



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	

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

	<ul style="list-style-type: none"> • Cubic spline interpolating polynomials.[3hr] <p>3. Curve Fitting</p> <ul style="list-style-type: none"> • Linear regression, Polynomial Models, Nonlinear Data.[2hr] <p>4. Root Finding:</p> <p>Roots of polynomials, Bisection method, Secant method, Newton-Raphson method.[3hr]</p> <p>5. Numerical Differentiation and 6. Numerical Integration:</p> <p>Forward, backward and central difference approximation.</p> <p>Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules. Double integrals using trapezoidal and Simpson's rules.[6hr]</p> <p>7. Solving System of Equations:</p> <p>Solution of linear system of equations by direct methods (Gaussian elimination and Gauss-Jordon). 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>8. Solution of Ordinary Differential Equations:</p> <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.[10 hr]</p> <p>Part Two : Basic Statistics in Chemical Engineering</p> <p>1: The Role of Statistics in Engineering</p> <p>Sample statistics, mean median, variance, standard deviation, etc.[2 hr]</p> <p>2: Data Summary and Presentation</p> <p>Histograms, Box plots[2 hr]</p> <p>3: Probability</p> <p>Sample spaces, Probability rules, Combinatorial analysis, Conditional probability & independence [4 hr]</p> <p>4: Discrete Random Variables and Probability Distributions</p> <p>Discrete random variables, Probability mass functions, Cumulative distribution functions, Mean and variance of a discrete random variable, Uniform, binomial, and Poisson distributions [3 hr]</p> <p>5: Continuous Random Variables and Probability Distributions</p> <p>Probability density functions, Mean and variance of a continuous random variable, Uniform and normal distributions, Central Limit Theorem[2 hr]</p> <p>6: Joint Probability Distributions</p> <p>Joint and marginal distribution functions, Bivariate normal distribution, Linear combinations of random variables, Error analysis for nonlinear equations[2 hr]</p>
Learning and Teaching Strategies	
Strategies	

	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 خلال 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 خلال 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

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

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

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1. "Numerical Methods for Engineers", Steven C. Chapra, Raymond P. Canale, McGraw Hill, 6 th 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 th Edition, Pearson Education, 2006. 4. Introduction to probability and statistics: Principles and applications for engineering and computing sciences, Milton and Arnold, 4 th ed., McGraw – Hill (2002).	Yes
Recommended Texts	1. "Numerical Methods for Chemical Engineers with MATLAB Applications", Alkis Constantinides, Navid Mostoufi, Prentice Hall, 1999.	Yes
Websites		

GRADING SCHEME				
مخطط الدرجات				
Group	Grade	التقدير	Marks (%)	Definition

Success Group (50 - 100)	A - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 - 49)	FX - Fail	مقبول بقرار	(45-49)	More work required but credit awarded
	F - Fail	راسب	(0-44)	Considerable amount of work required
Note:				
<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>				

Topics Covered (Syllabus)/ Numerical Analysis Laboratory Guide

No.	Contents
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