Course unit title:	Numerical Methods		
Course unit code:	AMAT 314		
Type of course unit:			
Level of course unit:	Bachelor		
Year of study:			
Semester when the unit is delivered:			
Number of ECTS credits allocated :	5		
Name of lecturer(s):			
Learning outcomes of the course unit:	▪ Explain the various methods for finding approximation of roots of nonlinear equations, employ these methods to solve applied engineering problems, and identify the advantages and disadvantages of each method through the solutions. ▪ Define the concept of interpolation and least squares for curve fitting, employ the two methods to obtain the interpolation polynomials for given data sets and various functions, and generate a set of criteria that allow the use of each method. ▪ Describe the concept of numerical integration, apply different techniques for the calculation of integral approximations, and identify when the relative errors become minimal. ▪ Explain the need for approximation of derivatives of any order, define the important approximation formulas and employ various methods to calculate approximate solutions of first and second order differential equations. ▪ Analyse approximate solutions and based on the analysis classify the different methods based on their order of approximation. ▪ Explain the concept of finite difference methods in two dimensions and relate to simple problems that arise in Engineering. ▪ Employ a computer programming language (Matlab) to solve applied engineering problems discussed throughout the course, and compare the approximate solutions with the ones obtained by hand.		
Mode of delivery:	Face-to-face		
Prerequisites:	AMAT 204	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	▪ **Introduction:** Use of mathematical modelling in engineering problem solving; Overview of modern engineering tools used in engineering practice (such as MATLAB); Approximations of errors. ▪ **Roots of Equations:** The Graphical method, The Interval Bisection Method and the method of the False Position, the Fixed-Point Iteration, the Newton-Rapson method and Secant Methods, Multiple Roots and Systems of Nonlinear Equations. ▪ **Curve Fitting:** Interpolation Methods, Interpolating polynomial in Lagrange Form and Interpolating polynomial in Newton form, Least-Squares Approximation. ▪ **Numerical Integration:** Newton-Cotes Integration Formulas (Trapezoidal Rule, Simpson's Rules, Integration with unequally spaced data, Open Integration Formulas), Introduction to Integration of Equations(Newton-Cotes Algorithms for Equations, Romberg Integration, Gauss Quadrature).		

	▪ **Numerical Differentiation:** High-Accuracy Differentiation Formulas, Richardson Extrapolation, Derivatives of Unequally Spaced Data. ▪ **Numerical Solution of Ordinary Differential Equations:** Initial value problems, single and multiple step problems, convergence and stability. Boundary value problems, finite difference methods using simple routines. The Euler Method, the Improved Euler Method, the Runge-Kutta Methods, and Multi-step Methods. ▪ **Numerical solution of field problems:** Finite difference methods, applications using simple routines. ▪ **Applied Engineering Problems using MATLAB**
Recommended and/or required reading:	None
Textbooks:	▪ Steven C. Chapra, Raymond Canale, ***Numerical Methods for Engineers: With Software and Programming Applications***, McGraw-Hill, 4th Edition, 2001.
References:	▪ Cleve Moler, ***Numerical Computing with MATLAB***, Society for Industrial and Applied Mathematics, 2008. ▪ Singiresu S. Rao, ***Applied Numerical Methods for Engineers and Scientists***, Prentice Hall, 2002. ▪ Laurene V. Fausett, ***Applied Numerical Analysis Using MATLAB***, Prentice Hall 1999. ▪ George Lindfield and John Penny, ***Numerical Methods Using MATLAB***, Prentice Hall, 1999.
Planned learning activities and teaching methods:	The method of interactive teaching is used for the delivery of the teaching material. A variety of strategies are employed to ensure that all students have equal opportunities to learn. The lesson plans are carried out in several ways such as by questioning, explaining, collaborating and demonstrating. Students can take in class lecture notes and are given additional practice problems either in class or through the website.
Assessment methods and criteria:	▪ Tests: 40% ▪ Final Exam 60%
Language of instruction:	English
Work placement(s):	No