *C1*. For all other units, including this one, a graphical calculator is allowed.

SECTION A – All topics in this section are to be studied.

FURTHER METHODS FOR ADVANCED MATHEMATICS, FP2		
Specification	**Ref.**	**Competence Statements**

POLAR COORDINATES		
Polar co-ordinates in two dimensions.	FP2P1	Understand the meaning of polar co-ordinates (r, θ) and be able to convert from polar to cartesian co-ordinates and vice-versa.
	2	Be able to sketch curves with simple polar equations.
	3	Be able to find the area enclosed by a polar curve.

CALCULUS		
The inverse functions of sine, cosine and tangent.	FP2c1	Understand the definitions of inverse trigonometric functions.
Differentiation of arcsin*x*, arccos*x* and arctan*x*.	2	Be able to differentiate inverse trigonometric functions.
Use of trigonometrical substitutions in integration.	3	Recognise integrals of functions of the form $(a^2 - x^2)^{-1/2}$ and $(a^2 + x^2)^{-1}$ and be able to integrate associated functions by using trigonometrical substitutions.

SERIES		
Maclaurin series. Approximate evaluation of a function.	FP2s1	Be able to find the Maclaurin series of a function, including the general term in simple cases.
	2	Appreciate that the series may converge only for a restricted set of values of *x*.
	3	Identify and be able to use the Maclaurin series of standard functions.

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COMPLEX NUMBERS

Modulus- argument form.	FP2j1	Understand the polar (modulus-argument) form of a complex number, and the definition of modulus, argument.
	2	Be able to multiply and divide complex number in polar form.
De Moivre's theorem and simple applications.	3	Understand de Moivre's theorem.
	4	Be able to apply de Moivre's theorem to finding multiple angle formulae and to summing suitable series.
Expression of complex numbers in the form $z = re^{j\theta}$.	5	Understand the definition $e^{j\theta} = \cos\theta + j\sin\theta$ and hence the form $z = re^{j\theta}$.
The n n^{th} roots of a complex number.	6	Know that every non-zero complex number has n n^{th} roots, and that in the Argand diagram these are the vertices of a regular n-gon.
	7	Know that the distinct n^{th} roots of $re^{j\theta}$ are: $r^{\frac{1}{n}}\left[\cos\left(\frac{\theta+2k\pi}{n}\right) + j\sin\left(\frac{\theta+2k\pi}{n}\right)\right]$ for k = 0, 1,…, $n-1$.
	8	Be able to explain why the sum of all the n^{th} roots is zero.
Applications of complex numbers in Geometry.	9	Appreciate the effect in the Argand diagram of multiplication by a complex number.
	10	Be able to represent complex roots of unity on an Argand diagram.
	11	Be able to apply complex numbers to geometrical problems.

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FURTHER METHODS FOR ADVANCED MATHEMATICS, FP2		
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MATRICES

Determinant and inverse of a 3x3 matrix.	FP2m1	Be able to find the determinant of any 3x3 matrix and the inverse of a non-singular 3x3 matrix.
Eigenvalues and eigenvectors of 2x2 and 3x3 matrices.	2	Understand the meaning of eigenvalue and eigenvector, and be able to find these for 2x2 or 3x3 matrices whenever this is possible.
Diagonalisation and powers of 2x2 and 3x3 matrices	3	Be able to form the matrix of eigenvectors and use this to reduce a matrix to diagonal form.
	4	Be able to find powers of a 2x2 or 3x3 matrix.
Solution of equations.	5	Be able to solve a matrix equation or the equivalent simultaneous equations, and to interpret the solution geometrically.
The use of the Cayley-Hamilton Theorem.	6	Understand the term *characteristic equation* of a 2x2 or 3x3 matrix.
	7	Understand that every 2x2 or 3x3 matrix satisfies its own characteristic equation, and be able to use this.

SECTION B One topic from this section is required. Section B of the examination paper contains two questions, one on each option. A candidate will only receive credit for an answer to one of them.

SECTION B OPTION 1

FURTHER METHODS FOR ADVANCED MATHEMATICS, FP2		
Specification	**Ref.**	**Competence Statements**
		HYPERBOLIC FUNCTIONS
Hyperbolic functions: definitions, graphs, differentiation and integration.	FP2a4	Understand the definitions of hyperbolic functions and be able to sketch their graphs.
	5	Be able to differentiate and integrate hyperbolic functions.
Inverse hyperbolic functions, including the logarithmic forms. Use in integration.	6	Understand and be able to use the definitions of the inverse hyperbolic functions.
	7	Be able to use the logarithmic forms of the inverse hyperbolic functions.
	8	Be able to integrate $(x^2+a^2)^{-1/2}$ and $(x^2-a^2)^{-1/2}$ and related functions.

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SECTION B OPTION 2

FURTHER METHODS FOR ADVANCED MATHEMATICS, FP2		
Specification	**Ref.**	**Competence Statements**

INVESTIGATION OF CURVES

The assessment of this option will be based on the assumption that candidates have a suitable graphical calculator.

Candidates who do not have such a calculator are advised not to attempt this option.

In this option students develop skills associated with curves. They learn to look for and recognise important properties of curves, making appropriate use of graphical calculators. They are expected to be able to generalise their findings; at times this will require analytical skills.

Examination questions will use a variety of curves but candidates will not be expected to know their particular properties. Instead the questions will test candidates' ability to select and apply the skills to investigate them.

It is, however, anticipated that while studying this option, students will meet a wide selection of curves.

Curves.	FP2C1	Know vocabulary associated with curves.
Graphical Calculator.	2	Be able to use a suitable graphical calculator to draw curves.
Properties of Curves.	3	Be able to find, describe and generalise properties of curves.
	4	Be able to determine asymptotes.
	5	Be able to identify cusps and loops.
	6	Be able to find and work with equations of chords, tangents and normals.
Conics.	7	Know the names and shapes of conics.
	8	Know the standard cartesian and parametric equations of conics.