MODULE **DESCRIPTOR**

MODULE TITLE	ORDINARY DIFFERENTIAL EQUATIONS		
MODULE CODE	MA2831 (L5)	**CREDIT VALUE**	20 CREDITS (10 ECTS)
CAMPUS	UCLAN CYPRUS		
SCHOOL	SCHOOL OF SCIENCE		

MODULE **AIMS**

- Present to students a coherent development of the theory of ordinary differential equations.
- Give students a range of techniques for solving ordinary differential equations analytically.
- Introduce the idea of Fourier series and their role in solving differential equations.

MODULE **CONTENT**

Recap
First order separable and linear equations (integrating factor method), 2nd order homogeneous and inhomogeneous ODEs with constant coefficients (auxillary equation, complimentary functions, particular integrals).

Second Order Differential Equations
Wronskian, Abel's Identity, general solution. Method of reduction of order. Inhomogeneous second order linear differential equations, variation of parameters. Euler-Cauchy ODEs.

Series Solutions of ODEs
Series solution of ordinary differential equations, use of Taylor Series and method of Frobenius.

Sturm-Liouville Theory
Adjoint, self-adjoint differential equations, normal version of the self-adjoint form. The Sturm-Liouville problem, eigenvalues and eigenfunctions, orthogonality of the eigenfunctions. Orthonormal systems, expansion of a function as a series of orthonormal eigenfunctions.

Systems of ordinary differential equations
Solutions of systems of linear equations with constant coefficients using eigenvalues and eigenvectors. Non-linear systems, phase diagrams, equilibrium points, stability. Linear approximation around equilibrium points.

Fourier Series
Odd, even & periodic functions. Fourier coefficients, Convergence of Fourier series, Dirichlet's theorem, Summation of a series using Fourier series, Fourier series for even & odd functions, Fourier sine and cosine series, Fourier series of period 2l.

Solving ODEs with a computer algebra package
Solving ODEs analytically & numerically, series solutions, solving systems of ODEs, plotting solutions.

INTENDED **LEARNING OUTCOMES**

On successful completion of this module a student will be able to:	
1.	Solve appropriate linear differential equations using techniques such as reduction of order, variation of parameters and series expansions.

2.	Demonstrate an understanding of the concepts of Sturm-Liouville theory and determine eigenvalues and eigenfunctions of appropriate Sturm-Liouville problems.
3.	Solve linear systems of first order differential equations with constant coefficients using eigenvalues and eigenvectors.
4.	Determine, and classify by linear analysis, the equilibrium solutions of a non-linear system of differential equations.
5.	Construct the Fourier series of period 2p or 2l of a function; use and apply the properties of odd or even functions to reduce work in finding Fourier coefficients; apply Dirichlet's Theorem to summation of series; obtain half-range Fourier expansions.
6.	Use a computer algebra package to solve ordinary differential equations.

TEACHING **METHODS**

Classes consist of formal lectures and tutorials. Lectures introduce the theory with some proof, and provide illustrative examples. Tutorial sheets containing practice questions will be provided for the students to attempt and these will be discussed in the tutorials.

The module will be assessed principally by examination. However, questions from the tutorial sheets will be assessed to gauge student understanding and engagement throughout the year.

ASSESSMENT **METHODS**

The module is assessed through Worksheets and a written examination.