Scheme of Work 2020-2021 Subject: Further Mathematics Specification: Edexcel Level : Year 2 A Level						
Lesson No	**Topic & Objectives**	**Key Activities & Specialist Terminology**	**Big Think Qs & Stretch**	**Assessment** **(Include relevant A Level Q stem)**	**Home work**	**Lit** **Num** **SMSC Codes**
	COMPLEX NUMBERS (18h) -be able to multiply and divide complex numbers in modulus-argument and exponential form; -be able to derive multiple angle formulae/expressions e.g. $\cos 3\theta$ in terms of powers of $\cos\theta$, and $\sin^3\theta$ in terms of multiple angles of $\sin\theta$; -be able to apply de Moivre's theorem to sum a geometric series.	1.Recap the skills taught at As FM 2.Students should know and use cosine and sine in terms of the exponential form. 3.Students should understand, remember and be able to use de Moivre's theorem: $z^n = r^n e^{in\theta} = r^n(\sin n\theta + i\cos n\theta)$; 4 Students should know how to solve completely equations of the form $z^n - a - ib = 0$, giving special attention to cases where $a = 1$, $b = 0$	Prove $e^{i\pi} = -1$ and consider the history and importance of this result. Derive the general statement of de Moivre's theorem by developing expressions for z^2, z^3 and z^4, and spotting the pattern to support the more obvious approach using $(e^{i\theta})^n = e^{in\theta}$.	Classroom test from Edexcel website	Exam style questions from the book and from maths	

	FURTHER ALGEBRA AND FUNCTIONS (12h) Objectives -be able to use the method of differences to sum simple finite series. -be able to find and use higher derivatives of functions; -be able to find the series expansion of composite functions.	2.Lots of practice is needed as these algebraic skills are fundamental to all subsequent work. Students must become fluent, and continue to develop thinking skills such as choosing an appropriate method, and interpreting the language in a question. 3.Where examples are in a real-life contexts, students should check that solutions are appropriate and be aware that a negative solution may not be appropriate in some situations 4. Students should know how to express functions as an infinite series in ascending powers using Maclaurin's expansion;	Start this topic with differences that do not involve fractions to introduce the idea e.g. $\sum_{r=1}^{n}\frac{1}{2}\big(r(r+1)-r(r-1)\big)$ $=\sum_{r=1}^{n}r$ $=\frac{n(n+1)}{2}$ Consider functions such as $\ln x$ and discuss if they have a Maclaurin expansion. Include the range of validity and consider how many terms are required to give a good degree of accuracy to the actual value of the function		genie. com	

	FURTHER CALCULUS (10h) Objectives: -know how to deal with infinity as a limit of a definite integral; -be able to integrate functions across limits which include values when the function is undefined i.e. deal with discontinuous integrands -be able to differentiate inverse trigonometric functions such as $\frac{1}{2}\arctan x^2$; -know how to integrate functions of the form $(a^2 - x^2)^{-\frac{1}{2}}$ and $(a^2 + x^2)^{-1}$	Students should understand and be able to evaluate the mean value of a function. Developing and proving the formula from Rolle's and emphasising the need to make sure that the working to solve problems is clear and well structured Integrating functions which can be split into partial fractions up to denominators with quadratic factors. Chosing trigonometric substitutions to integrate associated functions. Finding volumes of revolution for functions given in parametric form	A good way to develop this topic is too look at the two types of problems that will develop the learning points. Type A Not finite examples of which $\int_0^\infty e^{-x}\,dx$, $\int_1^\infty \frac{1}{x^2}\,dx$, $\int_{-\infty}^\infty \frac{1}{1+x^2}\,dx$. Type B Not continuous. Examples. - $\int_0^1 \frac{1}{x}\,dx$, $\int_{-2}^2 \frac{1}{x^2-1}\,dx$, $\int_0^\pi \tan x\,dx$, where these functions are not continuous across the limits			

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	POLAR COORDINATES (10h) Objectives: -be able to use polar coordinates and be able to convert between polar and Cartesian coordinates -be able to find tangents parallel and perpendicular to the initial line; -be able to find (compound) areas under polar graphs using the formula $\frac{1}{2}\int r^2 \mathrm{d}\theta$	Understanding, using polar coordinates and converting between polar and Cartesian coordinates. Sketching curves with *r* given as a function of ϑ, including use of trigonometric functions. Finding the area enclosed by a polar curve. Using and understanding $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\frac{\mathrm{d}y}{\mathrm{d}\theta}}{\frac{\mathrm{d}x}{\mathrm{d}\theta}}$ to derive gradients of tangents for each problem rather than using a general formula.	Introduce polar coordinates using a simple curve e.g. a circle centered at the origin. Relate to work already covered with Complex Numbers. Support the development of ideas by sketching points whenever possible. Reminding students that $x = r\cos\theta$ and $y = r\sin\theta$ can also be a very useful prompt. Online calculators can be used to check the answers of more demanding questions.			
	HYPERBOLIC FUNTIONS(10h) Objectives: -know the definitions of sinh *x*, cosh *x* and tanh *x* including their domains and ranges - be able to differentiate and integrate the hyperbolic functions and know the standard results - be able to derive, use and know the logarithmic forms of the inverse hyperbolic functions	Understanding the definitions of hyperbolic functions sinh *x*, cosh *x* and tanh *x*, including their domains and ranges, and drawing the sketch to their graphs. Differentiating and integrating hyperbolic functions. Deriving and using the logarithmic forms of the inverse hyperbolic functions. Integrating functions of the form $(x^2 + a^2)^{-\frac{1}{2}}$ and $(x^2 - a^2)^{-\frac{1}{2}}$ and chosing substitutions to integrate associated functions	Consider features such as $\sinh(-x) = -\sinh x$ using graph sketches. A reminder that $\frac{\mathrm{d}}{\mathrm{d}x}(\mathrm{e}^{-x}) = -\mathrm{e}^{-x}$ means the formulae for the derivatives and hence the integrals can be found as an exercise.			