نموذج وصف البرنامج الاكاديمي

اسم الجامعة : تكريت

الكلية: الهندسة

القسم العلمي: الهندسة الكيمياوية

اسم البرنامج الاكاديمي او المهني: بكالوريوس هندسة كيمياوية

اسم الشهادة النهائية: بكالوريوس علوم في الهندسة الكيمياوية

النظام الدراسي: فصول دراسية

تاريخ اعداد الوصف : 2023/6/28

تاريخ مليء الملف: 2023/7/4

التوقيع

اسم رئيس القسم : م.مها نزار اسماعيل

التاريخ: ٢٠٢٥/١/٢١

التوقيع

اسم المعاون العلمي: ا.م.د. سعد محمود رؤوف

التاريخ: ٢٠٢٥/١/٢١

دقق الملف من قبل

شعبة ضمان الجودة والاداء الجامعي

اسم مدير شعبة ضمان الجودة والاداء الجامعي : م.د. احمد ياسر رديف

التاريخ: ٢٠٢٥/١/٢٠

التوقيع

٢٠٢٥/١/٢١

مصادقة السيد العميد

الاستاذ المساعد الدكتور

سعد رمضان احمد

عميد كلية الهندسة

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Calculus I**			**Module Delivery**	
Module Type	**Basic**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**MATH-101**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester (s) offered**	1	
Administering Department	Chemical Engineering		**College**	Engineeeing	
Module Leader	Hiba R. Mohammed		**e-mail**	Hibamohammed92@tu.edu.iq	
Module Leader's Acad. Title	Assist. Lecturer		**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	1
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Enable students to develop a comprehensive understanding of the calculus basic fundamentals of derivatives and integrals and their application and how to apply these concepts in science and engineering fields.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Calculate limits, derivatives, and indefinite integrals of various algebraic and trigonometric functions of a single variable. 2. Apply the definition of continuity to pure and applied mathematics problems. 3. Utilize the definition of the derivative to differentiate various algebraic and trigonometric functions of a single variable. 4. Use the properties of limits and the derivative to analyze graphs of various functions of a single variable including transcendental functions. 5. Employ the principles of the differential calculus to solve optimization problems, related rates exercises, and other applications. 6. Calculate the area of regions in the plane with elementary Riemann sums. 7. Utilize the Fundamental Theorem of Calculus and the techniques of integration, including u-substitution, to calculate the area of regions in the plane and the volume and surface area of solids of revolution.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Precalculus and functions (8 hrs) • Limits and continuity (14 hrs) • Derivatives and their applications (16 hrs) • Integral and its applications (16 hrs) • Transcendental Functions, First order differential equation (16 hrs)
Course Description	This course covers topics of differential and integral calculus including limits and continuity, higher-order derivatives, curve sketching, differentials, definite and indefinite integrals (areas and volumes), and applications of derivatives and integrals. In addition, students review and extend their knowledge of trigonometry and basic analytic geometry. Important objectives of the calculus sequence are to develop and strengthen the students' problem-solving skills and to teach them to read, write, speak, and think in the language of mathematics. In particular, students learn how to apply the tools of calculus to a variety of problem situations.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 80** **In class tests 5** **Seminars 5**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 35** **Prepartion for tests 15** **HomeWorks 10**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Precalculus
Week 2	Functions and their graph
Week 3	Limits and continuity
Week 4	Limits and continuity, Cont'd
Week 5	**First exam, Derivatives**
Week 6	Derivatives Cont'd
Week 7	Derivatives Cont'd
Week 8	Applications of Derivatives
Week 9	Integrals
Week 10	Integrals Cont'd
Week 11	Applications of Definite Integrals
Week 12	Transcendental Functions
Week 13	**Second Exam, Techniques of Integration**
Week 14	Techniques of Integration Cont'd
Week 15	First-Order Differential Equations, Power series
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Calculus and Analytic Geometry, by, Thomas and Finny**	No
Recommended Texts	**Calculus, Ron Larson, 9th edition, Cengage Learning, ISBN 0547167024**	No
Websites	None	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Engineering Mechanics**	**Module Delivery**	
Module Type	**Suplement**	**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**ENG-102**		
ECTS Credits	**5**		
SWL (hr/sem)	**125**		
Module Level	1	**Semester (s) offered**	1
Min number of students	15	**Max number of students**	100
Administering Department	Mechanical Engineering	**College**	Engineering
Module Leader	Sabah Mahdi Salih	**e-mail**	sabahmahdi@tu.edu.iq
Module Leader's Acad. Title	Assistant Professor	**Module Leader's Qualification**	MSc
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	Dr. Ahmed Faaiq Sultan	**e-mail**	Ahmed.f.sultan@tu.edu.iq
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**		1
Co-requisites module	None	**Semester**		-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية		1) To provide definition of force and moment vectors and give necessary vector algebra 2) To explain the concept of equilibrium of particles and rigid bodies in plane and 3D space 3) To give information about support types and to give ability to calculate support reactions 4) To explain the equilibrium of structures and internal forces in trusses, and frames 5) To give information about distributed loads 6) To explain centroid of bodies and Figures. 7)To provide information on moment of inertia
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1)	2) Use both conceptual and numerical techniques to solve engineering problems. 3) Analyze and develop free-body diagrams for any system of forces in two and three dimensions. 4) Understand and use the general idea of equilibrium of a particle. 5) Understand and use the general ideas of force system resultants. 6) Determine the moment of a force about an arbitrary point and/or axes 7) Analyze the equilibrium of rigid bodies under any system of forces. 8) Analyze trusses, beams, frames, and machines. 9) Calculate center of gravity, centroids, and moments of inertia. 10) Apply friction forces and analyze their different applications.
Indicative Contents المحتويات الإرشادية		Indicative content includes the following. • Force Vectors (8 hrs) • Force System Resultants (8 hrs) • Equilibrium of a Rigid Body (8 hrs) • Friction (8 hrs) • Center of Gravity and Centroid (6 hrs) • Moments of Inertia and virtual work (8 hrs) • Structure (trusses and Frames) (10 hrs)
Course Description		The course covers the following topics; statics of particles: forces in plane, forces in space, equilibrium, moment of a force, moment of a couple, equivalent systems of forces on rigid bodies, equilibrium in two dimensions, equilibrium in three dimensions, distributed forces: centroids and center of gravity, analysis of structures: trusses, frames and machines, internal forces in beams and cables, friction, moments of inertia of areas, moments of inertia of masses.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies		The learning and teaching strategy is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 48** **In class tests 2** **Seminars 4** **Discussions 6**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Prepartion for tests 20** **Homeworks 15**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments (Homeworks)	5	10% (10)	2, 4, 6, 8, 10	LO # 1, 2, 3, 4, 5 and 6
	Seminars	4	8% (8)	Continuous	
	Discussions	6	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-5
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
week1	General principles, Principles of statics, vectors
Week 2	Planar forces, resultant of a force system
Week 3	Planar forces, resultant of a force system
Week 4	The free body diagram, definition of moment, moment of a couple
Week 5	The free body diagram, definition of moment, moment of a couple
Week 6	Equilibrium in 2-D, free body diagrams, equations of equilibrium
Week 7	Midterm exam
Week 8	Equilibrium in 3-D, free body diagrams, equations of equilibrium
Week 9	STRUCTURES Trusses and frames
Week 10	STRUCTURES Trusses and frames
Week 11	Center of mass, Gravity and centroid
Week 12	Centroids of Lines, Areas, and Volumes
Week 13	Moments of inertia

Week 14	Moments of inertia
Week 15	Friction (dry friction)
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Engineering Mechanics-Statics, J.L.Meriam, L.G.Kraige, Wiley, 5th Edition, 2003, ISBN: 0-471-26607-8**	Yes
Recommended Texts	**Engineering Mechanics-Statics, Hibbeler, R.C.13th Edition, Pearson Prentice Hall, 2016, ISBN 978-0-13-31892-2."**	yes
Websites	N/A	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**English I**			**Module Delivery**	
Module Type	**Suplement**			**Theory** **Lecture** **Tutorial** **Project** **Seminar**	
Module Code	**ENG-107**				
ECTS Credits	**3**				
SWL (hr/sem)	75				
Module Level	1		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Ahmed Subhi Abdulla		**e-mail**	Ahmedsubhi1981@tu.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Saba A. Gheni		**e-mail**	ghenis@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	
Relation With Other Modules العلاقة مع المواد الدراسية الأخرى					

Prerequisite module	None	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Identify various reading skills and apply them in reading, referencing and summarizing literature on engineering 2. Identify various skills of technical presentation and apply them in conducting short technical presentations based on information extracted from readings 3. Identify technical discussion skills and apply these in planning and conducting simulated technical discussions characteristic of those that go on in engineering contexts. 4. Identify and compare the structures and language characte-ristics of various types of written study and workplace reports characteristic of those produced by engineering students and practicing engineers (e.g., incident reports and progress reports) mainly, and applying this knowledge in writing one of the latter 5. Develop communication skills through active participation in class and group activities.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Technical presentations (5 hrs) • Conducting technical discussions about engineering projects (5 hrs) • Writing technical documents (5 hrs) • Writing business correspondence (5 hrs)
Course Description	This course is designed to provide engineering students with the necessary oral and written skills required for effective communication in academic and workplace contexts, both with experts in their field and lay persons. It begins by introducing them to the principles of good academic practice, which are also presented as a model for ethical workplace practice, and thus help them to avoid issues such as plagiarism. The main part then leads on to developing research and summarizing skills that form the basis for the later activities. Students next learn to apply these skills to conducting technical presentations, as well as in group discussions that culminate in project planning activities.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 15** **In class tests 2** **Seminars 13**	30	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 12** **Preparation for tests 13** **HomeWorks 10** **Project 10**	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	75		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	A technical presentation Students will perform various secondary research skills acquired to extract information of an engineering topic from different sources. They will then conduct a short technical presentation based on this information, using the presentation skills learnt
Week 2	
Week 3	
Week 4	Technical discussions and proposal writing Incorporating research results from the previous activities, students will develop a customised solution to address a context-specific problem facing a client's organization. The solution will need to be written in a recognized proposal format (e.g., a blueprint). Each student will craft one section of the document according to her/his role on the project team. Students will also plan and conduct a simulated technical
Week 5	
Week 6	

	team meeting with the client team to explain and discuss the solution by applying various planning and discussion skills learnt
Week 7	Midterm exam
Week 8	Conducting technical discussions about engineering projects Students will be guided to identify technical discussion skills through various types of exploratory and/or consciousness-raising activities, such as watching sample discussions and evaluating their effectiveness. They learn how to discuss with a client the customised technical design of a solution that can address a context-specific problem facing the client. They then apply these skills in conducting simulated technical team discussions, according to the roles assigned to them.
Week 9	
Week 10	
Week 11	A technical report Each student produces a technical report by applying the knowledge gained in the related TLAs
Week 12	
Week 13	
Week 14	Writing business correspondence Students will produce a business email, based on the results of the previous activities, and by applying the textual features learnt.
Week 15	
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Beer, D. & McMurrey, D. 2004, A Guide to Writing as an Engineer (2nd ed), New York: Wiley	No
Recommended Texts	Borowick, Jerome N., 2002, Technical Communication and its Applications (2nd ed), New Jersey: Prentice-Hall, Inc.	No
Websites	http://umich.edu/~elements/5e/lectures/index.html	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Introduction to Chemical Engineering**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**CHEM_ENG 101**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester (s) offered**	1	
Min number of students	20		**Max number of students**	80	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Mawah Noori Mohammed		**e-mail**	Marwa.n.mohammed@tu.edu.iq	
Module Leader's Acad. Title	Senior lecturer		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Hayder Akram Arif		**e-mail**	h.alnasri@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	-
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	To achieve its mission, the subject provides the Identify and understands the unit operations involved dimensions, units, symbols and conversion factors. Basis of calculation, principles and expressions of Density, specific gravity, Temperature, Pressure, Also, apply ideal gas rule and equations of state for real gases.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. An ability to define units, dimensions, and their conversion via conversion factors. 2. An ability to explain the principles of density and specific gravity, specific gravity scales 3. An ability to make estimations mole concept, mole fraction, mass fraction and demonstrate an understanding the concept of choosing basic. 4. An ability to understand the impact of Temperature, Pressure and their Scales. 5. An ability to identify the Ideal gas law, Ideal gas mixtures, Real gas relationships, and Real gas mixtures. 6. An ability to understand the concept of material balances without chemical reaction and demonstrates their application in different types of processes.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction to chemical engineering. Specify the basic and derived units in SI and American Engineering (AE) systems for mass, length, volume, density. Conversion of units and conversion factors (week1/4 hr) . • Explain and collection the difference between mass, mole, density, specific gravity, flow rate, mole and mass fraction formula, unites and solve examples. **Assignments** 1 (week 2&3 /8hr) • Investigate the concept and analyses of multicomponent solutions and mixtures, concentration of liquid solutions molarity, molality, normality, and parts per million (ppm). Assignments 2. Quiz1 (week 4&5 /8 hr) • Define temperature and explain the difference between absolute and relative temperature. Convert a temperature in any of the four common scales. Quiz 2 (week 6 /4 hr) • Midterm exam and Seminars 1 (week 7 / 4 hr) • Pressure and Its units. Measurement of Pressure. Differential Pressure Measurements. **Assignments** 3 (week 8&9 / 8 hr) • Brief understanding the Ideal Gas Law. Ideal Gas Mixtures and Partial Pressure. Quiz 3 (week 10&11 / 8 hr)		

	• Introduction the concept of material balance and Recognize different terms and types of process. Comprehend and execute the 10 steps strategy for solving material balance problem without chemical reactions. **Assignments 4** (week 12&13 / 8 hr) • Material balances for a process involving more than unit and multiple units material balance. Case study to reinforce the concepts material balance. Quiz 4. Seminars 2 (week 14 &15 / 8 hr) • **Final Exam** (week `16)
Course Description	This subject builds a strong foundation for the professional development of its students via deep understanding of the basic concepts of chemical engineering principles. Topics that will be covered include the definition of chemical engineering, dimensions, units, symbols and conversion factors of temperature, pressure, also, basis of calculation, Principles and expressions of Ideal gas law.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The effective strategies of teaching this subject are rewarding professional careers by skillfully leveraging chemical engineering principles. To achieve these broad objectives, the curse provides the knowledge, skills and professional development concepts of lecturers, tutorials and seminars.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 67** **In class tests 4** **Seminars 4**	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 45** **Preparation for tests 25** **HomeWorks 15**	75	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	16% (16)	4,6,11,14	LO #1, 2, 3, 4,5 and 6
	Assignments	6	16% (16)	2,5,9,12	LO #1, 2, 3, 4, 5 and 6
	Seminars	4	8% (8)	7, 15	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-4
	Final Exam	3	50% (50)	16	All

Total assessment	100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	-Explain the difference between dimensions and units. -Specify the basic and derived units in SI and American engineering (AE) systems. -Conversion of units and conversion factors
Week 2	-Explain the difference between weight and mass. - Collection the mole, density, specific gravity and flow rate
Week 3	Mole fraction and mass (weight) fraction formula, unites and solve examples
Week 4	Analyses of multicomponent solutions and mixtures
Week 5	Concentration of liquid solutions molarity, molality, normality, and parts per million (ppm)
Week 6	-Explain the difference between absolute and relative temperature. - Convert a temperature in any of the four common scales.
Week 7	Midterm exam
Week 8	-Define pressure. atmospheric pressure, barometric pressure, standard pressure, and vacuum -Explain difference between absolute and relative (gauge pressure). -Convert a pressure measured in one set of units to another
Week 9	Calculate the pressure from the density and height of a column of static fluid.
Week 10	-Calculate the values and units of the ideal law constant R in any of units from the standard conditions.
Week 11	-Ideal Gas Mixtures and Partial Pressure -Calculate the specific gravity and the density of a gas
Week 12	The Concept of a material balance. Open, closed, steady-state and unsteady-state systems. - Determine whether positive or negative accumulation occurs in a process. -Recognize a batch or semi-batch process and write the material balance for it
Week 13	- Comprehend and execute the 10 steps strategy for solving material balance problem without chemical reactions.
Week 14	-Material balances for a process involving more than one unit. -Solve problems multiple unit material balance
Week 15	A case study to reinforce the concepts of single and multiple units material balance without chemical reaction**.**
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	David M Himmelblau, ***Basic Principles and Calculations in Chemical Engineering, seventh Edition***	Yes

Recommended Texts	1- Hougen A, Watson K M, Ragatz R A, Chemical Process principles, John Wiley 2- Richard M Felder & Ronald W. Rousseau Elementary Principles of Chemical Processes, Wiley India.	No
Websites		

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Laboratory safety**			**Module Delivery**	
Module Type	**Suplement**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 102**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	1		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Saba A. Gheni		**e-mail**	ghenis@tu.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Safaa M. R. Ahmed		**e-mail**	safaamohamed@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Laboratory and process safety analysis which emphasizes prevention and mitigation. Application of chemical engineering principles to assessing hazards and risk.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Development of safety skills may be divided into four emphasis areas. 2. Recognize Hazards 3. Assess Risks 4. Minimize Risks 5. Prepare for Emergencies
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: • Introduction (2 hrs) • Recognize Hazards (10 hrs) • Assess Risk (10 hrs) • Minimize Risks (8 hrs) • Prepare for Emergencies (8 hrs)
Course Description	This course provides an introduction to laboratory safety concepts, including chemical, biological, and physical hazards, for sophomore Chemical & Biomolecular Engineering students. Students will acquire a level of safety knowledge appropriate to enter laboratories in the Chemical Engineering department, to ask intelligent questions about laboratory safety, and to understand further training in laboratory-specific hazards. Training in the ethical dimension of safety is included.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	The learning and teaching strategy is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems related to lab safety.

Student Workload (SWL)

الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 35** **In class tests 2** **Seminars 8**	45	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 10**	55	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.5

Preparation for tests **10** **HomeWorks** **15** **Project** **20**				
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100			

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	4	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	4	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to Laboratory Safety: The Texas Tech Incident (Lessons to be learned: Shared Responsibilities)
Week 2	Risks in a Research Laboratory Health Effects Due to “Hazardous” Chemical Exposure (How Does One Determine the Hazards Associated with Specific Chemicals?, Exposure Routes, Toxicity Risk Assessment. Personal Protective Equipment (PPE) Proper Attire (Eye/Face Protection, Lab Coats, Gloves, Respirators, Disposal/Removal of PPE)
Week 3	Emergency Equipment Safety Showers/Eye Washes, Case Study Dartmouth Chemical Poisoning (Key Lessons)
Week 4	Handling the Accidental Release of Hazardous Materials. Notifications, Spill Containment and Clean-up. Leaking Gas Cylinders, Fires Classification, Fire Extinguishers (how they work, types), Risk Assessment
Week 5	Case Study University of Texas Austin Sodium Fire (Lessons Learned).The New Safety Data Sheets (SDS) versus the Old Material Safety Data Sheets (MSDS)
Week 6	Assessment of Chemical Toxicity, Toxic Hazards (Dose, Risk Assessment, Types of Toxins, Flammable Hazards, Flammability Characteristics, Flammability Classes, Causes of Ignition, Reactive Hazards, Explosives
Week 7	**Midterm exam**
Week 8	Case Study University of Wisconsin – LiAlH4 Explosion (Lessons Learned). Ordering and Receiving Chemicals
Week 9	Regulatory Compliance – History of Occupational Safety and Environmental Laws. General Considerations (Chemical Segregation, Transfer and Transport, Chemical Fume Hoods (Safety, Types, Operation), Other Types of Ventilation)

Week 10	Working with Highly Toxic Compounds (General Considerations, Planning, Precautions for Minimizing Exposure – Handling, In the Event of a Spill). Case Study DuPont Facility – Phosgene Release (Lesson Learned)
Week 11	Managing and Working with Chemicals. Working with Flammable Substances (Standard Operating Procedures). Working with Highly Reactive or Explosive Substances
Week 12	Working with Compressed Gases (Parts of the Cylinder, Cylinder Pressure Regulator, Storage Guidelines, Transporting Cylinders, Handling Compressed Gas Cylinders)
Week 13	Working with Cryogenics (Health Hazards, Liquid N2), Waste Handling, Characterization of Waste
Week 14	Working with Water (liquid)-dependent Equipment (Hazards, Proper Use, Heating Baths) Working with High Pressure/Vacuum. Working with Vacuum Pump. Working with Stirring and Mixing Devices. Working with Heating Devices (Variacs, Oil, Salt, Sand Baths, Microwave Ovens. Ultrasonicators and Centrifuges and HPLCs
Week 15	Biosafety, Radiation, and Animals I. Radiation. Chemicals such as acrylamide & ethidium bromide. Pathogens. Biological waste handling. Recombinant DNA. Mammalian cell culture. Case Study. Hazards of nanoparticles. Preventative Measures. Disposal
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	Hill, Robert H, Jr. and David C. Finster, Laboratory Safety for Chemistry Students, Wiley, Hoboken, 2010. This is a comprehensive text that partitions safety considerations into three tiers, with increasingly more involved considerations being reflective of increased knowledge by students. Emphasis is on learning on a "need to know basis.	No
Recommended Texts	Guidelines for Chemical Laboratory Safety in Academic Institutions, ACS Committee on Chemical Safety, Washington, DC., 2016. A comprehensive document providing a broad overview of the range of safety considerations for undergraduate, graduate and continuing safety education.	No
Websites	TBD	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Organic Chemistry**			**Module Delivery**	
Module Type	**Basic**			**Theory** **Lecture** **Tutorial** **Laboratory** **Seminar**	
Module Code	**CHEM 101**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	100	
Administering Department	chemical Engineering		**College**	Engineering	
Module Leader	Mohammed Mezher Aftan		**e-mail**	mohamedmizher@tu.edu.iq	
Module Leader's Acad. Title	Assistant Professor		**Module Leader's Qualification**	Dr.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Israa Talib		**e-mail**	israatalib@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	1
Co-requisites module	CHEM_ENG102	**Semester**	1

