
	Ministry of Higher Education and Scientific Research - Iraq University of Technology Chemical Engineering Department	
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## MODULE DESCRIPTOR FORM

### نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Statistics & Numerical Analysis		Module Delivery
Module Type	Core		Theory • Lecture • Tutorial • Lab. •
Module Code	UOMU0102053		
ECTS Credits	5		
SWL (hr/sem)	125		
Module Level	UGx11 3	Semester of Delivery	1
Administering Department	Chemical engineering and petroleum industries	College	Engineering
Module Leader	Dr. Aseel safi hamzah	e-mail	ASEEL.SAFI.HAMZAH@uomus.edu.iq
Module Leader's Acad. Title	Lecturer	Module Leader's Qualification	Ph.D.
Module Tutor	Dr. Aseel safi hamzah	e-mail	ASEEL.SAFI.HAMZAH@uomus.edu.iq
Peer Reviewer Name		e-mail	

<b>Review Committee Approval</b>	1/05/20 25	<b>Version Number</b>	1.0
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<b>Relation With Other Modules</b> العلاقة مع المواد الدراسية الأخرى			
<b>Prerequisite module</b>	Computer COMP208	<b>Semester</b>	4
<b>Co-requisites module</b>		<b>Semester</b>	2
<b>Module Aims, Learning Outcomes and Indicative Contents</b> أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية			
<b>Module Aims</b> أهداف المادة الدراسية	<ul style="list-style-type: none"> <li>At the end of the semester the student should be able to:-</li> <li>To apply numerical methods including linear systems analysis , regression, curve fitting, root finding ,optimization, numerical integration, and solution of differential equations.</li> <li>To study numerical analysis methods and their applications in solving chemical engineering problems</li> <li>To solve chemical engineering problems with numerical analysis techniques</li> <li>To learn the basics of MATLAB programing and write simple MATLAB codes</li> <li>To apply the concepts from probability and statics including error propagation, hypothesis testing, and parameter estimation.</li> </ul>		
<b>Module Learning Outcomes</b> مخرجات التعلم للمادة الدراسية	Students will be informed which problems are used to assess each outcome: 1. An ability to knowledge of mathematics, science , and engineering 2. An ability to identify, formulates, and solves engineering problems. 3. An ability to use techniques, skills, and modern engineering tools necessary for engineering practice.		
<b>Indicative Contents</b> الإرشادية المحتويات	<b>Part One : Numerical Analysis in Chemical Engineering</b> <b>1. Introduction to Numerical Analysis:</b> Numerical Solution, type of errors; relative error, absolute error, percentage error, truncation error, round off error, Floating point.[2 hr] <b>2. Interpolation and Polynomials Approximation:</b> <ul style="list-style-type: none"> <li>Lagrangian Polynomials (Linear, Quadratic, and General Form).</li> <li>Newton's Divided differences (Linear, Quadratic, and General Form).</li> </ul>		

