Course Descriptor
< Math305-Numerical Methods>

Proposed Academic Year	2021-2022	**Last Reviewed Academic Year**	2020-2021
Course Code	Math305	**Course Title**	Numerical Methods
Credit hours	3	**Level of study**	Year3
College / Centre	Applied and Health Science	**Department**	Basic Science
Co-requisites	Nil	**Pre-requisites**	FPPM002 GFP Pure Mathematics

1. COURSE OUTLINE

This course will emphasize the development of numerical algorithms to provide solutions to common problems formulated in science and engineering. The primary objective of the course is to develop the basic understanding of the construction of numerical algorithms, and perhaps more importantly, the applicability and limits of their appropriate use. The emphasis of the course will be the thorough study of numerical algorithms to understand (I) the guaranteed accuracy that various methods provide, (2) the efficiency and scalability for large scale systems. And (3) issues of stability. Topics include the standard algorithms for numerical computation: root finding for nonlinear equations, interpolation and approximation of functions by simpler computational building blocks (for example - polynomials and splines), numerical differentiation and divided differences, numerical quadrature and integration, numerical solutions of ordinary differential equations and boundary value problems, numerical optimization and regularization algorithms

2. AIMS

An important component of numerical analysis is computational implementation of algorithms which are developed in the course in order to observe first-hand the issues of accuracy, computational work effort, and stability. Exercises will include computational experiments in a programming language of the student's choice. One class lecture will be devoted to a high level pseudo-code type programming language (Matlab) which will suffice in case students have not had prior programming experience.

3. LEARNING OUTCOMES, TEACHING, LEARNING and ASSESSMENT METHODS

Learning Outcomes ***(Definitive)*** Upon successful completion of this course, students will be able to**:**	**Teaching and Learning methods** ***(Indicative)***	**Assessment** ***(Indicative)***
1. Apply standard techniques to analyze key properties of numerical algorithms	lectures, power point presentations lab demonstration and lab work	quiz 1/mid-term test -1/ Final exam

such as stability and convergence.		
2. Implement a range of numerical algorithms efficiently in Matlab	Lab work, demonstration	Quiz 2/ Mid-tem 2/ Final exam
3. Perform data analysis efficiently and accurately using data fitting methods,	Lectures, discussions, group work. assignment	Quiz/mid-term test 1/Final exam
4. Derive and analyze numerical methods for Calculus	Lab work, power point presentations, demonstration	mid-term test 1/ Final exam

4. ASSESSMENT WEIGHTING

Assessment	Percentage of final mark (%)
Quiz 1	10%
Quiz 2	10%
Midterm Exam	20%
Assignment	10%
Participation	10%
Final exam	40%
TOTAL	**100%**

5. ACHIEVING A PASS

Students will achieve 3 credit hours for this course by achieving a minimum overall score of 50% and attending at least 80% of class lectures.

6. COURSE CONTENT (Indicative)

CHAP3: Approximations and Round-Off Errors
3.1Significant Figures
3.2 Accuracy and Precision
3.3 Error Definitions
3.4 Round-Off Errors

CHAP5: Bracketing Methods
5.1 Graphical Methods
5.2 The Bisection Method
5.3 The False-Position Method

CHAP6: Open Methods 6.1 Simple Fixed-Point Iteration 6.2 The Newton-Raphson Method 6.3 The Secant Method	
CHAP18: Interpolation 18.1 Newton's Divided-Difference Interpolating Polynomials 18.2 Lagrange Interpolating Polynomials 18.6 Spline Interpolation	
CHAP21: Newton-Cotes Integration Formulas 21.1 The Trapezoidal Rule 21.2 Simpson's Rules .	
CHAP25: Runge-Kutta Methods 25.1 Euler's Method 25.2 Improvements of Euler's Method 25.3 Runge-Kutta Methods	
TOTAL HOURS	**45**
Plus **RECOMMENDED INDEPENDENT STUDY HOURS**	**0**
TOTAL COURSE HOURS	**45**

7. RECOMMENDED REFERENCES

Numerical Methods for Engineers: With Software and Programming Applications by StevenC. Chapra, Raymond P. Canale, 6th edition, ISBN 978–0–07–340106–5, (2010)

Library + online resources:

Library + online resources: www.wolphramalpha.com
https://cosmolearning.org/video-lectures/excel-bisection-example/
www.desmos.com