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	1) To impart the basic concepts of organic chemistry 2) To develop understanding about concepts on organic reactions for analysis of unit processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	At the end of this course, you (the student) will be able to: 1. Interpret 3D representations of molecular structures. 2. Understand the geometry resulting from atomic orbital hybridization. 3. Know how electronegativity and resonance causes charge distribution on molecules 4. Relate geometry and charge distribution to chemical and physical properties 5. Understand how kinetics, thermodynamics and statistical mechanics describe chemical reactions 6. Draw the structures of the products given specific reactants 7. Write the mechanisms of reactions 8. Understand how physical conditions influence rate and path of reactions 9. Use IR, NMR, UV, and MS to determine molecular structure.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. **The theoretical part** • Introduction to organic chemistry, Hybridization (3hrs) • Introduction for Hydrocarbons (Alkane, alkenes, alkynes/cyclic and aliphatic) (6hrs) • Aromatic compound (6hrs) • Structure and Chemical reactions of alkyl halides (3hrs) • Alcohols, Ethers, epoxides, and sulfides (3hrs) • Stereochemistry (6hrs) • Carbonyl group (Ketones and Aldehydes) (3hrs) • Carbonyl group (Carboxylic acid and derivatives of Carboxylic acid) (3hrs) • ^{1}HNMR, FTIR, ultraviolet, mass spectroscopy (9hrs) **Practical part** • Thirteen practical experiments, two hours for each practical experiment. (30hrs)
Course Description	This course offers students the opportunity to learn the nature of carbon in organic compounds. It presents general principles of organic chemistry related to nomenclature, structure, stereochemistry, uses and synthesis.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب				
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **38** **In class tests** **2** **Seminars** **5** **Laboratory** **30**	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing35** **Preparation for tests** **25** **Homeworks** **15**	75	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	3	15% (15)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments (Homeworks)	4	20% (20)	2, 4, 6, 8, 10	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-5
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered

Week 1	Introduction to organic chemistry, Hybridization
Week 2	Introduction for Hydrocarbons (Alkane, alkenes, alkynes/cyclic and aliphatic)
Week 3	Introduction for Hydrocarbons (Alkane, alkenes, alkynes/cyclic and aliphatic)
Week 4	Aromatic compound
Week 5	Aromatic compound
Week 6	Structure and Chemical reactions of alkyl halides
Week 7	**Midterm exam**
Week 8	Alcohols, Ethers, epoxides, and sulfides
Week 9	Stereochemistry
Week 10	Stereochemistry.
Week 11	Carbonyl group (Ketones and Aldehydes)
Week 12	Carbonyl group (Carboxylic acid and derivatives of Carboxylic acid)
Week 13	1HNMR, FTIR, ultraviolet, mass spectroscopy
Week 14	1HNMR, FTIR, ultraviolet, mass spectroscopy
Week 15	1HNMR, FTIR, ultraviolet, mass spectroscopy
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	Finar, Organic Chemistry, Vol. I and II, ELBS	Yes
Recommended Texts	1. Morrison & Boyd, Organic Chemistry, Prentice-Hall of India- 2. Paula Yurkanis Bruice Organic Chemistry 3. Sony, P.L., Organic Chemistry, S. Chand	No
Websites	N/A	

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Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Analytical Chemistry**	**Module Delivery**	
Module Type	**Basic**	**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM 102**		
ECTS Credits	**6**		
SWL (hr/sem)	**150**		
Module Level	1	**Semester (s) offered**	2
Administering Department	15	**College**	100
Module Leader	Chemical Engineering	**e-mail**	Engineering
Module Leader's Acad. Title	Dr. Israa T. Humeidy	**Module Leader's Qualification**	israatalib@tu.edu.iq
Module Tutor	Assistant Professor	**e-mail**	Ph.D.
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	Dr. Mohammed Mezher	**Version Number**	mohamedmizher@tu.edu.iq

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Laboratory Safety (CHEM_ENG 102)	**Semester**	2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	Enable students to understanding and Knowledge of the principle of analytical chemistry and understand the procedures and applications of chemical reactions. In depth study of analytical chemistry for a wide range of chemical reactions. Introducing students to instrumental techniques and modern devices used in the instrumental analysis laboratory by studying the details of the devices' work and conducting practical experiments.Work to enhance the student's confidence and ability to deal with chemicals and laboratory equipment.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Enable students to know the basic concepts of analytical chemistry. 2. Enabling students to know the types of chemical analysis (gravimetric and volumetric analysis). 3. Enable students to know chemical calculations and chemical equilibrium. 4. Enabling students to know the Titration methods and chemical indicators. 5. Enabling students to know what is the Acid – Base equilibrium and what is the pH solution. 6. Enable students to know solubility, solubility product constant, precipitation reactions, and molecular precipitation. 7. Understand the nature of electromagnetic radiation and its effect on matter. 8. Understand the procedures and applications of analytical techniques. 9. Understand the principles of spectroscopic methods.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. **The theoretical part** • Principles of gravimetric analysis(4 hrs) • Principles of Volumetric analysis(4 hrs) • Acid – Base Equilibria and pH of solutions(4 hrs) • Titration curves and chemistry of indicators(5 hrs) • Buffer solutions(3 hrs) • Solubility Product (5 hrs) • Electromagnetic radiation and its effect on matter (6 hrs) • principle of UV - Visible Spectroscopy (6 hrs) • The principle of HPLC & GC (8 hrs) **Practical part** • Fifteen practical experiments, two hours for each practical experiment. **(30 hrs)**		
Course Description	This course aims to know and understand the principle of analytical chemistry and understand the procedures and applications of chemical reactions and analysis of substances through the use of automated analytical equipment prepared for this purpose. An in-depth study of analytical		

	chemistry for a wide range of chemical reactions and their development through laboratory experiments, developing skills in titrimetry, volumetric and gravimetric analysis, and instrumental analysis.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching strategy is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.In addition, Encourage discussions and questions to clear up any misconceptions

udent Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 30** **In class tests 10** **Seminars 10** **Discussions 10** **Laboratory 30**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 25** **Preparation for tests 25** **Homework 10**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	5	10% (10)	2, 4, 6, 8, 10	LO # 1, 2, 3, 4, 5 and 6
	Seminars	4	8% (8)	Continuous	
	Discussion	6	12%(12	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered

Week 1	Principles of gravimetric analysis and calculations based on the chemical analysis
Week 2	Gravimetric relations in the formula and chemical equation**(**Stoichiometric calculations)
Week 3	Principles of Volumetric analysis **&(** Molar methods**,** Equivalent methods)
Week 4	Acid – Base Equilibria & pH of solutions
Week 5	Calculation of pH of aqueous solution
Week 6	Titration curves
Week 7	Acids – Bases Indicators chemistry of indicators
Week 8	Buffer solutions
Week 9	Solubility Product
Week 10	Electromagnetic radiation and its effect on matter & Types of electronic transitions
Week 11	principle of UV - Visible Spectroscopy
Week 12	Beer-Lambert's law and its applications
Week 13	principle of atomic Absorption Spectroscopy(AAS)
Week 14	The principle of High Performance Liquid Chromatography
Week 15	The principle of Gas Chromatography
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Introduction of laboratory safety
Week 2	Separation and identification positive ions
Week 3	Separation and identification negative ions
Week 4	the preparation of liquid solutions (molarity- normality -density)
Week 5	the preparation of solid solutions **(**(molarity- normality)
Week 6	Neutralization titration
Week 7	Precipitation titration
Week 8	Redox titration
Week 9	Complexometric titration
Week 10	Determination of carbonate
Week 11	Determination of iron
Week 12	Determination of calcium
Week 13	Determination of aluminum

Week 14	Determination of chromium and cobalt in their mixture using spectrophotometric
Week 15	Find the concentration of an unknown solution Fe^{+3} using spectrophotometric
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Douglas A. Skoog, Fundamentals of Analytical Chemistry (2004)	Yes
Recommended Texts	David Harvey, modern Analytical Chemisrty, DePauw University,(2000),James M. Smith	No
Websites		

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Calculus II**			**Module Delivery**	
Module Type	**Basic**			**Theory** **Lecture** **Tutorial**	
Module Code	**MATH-102**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester (s) offered**	2	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Rana N. Hachim		**e-mail**	rana.n.hachem@tu.edu.iq	
Module Leader's Acad. Title	Assistant Lecture		**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		

Review Committee Approval	01/06/2023	Version Number	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Calculus I (MATH-101)	**Semester**	1
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	1) Be able to calculate the tangent and normal vectors. 2) Be able to apply differential operators to scalar and vector fields. 3) Be able to determine the limit and continuity of a functions of two variables. 4) Be able to determine the domain, codomain, range of functions of two or more variables, to do algebraic operations between them and sketch their graphs. 5) Be able to evaluate the derivatives of functions ot two or more variables. 6) Be able to solve simple real problems related to derivatives of functions of two or three variables. 7) Be able to solve problems related to integral of functions of two or three variables. 8) Be able to Understand that the modulus of a complex number is equal to the square root of the sum of the squares of the real and imaginary parts of the number.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1) Understanding of the concepts of vectors in space and vector valued functions. 2) Ability to compute derivatives and integrals of vector-valued functions and solve related problems with various applications. Evaluate the behaviors and graphs of functions 3) Ability to compute multiple integrals and use them in various applications ability to compute multiple integrals and use them in various applications. 4) understanding of the concepts of calculus of multi-dimensional quantities and solve related problems with various applications. 5) Ability to identify, formulates, and solves engineering problems. 6) Understanding that the modulus of a complex number is equal to the square root of the sum of the squares of the real and imaginary parts of the number.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Vectors (16 hrs) • Function of Two and more Variables and Their Derivatives (20hrs)

	• Multiple Integral (20hrs) • Complex Number (16hrs)
Course Description	A continuation of Calculus I. This is a study of multivariable calculus including vector-valued functions and the calculus of curves in space, differential calculus of multivariate functions, integral calculus of multivariate functions, spherical and cylindrical coordinates, line and surface integrals.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **88** **In class tests** **2**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **dorm, home memorizing** **20** **Prepartion for tests** **20** **Homeworks** **20**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	18% (18)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments (Homeworks)	6	12% (12)	2, 4, 6, 7	LO # 1, 2, 3, 4, 5 and 6
Summative assessment	**Midterm Exam**	2	20% (20)	8	LO # 1-6
	Final Exam	3	50% (50)	16	All

Total assessment	100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Vectors , Vector in Space
Week 2	Dot and Cross Products on Vectors
Week 3	Equations for Lines and Planes in Space
Week 4	Function of Two and more Variables and Their Derivatives
Week 5	Partial Derivatives , Chain Rules
Week 6	Gradient and Directional Derivatives
Week 7	Applications of Partial of Derivative (maximum, minimum and saddle point)
Week 8	Midterm exam
Week 9	Double integral
Week 10	Double integral in polar coordinates
Week 11	Changing Cartesian integrals into Polar integrals
Week 12	Triple integral (Rectangular, Cylindrical and Spherical)
Week 13	Complex Number , Addition, Subtraction, Multiplication and Division
Week 14	Polar representation of Complex Number
Week 15	Complex Number
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	**Calculus and analytical geometry , George B. Thomas Jr. ; Addison – Wesley publishing company ,7th edition ,1988.**	Yes
Recommended Texts	**- Calculus; James Stewart ,10th edition, 2003.**	No
Websites	N/A	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Electrical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Computer Science**			**Module Delivery**	
Module Type	**Supplement**			☐ Theory ☐ Lecture ☐ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**ENG-104**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	1		**Semester (s) offered**	1	
Administering Department	Electrical Engineering		**College**	Engineering	
Module Leader	Assistance lecture. Sahar Adnan Ahmed		**e-mail**	saharadnan@tu.edu.iq	

Module Descriptor

Module Leader's Acad. Title	Assistance Lecturer	**Module Leader's Qualification**	Msc.
Module Tutor	Assistance lecture. Sahar Adnan Ahmed	**e-mail**	saharadnan@tu.edu.iq
Peer Reviewer Name	Dr. Jalal N. Abdulbaqi	**e-mail**	Jalal.abdulbaqi@tu.edu.iq
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	The aim of this module is to provide students with a comprehensive understanding of the key concepts and principles of computer science. Through the study of topics such as history, data representation, computer components, algorithms, programming languages, operating systems, applications, internet and networking, and cybersecurity, students will gain a broad understanding of the field of computer science and how it has evolved over time.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Describe the historical development of computer science and its impact on society. 2. Understand the various methods of data representation and manipulation. 3. Identify the components of a computer and their functions. 4. Design and implement algorithms for a range of problems. 5. Understand the principles of programming languages and apply them to develop software. 6. Understand the structure and functions of operating systems. 7. Identify and analyze a range of applications of computer science. 8. Understand the principles of internet and networking technologies. 9. Identify and analyze various cybersecurity threats and methods of prevention.
Indicative Contents المحتويات الإرشادية	- History introduction: Evolution of computer science, pioneers and important milestones - Data representation: Binary numbers, hexadecimal, character sets, ASCII and Unicode

	- Computer components: CPU, memory, input/output devices, storage devices - Algorithms: Definition, representation, complexity, searching, sorting, optimization - Programming languages: Syntax, semantics, variables, functions, control structures, abstraction - Operating systems: Structure, file systems, process management, memory management - Applications: Databases, artificial intelligence, computer graphics, human-computer interaction - Internet and networking: Protocols, network architectures, security, privacy - Cybersecurity: Threats, attacks, prevention, detection, mitigation
Course Description	This course offers students a comprehensive exploration of the fundamental concepts and principles that underpin the field of computer science. By delving into various subjects including the historical development of computing, data representation, computer components, algorithms, programming languages, operating systems, applications, internet and networking, and cyber-security, students will develop a well-rounded understanding of the discipline. By examining the evolution of computer science over time, students will acquire a broad perspective on the field and its significance in contemporary society. Through a combination of theoretical knowledge and practical applications, this module equips students with the necessary foundation to pursue further studies or careers in computer science.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The module will use a range of learning and teaching strategies, including: - **Lectures**: To provide students with an overview of the main concepts and principles. - **Labs**: To provide students with hands-on experience of programming, algorithms, and data representation.

	- **Assignments and Quizzes**: To provide students with opportunities to apply their knowledge and skills to real-world problems and check their understanding.

Student Workload (SWL)

الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 25** **Preparation for tests 15** **Homeworks 25**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation

تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	2, 4, 6, 10	LO #1, 3, 5 and 6
	Assignments	2	15% (15)	3, 5, 13, 14	LO # 2, 4, 7 and 8
	Lab	14	15% (15)	Continuous	
Summative assessment	**Midterm Exam**	1.5	10% (10)	7	LO # 1-5
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	History introduction: Evolution of computer science, pioneers and important milestones
Week 2	Data representation: Binary numbers, hexadecimal, character sets, ASCII and Unicode
Week 3	Computer components: CPU, memory, input/output devices, storage devices
Week 4	Algorithms: Definition, representation, complexity, searching, sorting, optimization
Week 5	Programming languages I
Week 6	Programming languages II
Week 7	Midterm
Week 8	Operating systems I
Week 9	Operating systems II
Week 10	Applications I: Information Systems
Week 11	Applications II: artificial intelligence
Week 12	Applications III: computer graphics, human-computer interaction
Week 13	Networking
Week 14	Internet
Week 15	Cybersecurity: Threats, attacks, prevention, detection, mitigation
Week 16	Final Exam

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: Computer Operating System (e.g. Microsoft Windows)
Week 2	Lab 2: Document Processing I (e.g. Microsoft Word)
Week 3	Lab 3: Document Processing II (e.g. Microsoft Word)
Week 4	Lab 4: Data Processing I (e.g. Microsoft Excel)
Week 5	Lab 5: Data Processing II (e.g. Microsoft Excel)

Week 6	Lab 6: Presentation Slides I (e.g. Microsoft PowerPoint)
Week 7	Lab 7: Presentation Slides II (e.g. Microsoft PowerPoint)

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Computer Science Illuminated, by Dale, N and Lewis, J, 7th Ed, Jones & Bartlett Learning, 2020**	No
Recommended Texts	-	-
Websites	-	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Engineering drawing**		**Module Delivery**	
Module Type	**Suplement**		**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**E104**			
ECTS Credits	**4**			
SWL (hr/sem)	100			
Module Level	1	**Semester (s) offered**	2	
Administering Department	Chemical Engineering	**College**	Engineering	
Module teachers	**1-Sabah Mohammed Hassan** **2-Ekehwanh Abd Al-Majeed Rasheed**	**e-mail**	**sabahmohammed@tu.edu.iq** **ekehwanh.a.almajeed@tu.edu.iq**	
Module Leader's Acad. Title	**Asst.Lecturer**	**Module Leader's Qualification**	MSc	

Module Tutor	None	**e-mail**	None
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	1. Define and explain the uses of different drawing equipment. 2. Identify the different drawing equipment. 3. Layout drawing papers and prepare a title block. 4. Practically distinguish the types of dimensioning. 5. Carry out geometrical construction of different shapes. 6. Carry out isometric and orthographic drawing of objects.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	On completion of this course students will be able to: 1. Prepare and understand drawings. 2. Identify various curves used in Engineering Drawing and their applications. 3. Use the principles of orthographic projections. 4. By studying about isometric projections students will be able to visualize three-dimensional objects and that will enable them to design new products. 5. Design and fabricate surfaces of different shapes. 6. Represent the objects in three dimensional appearances
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction to Drawing Equipment (6hrs) • Engineering operations (18hrs) • Orthographic Projection (18hrs) • Sectional views(18hrs) • Isometric Projections(21hrs) • Dimensioning(9hrs)
Course Description	An engineering drawing course focuses on usage of drawing instruments, lettering, construction of geometric shapes, etc. Students study use of dimensioning, shapes and angles or views of such drawings. Dimensions feature prominently, with focus on interpretation, importance and accurate reflection of dimensions in engineering drawing. Other areas of study in this course may include projected views and development of surfaces.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 58** **In class tests 2**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 12** **Prepartion for tests 10** **Homeworks 18**	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.7
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	30% (30)	all	LO #1, 2, 3, and 4
	Assignments	6	10% (10)	All	LO # 1, 2, 3, 4, 5 and 6
Summative assessment	**Midterm Exam**	2	30% (30)	7	LO # 1-3
	Final Exam	3	30% (30)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to engineering drawing

Week 2	Primary elements of drawings
Week 3	Engineering operations(line bisection and division)
Week 4	Engineering operations(polygon)
Week 5	Engineering operations (ellipse)
Week 6	Engineering operations (Tangency and loci applications)
Week 7	*Dimensioning*
Week 8	Sections and Sectional views
Week 9	Sections and Sectional views
Week 10	Orthographic Projections
Week 11	Orthographic Projections
Week 12	Oblique Projection
Week 13	Isometric Projections
Week 14	Isometric Projections
Week 15	Isometric Projections
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Engineering Drawing, Abdul-Rassul Abdul-Hussain, University of Technology, 1986.	Yes
Recommended Texts	SIMMONS, C., MAGUIRE, D., PHELPS, N., 20**21**. Manual of engineering Drawing Technical product specification and Documentation to British and International Standards, **4** ed, Elsevier Ltd:Oxford REDDY, K. , 2008. Textbook of Engineering Drawing. 2ed, Adithya Art Printers:Hyderabad SHAH, M. B. , RANA, B. C. , 2007. Engineering Drawing. 2ed, Dorling Kindersley(India) Pvt. Ltd :India	No
Websites	المواقع الألكترونية ذات العلاقة بالاختصاص	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Departments of Engineering collage	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Workshop**			**Module Delivery**	
Module Type	**Supplement**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**ENG102**				
ECTS Credits	**3**				
SWL (hr/sem)	**75**				
Module Level	1		**Semester (s) offered**	2	
Administering Department	**All Departments**		**College**	**Engineering**	
Module Leader	**Abd Fares Ali**		**e-mail**	**abdfaris@tu.edu.iq**	
Module Leader's Acad. Title	**Lecturer**		**Module Leader's Qualification**	**MSC.**	

Module Tutor	**Mahmoud Shukri Dirar**	**e-mail**	mahmoed_alosi@yahoo.com
Peer Reviewer Name	**Abbas Ali & Qais k. Shaakir**	**e-mail**	Kanoosh.abbasali@tu.edu.iq / qshaakir@tu.edu.iq
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Theoretical and practical training in which the student is scientifically and technically established with the most necessary skills in the field of engineering technology
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	On completion of this course students will be able to: Knowledge of technical skills in the field of industrial safety, measurement, filing, carpentry, welding, mechanical operation, sanitary engineering and the basics of electrical work
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Industrial safety workshop(2 hours) • Measurement &Marking workshop(3 hours) • Filing workshop (5 hours) • Carpentry workshop(5 hours) • Welding workshop(5 hours) • Casting workshop(5 hours) • Machining workshop(5 hours) • plumbing workshop(5 hours) • Electrical workshop (5 hours)
Course Description	The engineering workshop course focuses on identifying risks in the work environment and industrial safety guidelines. And training on how to measure and determine, and the use of filing tools and their work. Learn about the types of wood used in carpentry, the process of shaping it, and the use of carpentry tools and machines. Training in welding work, its types, and the process of joining metals by

	welding. Training on various casting works and training on mechanical operation, which includes turning, milling, and grinding. Training on pipe knowledge, how to connect, sanitary engineering works, and training on the basics of electrical workshops.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)

الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 43** **In class tests 2**	45	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 10** **Prepartion for tests 5** **Homeworks 15**	30	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	75		

Module Evaluation

تقييم المادة الدراسية

	Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome

Formative assessment	**Quizzes**	9	5% (5)	all	LO #1, 2, 3, and 9
	Assignments	9	15% (15)	All	LO # 1, 2, 3, 4, 5 and 9
Summative assessment	**Midterm Exam**	2	30% (30)	7	LO # 1-5
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Industrial safety workshop & Measurement and marking workshop
Week 2	Filing workshop
Week 3	Filing workshop
Week 4	Carpentry workshop
Week 5	Carpentry workshop
Week 6	Welding workshop
Week 7	Welding workshop
Week 8	plumbing workshop
Week 9	plumbing workshop
Week 10	Machining workshop
Week 11	Machining workshop
Week 12	Casting workshop
Week 13	Casting workshop

Week 14	Electrical workshop
Week 15	Electrical workshop
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Technology of Machine Tools , Steve F. Krar & J. William Oswald ,McGraw-Hill Publishing Company, Fourth Edition , 1991	Yes
Recommended Texts	--	
Websites		

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Mass Balance**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**CHEM_ENG 103**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	1		**Semester (s) offered**	2	
Min number of students	20		**Max number of students**	80	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Mawah Noori Mohammed		**e-mail**	Marwa.n.mohammed@tu.edu.iq	