	<ul style="list-style-type: none"> <li>• Cubic spline interpolating polynomials.[3hr]</li> </ul> <p><b>3. Curve Fitting</b></p> <ul style="list-style-type: none"> <li>• Linear regression, Polynomial Models, Nonlinear Data.[2hr]</li> </ul> <p><b>4. Root Finding:</b> Roots of polynomials, Bisection method, Secant method, Newton-Raphson method.[3hr]</p> <p><b>5. Numerical Differentiation and 6. Numerical Integration:</b> Forward, backward and central difference approximation. Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules. Double integrals using trapezoidal and Simpson's rules.[6hr]</p> <p><b>7. Solving System of Equations:</b> Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordan). Solution of linear system of equations by Iterative methods (Jacobi and Gauss-Seidel). Solution of non-linear system of equations by Newton-Raphson.[4hr]</p> <p><b>8. Solution of Ordinary Differential Equations:</b> Initial value problems. Solution of first-order ordinary differential equations using Taylor', Euler, Runge-Kutta and Predict or corrector methods. Solution of simultaneous ordinary differential equations.[10 hr]</p> <p><b>Part Two : Basic Statistics in Chemical Engineering</b></p> <p><b>1: The Role of Statistics in Engineering</b> Sample statistics, mean median, variance, standard deviation, etc.[2 hr]</p> <p style="text-align: right;"><b>2: Data Summary and Presentation</b> Histograms, Box plots[2 hr]</p> <p style="text-align: right;"><b>3: Probability</b> Sample spaces, Probability rules, Combinatorial analysis, Conditional probability &amp; independence [4 hr]</p> <p><b>4: Discrete Random Variables and Probability Distributions</b> Discrete random variables, Probability mass functions, Cumulative distribution functions, Mean and variance of a discrete random variable, Uniform, binominal, and Poisson distributions [3 hr]</p> <p><b>5: Continuous Random Variables and Probability Distributions</b> Probability density functions, Mean and variance of a continuous random variable, Uniform and normal distributions, Central Limit Theorem[2 hr]</p> <p><b>6: Joint Probability Distributions</b> Joint and marginal distribution functions, Bivariate normal distribution, Linear combinations of random variables, Error analysis for nonlinear equations[2 hr]</p>
<b>Learning and Teaching Strategies</b> والتعليم التعلم استراتيجيات	
<b>Strategies</b>	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding

	their critical thinking skills. This will be achieved through classes, interactive and tutorials.
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Student Workload (SWL)			
الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب الفصل	78	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	47	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.13
Total SWL (h/sem) الحمل الدراسي الكلي للطالب الفصل	125		

Module Evaluation					
تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (5)	3,5,8,10,13	LO #2, 3, 4 and 5
	Online Assignments	2	10% (5)	Continuous	
	Lab.	1	10%(10)	continuous	LO # 1 and 6
	Onset Assignment	2	10% (5)		
Summative assessment	Midterm Exam	2hr	15% (10)		LO # 2, 3, 4 and 5
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)		
المنهاج الاسبوعي النظري		
Week	Material Covered	Duration

	<b>Part One : Numerical Analysis in Chemical Engineering</b>	
<b>Week 1</b>	<b>1. Introduction to Numerical Analysis:</b> <ul style="list-style-type: none"> <li>Numerical Solution, type of errors; relative error, absolute error, percentage error, truncation error, round off error.</li> <li>Floating point.</li> </ul>	
<b>Week 2</b>	<b>2. Interpolation and Polynomials Approximation:</b> <ul style="list-style-type: none"> <li>Lagrangian Polynomials (Linear, Quadratic, and General Form).</li> <li>Newton's Divided differences (Linear, Quadratic, and General Form).</li> <li>Cubic spline interpolating polynomials.</li> </ul>	
<b>Week 3</b>	<b>3. Curve Fitting</b> <ul style="list-style-type: none"> <li>Linear regression, Polynomial Models, Nonlinear Data.</li> </ul>	
<b>Week 4</b>	<b>4. Root Finding:</b> <p>Roots of polynomials, Bisection method, Secant method, Newton- Raphson method.</p>	
<b>Week 5</b>	<b>5. Numerical Differentiation</b> <p>Forward, backward and central difference approximation.</p>	
<b>Week 6</b>	<b>6. Numerical Integration</b> <p>Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules. Double integrals using trapezoidal and Simpson's rules.</p>	
<b>Week 7</b>	<b>7. Solving System of Equations:</b> <p>Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordan). Solution of linear system of equations by Iterative methods (Jacobi and Gauss-Seidel). Solution of non-linear system of equations by Newton-Raphson</p>	
<b>Week 8</b>	<b>8. Solution of ordinary Differential Equations:</b> <p>Initial value problems. Solution of first-order ordinary differential equations using Taylor', Euler, Runge-Kutta and Predict or corrector methods. Solution of simultaneous ordinary differential equations</p>	
	<b>Part Two : Basic Statistics in Chemical Engineering</b>	
<b>Week 9</b>	<b>1: The Role of Statistics in Engineering</b> <p>Sample statistics, mean median, variance, standard deviation, etc.</p> <b>2: Data Summary and Presentation</b> <p>Histograms, Box plots</p>	
<b>Week 10</b>	<b>3: Probability</b> <p>Sample spaces, Probability rules, Combinatorial analysis, Conditional probability &amp; independence</p>	
<b>Week 11-12</b>	<b>4: Discrete Random Variables and Probability Distributions</b> <p>Discrete random variables, Probability mass functions, Cumulative distribution functions, Mean and variance of a discrete random variable,</p>	

