Advanced Numerical Methods (MSM4474)

<table>
<tr><td>Course Code</td><td colspan="8">MSM4474</td></tr>
<tr><td>Course Name</td><td colspan="8">Advanced Numerical Methods</td></tr>
<tr><td>Credit Hour</td><td colspan="8">4</td></tr>
<tr><td>Prerequisite Course</td><td colspan="8">Computational Methods in Industry (MSM4413)</td></tr>
<tr><td rowspan="3">Contact Hours</td><td colspan="3">Lecture:</td><td>3</td><td>units</td><td colspan="3">(3 hour(s) per week)</td></tr>
<tr><td colspan="3">Tutorial:</td><td>0</td><td>unit</td><td colspan="3">(0 hour(s) per week)</td></tr>
<tr><td colspan="3">Laboratory:</td><td>2</td><td>units</td><td colspan="3">(2 hour(s) per week)</td></tr>
<tr><td>Rationale for the Inclusion</td><td colspan="8">Numerical methods are powerful problem-solving tools which are capable in handling large systems of equations, nonlinearities and complicated geometries that are common in science, engineering and industrial practices. Courses addressing numerical analysis enhance the student’s abilities to develop numerical algorithms, solve and analyse problems in science and engineering. The emphasis is on learning in a practical context that is students will learn to write a numerical algorithm and programming in Matlab. The programming will be illustrated and developed through their use in applications from a wide range of practical problems.</td></tr>
<tr><td>Course Objective</td><td colspan="8">To equip students with the concepts of numerical analysis and skills in the development of numerical algorithms for solving applied related problems.</td></tr>
<tr><td>Course Synopsis</td><td colspan="8">This course covers the numerical solutions of linear systems, nonlinear systems, ordinary differential equations (ODEs) and stochastic differential equations (SDEs). It also includes the development of cubic spline, B-spline, Bezier curves for curve fitting. The emphasis is on learning in a practical context for students to write numerical algorithms using Matlab or C/C++. The numerical algorithms will be developed through their use in applications from a wide range of practical problems such as traffic flow problems and cancer growth progression.</td></tr>
<tr><td rowspan="2">Program Outcomes</td><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td></tr>
<tr><td>/</td><td>/</td><td>/</td><td></td><td></td><td>/</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Soft Skills</td><td colspan="2">Code</td><td>CTPS</td><td>CS</td><td>TS</td><td>LL</td><td>ES</td><td>EM</td><td>LS</td></tr>
<tr><td colspan="2">KIM</td><td>4</td><td></td><td></td><td>3</td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Course Outcomes</td><td colspan="9">By the end of semester, students should be able to:</td></tr>
<tr><td>CO1</td><td colspan="8">Formulate the algorithms of numerical methods for solving various industrial problems of linear and nonlinear systems, curve fitting, ODEs and SDEs.</td></tr>
<tr><td>CO2</td><td colspan="8">Provide the recommendations or conclusions for the selected industrial problems that based on the numerical solutions obtained by using numerical methods.</td></tr>
<tr><td>CO3</td><td colspan="8">Adapt mathematical software in solving various problems of linear and nonlinear systems, curve fitting, ODEs and SDEs .</td></tr>
<tr><td>CO4</td><td colspan="8">Organize various approaches to use the information and other related skills in solving real industrial problems.</td></tr>
<tr><td>Assessment</td><td colspan="2">Methods</td><td colspan="2">Weighting</td><td>CO1</td><td>CO2</td><td>CO3</td><td>CO4</td><td></td></tr>
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Methods	Project (Case Study)	40%	/	/	/	/	
	Test	20%	/	/			
	Final Examination	40%	/	/			
	Total	**100%**					

Learning References	1	K. David and C. Ward, Numerical Analysis: Mathematics of Scientific Computing, 3rd Edition, Thomson Learning, 2002 (latest version-Main Reference for Chapter 1- Chapter 5)
	2	P. Kloeden and E. Platen, Numerical Solution of Stochastic Differential Equations, Springer, 1992 (latest version- Main Reference for Chapter 6)
	3	G. Dahlquist and Ake Bjorck, Numerical Methods in Scientific Computing, Volume 1, Society for Industrial and Applied Mathematics, 2008 (latest version)
	4	P. Kloeden and E. Platen, Numerical Solution of Stochastic Differential Equations with Computer Experiment, Springer, 1992 (latest version)
	5	S. C. Chapra and R. P. Canale, Numerical Methods for Engineers, 7th Edition, McGraw-Hill Education, 2015.