Module Leader's Acad. Title	Senior lecturer	**Module Leader's Qualification**	Ph.D.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	Dr. Hayder Akram Arif	**e-mail**	h.alnasri@tu.edu.iq
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	CHEM_ENG 102	**Semester**	1
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	This subject presents a comprehensive methodology that solves material balance problems. Through describe a strategy of analysis, understand and memorize the steps to improve student capabilities. Also, enhance understanding stoichiometry of chemical reaction equations then focuses on combustion process. Recycle, Purge and bypass will also be explained along with the industrial uses of material balances.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. An ability to understand the concept of material balances with chemical reaction, and demonstrates their application in different types of processes. 2. An ability to provide guidelines so that can be efficient and effective in solving material balance problems. 3. An ability to determine the stoichiometric quantities of reactants and products in moles or mass given the chemical reaction. 4. An ability to understand the meanings of stack gas, flue gas, Orsat analysis, dry basis, wet basis, theoretical air (oxygen) and excess air (oxygen), and employ these concepts in combustion problems. 5. An ability to utilize of a recycle, a bypass, and a purge stream in industry also how material balances are used.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction to the concept of material balances with chemical reaction and demonstrates stoichiometric quantities of reactants and products. Define excess and limiting reactant.(week 1 /4 hr). • Identify and understand the extent of a reaction in a reaction, and calculate the fraction or percent excess reactant, percent conversion and the yield. Assignment1 (week 2&3 / 8 hr). • Apply 10-step strategy to solve problems with chemical reactions. Quiz1		

	(week 4 / 4 hr) • Formulate and solve material balances using species and element balances. Assignment2. Quiz2. (week 5&6 / 8 hr) • Midterm exam and Seminars 1 (week 7 / 4 hr) • Material Balances Involving Combustion. Understand the meanings of stack gas, flue gas, orsat analysis, dry basis, wet basis, theoretical air and excess air. Material balances for multiple units with reaction occurs . Assignment3 (week 8,9 &10 /12 hr) • Industrial application of material balance. Recycle without Chemical Reaction. Utilize terminology extent of reaction, overall conversion and single pass conversion in solving recycle problems involving reactors. Assignment4. Quiz3. (week 11 &12 / 8 hr) • Explain the purpose and Calculations of a bypass and purge stream. Quiz4. (week 13&14 / 8hr) • Case study material balances in industry. Seminar2 (week 15 / 4hr)
Course Description	This subject builds a strong foundation for the professional development of its students via deep understanding the concepts of material balances. Topics that will be covered include the strategy for solving problems with and without chemical reactions. Identify the limiting and excess reactants in stoichiometric equations. Employ some concepts such as (orsat analysis, dry basis, wet basis, theoretical air and excess air), in combustion problems. Understand in a general sense how material balances in industry process include recycle, bypass and purge streams.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The effective strategies of teaching this subject are rewarding professional careers by skillfully leveraging chemical engineering principles. To achieve these broad objectives, the curse provides the knowledge, skills and professional development concepts of lecturers, tutorials and seminars.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 75** **In class tests 2** **Seminars 13**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Preparation for tests 15** **HomeWorks 15**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem)	150		

الحمل الدراسي الكلي للطالب خلال الفصل	

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	16% (16)	4,6,11,14	LO #1, 2, 3, 4 and 5
	Assignments	6	16% (16)	2,5,9,12	LO #1, 2, 3, 4 and 5
	Seminars	4	8% (8)	7,15	
Summative assessment	Midterm Exam	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	- Write and balance chemical reaction equations. - Determine the stoichiometric quantities of reactants and products. -Define excess and limiting reactant
Week 2	Understand terminology of conversion, degree of completion, selectivity, yield,
Week 3	- Identify the extent of a reaction in a reaction, and calculate the fraction or percent excess reactant, percent conversion and the yield.
Week 4	-Apply 10-step strategy to solve problems with chemical reactions
Week 5	-Formulate and solve material balances using species balances
Week 6	-Formulate and solve material balances using element balances
Week 7	Midterm exam
Week 8	Material Balances Involving Combustion.
Week 9	Understand the meanings of stack gas, flue gas, Orsat analysis, dry basis, wet basis, theoretical air and excess air.
Week 10	Material balances for multiple units with reaction occurs
Week 11	-Industrial application of material balance -Recycle without Chemical Reaction
Week 12	-Utilize terminology extent of reaction, overall conversion and single pass conversion in solving recycle problems involving reactors.
Week 13	Explain the purpose and Calculations of a bypass stream
Week 14	Explain the purpose and Calculations of a purge stream
Week 15	Case study material balances in industry.

Week 16	Final Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	David M Himmelblau, ***Basic Principles and Calculations in Chemical Engineering, seventh Edition***	Yes
Recommended Texts	1- Hougen A, Watson K M, Ragatz R A, Chemical Process principles, John Wiley 2- Richard M Felder & Ronald W. Rousseau Elementary Principles of Chemical Processes, Wiley India.	No
Websites		

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية		
Module Title	**Energy Balance**	**Module Delivery**
Module Type	**Core**	**Theory** **Lecture** **Tutorial** **Practical** **Seminar**
Module Code	**CHEM_ENG 201**	
ECTS Credits	**6**	
SWL (hr/sem)	150	

Module Level	2	**Semester (s) offered**	1
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Dr. Safaa M.R. Ahmed	**e-mail**	Safaamohamed@tu.edu.iq
Module Leader's Acad. Title	Assist. Proff.	**Module Leader's Qualification**	Ph.D.
Module Tutor	Hiba S. Ayob	**e-mail**	hebahsaadi@tu.edu.iq
Peer Reviewer Name		**e-mail**	
Review Committee Approval		**Version Number**	1.0

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	CHEM_ENG 103	**Semester**	2
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	By teaching energy balance in chemical engineering, students acquire the knowledge and skills to analyze and optimize energy use in chemical processes, which is essential for a sustainable and efficient operation in the field of chemical engineering.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Understanding the Multi-phase equilibrium. 2. An ability to define heat, work, energy, enthalpy, etc. 3. An ability to make estimations of heat capacity and to calculate enthalpy changes for systems without and with phase changes. 4. An ability to use the steam tables. 5. An ability to solve energy balances for closed and open systems (without chemical reaction) at steady and unsteady modes. 6. An ability to solve energy balances for systems with chemical reaction. 7. An ability to solve simple combined material and energy balances (systems without and with chemical reaction). 8. An ability to use the humidity chart, determine heat of solution, dissolution, and mixing.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Undergraduate Review (4 hrs)		

	• Understanding the Multi-phase equilibrium (6 hrs). • Fundamentals of Energy Balance (6 hrs) • Estimation of enthalpy of vaporization, latent heat, • Energy Balance for non-reactive systems (20 hrs) • Energy Balance for reactive systems (20 hrs) • Integrated Material and energy balance (6 hrs) • Case study (6 hrs).
Course Description	This course introduces students to the fundamental principles and applications of energy balance in chemical engineering. It focuses on the analysis and quantification of energy flows within chemical processes and the optimization of energy usage for improved efficiency and sustainability. Through lectures, problem-solving exercises, and laboratory work, students develop a comprehensive understanding of energy conservation, heat transfer mechanisms, and the application of energy balance equations.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Begin to establish a strong conceptual understanding of the principles of energy balance. Use real-life examples and measurements to help students relate abstract concepts to everyday experiences. Encourage discussions and questions to clear up any misconceptions. In addition, provide students with real-world problem scenarios that require the application of energy balance principles. Encourage active participation and group discussions to enhance critical thinking and problem-solving skills. Guide students through the problem-solving process and provide constructive feedback.

Student Workload (SWL) الحمل الدراسي للطالب				
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **68** **In class tests** **2** **Seminars** **5**		75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** **30** **Preparation for tests** **30** **Homework** **15**		75	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل		150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	5% (5)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	Midterm Exam	2	20% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Multiphase Equilibrium: Phase Diagrams and the Phase Rule, Single Component Two-Phase Systems (Vapor Pressure)
Week 2	Multiphase Equilibrium: Two-Component Gas/Single-Component Liquid Systems, Two Component Gas/Two Component Liquid Systems, Multicomponent Vapor-Liquid Equilibrium
Week 3	Effect of temperature on heat capacity of gas, Mean heat capacity of gas, Kopp's rule
Week 4	Latent heats, Heat of fusion, Heat of vaporization.
Week 5	Estimation of heat capacity, calculation of enthalpy changes for systems without and with phase change.
Week 6	Types of Energy to Be Included in Energy Balances, Energy Balances without Reaction.
Week 7	The Standard Heat (Enthalpy) of Formation, The Heat (Enthalpy) of Reaction.
Week 8	Integration of Heat of Formation and Sensible Heat, The Heat (Enthalpy) of Combustion
Week 9	Enthalpy change for mixtures, enthalpy-concentration charts and applications
Week 10	Kirchoff's equation. Adiabatic and non-adiabatic reactions. Theoretical and actual flame temperatures.
Week 11	Heat balance calculations in processes with chemical reaction, Heat of reaction, standard heats of formation.
Week 12	The humidity, Humidity chart, Applications of the Humidity Chart.
Week 13	Determining the heat of solution, dissolution, and mixing
Week 14	Solving Material and Energy Balances Using Process Simulators (Flow sheeting Codes).

Week 15	Unsteady-State Material and Energy Balances
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	David M Himmelblau, Basic principles and calculations in chemical engineering, Prentice Hall.	Yes
Recommended Texts	Richard M Felder & Ronald W. Rousseau Elementary Principles of Chemical Processes, Wiley India.	Yes
Websites		

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Engineering analysis**			**Module Delivery**	
Module Type	**Basic**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**MATH-201**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	2		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	60	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Saad Nahi Saleh		**e-mail**	snsaleh@tu.edu.iq	
Module Leader's Acad. Title	Assistant Professor		**Module Leader's Qualification**	Ph.D	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Omar Saeed Lateef		**e-mail**	o.s.lateef@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Calculus II (MATH-102)	**Semester**	2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	The overall goal of this course is to enable students to apply appropriate analytical methods to calculate solutions of engineering problems. The student must be able to solve first order and higher order differential equations (ordinary and partial) by various methods. Using Laplace transforms for solving differential equations are also considered.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Build skills with mathematical techniques to solve problems in chemical engineering. 2. Review the most common analytical methods to solve ordinary differential equations (ODEs). 3. Apply diverse techniques to solve the differential equation in a quantitative manner. 4. Interpret the results of the solution of the differential equations. 5. Use some advance mathematical methods such as Laplace Transform to solve the models of engineering problems. 6. Apply some techniques for solving partial differential equations most likely to be encountered and used by students
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Ordinary Differential Equations (8 hrs) • Linear Differential Equations (4 hrs) • Simultaneous Differential Equations (4 hrs) • Solution by Series (6 hrs) • Functions and Definite Integrals (4 hrs) • Laplace Transform (8 hrs) • Partial Differential Equations (8 hrs)
Course Description	This course is offered to undergraduates and introduces students to the techniques for analytical solution of engineering problems. Ordinary and partial differential equations are considered. Throughout the course, an advanced mathematical methods are used in solution of the problems.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 65** **In class tests 2** **Seminars 4** **Discussions 4**	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 40** **Prepartion for tests 20** **Homeworks 15**	75	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #2, 3, 5 and 6
	Assignments (Homeworks)	5	10% (10)	2, 4, 6, 8, 10	All
	Seminars	4	8% (8)	Continuous	
	Discussions	6	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	First Order Differential Equations (Separable, Homogeneous, Exact Equations)
Week 2	First Order Differential Equations (Linear Equations, Bernoulli Equation)
Week 3	Second Order Differential Equations (Homogeneous, un-determent Coefficient)
Week 4	Second Order Linear Differential Equations, Differential Operators
Week 5	Higher Order of Linear Differential Equations, The Euler Cauchy Differential Equations
Week 6	Simultaneous Linear Differential Equations
Week 7	Midterm exam
Week 8	Power Series Solutions
Week 9	Special Functions, Error Function, Gamma Function, Beta Function
Week 10	Laplace Transform, The Transform of Special Functions, The Differentiation and Integration of Transforms
Week 11	The Shifting Theorems, Step Functions
Week 12	Solving Differential Equations by Laplace Transform
Week 13	Fourier Series, The Euler Formulas, Half Range Expansion
Week 14	Partial Differential Equations, Separation of Variables
Week 15	Heat Equations ,Wave Equation
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	**Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.**	Yes
Recommended Texts	**C. Ray Wylie, Advanced Engineering Mathematics, 6e, McGraw-Hill**	Yes
Websites	N/A	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Fluid Flow I**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 202**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	2		**Semester (s) offered**	1	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Burhan S. Abdulrazzaq		**e-mail**	burhansadik@tu.edu.iq	
Module Leader's Acad. Title	Ass. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	MASS BALANCE (CHEM_ENG 202)	**Semester**	1,2
Co-requisites module	ENERGY BALANCE (CHEM_ENG 201)	**Semester**	1,2

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	1. To understand the basic concept of fluid flow, properties, viscosity, vapor pressure, cavitation and Newton law of viscosity 2. To get acquainted the pressure due to fluid. Also, the measurement devices used to estimate this pressure such as, manometer, simple manometer, piezometer, u-tube manometer, differential manometer, mechanical gauge 3. To understand mass and volume flow rate, continuity and energy equations. 4. To develop problem solving Bernoulli's eq and its application. Velocity profile. 5. To know how measure the flow by using venturi, orifice, pitot tube, rotameter, and nozzle 6. To accommodate the flow pattern, velocity profile in laminar and turbulent flow 7. To get acquainted the static, kinematic and dynamic fluids 8. To understand energy losses and pressure drop in pipe and multiple pipe flow 9. To fathom the fitting used in the pipes 10. To distinguish between the major and minor losses due to friction in pipe
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After successful completion of the module, students will be able to : 1. Explain the concept of continuum description of matter and the description of fluids in terms of field, and related concepts such as streamlines and path line 2. Describe in mathematical terms the main forces in fluids, such as pressure, viscous, friction, and gravity forces 3. Definition and applications of Newton's law of the viscosity 4. Identify the laminar and turbulent flow in pipe 5. Recognize all the flow measurements 6. Solve some basic static and dynamics fluid 7. Explain and use equation of continuity, conservation of momentum and conservation of energy, and able to employ them to derive the conservation laws for a control volume staring from those for a system. 8. Explain the physical meaning and assumption of the Bernoulli equation and able to solve some basic fluid flow problems. 9. Derive the differential equation for internal flow problems and be able to solve it to obtain the velocity profile.

	10. Explain qualitatively the basic feature of turbulent flow
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Properties of fluid, newton low of viscosity, fluid types, surface tension and capillary, compressibility and bulk modules, dimensional analysis Pressure measurement, manometers, simple manometer, piezometer, u-tube manometer, differential manometer, mechanical gauges Fluid kinematics, types of fluid flow, Reynolds number, flow pattern, continuity equation [15 hrs.] Dynamic fluid, mass flowrate, volumetric flowrate, energy and Bernoulli equation, application of Bernoulli equation friction in pipe, [15 Hs.] velocity distribution in laminar and turbulent flow, graphical evaluation of friction factor, major and minor losses in straight pipe and fitting, [15 Hrs.] Losses in noncircular conduits, piping network, pipe in series and parallel, Flow measurement, rotameter, pitot tube, venturi, orifice, weir [15 Hrs.]
Course Description	The course begins with fluid flow applied to a range of problems in chemical engineering, including Fluid properties, Static fluid and its application, kinematic fluid, Dynamic fluid, flow pattern, flow in pipes, friction in multiple pipe connection, continuity equation, energy equation, pressure drop in pipes and its fitting, equivalent diameter, flow measurements, Students will work to formulate the models necessary to study, analyses, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The main strategy that will be adopted in delivering this module is • encourage students' participation in the exercises, • refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials. • by considering type of simple experiments involving some sampling activities that are interesting to the students. • Developing students' abilities in research by asking students to group discussion sessions • urging students to look at sources, books and the Internet as a source of information in addition to homework

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 53** **In class tests & HW 33** **Seminars 4**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0

Preparation for tests **20** **Homework's** **10**				
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150			

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #1, 2, 3, 4, 5, 6, 7, and 8
	Assignments	3	18% (18)	3, 6, 10,	LO # 1, 2, 3, 4, 5, 6, 7, and 8
	Seminars	1	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	1	10% (10)	7	LO # 1-4
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction – physical properties
Week 2	viscosity Newton law of viscosity
Week 3	Static fluid and its application
Week 4	Kinematics flow pattern continuity equation
Week 5	Dynamics fluids, Reynold number, Energy equation
Week 6	Bernoulli's equation and its Application
Week 7	Flow measurements, venturi, orifice, rotameter
Week 8	flow in closed channel, pitot tube
Week 9	Flow in open channel, wires, rectangular, triangular, trapezoidal
Week 10	Pressure drops in pipe,
Week 11	Velocity distribution in laminar flow
Week 12	Velocity distribution in turbulent flow
Week 13	Major and minor loss in pipe and fitting
Week 14	Multiple pipe configuration system,
Week 15	**Preparatory Week**

Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1. **J, M. Coulson and J. F. Richardson "Chemical Eng. Vol. 1** 2. **Fluid Mechanics / Frank M. White/ 7th edition**	Yes
Recommended Texts	**McCabe W.L. & Smith J.C., Unit Operations of Chemical Engg, McGraw Hill** **Holland F. A. " fluid flow for Chem. Eng."**	No
Websites	https://www.google.com/search?q=fluid+flow+lecture&oq=fluid+flow+lecture&aqs=chrome..69i57j0i22i30l2j0i10i22i30j0i22i30l6.9066j0j15&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:955c3834,vid:yUYdIPwH2Bo	

Ministry of Higher Education and Scientific Research - Iraq
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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Physical chemistry**			**Module Delivery**	
Module Type	**Basic**			**Theory** **Lecture** **Lab** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM201**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	2		**Semester (s) offered**	1	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Ahmed.S.Othman		**e-mail**	dra.dabbagh@tu.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	-
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	1. To understand the concept of chemical kinetic 2. To discuss their applications to the chemical kinetic reaction 3. To get acquainted the basic concept of the types of chemical reaction 4. Simplify the applications of each each law in chemical kinetics 5. To explain the kinetic theory of the chemical reaction		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After successful completion of the module, students will be able to : 1. Ability the application law of kinetics that can be used for any order of reactions 2. To be enable to solve problems in different cases of processes in chemical kinetic by using the law s of kinetics 3. Interpret experimental and test results and present these in an appropriate engineering report format 4. Collaborate with others in a team project environment to conduct engineering investigations and produce engineering reports		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Phase equilibrium Real and ideal solutions Order of reaction [15 Hrs.] Zero order reaction First order reactions Second order reaction Third order reaction 5 Hrs.] Complex reaction Methods for measuring order of reaction Electro chemistry [15 Hrs.]		
Course Description	The course begins with chemical kinetic applied to a range of problems in chemical kinetics, the physical chemistry course covered the Energetic introduction to these concepts, and to develop the problem-solving skills essential to good engineering practice of physical chemistry in practical applications. And how to calculate the order of any simple reaction also included rate of reaction method for measuring order of reaction for sim;le and complex reaction, also to know the theory of reaction		
Learning and Teaching Strategies استراتيجيات التعلم والتعليم			
Strategies	The main strategy that will be adopted in delivering this module is • encourage students' participation in the exercises,		

	• refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials. • by considering type of simple experiments involving some sampling activities that are interesting to the students. • Developing students' abilities in research by asking students to group discussion sessions • urging students to look at sources, books and the Internet as a source of information in addition to homework

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 7** **Laboratory 30**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 20** **Preparation for tests 22** **Homework's 18**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #1, 2, 3, 4, 5, and 6
	Assignments	2	10% (10)	3, 6, 10,	LO # 1, 2, 3, 4, 5, and 6
	Projects / lab.	1	10% (10)	Continuous	
	Seminars	1	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	1	10% (10)	7	LO # 1-6
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Clarification of rate of reaction Order of reaction Molecularity Half life period
Week 2	Simple reaction Type of order reaction Zero order reaction First order reaction Second order reaction
Week 3	Third order reaction Methods for measuring order of reaction
Week 4	Theories of chemical reactions
Week 5	Methods for measuring the order of reaction
Week 6	Parallel reaction Consecutive reaction
Week 7	Catalytic reactions
Week 8	Ionic reactions
Week 9	Chain reactions
Week 10	Electro chemistry conductance, electrolytic conductance
Week 11	Specific conductance
Week 12	Equivalent conductance, molar conductance
Week 13	Weak and strong electrolyte
Week 14	Faraday law
Week 15	**Preparatory Week**
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered

Week 1	Catalytic decomposition of hydrogen peroxide
Week 2	Lab 2: determination the equivalent conductance of strong electrolyte
Week 3	Lab 3: determination the order of the decomposition of ethyl acetate
Week 4	Lab 4: determination the end point of the conc of bases by PHmeter
Week 5	Lab 5: determination the specific conductance of weak electrolyte
Week 6	Lab 6: the effect of temperature of rate of reaction
Week 7	

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1-Physical Chemistry by Daniel and alberty 7th Edittion 2-Atkins & de Paula, Atkin's Physical Chemistry, 7th Edn., Oxford University Press	Yes
Recommended Texts	1. S. Glasston, A Textbook of Physical Chemistry, McMillan India	No
Websites		

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Pollution**		**Module Delivery**	
Module Type	**Core**		**Theory** **Lecture** **Seminar**	
Module Code	**CHEM_ENG203**			
ECTS Credits	**3**			
SWL (hr/sem)	75			
Module Level	2	**Semester (s) offered**	1	
Administering Department	Chemical Engineering	**College**	Enginreeing	

Module Leader	A.L Mudheher m. Ali	**e-mail**	Mudher.M.Ali10477@st.tu.edu.iq
Module Leader's Acad. Title	Ass. Leacture	**Module Leader's Qualification**	Msc.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	-
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	1- To impart the basic concepts of environmental engineering 2-To develop understanding about pollution and its treatment methodology.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Identify the major sources and sinks of air and water pollutants. 2- Understand the key chemical transformations of air and water pollution. 3- Describe engineering solutions to air and water pollution problems		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Undergraduate Review (4 hrs) • Fundamentals of natural reasourcse (8 hrs) • Air pollution and control (8 hrs) • Water pollution and cotrol (8 hrs)		
Course Description	To understand the problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues and create awareness among the students to address these issues and conserve the environment in a better way.		
Learning and Teaching Strategies استراتيجيات التعلم والتعليم			
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical)		

	examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 25** **In class tests 2** **Seminars 3**	30	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 10** **Prepartion for tests 10** **Homeworks 25**	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	75		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	30% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars				
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction - Basics of environment
Week 2	The Multidisciplinary nature of environmental science, Definition-scope and importanceneed for public awareness.
Week 3	Timber extraction, mining, dams and their defects on forests and tribal people.-water resources.
Week 4	Elements of ecology: definition: species, population, community, Ecosystems-Concept of an ecosystem-structureand function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession.