	Uniform, binominal, and Poisson distributions	
<b>Week 13</b>	<b>5: Continuous Random Variables and Probability Distributions</b> Probability density functions, Mean and variance of a continuous random variable, Uniform and normal distributions, Central Limit Theorem	
<b>Week 14-15</b>	<b>6: Joint Probability Distributions</b> Joint and marginal distribution functions, Bivariate normal distribution, Linear combinations of random variables, Error analysis for nonlinear equations	
	<b>Final Examination</b>	

### Learning and Teaching Resources

#### مصادر التعلم والتدريس

	Text	Available in the Library?
<b>Required Texts</b>	1. "Numerical Methods for Engineers", Steven C. Chapra, Raymond P. Canale, McGraw Hill, 6 <sup>th</sup> edition, 2010. 2. "Numerical Methods for Engineers and Scientists", Joe Hoffman, McGraw-Hill Book Company, 1993. 3. "Applied Numerical Analysis", Gerald, C.F. and Wheatley, P.O., 6 <sup>th</sup> Edition, Pearson Education, 2006. 4. Introduction to probability and statistics: Principles and applications for engineering and computing sciences, Milton and Arnold, 4 <sup>th</sup> ed., McGraw – Hill (2002).	Yes
<b>Recommended Texts</b>	1. "Numerical Methods for Chemical Engineers with MATLAB Applications", Alkis Constantinides, Navid Mostoufi, Prentice Hall, 1999.	Yes
<b>Websites</b>		

### GRADING SCHEME

#### مخطط الدرجات

Group	Grade	التقدير	Marks (%)	Definition
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<b>Success Group</b> <b>(50 - 100)</b>	<b>A - Excellent</b>	امتیاز	90 - 100	Outstanding Performance
	<b>B - Very Good</b>	جيد جدا	80 - 89	Above average with some errors
	<b>C - Good</b>	جيد	70 - 79	Sound work with notable errors
	<b>D - Satisfactory</b>	متوسط	60 - 69	Fair but with major shortcomings
	<b>E - Sufficient</b>	مقبول	50 - 59	Work meets minimum criteria
<b>Fail Group</b> <b>(0 - 49)</b>	<b>FX – Fail</b>	مقبول بقرار	(45-49)	More work required but credit awarded
	<b>F – Fail</b>	راسب	(0-44)	Considerable amount of work required
<b>Note:</b>				
<p>NB Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.</p>				
<p style="text-align: center;"><b>Topics Covered (Syllabus)/ Numerical Analysis Laboratory Guide</b></p>				
<b>No.</b>	<b>Contents</b>			
1	Review of properties of Matlab programming language			
2	Bisection method and Secant method.			
3	Newton-Raphson method.			
4	Lagrange interpolation.			
5	Newton's forward and backward difference formulas.			
6	Trapezoidal rule.			
7	Simpson's 1/3 and 3/8 rules.			
8	Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon).			

9	Solution of linear system of equations by Iterative methods (Gauss-Seidel and Jacobi).
10	Solution of differential equation using Euler's method.
11	Solution of differential equation using Runge-Kutta method.
12	Solution of partial differential equations using explicit and implicit methods.
13	Solution of partial differential equations using Crank-Nicolson method.
14	Solution of steady state diffusion through catalyst
15	Solution of un-steady state diffusion through catalyst