Week 5	Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest.
Week 6	Air pollution and control.
Week 7	Midterm exam
Week 8	Removal of particles from a Gas stream: (collection efficiency, Cyclone separator, baghouse, catalytic converter, Venturi scrubber, settling champers)
Week 9	Electrostatic precipitators: overall design, Andersen-Deutsh equation, corona generation, particle charging, diffusion charging.
Week 10	Filtration of particle from gas stream: mechanism-inception & diffusion, flow field, efficiency, fabric filters, granular bed.
Week 11	Water Pollution and Control
Week 12	Waste water management.
Week 13	Primary treatment methods.
Week 14	Secondary treatment process.
Week 15	**Tertiary treatment.**
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Anil Kumar De and Arnab Kumar De, "Environmental Engineering" New Age International (P) Ltd., Publishers, New Delhi, India, 2009.**	Yes
Recommended Texts	**Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd.,1991.**	No
Websites	http://umich.edu/~elements/5e/lectures/index.html	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Environment Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Democracy and Human Right(الديمقراطية وحقوق الانسان)**		**Module Delivery**	
Module Type	**Supplement**		**محاضرات نظرية**	
Module Code	**ENG-108**			
ECTS Credits	**3**			
SWL (hr/sem)	75			
Module Level	2	**Semester (s) offered**	1	
Min number of students	15	**Max number of students**	100	
Administering Department	environment Engineering	**College**	Engineering	

Module Leader	Sabah Mahdi Salih	**e-mail**	sabahmahdi@tu.edu.iq
Module Leader's Acad. Title	Assistant Professor	**Module Leader's Qualification**	MSc
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	Ahmed Hussein Khunfas	**e-mail**	ahmed.husain@tu.edu.iq
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	لايوجد	**Semester**	1
Co-requisites module	لايوجد	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	**1-القدرة على ادراك المفهوم الاساسي لحقوق الانسان والطفل والديمقراطية.** **2- القدرة على فهم الاصول التاريخية للمفهومين. ومعرفة ايجابيات وسلبيات حقوق الانسان والديمقراطية.** **3- الاطلاع على حقوق الانسان والطفل والديمقراطية في الاسلام.** **4- التعرف على مصادر حقوق الانسان والطفل وخصائص وسمات الديمقراطية.** **5ـــمعرفة اثر التطور التكنولوجي على حقوق الانسان والطفل والديمقراطية.** **6-التطرق لمفاهيم ذات صلة بالمصطلحين مثل (العولمة، مؤسسات المجتمع المدني ، الانتخابات والاستفتاء ، الحكم الرشيد ، الجرائم الانسانية، الدستور).** **7-الاطلاع على الضمانات التي تكفل حقوق الانسان والطفل وتكفل النظام الديمقراطي والحقوق والحريات العامة.**
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**1- التعرف على المصطلحات ذات الصلة بمفهوم حقوق الانسان والطفل والديمقراطية.** **2- التعرف على اهم الحقوق التي كفلها الإسلام للإنسان والطفل واستثمارها في معالجة الآفات والحالات السلبية التي تغزو المجتمعات في العصر الحالي .** **الاستفادة من مزايا الديمقراطية ومكوناتها في معالجة التذبذب وعدم الاستقرار في المجتمع والحفاظ على الاستقرار والسلم المجتمعي.** **3- الاطلاع على المواثيق الدولية المختصة بمجالات حقوق الانسان والطفل الصادرة عن المنظمات الدولية وجمعية الأمم المتحدة.** **4- الاستفادة من تجارب الاخرين (الدول المتقدمة في مجالات حقوق الانسان والطفل والديمقراطية).** **5- اللمام بالقوانين والدساتير الدولية والإقليمية والمحلية المختصة بقضايا حقوق الانسان والحريات العامة والديمقراطية.** **7- التعرف على جرائم الإبادة الجماعية والجرائم الإنسانية ومدى تأثيرها على مفهوم حقوق الانسان والطفل والديمقراطية.**
Indicative Contents المحتويات الإرشادية	**يتضمن المحتوى الارشادي مايأتي:** **1- حقوق الانسان والطفل والديمقراطية في الحضارات القديمة والإسلام (8 ساعات).** **2- مصادر حقوق الانسان العالمية والمحلية، خصائص وسمات الديمقراطية (4 ساعات).** **3- ضمانات حقوق الانسان العالمية والمحلية وضمانات النظام الديمقراطي (4 ساعات).** **4- حقوق الانسان والطفل والديمقراطية واثر التقدم التكنولوجي عليهما (4 ساعات).** **5- العولمة ، مؤسسات المجتمع المدني ، الانتخابات والاستفتاء، الدستور(4 ساعات)**

	6- الجرائم الإنسانية وانواعها ، الحكم الرشيد ، (2 ساعة). 7- الوثائق الدولية الخاصة بحقوق الطفل والديمقراطية المعاصرة (4 ساعات).
Course Description	**حقوق الانسان: هي حقوق يتمتع بها جميع مكونات البشر لمجرد اننا من ابناء البشر, وهذه الحقوق متأصلة في جميع البشر مهما كان عرقهم او جنسهم او قوميتهم او مذهبهم ولاتمنح من أي دولة، وتتضمن حقوق الانسان والطفل في الحضارات القديمة والاسلام، المواثيق الدولية ، مصادر وضمانات حقوق الانسان ، القوانين والدساتير، مجلس حقوق الانسان، العولمة، التقدم التكنولوجي واثره على حقوق الانسان.** **الديمقراطية: يرجع مصطلح الديمقراطية الى الحضارة اليونانية القديمة وهي عبارة عن مصطلح مكون من مقطعين هما: (Cratia) التي تعني حكم و (Demo) التي تعني الشعب ليصبح المفهوم حكم الشعب ، وتتضمن الديمقراطية التطرق الى مفهومها ومعرفة الجذور التاريخية لها ، المكونات ، الخصائص ، المميزات ، الضمانات ، علاقة الديمقراطية ب (الدستور ، مؤسسات المجتمع المدني ، حقوق الانسان ، الحكم الرشيد، الانتخابات) ، الديمقراطية المعاصرة**
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	تم وضع استراتيجية التعلم والتعليم من اجل ان يحصل الطالب على معلومات كاملة تغطي المنهج الدراسي المعد للمادة ولكي تتحقق الغاية الاساسية للمنهج الذي ينصب نحو المام وادراك الطالب بالمفاهيم الاساسية لحقوق الانسان والديمقراطية ، والاطلاع على المصادر والضمانات والمواثيق الدولية للمصطلحين من اجل استثمارها في معالجة الظواهر السلبية في المجتمع والحفاظ على الاستقراروالسلم المجتمعي .

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 28** **In class tests 2**	30	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Memorizing: 25** **Prepartion for test : 10** **Project: 10**	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.8
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	75		

Module Evaluation

تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	4	20% (20)	3, 5, ,7, 9,11,13,	LO #1, 2,3,....., 11
	Assignments (Homeworks)	6	15% (15)	2, 4, 6, 10,12,14	LO # 1, 2, 3, ...,11
	Discussions	7	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	8	LO # 1-7
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	الجذور التاريخية لحقوق الانسان والديمقراطية في الحضارات القديمة
Week 2	حقوق الانسان والطفل والديمقراطية في الاسلام
Week 3	مصادر حقوق الانسان على المستوى الخارجي الدولي، سمات وخصائص الديمقراطية
Week 4	مصادر حقوق الانسان على المستوى الداخلي المحلي، مزايا الديمقراطية
Week 5	ضمانات حقوق الانسان على المستوى المحلي، مكونات الديمقراطية
Week 6	ضمانات حقوق الانسان على المستوى الدولي، الضمانات التي تكفل النظام الديمقراطي
Week 7	مجلس حقوق الانسان، الانتخابات واهميتها
Week 8	امتحان نصف الفصل
Week 9	التطور التكنولوجي واثره على حقوق الانسان والطفل والديمقراطية
Week 10	مفهوم العولمة، مؤسسات المجتمع المدني
Week 11	الحكم الرشيد (المبادئ، المعايير) ، الاستفتاء
Week 12	الدستور وانواعه
Week 13	حقوق الطفل في المواثيق والعهود الدولية
Week 14	الجرائم الانسانية (جرائم الابادة الجماعية) وتأثيرها على حقوق الانسان والطفل والانظمة الديمقراطية
Week 15	الديمقراطية المعاصرة وحقوق الانسان والطفل ودراسة حالات لأمثلة واقعية حدثت في المجتمعات الدولية والعربية وفي العراق.
Week 16	امتحان نهاية الفصل

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	**كتاب حقوق الانسان والديمقراطية.**	Yes

	من تأليف :1-ا.د. ماهر صالح علاوي الجبوري، ا.د رياض عزيز هادي ، ا.د. رعد ناجي الجدة، ا.م.د كامل عبد العنكود ، ا.م.د علي عبد الرزاق محمد، ا.د. حسان محمد شفيق، (2009)	
Recommended Texts	1- -الديمقراطية ،من تأليف : تشارلز تيللي ، ترجمة محمد فاضل طباخ ، الهيئة المصرية العامة للكتاب،(2010). 2- كتاب حقوق الانسان الاساسية والدور الامني لحمايتها، المؤلف: الدكتور مبارك علوي محمد،(2019).	No
Websites	N/A	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Industrial & Petrochemical Processes**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Seminar**	
Module Code	**CHEM_ENG 204**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	2		**Semester (s) offered**	2	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Rasha K. Ahmed		**e-mail**	rashakhalid@tu.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	Ph.D.	

Module Tutor	None	**e-mail**	None
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	1/06/2023	**Version Number**	1.0

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	2
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	To impart the basic concepts of chemical process design & Petrochemical chemical process industry		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	The outcomes of this course lead the students at the end of this course have the following knowledge: 1. A chemical industry processes for different sectors water, detergent, construction materials, and food, acid and base industries. 2. Equipment used in different industries. 3. Standard specifications and procedures for high quality control. 4. Process operation conditions and procedures for process control. 5. Raw materials preparation process. 6. Storages for different kind of products. 7. Cleaning and sterilization processes. 8. Reading process flow diagram (PFD) and process and instrument diagram (P&ID). 9. Clarify the petrochemical industries and their products and consider them as raw materials for the various chemical industries. 10. Knowing the forms and types of equipment needed for each industry and how to choose and deal with them. 11. The ability to know the advantages and disadvantages of each industry and how to deal with them and choose the best. 12. The ability to determine the necessary and required equipment for each industry and know what is best to give better and more productivity		
Indicative Contents	Indicative content includes the following:		

المحتويات الإرشادية	1. Introduction to chemical process design (4hr) 2. Design Information, Process creation, Process Structure (12 hr) 3. Chemical industries (16hr) 4. Industrial gases (6hr) 5. Introduction to petrochemical processes (4hr) 6. Petrochemical industries (12hr) 7. Biogas industries (4 hrs)
Course Description	1. This course considers processing of raw materials into useful and profitable products. These products are used both as consumer goods and as intermediates for further chemical and physical modification to yield consumer products. 2. This course considers the functional area in which chemical engineers are employed in different industrial fields (production, maintenance, quality control, process, design, administration, research, development, consulting, others) 3. Getting to know the industries that produce petroleum, how are the production processes in the factories? 4. How to control the production process. The study of how interactions between substances and compounds take place. The effect of pressure and temperature on the petrochemical industries
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 68** **In class tests 3** **Seminars 4**	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 20** **Prepartion for tests 25** **Homeworks 5**	50	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation

تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments (Homework)	5	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to chemical process design
Week 2	Flowsheets -Design Information
Week 3	Process creation, Process Structure - basic process operations, process operating conditions
Week 4	Sulphur and sulphuric acid/ Chlor-alkali industries
Week 5	Nitrogen industries: ammonia / Fertilizer industries, Nitric acid
Week 6	Cement, lime, gypsum / Glass industries
Week 7	**Midterm exam**
Week 8	Industrial gases: carbon dioxide / Hydrogen / Nitrogen & oxygen
Week 9	Vegetable oils and animal fats and oils / soaps and detergents
Week 10	Introduction to petrochemical processes
Week 11	Methanol from Synthesis gas route
Week 12	Formaldehyde from Methanol
Week 13	Vinyl chloride from ethylene using two step process
Week 14	Ethylene and acetylene production
Week 15	Styrene from Benzene, DDT manufacture from Benzene
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	Austin G.T. (Ed.), Shreve's Chemical Process Industries, McGraw Hill	Yes

Recommended Texts	Seider et al (2004) 2nd ed. ,Product and process design principles. Silla (2003) CHEMICAL PROCESS ENGINEERING; Design and Economics. krik_&Othmer encyclopedia of Chemical Technology	No
Websites		

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

	Module Information معلومات المادة الدراسية				
Module Title	**Computer Programming**			**Module Delivery**	
Module Type	**Suplement**			☐ Theory ☐ Lecture ☐ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**ENG-105**				
ECTS Credits	**5**				
SWL (hr/sem)	125				
Module Level	2			**Semester (s) offered**	2
Administering Department	Chemical Engineering	**College**		Engineering	
Module Leader	Ass. lecturer Sahar Adnan Ahmed	**e-mail**		saharadnan@tu.edu.iq	

Module Leader's Acad. Title	Assistance Lecturer		**Module Leader's Qualification**	Msc.	
Module Tutor	None	**e-mail**	-	-	
Peer Reviewer Name	Ass. Prof. Dr. Jalal N. Abdulbaqi	**e-mail**	Jalal.abdulbaqi@tu.edu.iq		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	**ENG-104**	**Semester**	1
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	• To introduce students to the Python programming language and its syntax. • To provide students with an understanding of the conditional and iteration statements used in programming. • To enable students to design and implement functions to solve programming problems. • To introduce students to the basic data structures of Python, including lists, tuples, dictionaries, and sets. • To provide students with an understanding of string manipulation and regular expressions in Python.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Demonstrate an understanding of the Python programming language and its syntax. 2. Design and implement conditional and iteration statements in Python. 3. Design and implement functions to solve programming problems. 4. Demonstrate an understanding of the basic data structures of Python, including lists, tuples, dictionaries, and sets. 5. Demonstrate an understanding of string manipulation and regular

	expressions in Python. 6. Demonstrate an understanding of how to deal with files and exceptions.
Indicative Contents المحتويات الإرشادية	• Introduction to Python: syntax, data types, and control structures. • Condition Statements: if, elif, and else statements. • Iteration Statements: for and while loops. • Functions: defining functions and parameter passing. • Lists: creation, indexing, and slicing. • Tuples: creation and unpacking. • Dictionaries: creation and manipulation. • Sets: creation and manipulation. • Strings: creation, manipulation, and regular expressions. • Files: creation, saving and manipulation.
Course Description	This module introduces students to the Python programming language, its syntax, and its use in solving programming problems. The module covers the basic programming concepts of condition statements and iteration statements, along with the design and implementation of functions. The module also covers the basic data structures of Python, including lists, tuples, dictionaries, and sets. The module concludes with an introduction to string manipulation and regular expressions in Python.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The module will be delivered through a combination of lectures, assignments, quizzes, and lab sessions. Lectures will provide an overview of the topics, while assignments and quizzes will enable students to apply their knowledge and check their understanding. Lab sessions will provide hands-on experience with Python programming tools and techniques. The module will also include self-directed learning, where students are expected to read and research on their own to enhance their understanding of the subject matter.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0

Class lectures: 23 **Class test:2** Seminars: 5 Practical: 30			
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 25** **Prepartion for tests 10** **Homeworks 30**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation

تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	2, 6, 14	LO # 1, 3, 6
	Assignments	2	15% (15)	3, 9, 11, 13	LO # 2, 4, 5
	Lab	14	15% (15)	Continuous	
Summative assessment	**Midterm Exam**	1.5	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to Python: syntax, data types, and control structures
Week 2	Condition Statements: if, elif, and else statements.
Week 3	Iteration Statement: while loop
Week 4	Iteration Statement: for loop
Week 5	Functions: defining functions and parameter passing.

Week 6	Functions: Libraries and their functions
Week 7	Midterm
Week 8	Lists: creation, indexing, and slicing.
Week 9	Tuples: creation and unpacking.
Week 10	Dictionaries: creation and manipulation.
Week 11	Sets: creation and manipulation.
Week 12	Strings: creation, manipulation, and regular expressions.
Week 13	Files
Week 14	Exceptions
Week 15	Array-Oriented Programming with “numpy”
Week 16	Final Exam

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Introduction to Python IDLE + mathematical manipulation
Week 2	Condition Statements
Week 3	Iteration Statements
Week 4	Functions
Week 5	List and Tuples
Week 6	Dictionaries and sets
Week 7	Strings and files

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	**Available in the Library?**

Required Texts	***Intro to Python® for Computer Science and Data Science: Learning to Program with AI, Big Data and the Cloud by Paul & Harvey Deitel,* 1st Ed, Pearson Education, 2020**	No
Recommended Texts	**جِرار سوينُ، ترجمة: هشام رزق الله وآخرون، تعلم البرمجة مع بايثون 3، 2013** **ألن داوني، ترجمة طارق زيد الكيالين، فكر بايثون: كيف تفكر كعالم حاسوب، منشورات جرين يت، 2012**	No
Websites	Python.org, learnpython.org, realpython.com	

Ministry of Higher Education and Scientific Research - Iraq
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College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Engineering Materials**			**Module Delivery**	
Module Type	**Suplement**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 207**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	2		**Semester (s) offered**	2	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader			**e-mail**		
Module Leader's Acad. Title	Asst. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Ghassan H. Abdulla		**e-mail**	Ghassan.hamad@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Engineering mechanics (ENG-102)	**Semester**	1
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	Students will gain a basic knowledge of metals, polymers, and ceramics, along with some aspects of nanomaterials. Students will also learn the fundamental properties of materials, along with the fundamental aspects of phase diagrams and the concepts of degradation and failure.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Describe various kinds of materials (metals, polymers, and ceramics), and account for their characteristics. 2. Account for the relationship between the structure and some mechanical properties of various materials. 3. Determine contributions of various strengthening mechanisms, including solid solution strengthening, precipitation strengthening, and strain hardening. 4. Understand the relations between the composition, temperature and phase fractions applied to equilibrium phase diagrams for given material systems.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction to material science (2 hrs) • Atomic Structure and Bonding (Atomic Structure, Bonding Types and correlations with properties) (8 hrs) • Material Building Blocks (22 hrs) • Mechanical Properties, Deformation, and Strengthening Mechanisms (12 hrs) • Phase Diagrams and Diffusion (6 hrs) • Materials Failure (6 hrs)		
Course Description	This course aims to establish fundamental knowledge of Engineering Materials. Presentation of the course starts with principles of bonding, structure, and structure/property relationships for metals and their alloys, ceramics, polymers and composites. Emphasis on properties and how processes change structure. Study deeply the phase diagrams, diffusion and materials failure		
Learning and Teaching Strategies استراتيجيات التعلم والتعليم			
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical)		

	examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures and lab 26** **In class tests 5** **Seminars 2** **Laboratory 30**	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 20** **Preparation for tests 22** **Homework 20**	62	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.1
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, and 4
	Seminars	4	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	8	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to material science
Week 2	The structure of crystalline solids
Week 3	Structures of Polymers
Week 4	Imperfections in Solids
Week 5	Introduction to Ceramics

Week 6	Mechanical properties of metals
Week 7	Dislocations and strengthening mechanisms
Week 8	Midterm exam
Week 9	Mechanical Properties: Deformation
Week 10	Mechanical Properties: Strengthening Mechanisms
Week 11	Material Failure
Week 12	Phase diagrams
Week 13	Diffusion
Week 14	Thermal Properties
Week 15	Introduction to Nanomaterials
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Lab 1: Prepare a sample for laboratory examination
Week 2	Lab 2: Cooling curve
Week 3	Lab 3: Hardness test
Week 4	Lab 4: The Tensile test
Week 5	Lab 5: The Impact test
Week 6	Lab 6: The Wear test
Week 7	Lab 7: The Bending
Week 8	Lab 8: Heat treating

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	The Science and Engineering of Materials, Third Edition,Donald R. Askeland, Frank Haddleton, Phil Green, Howard Robertson.	Yes
Recommended Texts		No

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Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**English II**			**Module Delivery**	
Module Type	**Suplement**			**Theory** **Lecture** **Tutorial** **Project** **Seminar**	
Module Code	**ENG-109**				
ECTS Credits	**3**				
SWL (hr/sem)	**75**				
Module Level	2		**Semester (s) offered**	2	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Ahmed Subhi Abdulla		**e-mail**	Ahmedsubhi1981@tu.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	Develop the ability/skill needed to earn a job and develop his/her critical thinking skills to work, develop and communicate.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	Upon successful completion of the course, the students should be able to: • learn how to make job applications and which recruitment procedures they must go through in the process • acquire the special terminology used in job applications and recruitment procedures • learn how to design a letter of application and CV • have a clear idea about how to prepare for an interview and how to behave during an interview • become familiar with the methods of writing a "letter of intent" ("statement of purpose") when applying for academic studies • have an idea about the "letter of recommendation" that they will need when applying for an academic program after completing their university education • gain an understanding of presentation techniques • become familiar with the basic principles of "Paragraph Writing" • learn and practise the key concepts of paragraph writing such as Topic Sentence, Supporting Sentences, Concluding Sentence, Unity and Coherence • gain insight into the essential principles of "Essay Writing"
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Job applications and which recruitment procedures (6 hrs) • Learn how to design a letter of application and CV and how to prepare for an interview and how to behave during an interview (8 hr) • Presentation techniques (6 hrs) • Paragraph Writing (10 hrs)
Course Description	You will also develop the business communication skills required for anyone in the global economy. This includes topics like delivering presentations, writing emails, or speaking in meetings. This gives you the ability to communicate across departments with a strong ability in reading, writing, speaking, and listening.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب				
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **23** **In class tests** **2** **Seminars** **5**	30	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** **20** **Preparation for tests** **10** **HomeWorks** **5** **Project** **10**	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	75		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	– Describing technical functions and applications – Explaining how technology works – Emphasising technical advantages
Week 2	
Week 3	
Week 4	– Describing specific materials – Discussing quality issues – Describing component shapes and features
Week 5	
Week 6	
Week 7	Midterm exam
Week 8	– Explaining and assessing manufacturing techniques – Working with drawings – Describing design phases and procedures
Week 9	
Week 10	
Week 11	– Discussing repairs and maintenance – Assessing feasibility – Describing improvements and redesigns
Week 12	
Week 13	
Week 14	– Resolving design problems – Describing types of technical problem – Assessing and interpreting faults
Week 15	
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Beer, D. & McMurrey, D. 2004, A Guide to Writing as an Engineer (2nd ed), New York: Wiley	No
Recommended Texts	Borowick, Jerome N., 2002, Technical Communication and its Applications (2nd ed), New Jersey: Prentice-Hall, Inc.	No
Websites	http://umich.edu/~elements/5e/lectures/index.html	

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Fluid Flow II**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Lab** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 206**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	2		**Semester (s) offered**	2	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Burhan S. Abdulrazzaq		**e-mail**	burhansadik@tu.edu.iq	
Module Leader's Acad. Title	Ass. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	CHEM_ENG 202	**Semester**	1

Co-requisites module	None	Semester	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	1. To understand pumping in liquids, types of pumps 2. To understand the calculation of energy needed to pump liquid in the pipe system 3. To knowledge about dimensional analysis 4. Simplify the Dimensional analysis and the dimensionless group 5. To get acquainted the basic concept of the boundary layer 6. To get acquainted the compressible fluid, isothermal and adiabatic flow 7. To understand the compressor and the energy required to compress the fluids 8. To explain the mixing of liquids 9. To comprehend the flow in presence of solid particle
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After successful completion of the module, students will be able to : 1. Identifying the types of pumps and homogenous centrifugal pump relations. 2. be able to evaluate the operating points for different systems using pumps connected in series or in parallel 3. Understand the concept of vorticity and rotational and irrotational flow 4. Explain the compressible fluids and compressors 5. Learn about mixers, their types and extent of use Vortex and their types 6. Definition of the boundary layer 7. Ability to derive the terminal settling velocity, including their forces 8. Interpret experimental and test results and present these in an appropriate engineering report format 9. Collaborate with others in a team project environment to conduct engineering investigations and produce engineering reports
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Dimensional Analysis Boundary layer Pumping of liquid, types of pump, system heads, [15 Hrs.] operation characteristics, centrifugal pump relation, pumps in series and parallel Flow of compressible fluid, [15 Hrs.] isothermal and adiabatic flow, compressor and compressing of gas, [15 Hrs.] Mixing of liquid, power curve, Flow in presence of solid particle, [15 Hrs.]
Course Description	The course begins with fluid flow applied to a range of problems in chemical engineering, including dimensional analysis, Pumps, pumps types, calculation of the energy required to pumping the liquid through the pipes,

	compressible fluids, compressor, mixing and their ranges of application, flow in the presence solid particle Students will work to formulate the models necessary to study, analyses, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The main strategy that will be adopted in delivering this module is • encourage students' participation in the exercises, • refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials. • by considering type of simple experiments involving some sampling activities that are interesting to the students. • Developing students' abilities in research by asking students to group discussion sessions • urging students to look at sources, books and the Internet as a source of information in addition to homework

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 56** **In class tests & Lab 30** **Seminars 4**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 40** **Preparation for tests 20** **Homework's 10**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #1, 2, 3, 4, 5, and 6
	Assignments	2	10% (10)	3, 6, 10,	LO # 1, 2, 3, 4, 5, and 6

	Projects / lab.	1	10% (10)	Continuous	
	Seminars	1	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	1	10% (10)	7	LO # 1-6
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Pumping of liquid, types of pumps
Week 2	Centrifugal Pump relation,
Week 3	pump in parallel and series
Week 4	basic concept of the Boundary layer
Week 5	Dimensional Analysis
Week 6	Compressible fluids
Week 7	Energy equation for compressible fluid, isothermal
Week 8	Energy equation for compressible fluid, adiabatic
Week 9	Compressor and the energy required the compress the fluid
Week 10	Mixing of liquid
Week 11	Vortex and its types
Week 12	Power curve and energy required for mixer
Week 13	Power curve
Week 14	Flow in the presence of solid particle
Week 15	**Preparatory Week**
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: Calibration of Rotameter
Week 2	Lab 2: Center of Pressure
Week 3	Lab 3: Bernoulli's Equation
Week 4	Lab 4: A flow through a Venturi meter

Week 5	Lab 5: Impact of Jet
Week 6	Lab 6: Friction Losses in the Tubes
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	1. **J, M. Coulson and J. F. Richardson "Chemical Eng. Vol. 1** 2. **Fluid Mechanics / Frank M. White/ 7th edition**	Yes
Recommended Texts	**McCabe W.L. & Smith J.C., Unit Operations of Chemical Engg, McGraw Hill** **Holland F. A. " fluid flow for Chem. Eng."**	No
Websites	https://www.youtube.com/watch?v=BaEHVpKc-1Q&ab_channel=Lesics	

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	Numerical Analysis		**Module Delivery**	
Module Type	**Suplement**		**Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	MATH-301			
ECTS Credits	**6**			
SWL (hr/sem)	**150**			
Module Level	3	**Semester (s) offered**	1	
Administering Department	Chemical Engineering	**College**	Engineering	
Module Leader	Omar Saeed Lateef	**e-mail**	o.s.lateef@tu.edu.iq	
Module Leader's Acad. Title	Assistant Teacher	**Module Leader's Qualification**	M.Sc.	
Module Tutor	-	**e-mail**	None	
Peer Reviewer Name	Hiba Ramadhan	**e-mail**	Hibamohammed92@tu.edu.iq	
Review Committee Approval	01/06/2023	**Version Number**	1.0	

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	**Engineering Analysis (MATH-201), Computer Programming (ENG-105)**	**Semester**	2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	*Understand the need for numerical methods, and go through the stages (mathematical modeling, solving and implementation) of solving a particular physical problem.* *Understand the basics of differentiation, relate the slopes of the secant line and tangent line to the derivative of a function, use rules of differentiation to differentiate functions, find maxima and minima of a function, and apply concepts of differentiation to real world problems.* *Use several minimizing of residual criteria to choose the right criterion, derive the constants of a linear regression model based on least squares method criterion, use in examples, the derived formulas for the constants of a linear regression model, and prove that the constants of the linear regression model are unique and correspond to a minimum.* *Define an ordinary differential equation, differentiate between an ordinary and partial differential equation, and solve linear ordinary differential equations with fixed constants by using classical solution and Laplace transform techniques.*
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	• *Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.* • *Apply numerical methods to obtain approximate solutions to mathematical problems.* • *Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.* • *Analyze and evaluate the accuracy of common numerical methods.* • *Implement numerical methods in Matlab, Comsol and Excel* • *Write efficient, well-documented Matlab code and Excel sheet and present numerical results in an informative way.* • *Recognize when numerical methods can be employed to solve problems in mathematics.* • *Apply numerical methods in solving systems of linear equations* *Solve initial-value problems in ordinary differential equations Estimate eigenvalues and eigenvectors.*
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Errors, Approximations and Series Approach (2 hrs.) • Roots Estimation, fundamentals and its application (4 hrs.) • System of equation (Linear and non-linear) (4 hrs.) • Integration, differentiation and Interpolation (6 hrs.) • Regression (linear, multilinear and non-linear) (4 hrs.) • ODE and PDE (10 hrs.)

Course Description	*To explore complex systems, physicists, engineers, financiers and mathematicians require computational methods since mathematical models are only rarely solvable algebraically. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science. Such methods include techniques for simple optimization, interpolation from the known to the unknown, linear algebra underlying systems of equations, ordinary differential equations to simulate systems, and stochastic simulation under random influences. Topics covered are: the mathematical and computational foundations of the numerical approximation and solution of scientific problems; simple; vectorization; clustering; polynomial and spline interpolation; regression; pattern recognition; integration and differentiation; solution of large scale systems of linear and nonlinear equations; modelling and solution with sparse equations; explicit schemes to solve ordinary differential equations and partial differential equations.*

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 45** **In class tests 2** **Seminars 13** **Practical 30**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Prepartion for tests 15** **Homeworks 15**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Mathematical Background: - matrix - matrix operations (addition, multiplication,…. - Determinant - Matrix inversion
Week 2	System Of Linear Algebraic Equations - Gauss Elimination - Matrix Inversion - The Gauss-Seidle Method
Week 3	Open Methods to Estimate Root. - The Newton Raphson Method - The Secant Method
Week 4	*Closed Methods for Root Estimation* - *Bisection Methods* - *False Position Methods*
Week 5	Curve Fitting - Linear Regression - Newton's Divided-Difference Interpolation Polynomials - Lagrange Interpolation Polynomials
Week 6	Curve Fitting - *Multi-linear Regression* - *Non-Linear Regression*
Week 7	*Partial Exam*

Week 8	Numerical Integration - The Trapezoidal Rule - Simpson Rules
Week 9	Numerical Differentiation - Richardson Extrapolation
Week 10	Ordinary Differential Equations - Euler's Method - Modified Euler's Method
Week 11	Ordinary Differential Equations - Runge -Kutta Methods (2^{nd} and 4^{th} order methods)
Week 12	Partial Differential Equations - Finite Difference. Elliptic Equations
Week 13	Partial Differential Equations Finite Difference. Parabolic Equations
Week 14	Partial Differential Equations Special B.C for PDE
Week 15	*Final Review and Advanced Application*
Week 16	*Final Exam*

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: MATLAB Introduction, m-file, and Excel Sheet fundamentals
Week 2	Lab 2: Writing a program /Excel technique for solving sin(x) in Taylor series
Week 3	Lab 3: Writing a program for solving (x^2-3x-9=0 and mode), by bi-section method and false-position method
Week 4	Lab 4: Writing a program /Excel technique for solving (x^2-3x-9=0 and mode), by Newton-Raphson method and fixed-point iteration method
Week 5	Lab 5: Writing a program /Excel technique to solve three linear equations system, (matrix approach)
Week 6	Lab 6: Writing a program /Excel technique to solve three linear equations system, (iterative approach)
Week 7	Lab 7: Writing a program /Excel technique to solve Newton Divided Difference example
Week 8	Lab 8: Writing a program /Excel technique to solve Numerical Differentiation and Integration examples
Week 9	Lab 9: Writing a program /Excel technique to solve Numerical Interpolation by Lagrange method
Week 10	Lab 10: Writing a program /Excel technique to solve ODE by Euler ad RK (IVP)
Week 11	Lab 11: Writing a program /Excel technique to solve ODE by Euler ad RK (BVP)

Week 12	Lab 12: Writing a program /Excel technique to solve system of ODE by Euler method
Week 13	Lab 13: Writing a program /Excel technique to solve system of PDE by finite element method
Week 14	Lab 14: Review
Week 15	Lab 15: Lab. Exam

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Stephan Chapra, Numerical methods for Engineers	Yes
Recommended Texts	Joe D. Hoffman, Numerical Methods for Engineers and Scientists	No
Websites		

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Chemical process safety and professional Ethics**		**Module Delivery**	
Module Type	**Core**		**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 304**			
ECTS Credits	**5**			
SWL (hr/sem)	**125**			
Module Level	3	**Semester (s) offered**	1	
Min number of students	15	**Max number of students**	100	
Administering Department	Chemical Engineering	**College**	Engineering	
Module Leader	Dr. Saba A. Gheni	**e-mail**	ghenis@tu.edu.iq	
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.	
Module Tutor	None	**e-mail**	None	
Peer Reviewer Name	Dr. Safaa M. R. Ahmed	**e-mail**	safaamohamed@tu.edu.iq	
Review Committee Approval	01/06/2023	**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Laboratory Safety (CHE_ENG 102), Industrial & Petrochemical Processes (CHE_ENG 204)	**Semester**	-
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	The standard is designed to minimize or prevent incidents and accidents from the release of toxic, flammable, reactive or explosive chemicals. The goal of process safety management is to minimize and prevent incidents resulting from the release of hazardous chemicals. It also focus on ethical behavior of the graduates.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	The student will be able to 1. define major components of process safety and Process Safety Management (PSM) 2. use online e-learning tools and obtain a SACHE certificate while recognizing the need for life-long learning in chemical process safety 3. explain and apply OSHA PSM and it 14 elements when applicable 4. identify the components of PSI and explain how it is obtained and utilized 5. describe safety and differentiate inherently safe and safe 6. describe risk in terms of frequency and consequences and use risk to define safety levels 7. identify and explain most common process hazard analysis (PHA) and risk assessment techniques (LOPA) 8. identify most of the basic toxicology terms and concepts that can impact workers in the chemical industry 9. identify between compressible and incompressible fluids and calculate critical pressure and flows for compressible fluids. Describe the fire triangle and differentiate various types of fires 10. describe the explosion pentagon and differentiate various types of explosions. 11. describe overpressure and calculate safe distance from overpressure development 12. Be aware of ethical issues and principles in chemical engineering practice.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction, (2 hrs) • Recognize Hazards (10 hrs) • Assess and minimize risk (18 hrs) • Professional ethics (6 hrs) • Prepare for Emergencies (6 hrs)		
Course Description	A study of the technical fundamentals of chemical process safety: includes impact of chemical plant accidents and concepts of societal and individual risk; hazards		

	associated with chemicals and other agents used in chemical plants, including toxic, flammable and reactive hazards: concepts of inherently safer design; control and mitigation of hazards to prevent accidents, including plant procedures and designs; major regulations that impact safety of chemical plants; consequences of chemical plant incidents due to acute and chronic chemical release and exposures; hazard identification procedures; introduction to risk assessment. It also introduces the studets to AIChE code of chemical engineers ethics and social responsibilities.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 53** **In class tests 2** **Seminars 5**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 35** **Preparation for tests 10** **HomeWorks 10** **Project 10**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	4	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5, 6, 7, 8, 9 and 12
	Seminars	4	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-6
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Introduction to Process safety, Accidents and Loss statistics
Week 2	Professional chemical Engineering ethics based on AIChE code
Week 3	Toxicological Studies
Week 4	Prevention of Fire and Explosion
Week 5	Source model and dispersion
Week 6	Relief and relief Sizing
Week 7	**Midterm exam**
Week 8	Hazard Identification, HAZOP analysis
Week 9	Risk Assessment
Week 10	QRA and LOPA
Week 11	Process of Accident Investigation
Week 12	Reliability Engineering
Week 13	Economics of loss prevention
Week 14	Flow of gases in pipes, Flashing liquids, worst case analysis
Week 15	Ventilation calculations.
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Daniel A. Crowl and J. F. Louvar, Chemical Process Safety, Fundamentals with Applications, 3rd ed., Prentice Hall, 2011. 723 pages. ISBN-13: 978-0-13-138226-8	No
Recommended Texts	Lees F.P. Lee's Loss Prevention in Process industries: Hazard Identification, Assessment and control	No
Websites	TBD	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**HEAT TRANSFER I**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**CHEM_ENG 302**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	3		**Semester (s) offered**	1	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Harith N. Mohammed		**e-mail**	hnmohammed@tu.edu.iq	
Module Leader's Acad. Title	Asst. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Suhaib S. Salih		**e-mail**	Suhaibsalih@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Physical chemistry (CHE_ENG 201), Fluid Flow II (CHE_ENG 206)	**Semester**	1,2

Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Enable students to develop a comprehensive understanding of the heat transfer mechanisms through the bodies and thermal systems, heat transfer methods, thermal resistance, selection criteria thermal insulations, and heat transfer in unsteady-state condition.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Identify the heat transfer method through the system. 2. Identify the type of the thermal resistance and its impact on the heat transfer rate. 3. Find appropriate solutions for the system contains internal heat generation. 4. Specify critical thickness of insulation that covered cylinders and pipe. 5. Find appropriate solutions for determination of temperature distribution in semi-infinite bodies at unsteady-state condition.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Heat transfer methods (6 hrs) • Steady-state conduction one-dimension (24 hrs) • Steady-state conduction two-dimension (8 hrs) • Unsteady-state conduction (16 hrs)
Course Description	This course is aimed to establish fundamental knowledge of heat transfer. Presentation of the course starts by introducing the heat transfer method and then utilizes it to solve problems in steady-state conduction, with and without heat generation, in three geometries: plane wall, cylinder and sphere. The thermal resistance calculation in these geometries is presented. In addition, the temperature prediction in semi-infinite bodies at unsteady-state conditions is discussed.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching strategy can be achieved through: focusing on the principle of the module subjects, explain the theoretical material through practical applications, solving adequate number of problems (tutorial and homework) and evaluate the student learning by conducting exams.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** 67	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0

In class tests 2 **Seminars** 6				
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** 40 **Preparation for tests** 20 **Homeworks** 15	75	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (15)	2, 4, 6, 8, 10, 12	
	Seminars	3	12% (15)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	10	LO # 1-4
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction –Heat transfer methods, Conduction Heat Transfer
Week 2	Thermal conductivity, convection heat transfer
Week 3	Radiation heat transfer,
Week 4	Steady-state conduction in plane wall.
Week 5	Steady-state conduction in cylinder and sphere.
Week 6	Overall heat transfer coefficient, critical insulation thickness
Week 7	Heat source system
Week 8	Fins
Week 9	Fin effectiveness and fin performance, thermal resistance for fin-wall combinations, thermal contact resistance
Week 10	Midterm exam
Week 11	Steady-state conduction-two dimension, numerical methods
Week 12	Numerical solution and software

Week 13	Unsteady-State Conduction, Lumped Heat Capacity System
Week 14	Transient heat flow in a semi-infinite solid
Week 15	Heisler Charts
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Heat Transfer 10th Edition by J.P. Holman, 2010, McGraw-Hill, New York, USA.**	Yes
Recommended Texts	**Heat Transfer; A Practical approach, 2nd Edition by Yunus A. Cengel, 2002, McGraw-Hill, New York, USA.**	No
Websites	https://www.researchgate.net/profile/Md_Washim_Akram/post/Good-books-on-Fluid-mechanics-and-Heat-Transfer/attachment/5ab22ae44cde266d5892d50a/AS%3A606556357918729%401521625713296/download/heat-transfer-a-practical-approach-by-y-a-cengel.pdf	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Mass Transfer I**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHE_ENG 303**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	3		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	80	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Suhaib S. Salih		**e-mail**	Suhaibsalih@tu.edu.iq	
Module Leader's Acad. Title	Asst. Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Hayder A. Arif		**e-mail**	h.alnasri@tu.edu.iq	
Review Committee Approval	22/05/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	CHE_ENG 103	**Semester**	1,2

Co-requisites module	None	Semester	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Introduce the fundamentals of the basic concepts of mass transport such as the equimolar counter diffusion, stagnant layer diffusion and convective mass transfer, and two- phase mass transfer with diffusivity prediction from liquid phase activity coefficients. Moreover, introduce the basic principles of chemical engineering separation processes and mass transfer and then proceed to study the design and operation of separation processes units operation such as gas-liquid absorption, stripping, and solid-liquid extraction.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	On successful completion of this module the student will be able to: 1. Ability to calculate diffusion coefficients in various systems. 2. Demonstrate a broad and integrated knowledge for mass transfer theories and their relevance to the chemical process industries. 3. Explain the physical phenomena, theoretical concepts, and design aspects of mass transfer in separation processes, including gas-liquid absorption, stripping, and solid-liquid extraction. 4. Analyze the important separation processes of gas absorption, striping, and solid-liquid extraction and carry out design calculations appropriately of the above processes. 5. Apply simplifying assumptions to complex problems in order to gain useful design information individually and in a team. 6. Communicate (written and verbal) outcome of practical work.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction to mass transfer and separation processes (4 hrs) • Fundamentals of diffusion (16 hrs) • gas-liquid absorption (16 hrs) • Stripping (8 hrs) • solid-liquid extraction (12 hrs)
Course Description	This course aims to cover the fundamentals of the basic concepts of mass transport and understanding the separation processes such as gas absorption, stripping, and leaching.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: • Allow students to develop the necessary skills and knowledge to fulfil the module learning outcomes. • Allow students to practice applying their learning to selected tutorial problems in a supportive environment and in so doing develop further their skill base.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 53** **In class tests 2** **Seminars 5**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 45** **Preparation for tests 25** **Homework 20**	90	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	4, 7, 10, 13	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 5, 6, 8, 9, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	8	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction –mass transfer and separation processes, molecular diffusion – Fick's law
Week 2	Stagnant diffusion, equimolecular counter diffusion, diffusion with reaction, diffusion coefficient in gases and in liquids.
Week 3	Unsteady-state Diffusion, diffusion through variable cross-sectional area, mass transfer coefficient.
Week 4	Mass transfer theories, overall gas-phase and overall liquid-phase mass transfer coefficients.
Week 5	Gas and liquid-side resistances in interfacial mass transfer, Empirical correlations of mass transfer coefficient
Week 6	Introduction to absorption process, solubility of gases in liquids, selection of solvent for absorption, packed tower absorption.

Week 7	Determine packed absorption height, minimum liquid flow rate.
Week 8	Midterm exam
Week 9	Plate absorption tower, calculating trays number and height, absorption column efficiency.
Week 10	Type of trays, advantages and disadvantages of trayed columns and packed columns.
Week 11	Introduction to stripping process (Desorption), driving forces, operating line.
Week 12	Determine the height of stripping column and the number of trays.
Week 13	Introduction to solid-liquid extraction, batch leaching.
Week 14	Continuous leaching for counter current constant and variable underflow.
Week 15	Continuous leaching for co-current (cross current) - constant and variable underflow.
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 1, six edition, ELBS, Pergamon Press. 2002.**	Yes
Required Texts	**Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 2, fifth edition, ELBS, Pergamon Press. 2002.**	Yes
Recommended Texts	**Cussler E.L., Diffusion Mass Transfer in Fluid Systems Third Edition, 2009.**	No

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Process modeling**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 301**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	3		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	60	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Saad Nahi Saleh		**e-mail**	snsaleh@tu.edu.iq	
Module Leader's Acad. Title	Assistant Professor		**Module Leader's Qualification**	Ph.D	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Omar Saeed Lateef		**e-mail**	o.s.lateef@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	ENGINEERING ANALYSIS (MATH-201)	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	The overall goal of this course is to enable students to formulate mathematical models of chemical engineering systems, apply analytical methods and computer programs to calculate solutions, estimate its behavior and make predictions about behavior of these systems. The focus of the course will be on studying and applying various modeling techniques to creating mathematical description of the chemical engineering systems.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Handle freely the basic chemical engineering principles using in mathematical modeling. 2. Analyze a simple transport phenomena in order to create a mathematical model. 3. Apply basic principles to model the chemical engineering systems in a form of differential equations or difference equations. 4. Interpret the results in order to predict the behavior of the chemical engineering systems 5. Understand the mechanism of mathematical modeling in chemical engineering
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Lumped models (4 hrs) • Distributed Models (4 hrs) • Finite Difference Models (4 hrs) • Modeling Applications (6 hrs) • Computer-Aided Modeling (4 hrs) • Treatment of Experimental Results (4 hrs)
Course Description	This course is offered to undergraduates and introduces students to the mathematical modeling and applied mathematics. It necessitates both a sound understanding of the chemical engineering fundamentals and a quite sophisticated engineering analysis. It also requires a computer program to solve problems that are not tractable by hand.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 43** **In class tests 2** **Seminars 8** **Discussions 7**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 25** **Prepartion for tests 20** **Homeworks 20**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, and 3
	Assignments (Homeworks)	5	10% (10)	2, 4, 6, 8, 10	All
	Seminars	4	8% (8)	Continuous	
	Discussions	6	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	The Mathematical Statement of the Problem, Modeling Scales and Representation
Week 2	Constitutive Relations
Week 3	Model types and characteristics
Week 4	Ordinary Differential Equation Models
Week 5	Lumped models

Week 6	Distributed Models
Week 7	Midterm exam
Week 8	Partial Differential Equation Models
Week 9	Partial Differential Equation Models
Week 10	Finite Difference Models
Week 11	Modeling Applications
Week 12	Modeling Applications
Week 13	Computer-Aided Modeling
Week 14	Computer-Aided Modeling
Week 15	Treatment of Experimental Results
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Jenson & Jeffreys, Mathematical Methods in Chemical Engineering, 2ed, Academic Press.**	Yes
Recommended Texts	**Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.**	Yes
Websites	N/A	

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Statistics and Probability**			**Module Delivery**	
Module Type	**Suplement**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**MATH-302**				
ECTS Credits	**3**				
SWL (hr/sem)	**100**				
Module Level	3		**Semester (s) offered**	1	
Min number of students	25		**Max number of students**	80	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Kumait S. Kumait		**e-mail**	Kumait.s.awad@tu.edu.iq	
Module Leader's Acad. Title	Assistant Lecturer		**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	-

Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	This module aims to provide chemical engineering students with a thorough understanding of a number of separation processes that are essential to the process industry, such as sedimentation, filtration, Screening, Fluidization, Membrane separation and Centrifugation processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After completing this module successfully, the student will be able to: 1. Gain the knowledge and abilities necessary to apply theory, experimentation, data analysis, and interpretation into unit operations. 2. Students are learned the basic principles in separation engineering such as (Filtration, fluidization, membranes separation, sieving, sedimentation etc). 3. Develop the ability to understand Sedimentation processes including gravity settling, sink-and-float methods, and differential settling methods, uses of clarifiers and thickeners, flocculation, and batch sedimentation; 4. Understand how to evaluate the screen effectiveness as a measure of a screen's success in separating solid particles. Know the properties of masses of particulate solids. 5. Explain the principles of fluidization technology, characteristics of fluidized systems; mass and heat transfer between fluids and particles; liquid-solids and gas-solids systems. 6. Describe the filtration separation method. Mechanism that controls how fluids move through porous beds. The various forms of industrial filtration and the filter medium. 7. Understand the centrifugal design and analysis. 8. Describe and evaluate the fundamentals and uses of membrane treatment systems.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • **Statistics I: pure applied probability** (8 hrs) • **Statistics II: applied probability** (7 hrs) • **Probability** (10 hrs)
Course Description	Students are introduced to: Introduction to **statistics**; Frequency Tables; Measures of central tendency: Average, mode, and median; Measures of dispersion: Variance and standard deviation; Introduction to probabilities: Sample space, Events, axioms of probability; Conditional probabilities and Independence; Random variables

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	This module covers a variety of theoretical, conceptual and practical areas, which require a range of knowledge and skills at a more advanced level to be displayed and exercised. Delivery of its syllabus content therefore involves a diversity of teaching and assessment methods suitable to the learning outcomes of the module; these include formal lectures, structured

	tutorials (work closely integrated with the lecture material), laboratory exercises to develop practical skills and familiarization with equipment and experimental techniques.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 40** **In class discussion 3** **In class tests 2**	45	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 15** **Preparation for tests 10** **Project 5**	30	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	75		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	3	10% (10)	3, 5, 9, 12	LO #1, 2, 3, 4,5 and 6
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	15% (15)	7	LO # 1-5
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction: - Data collection - Data collection
Week 2	Central measurements: - arithmetic mean, geometric mean, Harmonic mean and median - comparisons between central measurements.
Week 3	
Week 4	Variation measurements - Range, Mean deviation, Variation Coefficient of variance, sequence and, measurements comparisons between variation measurements
Week 5	
Week 6	Variation measurements

	- Range, Mean deviation, Variation Coefficient of variance, sequence and, measurements, comparisons between variation measurements
Week 7	Midterm exam
Week 8	Sampling theory - Random variables - Sample size - Random experiments
Week 9	Probability - Principles of probability theory - Probability laws and methods
Week 10	Probability Distributions - Discrete probability distribution - Continuous probability distribution
Week 11	Washing filter cakes, Compressible cakes,
Week 12	Hypothesis tests for means - One population - Two population or more Hypothesis tests - For variation (one way) - For variation (two way)
Week 13	
Week 14	Correlation and Regression - Person coefficient - Rank coefficient
Week 15	
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Probability and Statistics for the engineering and the sciences, By Jay L. Devore. Cengage Learning, 2016**	No
Recommended Texts	**A Second Course in Probability 2nd Edition, Sheldon M. Ross, University of Southern California, Erol A. Peköz, Boston University, PUBLICATION PLANNED FOR: July 2023**	No
Websites	N/A	

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Thermodynamics I**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	CHEM_ENG 302				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	3		**Semester (s) offered**	1	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Duraid F. Ahmed		**e-mail**	drduraid@tu.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor					
Peer Reviewer Name			**e-mail**		
Review Committee Approval			**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	CHEM_ENG 201	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	The module aims to provide students with a solid understanding of the principles and applications of thermodynamics, enabling them to apply these concepts to solve problems and analyze various systems and processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	● Understand the concepts of thermodynamics, heat and work. ● Identify the application and characteristics the first law of thermodynamics, Joule's experiment. Internal energy, Enthalpy. Steady-State steady-flow processes. ● Develop Equilibrium and the phase rule. Reversible processes. Processes at constant volume and constant pressure. Heat capacities. ● Able to apply volumetric properties of pure fluid,: PV- T diagrams. Ideal gas. Virial equation and its applications. Cubic equations of state. Generalized correlations for gases and liquids . ● Identify the application and characteristics second law of thermodynamics: Statement of the second law. Heat engines. Carnot cycle. Thermodynamic scale of temperatures. Entropy. The third law of thermodynamics.
Indicative Contents المحتويات الإرشادية	● Undergraduate review (4 hr). ● Introduction to thermodynamics (4 hr). ● Basic concepts and definitions (system, surroundings, boundary, state, equilibrium, etc.) (4 hr). ● Laws of thermodynamics (First law of thermodynamics (conservation of energy), Second law of thermodynamics (entropy and energy transfer), Third law of thermodynamics and absolute zero. (18 hr). ● Properties of pure substances: Properties of substances and equations of state Phase diagrams and phase transitions, Ideal gas law and real gas behavior. (12 hr). ● Energy and heat transfer: Forms of energy (internal energy, potential energy, kinetic energy, Heat, work, and energy transfer mechanisms Heat capacity and specific heat. (14 hr).
Course Description	In this course, students learn some details of present the laws of thermodynamics, showing their application to the study of thermal effects in chemical processes and the analysis of power cycles. Study and evaluate the thermodynamic properties of pure fluids. Principal To impart the detail concepts of thermodynamics and so on.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Employ various strategies to enhance student understanding and engagement with the subject matter. Here are some effective strategies for teaching thermodynamics such as: Conceptual Understanding, Active Learning, Visualization Tools, Practical Applications, Problem-Solving Approach, and Real-World Examples.

Student Workload (SWL) الحمل الدراسي للطالب				
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **56** **In class tests** **4** **Seminars** **2**	75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** **25** **Preparation for tests** **15** **Homework** **10**	50	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	5% (5)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	20% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	The Scope of Thermodynamics, Force, Temperature, Work, Energy, Heat.
Week 2	Fundamental concepts and definitions - closed, open and isolated system - intensive and extensive properties - path and state functions –reversible and irreversible process - temperature - Zero law of thermodynamics.
Week 3	
Week 4	First law of thermodynamics – internal energy - enthalpy - heat capacity.
Week 5	

Week 6	First law for cyclic, non-flow and flow processes – applications.
Week 7	P-V-T behavior of pure fluids - ideal gases and ideal gas processes.
Week 8	Equations of state - vander Waals equation, Redlich-Kwong equation, Virial equation - principle of corresponding states - critical and pseudo critical properties - Compressibility charts.
Week 9	
Week 10	Second law of thermodynamics: Statement of the second law. Heat engines. Carnot cycle.
Week 11	Thermodynamic scale of temperatures. Entropy..
Week 12	The third law of thermodynamics
Week 13	THERMODYNAMIC PROPERTIES OF PURE FLUIDS: Maxwell's equations. Helmholtz and Gibbs functions. Residual properties.
Week 14	
Week 15	Two-Phase systems. Tables and diagrams of thermodynamic properties of gases and liquids.
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Introduction to chemical engineering thermodynamics" by J. M. Smith, H. C. Van Ness, M. M. Abbot, and M. T. Swihart. Eighth ed. McGraw, 2018, ISBN- 978-1-259-69652-7.	Yes
Recommended Texts	• Chemical Engineering Thermodynamics, Narayanan, PHI • Chemical Engineering Thermodynamics: Y.V.C. Rao. • Chemical Process Principles (Vol-2): O.A.Hougen, K.M. Watson and R.A.Ragatz • Chemical and Process Thermodynamics: Kyle PHI.	Yes
Websites		

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MODULE DESCRIPTOR
وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Engineering economics**	**Module Delivery**	
Module Type	**Suplement**	**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**ENG-110**		
ECTS Credits	**4**		
SWL (hr/sem)	**100**		
Module Level	3	**Semester (s) offered**	2
Min number of students	25	**Max number of students**	80
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Kumait S. Kumait	**e-mail**	Kumait.s.awad@tu.edu.iq
Module Leader's Acad. Title	Assistant Lecturer	**Module Leader's Qualification**	MSc
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Industrial & Petrochemical Processes (CHE_ENG204)	**Semester**	1
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	This module aims to provide chemical engineering students with a thorough understanding of economic aspects to manage a business project and to assess the economics.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After completing this course, students will be able to: 1. conduct simple economic studies. 2. make evaluation of engineering projects 3. make decisions related to investment
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction (2 hrs) • Interest and Time Value of Money (4 hrs) • Basic Methodologies of Engineering Economic Analysis (4 hrs) • Comparative Analysis of Alternatives (4 hrs) • Replacement Analysis (4 hrs) • Risk Analysis (2 hrs) • Depreciation and Corporate Income Taxes. (4 hrs) • Inflation and Its Impact on Project Cashflows (2 hrs)
Course Description	After completing this course, students will be able to conduct simple economic studies. They will also be able to make evaluation of engineering projects and make decisions related to investment.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	This module covers a variety of theoretical, conceptual and practical areas, which require a range of knowledge and skills at a more advanced level to be displayed and exercised. Delivery of its syllabus content therefore involves a diversity of teaching and assessment methods suitable to the learning outcomes of the module; these include formal lectures, structured tutorials (work closely integrated with the lecture material), laboratory exercises to develop practical skills and familiarization with equipment and experimental techniques.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 30** **In class tutorial 10** **In class tests 2**	45	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 25** **Preparation for tests 20** **HomeWorks 10**	55	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.7
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	3	10% (10)	3, 8	LO #1, and 2
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, and 3
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	15% (15)	7	LO # 1-2
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	1.Introduction 1.1. Origin of Engineering Economy 1.2. Principles of Engineering Economy 1.3. Role of Engineers in Decision Making 1.4. Cash Flow Diagram.
Week 2	2. Interest and Time Value of Money 2.1. Introduction to Time Value of Money 2.2. Simple Interest 2.3. Compound Interest 2.3.1. Nominal Interest rate 2.3.2. Effective Interest rate 2.3.3. Continuous Compounding 2.4. Economic Equivalence
Week 3	3. Development of Interest Formulas 3.1. The Five Types of Cash flows 3.2. Single Cash flow Formulas 3.3 Uneven Payment Series 3.4. Equal Payment Series 3.5. Linear Gradient Series. 3.6. Geometric Gradient Series
Week 4	4. Basic Methodologies of Engineering Economic Analysis 4.1. Determining Minimum Attractive (Acceptable) Rate of Return (MARR). 4.2. Payback Period Method 4.3. Equivalent Worth Methods 4.4.1. Present Worth Method
Week 5	5. Future Worth Method. 5.1. Annual Worth Method. 5.2. Rate of Return Methods 5.3. Internal Rate of Return Method. 5.4. External/Modified Rate of Return Method. 5.5. Public Sector Economic Analysis (Benefit Cost Ratio Method). 5.6. Introduction to Lifecycle Costing

	5.7. Introduction to Financial and Economic Analysis
Week 6	6.Comparative Analysis of Alternatives 6.1. Comparing Mutually Exclusive Alternatives having Same useful life by 6.1.1. Payback Period Method and Equivalent Worth Method 6.1.2. Rate of Return Methods and Benefit Cost Ratio Method 6.2. Comparing Mutually Exclusive Alternatives having different useful lives.
Week 7	Midterm
Week 8	8.1 Repeatability Assumption 8.2. Co-terminated Assumption 8.3. Capitalized Worth Method 8.4. Comparing Mutually Exclusive, Contingent and Independent Projects in Combination.
Week 9	9. Replacement nalysis: 9.1 Fundamentals of Replacement Analysis 9.2 Basic Concepts and Terminology 9.3 Approaches for Comparing Defender and Challenger 9.4 Economic Service Life of Challenger and Defender
Week 10	10. Replacement Analysis When Required Service Life is Long. 10.1. Required Assumptions and Decision Framework 10.2. Replacement Analysis under the Infinite Planning Horizon 10.3. Replacement Analysis under the Finite Planning Horizon
Week 11	11 Risk Analysis 11.1. Origin/Sources of Project Risks. 11.2. Methods of Describing Project Risks. 11.3. Sensitivity Analysis
Week 12	12.1. Breakeven Analysis 12.2. Scenario Analysis 12.3 Probability Concept of Economic Analysis 12.4 Decision Tree and Sequential Investment Decisions
Week 13	13. Depreciation and Corporate Income Taxes 13.1. Concept and Terminology of Depreciation 13.2. Basic Methods of Depreciation 13.3. Straight line method 13.4. Declining Balance Method
Week 14	14. Sinking Fund Method, 14.1. Sum of the Year Digit Method 14.2. Modified Accelerated Cost Recovery System (MACRS) 14.3 Introduction to Corporate Income Tax. 14.4 After Tax Cash flow Estimate. 14.5 General Procedure for Making After Tax Economic Analysis.
Week 15	Presentation of project
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	Chan S. Park, Contemporary Engineering Economics,	No

	Prentice Hall, Inc.	
Recommended Texts	E. Paul De Garmo, William G. Sullivan and James A. Bonta delli, Engineering Economy, MC Milan Publishing Company	No
Websites	N/A	

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information

معلومات المادة الدراسية

Module Title	**HEAT TRANSFER II**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 307**		
ECTS Credits	**6**		
SWL (hr/sem)	**150**		
Module Level	3	**Semester (s) offered**	2
Administering Department	Chemical Engineering	**College**	Engineering

Module Leader	Dr. Harith N. Mohammed	**e-mail**	hnmohammed@tu.edu.iq
Module Leader's Acad. Title	Asst. Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	Dr. Suhaib S. Salih	**e-mail**	Suhaibsalih@tu.edu.iq
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	HEAT TRANSFER I (CHEM_ENG 302), FLUID FLOW I CHEM_ENG 202	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Enable students to develop a comprehensive understanding of the principles of convection heat transfer, application of empirical equations for convection heat transfer, and heat transfer calculations in heat exchangers.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Identify the significant parameters on convection heat transfer. 2. Identify the relation between the fluid flow and convection heat transfer. 3. Find appropriate solutions for isothermal system and for that exposed to a constant heat flux. 4. Apply the appropriate heat transfer equation for internal and external flow in different geometries. 5. Identify the significant parameters in heat exchanger design.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Principles of convection (4 hrs) • Viscous flow, viscous and thermal boundary layer and Nusselt equations for flat plate. (20 hrs) • Empirical and practical relations for forced-convection. (16 hrs) • Natural convection systems. (8 hrs) • Heat exchangers. (8 hrs)
Course Description	This course is aimed to establish fundamental knowledge of convection heat transfer. Presentation of the course starts by introducing the forced convection heat

	transfer then utilizes it to solve problems in the systems contain fluid flow. The applications of empirical relations for forced convection in different geometries are presented. In addition, natural convection heat transfer relations are discussed. The heat transfer and design calculations of heat exchanges are presented.

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	The learning and teaching strategy can be achieved through: focusing on the principle of the module subjects, explain the theoretical material through practical applications, solving adequate number of problems (tutorial and homework) and evaluating the student learning by conducting exams.

Student Workload (SWL)

الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **56** **In class tests** **4** **Seminars** **1** **Laboratory** **14**		75	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** **50** **Preparation for tests** **10** **Homeworks** **15**		75	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل		150		

Module Evaluation

تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (15)	2, 4, 6, 8, 10, 12	
	Seminars	2	12% (15)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	10	LO # 1-4
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Principles of Convection, viscous flow
Week 2	Laminar boundary layer on flat plate.
Week 3	Thermal boundary layer for laminar flow, Prandtl number
Week 4	Nusselt number for isothermal plate and plate exposed to constant heat flux
Week 5	The relation between fluid friction and heat transfer (laminar and turbulent flow)
Week 6	Thermal boundary layer for turbulent flow, Bulk Temperature inside the pipes
Week 7	Empirical relations for pipe and tube flow, Turbulent flow in smooth pipe, Laminar flow in smooth pipe
Week 8	Accurate relation for turbulent flow in smooth pipe, Fluid friction and heat transfer analogy

Week 9	Non-circular duct, Flow across cylinders and spheres,
Week 10	Midterm exam
Week 11	Flow across tube banks
Week 12	Natural Convection Systems, free convection heat transfer on vertical flat plate
Week 13	Empirical relations for free convection heat transfer
Week 14	Heat Exchangers, the overall heat transfer coefficient, Fouling factor
Week 15	Types of heat exchangers, the log mean temperature difference
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: Calibration of temperature measurement devices
Week 2	Lab 2: Thermal contact resistance and thermal conductivity measurement
Week 3	Lab 3: Forced convection heat transfer
Week 4	Lab 4: Natural convection heat transfer
Week 5	Lab 5: Radiation heat transfer
Week 6	Lab 6: Heat exchanger

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	**Available in the Library?**

Required Texts	**Heat Transfer 10th Edition by J.P. Holman, 2010, McGraw-Hill, New York, USA.**	Yes
Recommended Texts	**Heat Transfer; A Practical approach, 2nd Edition by Yunus A. Cengel, 2002, McGraw-Hill, New York, USA.**	No
Websites	https://www.researchgate.net/profile/Md_Washim_Akram/post/Good-books-on-Fluid-mechanics-and-Heat-Transfer/attachment/5ab22ae44cde266d5892d50a/AS%3A606556357918729%401521625713296/download/heat-transfer-a-practical-approach-by-y-a-cengel.pdf	

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Mass Transfer II**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 308**		
ECTS Credits	**6**		
SWL (hr/sem)	**150**		

Module Level	3	**Semester (s) offered**	2
Min number of students	15	**Max number of students**	80
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Dr. Suhaib S. Salih	**e-mail**	Suhaibsalih@tu.edu.iq
Module Leader's Acad. Title	Asst. Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	Dr. Hayder A. Arif	**e-mail**	h.alnasri@tu.edu.iq
Review Committee Approval	22/05/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	MASS TRANSFER I (CHEM_ENG 303)	**Semester**	1,2

Co-requisites module	None	Semester	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	The aim of this module is to give the participants an understanding of separation process technology currently used in the modern chemical industry. This module gives an overview of the technology and design methods for four industrially important separation techniques: distillation, liquid-liquid extraction, evaporation, and drying-based processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	On successful completion of this module the student will be able to: 1. Recognize models used to describe phase equilibrium in ideal mixtures. 2. Predict equilibria for binary vapor-liquid systems and interpret appropriate graphical representations of these equilibria. 3. Design stage processes for binary distillation, liquid-liquid extraction, evaporation, and drying using equilibria, operating lines and tie lines. 4. Recall the methods used to separate multi feeds and stream sides systems by distillation. 5. Recall the short-cut methods used for multi-component distillation. 6. Develop critical understanding of emerging technologies in separation processes and their fit for purpose and limitations and understand how to combine and adapt different aspects of systems thinking to complex and novel processes.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Distillation (28 hrs) • Liquid-liquid extraction (12 hrs) • evaporation (8 hrs) • Drying (8 hrs)
Course Description	This course provides an introduction to separation processes in general, but with particular emphasis on equilibrium staged separations of binary mixtures. Processes covered include binary distillation, liquid-liquid extraction, evaporation and drying.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: • Allow students to develop the necessary skills and knowledge to fulfil the module learning outcomes. • Engage the students at an early stage in the semester and provide students with the opportunity to demonstrate all module learning outcomes, through a balanced mix of theoretical questions and design exercises.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 53** **In class tests 2** **Seminars 5**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 47** **Preparation for tests 28** **Homework 15**	90	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	4, 7, 10, 13	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 5, 6, 8, 9, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	8	LO # 1-4
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction –distillation, vapor–liquid equilibrium.
Week 2	Batch distillation, Flash distillation.
Week 3	Fractional distillation, the top and bottom operating line, the q line and energy balances,
Week 4	McCabe-Thiele graphical method, distillation operations economics.
Week 5	Column and plate efficiency, Lewis- Soral method.
Week 6	Multi-component distillation.
Week 7	Multi feeds and side streams distillation.
Week 8	Midterm exam

Week 9	Introduction to liquid – liquid extraction, Simple multi-stage contactors
Week 10	Counter-current contact.
Week 11	Total and partial immiscibility, triangular diagrams and stage to stage graphical constructions.
Week 12	Introduction to evaporation, heat transfer in evaporators.
Week 13	Single and multiple-effect evaporators, rate of evaporation.
Week 14	Introduction to drying and general principles.
Week 15	Rate of drying.
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 1, six edition, ELBS, Pergamon Press. 2002.**	Yes
Required Texts	**Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 2, fifth edition, ELBS, Pergamon Press. 2002.**	Yes
Recommended Texts	**Cussler E.L., Diffusion Mass Transfer in Fluid Systems Third Edition, 2009.**	No

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MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Process Simulation**			**Module Delivery**	
Module Type	**Core**			**Lectures** **Tutorials** **Computer Labs** **Seminars**	
Module Code	**CHEM_ENG 305**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	3		**Semester (s) offered**	2	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader			**e-mail**		
Module Leader's Acad. Title			**Module Leader's Qualification**		
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Industrial and Petrochemical industries (CHEM_ENG 204)	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	This course aims to establish fundamental knowledge of process simulation. The basics of Aspen Plus and its chemical engineering applications are focused in this course.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Learn the basics of process simulation/process simulator. 2- Learn the basics of Aspen Plus simulator. 3- Simulate Flash Separators/Distillation Columns/Liquid Extractors. 4- Simulate different types of (simple/complex) reactors. 5- Design different types of heat exchangers. 6- Choose the appropriate pressure changers (valves, pumps, compressors, pipe fittings, etc. 7- Analyze/Optimize chemical process
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: • Fundamentals of Process Simulation/Aspen Plus (10 hr) • Separation Processes Simulation (10 hr) • Reactors Simulation (10 hr) • Heat Exchangers Design/Simulation (10 hr) • Pressure Changers (Pumps, Valves, Pipes, etc.) (10 hr) • Process Analysis/Optimization (10 hr)
Course Description	This course represents the outlines of process simulation/process simulators. It focused on the chemical engineering applications of Aspen Plus simulator by explaining the simulation of different unit operations: separators, reactors, heat exchangers, pumps, etc.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 54** **In class tests 2** **Seminars 4**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Preparation for tests 20**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3

Homework's **15**			
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Assignments**	2	10% (10)	3, 5, 7, 10, 13	LO# 1-2, 3, 4, 5, 6-7
	Projects	3	20% (10)	Continuous	
	Lab./Seminars	3	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	1	10% (10)	7	LO# 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to Process Simulation and Process Simulators
Week 2	Introduction to Aspen Plus
Week 3	Flash Separators (Flash Calculations)
Week 4	Shortcut Distillation Models
Week 5	Rigorous Models of Distillation Columns
Week 6	Liquid–Liquid Extractors
Week 7	**Midterm Lab Exam**
Week 8	Reactors with Simple Reaction Kinetic Forms
Week 9	Reactors with Complex (Non-Conventional) Reaction Kinetic Forms
Week 10	Heat Exchanger (H.E.) Design
Week 11	Pressure Changers (Valves, Pumps, Pipe Fittings, etc.)
Week 12	Optimization Tool
Week 13	Term Projects (Seminars/Discussions)
Week 14	Term Projects (Seminars/Discussions)
Week 15	Term Projects (Seminars/Discussions)
Week 16	**Final Lab Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	ASPEN Tutorial #1: Mixing Rule
Week 2	ASPEN Tutorial #2: Property Analysis (binary mixture)
Week 3	ASPEN Tutorial #3: Phase Equilibrium (Flash Calculations)
Week 4	ASPEN Tutorial #4: DSTWU Distillation Models
Week 5	ASPEN Tutorial #5: RADFRAC Distillation Models
Week 6	ASPEN Tutorial #6: Extraction Process Simulation (Separation of MEK from Octanol)
Week 7	Midterm Lab Exam
Week 8	ASPEN Tutorial #7: Simplified Vinyl-Acetate Process: Introduction to Reaction Kinetics
Week 9	ASPEN Tutorial #8: Hydrodealkylation of Toluene: A Look at Reactor Models
Week 10	ASPEN Tutorial #9: Heat Exchangers Models
Week 11	ASPEN Tutorial #10: Pressure Changers Models (Pentane Transport System)
Week 12	ASPEN Tutorial #11: Process Optimization (Simplified Pipe Diameter Optimization)
Week 13	ASPEN Tutorial #12: Process Simulation Analysis [Production of Formaldehyde from Methanol (Sensitivity Analysis)]
Week 14	Final Lab Exam Review

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Kamal I.M. AL-Malah, Aspen Plus Chemical Engineering Applications, John Wiley and Sons, New York (2017)	No
Recommended Texts	• Dominic C. Y. Foo, Chemical Engineering Process Simulation, 2nd edition, Elsevier, Netherlands (2023) • Iva´n Darı´o Gil Chaves et al., Process Analysis and Simulation in Chemical Engineering, Springer, Switzerland (2016) • Amiya K. Jana, Chemical Process Modelling and Computer Simulation, PHI, Delhi (2011) • Juma Haydary, Chemical Process Design and Simulation (Aspen Plus and Aspen HYSYS Applications), JohnWiley & Sons, New York (2019)	No
Websites		

Ministry of Higher Education and

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University of Tikrit

College of Engineering

Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information

معلومات المادة الدراسية

Module Title	**Thermodynamics II**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	CHEM_ENG 306		
ECTS Credits	**5**		
SWL (hr/sem)	**125**		
Module Level	3	**Semester (s) offered**	2
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Dr. Safaa M.R. Ahmed	**e-mail**	Safaamohamed@tu.edu.iq
Module Leader's Acad. Title	Assist. Proff.	**Module Leader's Qualification**	Ph.D.
Module Tutor			
Peer Reviewer Name		**e-mail**	

Review Committee Approval		**Version Number**	1.0

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	CHEM_ENG 205	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	The module aims to provide students with a solid understanding of the principles and applications of thermodynamics, enabling them to apply these concepts to solve problems and analyze various systems and processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	● Understanding the relation of the changes in entropy to T and P for substances in the ideal-gas state. ● Determining the Lost Work. ● Understanding the Third Law of Thermodynamics and solve problems. ● Understanding the Fundamental Property Relations, Residual Properties from the Virial Equations of State, and Generalized Property Correlations for Gases. ● Understanding the fundamentals of Turbines (Expanders), and Compression Processes. ● Understanding and solve problems on the Steam Power Plant. ● Understanding and solve problems on the Carnot Refrigerator, the Vapor-Compression Cycle, Absorption Refrigeration, and the Heat Pump.
Indicative Contents المحتويات الإرشادية	● Undergraduate review (4 hr). ● the relation of the changes in entropy to T and P for substances in the ideal-gas state (4 hr). ● Lost Work (4 hr). ● The Third Law of Thermodynamics. (4 hr). ● Fundamental Property Relations, Residual Properties from the Virial Equations of State, and Generalized Property Correlations for Gases. (8 hr). ● Turbines (Expanders), Compression Processes, Throttling, and pumps

	(12 hr). ● The Steam Power Plant (8 hr). ● The Carnot Refrigerator, the Vapor-Compression Cycle, Absorption Refrigeration, and the Heat Pump (12 hr).
Course Description	In this course, students learn some details of present the laws of thermodynamics, showing their application to the study of thermal effects in chemical processes and the analysis of power cycles. Study and evaluate the thermodynamic properties of pure fluids. Principal To impart the detail concepts of thermodynamics and so on.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Employ various strategies to enhance student understanding and engagement with the subject matter. Here are some effective strategies for teaching thermodynamics such as: Conceptual Understanding, Active Learning, Visualization Tools, Practical Applications, Problem-Solving Approach, and Real-World Examples.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **56** **In class tests** **4** **Seminars** **2**	62	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** **33** **Preparation for tests** **20**	63	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.4

Homework **15**			
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation

تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	5% (5)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	20% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	
Week 2	The relation of the changes in entropy to T and P for substances in the ideal-gas state.
Week 3	
Week 4	Lost Work.

Week 5	Fundamental Property Relations, Residual Properties from the Virial Equations of State, and Generalized Property Correlations for Gases.
Week 6	
Week 7	Case study
Week 8	Applications of Thermodynamics to Flow Processes: Turbines (Expanders), Compression Processes, Throttling, and pumps.
Week 9	
Week 10	Production of Power from Heat.
Week 11	
Week 12	The Carnot Refrigerator, the Vapor-Compression Cycle, Absorption Refrigeration, and the Heat Pump.
Week 13	
Week 14	Case study.
Week 15	
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Introduction to chemical engineering thermodynamics" by J. M. Smith, H. C. Van Ness, M. M. Abbot, and M. T. Swihart. Eighth ed. McGraw, 2018, ISBN- 978-1-259-69652-7.	Yes
Recommended Texts	• Chemical Engineering Thermodynamics, Narayanan, PHI • Chemical Engineering Thermodynamics: Y.V.C. Rao. • Chemical Process Principles (Vol-2): O.A.Hougen, K.M. Watson and R.A.Ragatz • Chemical and Process Thermodynamics: Kyle PHI.	Yes
Websites		

Ministry of Higher Education and Scientific Research - Iraq
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Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Unit operations**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Laboratory** **Seminar**	
Module Code	CHEM_ENG 309		
ECTS Credits	**4**		
SWL (hr/sem)	**100**		
Module Level	3	**Semester (s) offered**	2
Min number of students	25	**Max number of students**	80
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Shymaa Ali Hameed	**e-mail**	sh.a.hamed@tu.edu.iq
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	MSc
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Mass Balance (CHEM_ENG 103), Fluid Flow II (CHEM_ENG 206)	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	This module aims to provide chemical engineering students with a thorough understanding of a number of separation processes that are essential to the process industry, such as sedimentation, filtration, Screening, Fluidization and Centrifugation processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	After completing this module successfully, the student will be able to: 1. Gain the knowledge and abilities necessary to apply theory, experimentation, data analysis, and interpretation into unit operations. 2. Students are learned the basic principles in separation engineering such as (Filtration, fluidization, sieving, sedimentation etc). 3. Student understands the principles of Packed Column analysis and design. 4. Develop the ability to understand Sedimentation processes including gravity settling, sink-and-float methods, and differential settling methods, uses of clarifiers and thickeners, flocculation, and batch sedimentation; 5. Understand how to evaluate the size reduction for solid particles. Know the properties of masses of particulate solids. The screen effectiveness as a measure of a screen's success in separating solid particles. Know the properties of masses of particulate solids. 6. Explain the principles of fluidization technology, characteristics of fluidized systems; mass and heat transfer between fluids and particles; liquid-solids and gas-solids systems. 7. Describe the filtration separation method. Mechanism that controls how fluids move through porous beds. The various forms of industrial filtration and the filter medium. 8. Understand the centrifugal design and analysis.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Packed columns (4hrs) • Sedimentation and settling (4 hrs) • solid particles and Screening process (4 hrs) • Fluidization (4 hrs) • Filtration process (8 hrs) • Centrifugation process (4 hrs)
Course Description	In this course, the aim is to provide students with a basic knowledge of separation processes in unit operations, which is important for understanding the structure, operation, and design of chemical reactions, Learn the diluted and concentrated slurry in sedimentation systems and properties of filtration methods including cake filters, discontinuous pressure filters, filter presses, continuous vacuum filters, rotary drum filters,

	characteristics of fluidized, liquid-solids, and gas-solids systems; and applications centrifugation processes.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	This module covers a variety of theoretical, conceptual and practical areas, which require a range of knowledge and skills at a more advanced level to be displayed and exercised. Delivery of its syllabus content therefore involves a diversity of teaching and assessment methods suitable to the learning outcomes of the module; these include formal lectures, structured tutorials (work closely integrated with the lecture material), laboratory exercises to develop practical skills and familiarization with equipment and experimental techniques.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 28** **In class tests 2** **Laboratory 20** **In lab test 2** **Seminars 3**	55	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	3.6
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing18** **Preparation for tests 15** **HomeWorks 12**	45	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	4, 10	LO #1, 2, 3, 4 and 5
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	15% (15)	7	LO # 1-5
	Final Exam	3	50% (50)	16	All
Total assessment			100%		

	(100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Flow of fluids through Packed Beds, Streamline flow-Carman _Kozeny equation.
Week 2	Loading and flooding points, The generalized pressure drop correlation, Falling velocity of a particle,
Week 3	Sedimentation. Sink and Float method,
Week 4	Differential Method, horizontal Gas-Oil separator. Thickener.
Week 5	Size reduction, Energy for Size reduction ,Mill equipment,
Week 6	Crushing Rolls. Ideal screen, Actual screen
Week 7	Midterm exam
Week 8	Introduction about Fluidization, Types of fluidization,
Week 9	Minimum fluidizing velocity (U_{mf}),
Week 10	Introduction about filtration, Types of filtration,
Week 11	Classification of filtration equipment. Theory of filtration,
Week 12	Flow of filtrate through the cloth and cake combined.
Week 13	Washing filter cakes. Compressible cakes.
Week 14	Centrifugation, Types of Centrifuges,
Week 15	Centrifugal Sedimentation, Centrifugal Filtration.
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Illustration of experiments of the course.
Week 2	Absorber.
Week 3	Bubble column.
Week 4	Centrifuge.
Week 5	Film and drop condenser.
Week 6	Fluidized bed column.
Week 7	Rotating vacuum drum filter.

Week 8	Sedimentation.
Week 9	Sieving.
Week 10	Tray dryer.
Week 11	Course exam.

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Warren L. McCabe, Julian C. Smith and Peter Harriot, Unit Operations of Chemical Engineering, McGrawHill, (Fifth Edition), 1993.**	Yes
Recommended Texts	**J. F. Richardson, J. R. Harker, and J. R. Backhurst, Chemical Engineering Particle Technology and Separation Processes-Volume 2, Butterworth Heinemann, 3th Edition.**	Yes
Websites	https://ostad.nit.ac.ir/payaidea/ospic/file2634.pdf https://edisciplinas.usp.br/pluginfile.php/5464081/mod_book/chapter/23386/Particle%20Technology%20and%20Separation%20Processes%20-%20Richardson-Harker-Backhurst.pdf	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Chemical Engineering equipment Design I**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	CHEM_ENG403				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	4	**Semester (s) offered**	1		
Administering Department	Chemical Engineering	**College**	Engineering		
Module Leader	Dr. Hayder Al-Naseri	**e-mail**	h.alnasri@tu.edu.iq		
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	Ph.D.		
Module Tutor	None	**e-mail**	None		
Peer Reviewer Name		**e-mail**			
Review Committee Approval	01/06/2023	**Version Number**	1.0		

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Heat Transfer II (CHEM_ENG 307), Mass Transfer II(CHEM_ENG 308), Unit Operations (CHEM_ENG 309), Fluid Flow II (CHEM_ENG 206)	**Semester**	1,2
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	Provide the students the capability to combine the information in the principles of chemical engineering processes (mass transfer, heat transfer, reactors, etc.) to design the equipment for these processes regarding the requirement needed.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. The student will be ready to insert the outline including material and energy with total cost 2. Capability to choosing the process line that will be fit with the requirement from the project 3. Apply the chemical engineering processes algorithms to a range of equipment for design 4. Selection type of equipment (for the same category) depends on the preference in the operation condition which depend on the physical properties 5. Design the equipment and optimize the efficiency in terms of the cost, and restrictions of operating 6. Utilization of engineering software (Hysys or Aspen plus)		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Material and energy review (8 hrs) • Physical properties (4 hrs) • Pump, piping, and compressors (12 hrs) • Tanks, drums, and vessels (15 hrs) • Supports (4 hrs)		
Course Description	This subject covers the outline of projects requirements and the basic design for the equipment, including vessels that content a process inside (like, distillation, reactor, heat exchanger etc.), pumps, compressors		
Learning and Teaching Strategies استراتيجيات التعلم والتعليم			
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.		

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Prepartion for tests 20** **Homeworks 15**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Material balance, and Energy balance (recall)
Week 2	Physical properties
Week 3	Flow sheeting
Week 4	Metal’s structure, and corrosions
Week 5	Compression and expansion of gases
Week 6	Multi-stage compression
Week 7	Pump, and pump selection

Week 8	Pump; power requirement, and efficiency
Week 9	Mechanical design of piping systems
Week 10	Design of tanks, vessels, and drums
Week 11	• Internal pressure
Week 12	• External pressure
Week 13	Design of vessels subject to combined loading (internal pressure)
Week 14	Design of vessels subject to combined loading (vacuum/ external pressure)
Week 15	Design equipment supports
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Chemical Engineering Design 6th Edition by R. Sinnott and G. Towler. 2020 Publisher: Pearson ISBN: 978-0-08-102599-4**	Yes
Recommended Texts	**Chemical Engineering Vol. 2, 5th Edition. By J H Harker, J R Backhurst, J.F. Richardson ISBN: 9780750644457**	Yes

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Chemical Process Dynamics**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	CHEM_ENG 404				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	4		**Semester (s) offered**	1	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Thaer A. Abdulla		**e-mail**	adnan.thaer@tu.edu.iq	
Module Leader's Acad. Title	Lecturer Dr.		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	None		**e-mail**	None	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Numerical Analyses (CHEM_ENG 301), Engineering Analyses (MATH201)	**Semester**	2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	• Enable students to develop different mathematical models based on the equations of material and/or energy conservation. • Enable students to solve different theoretical models of chemical processes. • Understand the dynamic behavior difference between 1st and 2nd order systems • Understand the difference between SISO and MIMO processes
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Formulate and solve mathematical dynamic ODE models of chemical processes 2- Formulate Transfer Function models for different systems 3- Linearize of Non-Linear Models 4- Recognize the dynamic response of 1st order, integrating and 2nd order systems to different forcing functions 5- Understand the effect of poles, zeros and time delays on the dynamic response of complex systems 6- Approximate complex (higher order) TF models to simple models 7- Formulate State-Space and Transfer Function Matrix models for MIMO systems
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: • Fundamentals of Mathematical ODE models (10 hr) • Fundamentals of Laplace Transforms Technique (10 hr) • Fundamentals of TF Models (10 hr) • Dynamic response of simple (1st and 2nd) models (10 hr) • Dynamic response of complex (higher order) models (10 hr) • Fundamentals of State-Space and TF Matrix models for MIMO systems (10 hr)
Course Description	This course aims to establish fundamental knowledge of process dynamics and control. It starts by introducing the mathematical ODE models of chemical processes followed by explaining the ODE solution method (Laplace Transforms). Transfer Function models and their dynamic response for simple and complex models are discussed in this course. Finally, State-Space and TF Matrix models for MIMO systems are focused in this course.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 20** **Preparation for tests 10** **Homework's 10**	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	3.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 7, 12, 15	LO # 1, 2-3, 4, 5-7
	Assignments	2	10% (10)	5, 7, 12, 15	LO # 1, 2-3, 4, 5-7
	Projects	2	10% (10)	Continuous	
	Lab./Seminars	2	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Theoretical ODE Models of Chemical Processes (ODE Introduction)
Week 2	Theoretical ODE Models of Chemical Processes (ODE Examples)
Week 3	Laplace Transforms Method for solving ODE System (Review)
Week 4	Laplace Transforms Method for solving ODE System (Applications)
Week 5	Transfer Function (TF) Models (TF Introduction/Properties)
Week 6	Transfer Function (TF) Models (Linearization of Non-Linear Models)

Week 7	**Midterm Exam**
Week 8	Dynamic Behavior of 1st and 2nd order Processes (Standard Process Inputs)
Week 9	Dynamic Behavior of 1st and 2nd order Processes (Response of 1st Processes)
Week 10	Dynamic Behavior of 1st and 2nd order Processes (Response of Integrating Processes)
Week 11	Dynamic Behavior of 1st and 2nd order Processes (Response of 2nd Processes)
Week 12	Dynamic Response Characteristics of More Complicated Processes (Effect of Poles, Zeros and Time Delays)
Week 13	Dynamic Response Characteristics of More Complicated Processes (Approximation of Higher-Order Transfer Functions)
Week 14	State-Space and Transfer Function Matrix Models
Week 15	Multiple-Input, Multiple-Output (MIMO) Processes
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle, Process Dynamics and Control (PDC), 4th edition, John Wiley and Sons, New York (2017)	No
Recommended Texts	Coughanewr D.P., Process System Analysis & Control, 3rd edition, McGraw Hill, New York (2009)	Yes
Websites		

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Corrosion engineering**			**Module Delivery**	
Module Type	**Elective**			**Theory** **Lecture** **Seminar**	
Module Code	**CHE_ENG 406**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	4		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader			**e-mail**		
Module Leader's Acad. Title			**Module Leader's Qualification**		
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	ENGINEERING MATERIALS (CHEM_ENG 207)	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	The main objective of this course is to introduce graduate students to the principles and theories of corrosion science and engineering. Students will be able to identify different forms of corrosion, understand the thermodynamics and the kinetics of corrosion, how to control and if possible prevent corrosion. In addition students will be exposed to topics of industrial importance such as corrosion inhibition, passivity, stress corrosion cracking, hydrogen embrittlement and cathodic protection. Challenges facing today's Corrosion Engineers will be elucidated
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Understand the fundamental concepts of corrosion: electrochemical kinetics and thermodynamics. 2. Identify and recognize the common forms of corrosion such as general corrosion, pitting corrosion, stress corrosion and hydrogen embrittlement. 3. Understand the concept of passivity. 4. Understand various techniques of corrosion measurements 5. Select corrosion resistant materials for a given application. 6. Select technique for corrosion prevention.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following - Introduction about corrosion and electrochemical. (4hrs.) - Electrochemical thermodynamics and kinetics. (12hrs.) - Passivity, pitting and crevice corrosion. (8 hrs.) - Environmental factors that cause corrosion and cracking (8 hrs.) - Atmospheric corrosion. Control or prevention the corrosion and the Inhibitors. (12 hrs.) - Coating and Material selection. (12 hrs.)
Course Description	Corrosion is the destructive attack of a metal by its reaction with environment. Thus corrosion refers to the degradation of a metal by its environment. The course content include: Fundamentals of electrochemical thermodynamics and kinetics pertinent to corrosion processes; Corrosion inhibition; passivity; anodic and cathodic protection; pitting; stress corrosion and hydrogen embrittlement.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Understand and be able to

	explain the concept of corrosion, its causes, and its environmental consequences. Understand the relationship between corrosion, galvanic cells and electrochemistry. Know and be able to discuss methods used to prevent corrosion.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 15** **Preparation for tests 10** **HomeWorks 10** **Project 5**	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Basic concepts: Definition and importance, Electrochemical nature and forms of corrosion, Corrosion rate and its determination.
Week 2	Electrochemical thermodynamics and kinetics: Electrode potentials, Potential-pH (Pourbiax) diagrams, Reference electrodes and experimental measurements, Faraday's laws, Instrumentation and experimental procedure.
Week 3	Galvanic and concentration cell corrosion: Basic concepts, Experimental measurements, and

	determination of rates of galvanic corrosion, Concentration cells.
Week 4	Corrosion measurement through polarization techniques: Tafel extrapolation plots, Polarization resistance method, Commercial corrosion probes, Other methods of determining polarization curves.
Week 5	Passivity: Basic concepts of passivity, Properties of passive films, Experimental measurement, Applications of Potentiostatic Anodic Polarization, Anodic protection
Week 6	Pitting and crevice corrosion: Mechanisms of pitting and crevice corrosion, Secondary forms of crevice corrosion, Localized pitting, Metallurgical features and corrosion: Intergranular corrosion, Weldment corrosion, De-alloying and dezincification
Week 7	Midterm exam
Week 8	Environmental induced cracking: Stress corrosion cracking, Corrosion fatigue cracking, Hydrogen induced cracking, Methods of prevention and testing, Erosion, Fretting and Wear.
Week 9	Environmental factors and corrosion: Corrosion in water and aqueous solutions, Corrosion in sulphur bearing solutions, Microbiologically induced corrosion, Corrosion in acidic and alkaline process streams
Week 10	Atmospheric and elevated temperature corrosion: Atmospheric corrosion and its prevention, Oxidation at elevated temperatures, Alloying, Oxidizing environments
Week 11	Prevention and control of corrosion: Cathodic protection
Week 12	Inhibitors
Week 13	Coatings including metals, oxides and polymers and take a look at the mechanisms of corrosion at the metal/oxide /polymer interface for painted materials.
Week 14	Material selection and design
Week 15	Material selection and design, Contn'd
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Revie, R. W and Uhlig, H. H. Corrosion and Corrosion Control, 4th edition, John Wiley & sons, N. Y., (2008).	No
Recommended Texts	Zaki, A. Principles of Corrosion Engineering and Corrosion Control,1st edition, Elsevier Science,(2006).	No
Websites	https://www.google.iq/books/edition/Principles_of_Corrosion_Engineering_and/10U1CRPV_BUC?hl=ar&gbpv=1&dq=inauthor:%22Zaki+Ahmad%22&printsec=frontcover	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Graduation project**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Seminar**	
Module Code	**CHE_ENG 405**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	4		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	80	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	All faculty members		**e-mail**	-	
Module Leader's Acad. Title	-		**Module Leader's Qualification**	-	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Intro to Chemical Engineering (CHEM_ENG-103), Mass Balance (CHEM_ENG-201)	**Semester**	1

Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	The main aim of this course is to prepare students for the practical tasks of the work place after graduation. This includes building his/her ability to perform a complete project.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Upon completion of this course, the student should be able to: 2. Structure a working schedule for the project. 3. Present Clear aim and objectives of the graduation project. 4. Present the literature review with relation to the selected topic. 5. Carry out the design (or any topic selected). 6. Write a technical report. 7. Defend the technical report in front of a committee and be able to answer questions asked by the committee members.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: - Basic concepts of a project. (6hrs) - Physical and Chemical Properties of a product (6 hr) - Stoarge, handling and transportation (4 hr) - Material balance (16 hrs)
Course Description	Preparatory studies of the literature and data collection for the graduation project in a particular area of concentration and under the supervision of one of the faculty members. The course covers directed readings in the literature of civil engineering, introduction to research methods, seminar discussions dealing with special engineering topics of current interest. Planning, design, construction and management of an engineering project. Writing a technical report.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully describe the course design and teaching methodology for project and applications lectures specifically aimed at small college and university instruction.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل		30	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	2.0
In class lectures	**0**			
Office hours	**20**			
In class tests	**0**			
Discussions	**6**			
Practical	**4**			

Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home searchimg 40** **Preparation for final test 10** **Technical writing 20**	70	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Discussion**	30	30% (30)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	0	0% (0.0)	-	LO # 1, 2, 3, 4, 5 and 6
	Seminars	10	10% (10)	Continuous	All
Summative assessment	**Midterm Exam**	0	0% (0)	-	-
	Final defence	3	60% (60)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Project Overview
Week 2	Prepartion of introduction
Week 3	Prepartion of physical properties
Week 4	Prepartion of chemical properties
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	Material balance
Week 11	
Week 12	
Week 13	
Week 14	
Week 15	

Week 16	Final Exam

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required References	Perry's Chemical Engineers' Handbook, Ninth Edition. Don W. Green, Marylee Z. Southard McGraw Hill Professional, Jul 13, 2018 - Technology & Engineering - 2352 pages.	No
Recommended Texts	**Coulson Richardson's Chemical Engineering Vol.6 Chemical Engineering Design 4th Edition. R. K. Sinnott, J. M. Coulson, J. F. Richardson. Elsevier Butterworth-Heinemann, Oxford, 2005**	Yes
Websites	TBD	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information

معلومات المادة الدراسية

Module Title	**Petroleum Refining I**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Practical** **Seminar**	
Module Code	**CHEM_ENG 402**		
ECTS Credits	**6**		
SWL (hr/sem)	**150**		
Module Level	4	**Semester (s) offered**	1
Min number of students	15	**Max number of students**	100
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Prof. Dr. Aysar T. Jarullah	**e-mail**	a.t.jarullah@tu.edu.iq
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.

Module Tutor	None	**e-mail**	None
Peer Reviewer Name		**e-mail**	
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Intro to Chem. Eng. (CHEM_ENG 101), Mass Balance (CHEM_ENG 103), Thermodynamics II (CHEM_ENG 306), Mass transfer II(CHEM_ENG 308), Physical Chemistry (CHEM_ENG 201)	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	This module will provide a deep understanding of the context in which the global petroleum refining industry operates, highlighting its significance to the world economy. The aim of this module is also providing the students with knowledge and skills relating to petroleum refining industries, the formation of hydrocarbons, and the facilities and operations required for the exploration, development, production and transport of crude oil and natural gas to initial processing.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**At the end of this course, the student will be able to:** 1. Describe how crude oils have been classified, found and evaluated, and identify the composition of crude oils. 2. Advise how deposits of crude oil are discovered and determine the physical and chemical properties of crude oil and oil products. 3. Describe the types of distillation curves and the conversion between distillation curves. 4. Analyze and assess the thermal properties and evaluating the thermo-physical properties. 5. Provide a specification of a refinery for processing crude oil into refined products starting with a crude oil pre-treatment and operation of crude distillation units (atmospheric and vacuum distillation, light end fractionation and process description) 6. Estimate yields of crude oils and distillation tower temperature of a process 7. Appreciate the difference between thermal cracking and cocking processes involving visbreaking process, delayed coking, fluid coking and flexicoking process. The design calculations will also be included for all such processes.

	8. Experimentally test and evaluate the main properties of crude oil and oil fractions.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Classification of Crude Oils, Composition of Crude Oils (**6 hrs**) • Physical and Chemical Properties of Crude oil and Oil Products (**9 hrs**) • Evaluation of Crude Oils (**9 hrs**) • Crude Oil Pre-treatment and Fractionation of Crude Oil (**6 hrs**) • Yield Estimation of Crude Oil (**3 hrs**) • Thermal Cracking and Coking Processes (**9 hrs**)
Course Description	This course presents a comprehensive introduction to petroleum refining technology and calculations. The focus is on transportation fuels refineries. The program includes an overview classification of crude oils, composition of crude oils, physical and chemical properties of crude oil and oil products, evaluation of crude oils, crude oil pre-treatment, fractionation of crude oil (Atmospheric and Vacuum Distillation, Light End Fractionation, Process Description) and thermal cracking and coking processes.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	**The learning and teaching strategy is designed** to cover the necessary fundamental knowledge and analysis of upstream operations in the petroleum refining industries and the necessary fundamental material and analytical techniques related to refining processes. Also, allow students to consolidate and apply understanding practice the techniques based on a large number of carefully real-world problem scenarios, which require the application of the fundamental of petroleum refining principles.
Student Workload (SWL) الحمل الدراسي للطالب	

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 56** **In class tests 2** **In lab 28** **In lab tests 2** **Seminars 2**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 25** **Preparation for tests 25** **HomeWorks 10**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation

تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	5% (5)	5, 10, 12, 14	LO #1, 2, 3, and 5
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	20% (20)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction - Composition and Classification of Crude Oils
Week 2	Products Composition, Evaluation of Crude Oils
Week 3	Physical and Chemical Properties of Crude Oil and Oil Products (Density, Specific Gravity, and API Gravity, viscosity, pour point, carbon residue, salt content, sulfur content, flash point)
Week 4	Physical and Chemical Properties of Crude Oil and Oil Products (octane number, aniline point, cetane number, smoke point, freezing point, reid vapor pressure, molecular weight, distillation range)
Week 5	Types of distillation curves, average boiling point, conversion of distillation curves
Week 6	Thermal properties (specific heat, heat of combustion)
Week 7	**Midterm exam**
Week 8	Thermal properties (coefficient of heat expansion, latent heat of vaporization, heat content), Generalized Equation for Thermo-physical Properties, Crude Oil Pre-treatment (desalting)
Week 9	Fractionation of Crude Oil (Atmospheric Distillation, Operation of Crude Distillation Units, Steam Quantity Required, Reflux and Reflux Ratio)
Week 10	Products from ADU, Vacuum Distillation Column
Week 11	Yield Estimation of Crude Oil
Week 12	Distillation Tower Temperature, Light End Fractionation,
Week 13	Thermal Cracking and Coking, Visbreaking Process
Week 14	Delayed Coking
Week 15	Fluid Coking, Flexicoking
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: Introduction to the experimental tests for petroleum lab.
Week 2	Lab 2: Evaluation of density of oil fractions by hydrometer
Week 3	Lab 3: Evaluation of density of oil fractions by pychnometer
Week 4	Lab 4: Evaluation of viscosity of oil fractions by U-tube

Week 5	Lab 5: Evaluation of viscosity of oil fractions l by Red-Wood
Week 6	Lab 6: Evaluation of color of oil fractions
Week 7	Lab 7: Evaluation of flash point of oil fractions
Week 8	Lab 8: Evaluation of pour point of oil fractions
Week 9	Lab 9: Evaluation of aniline point of oil fractions
Week 10	Lab 10: ASTM distillation of oil fractions
Week 11	Lab 11: Evaluation of ash content of crude oil
Week 12	Lab 12: Evaluation of salt content of crude oil
Week 13	Lab 13: Evaluation of water content of crude oil
Week 14	Lab 14:Final exam

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Fundamentals of Petroleum Refining. Fahim, M.A.; Al-Shahhaf, T.A. and Elkilani, A.S., 2009, Elsevier. ISBN: 9780444527851**	Yes
Recommended Texts	**1- Characterization and Properties of Petroleum Fractions. Riazi, M. R. 2005, ASTM International. ISBN: 978-0803133617** **2- Practical Advances in Petroleum Processing. Hsu, Ch.s. and Robinson, P.R., 2007, Springer. ISBN: 9780387257891**	No
Websites	https://www.elsevier.com/books/fundamentals-of-petroleum-refining/fahim/978-0-444-52785-1 https://www.google.iq/books/edition/Characterization_and_Properties_of_Petro/F5QWBjLDNVkC?hl=en&gbpv=1&dq=Characterization+and+Properties+of+Petroleum+Fractions&printsec=frontcover	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Polymer technology**			**Module Delivery**	
Module Type	**Elective**			**Theory** **Lecture** **Seminar**	
Module Code	**CHE_ENG 407**				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	4		**Semester (s) offered**	1	
Min number of students	15		**Max number of students**	80	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Shayma Ali Hameed		**e-mail**	Sh.a.hameed@tu.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Organic Chemistry (CHEM 101), Engineering Materials (CHEM_ENG 207)	**Semester**	-
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	Today, almost every component of daily life uses polymeric materials, and manufacturing them is an important worldwide industries. The course introduces students to the basic concepts of polymer technology and focuses on developing an understanding of polymers, their structure, the main types of polymers, and typical additives and modifiers.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Explain (1) step-growth and chain-growth polymerization, with respect to synthesis mechanisms and kinetics, (2) crystalline melting temperature and glass transition temperature, including the influence of kinetics, and (3) the flow properties of polymer melts and polymer solutions, with respect to both temperature and molecular weight. 2. Derive gelation conditions in systems containing a mixture of binary and multi-functional monomers, and thereby designate the experimental conditions resulting in gelation for a given system. 3. Distinguish between enthalpic and entropic contributions to polymer crystallization, and evaluate factors such as polymer structure, molecular weight, branching, and dilution on crystallinity. 4. Interpret experimental data and determine parameters such as polymerization rates, reactivity ratios, and co-polymer composition, as well as predict changes with time in produced product composition and characteristics for a given co-polymerization process, based on these parameters. 5. Calculate the solubility of a given polymer in a given solvent, as well as the mutual miscibility of various polymer types. 6. Demonstrate an ability to quickly acquire knowledge in new polymer-related applications and to acquire new knowledge for the innovation and development of polymer materials and related processes, also with respect to sustainability considerations		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: - Basic concepts of high polymer systems (4hrs.) - Condensation polymerization or Step growth polymerization . (8 hrs.) - Polymerization techniques. (12hrs.) - Copolymerization and stereo-regular polymerization (12hrs.) - Ionic chain polymerization. (16 hrs.) - Reactions of polymers. (4 hrs.)		

Course Description	In this course, basic methods in the synthesis of polymers are addressed and discussed, including the various types of polymerizations and their applications toward both common and new promising polymer products. This class presents the most common synthetic methods used in polymerization, the basic differences in the kinetics of these methods, the final end-products obtained, and the synthetic processing techniques that might be used for various applications.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully describe the course design and teaching methodology for polymer chemistry and applications lecture class specifically aimed at small college and university instruction. This intermediate course for undergraduates a students focuses on teaching the basics of polymer history, synthesis, and characterization with connections to the core chemistry curriculum. Furthermore, an extensive overview of the applications of polymeric materials gives students a connection to real-life applications. The course includes polymer case studies, informational lessons on real-world objects made of polymers, and demonstrations. Student presentations on how polymers are important to society help connect the course to the world around them. The course is designed to instill the knowledge necessary for students to be successful in a career in polymers.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures** **50** **In class tests** **2** **Seminars** **6**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing** **20** **Preparation for tests** **10** **HomeWorks** **10**	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	1.8
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	15% (15)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	2	15% (15)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Course Overview, Polymer Design and Synthesis, Reaction Types and Processes, Introduction to Step Growth
Week 2	Molecular Weight (MW) Control, Molecular Weight Distribution (MWD) in Equilibrium Step Condensation Polymerizations, Interchange Reactions: Effects on Processing and Product, Application Example: Common Polyesters
Week 3	Step Growth Polymerization, Types of Monomers, Kinetics and Equilibrium Considerations, Closed vs. Open System
Week 4	Common Processing Approaches, Near-equilibrium vs. Far from Equilibrium, Homogeneous Solution and Bulk Polymerization
Week 5	Other Polymers of Interest Obtained by Step-Growth, Polyaramids, Polyimides, Segmented and Block Copolymers from Step Condensation Methods
Week 6	Crosslinking and Branching, Network Formation and Gelation, Carothers Equation: Pn Approach
Week 7	Midterm exam
Week 8	Processing Approaches: Emulsion Polymerization Processes
Week 9	Processing Approaches: Suspension (Bead) Polymerization Processes, Polyvinyl Chloride Via Precipitation Polymerization, Polyethylene Via Radical Polymerization
Week 10	Ziegler-Natta Catalysis, Stereochemistry of Polymers, Stereoregular Polymerizations, Radical Copolymerization: Alternating to Block Copolymers
Week 11	Introduction to Anionic Polymerization, Monomers Applicable to Anionic Methods, Kinetics of “Nonliving” Anionic Polymerization
Week 12	Anionic Block Copolymerization
Week 13	Anionic Ring Opening Polymerization, End Group Functionalization, Telechelic Oligomers and Novel Architectures Using Coupling Techniques
Week 14	Introduction to Cationic Polymerization, Monomers, Kinetics, “Living” Cationic Polymerizations, Examples of Cationic Polymerization, Isobutyl Rubber Synthesis, Polyvinyl Ethers

Week 15	Polymer Functionalization: Motivations, Yield, Crystallinity, Solubility Issues
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Odian, George. *Principles of Polymerization*. 4th ed. Hoboken, NJ: Wiley-Interscience, 2004. ISBN: 9780471274001.	No
Recommended Texts	P. Ghosh. Polymer Science And Technology: Plastics, Rubber, Blends And Composites, 3Rd Edition, Mc Graw Hill India,(2010). ISBN 13: 9780070707047	No
Websites	TBD	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Chemical Reactor I**		**Module Delivery**	
Module Type	**Core**		**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	CHEM_ENG401			
ECTS Credits	**5**			
SWL (hr/sem)	**125**			
Module Level	4	**Semester (s) offered**	1	
Min number of students	15	**Max number of students**	100	
Administering Department	Chemical Engineering	**College**	Engineering	
Module Leader	Dr. Saba A. Gheni	**e-mail**	ghenis@tu.edu.iq	
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.	
Module Tutor	None	**e-mail**	None	
Peer Reviewer Name	Dr. Safaa M. R. Ahmed	**e-mail**	safaamohamed@tu.edu.iq	
Review Committee Approval	01/06/2023	**Version Number**	1.0	

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Engineering Analysis (CHEM_ENG201), Mass Balance (CHEM_ENG103), Thermodynamics II(CHEM_ENG306), Heat Transfer II (CHEM_ENG307)	**Semester**	1,2
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	Enable students to develop a comprehensive understanding of the methodology of linking chemical kinetics with material and energy conservation in the design of idealized homogeneous chemical reactors and heterogeneous-reactors, operating either in batch or continuous mode, and under isothermal conditions.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Interpret and analyses chemical reaction kinetics data. 2. Apply the chemical reaction engineering algorithm to a range of reaction systems and reactor designs 3. Identify and formulate problems in chemical reaction engineering and find appropriate solutions 4. Specify and size the most common industrial chemical reactors to achieve production goals for processes involving homogeneous or heterogeneous reaction systems 5. Sizing and reactor selection at isothermal conditions. 6. Utilization of engineering softwares such as Polymath, Matlab, and COMSOL in problem solving and optimization.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Undergraduate Review on mole balance (4 hrs) • Fundamentals of Chemical Kinetics (16 hrs) • Reactor Design/Batch, CSTR, PFR and combination of reactors (20 hrs) • Catalytic reactor (4 hrs) • Membrane reactor (4 hrs) • Case studies,current/classic literature in chemical engineering (6 hrs)		
Course Description	This course aims to establish fundamental knowledge of chemical reactor design and engineering. Presentation of the course starts by introducing the chemical reaction engineering algorithm and then utilizes it to solve problems in steady state isothermal reactors. Elementary and non-elementary reactions are discussed. Catalytic reactions are also introduced.		
Learning and Teaching Strategies استراتيجيات التعلم والتعليم			
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.		

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 54** **In class tests 2** **Seminars 4**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Preparation for tests 25** **HomeWorks 10**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction -Mole balances
Week 2	Rate laws and stoichiometry, introduction and elementary rate law
Week 3	Rate laws and stoichiometry, continued, non-elementary rate law, half life time
Week 4	Collection and analysis of rate data, differential method
Week 5	Conversion and reactor sizing, integrated method, initial rates
Week 6	Isothermal Reactor Design, general algorithm

Week 7	Midterm exam
Week 8	Isothermal Reactor Design Cont'd, batch reactor
Week 9	Isothermal Reactor Design Cont'd, mixed flow reactor
Week 10	Isothermal Reactor Design Cont'd, plug flow reactor
Week 11	Isothermal Reactor Design Cont'd, multiple reactors
Week 12	Packed bed reactor
Week 13	Packed bed reactor, Cont'd
Week 14	Membrane reactor
Week 15	Membrane reactor, Cont'd
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	**Elements of Chemical Reaction Engineering 6th Edition by H. Scott Fogler. 2020 Publisher: Pearson ISBN: 9780135486252**	Yes
Recommended Texts	**Chemical Reaction Engineering, 3rd Edition. By Octave Levenspiel. 1999, John Wiley & Sons, 1998 ISBN: 978-0-471-25424-9**	No
Websites	http://umich.edu/~elements/5e/lectures/index.html	

Ministry of Higher Education and Scientific Research - Iraq
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College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Biochemical engineering**			**Module Delivery**	
Module Type	**Elective**			**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	CHEM_ENG 413				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	4		**Semester (s) offered**	2	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader			**e-mail**		
Module Leader's Acad. Title			**Module Leader's Qualification**	MSc	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name			**e-mail**		
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Reactor Design I (CHEM_ENG 401), Reactor Design II (CHEM_ENG 408)	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	The objective of this course is to develop a systematic and quantitative description of medium formulation, medium and equipment sterilization, cell growth kinetics, bioreactor and bioprocess design, and product isolation and purification. Students will be introduced to several current biochemical engineering-based processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Design culture medium based on nutritional requirements of microbial cells. 2. Specify design criteria for medium sterilization and solve problems involving both batch and continuous sterilization 3. Apply the principles of microbial growth kinetics in bioreactors 4. Simulate and evaluate bioreactor performance. 5. Apply mass and heat transfer correlations to bioreactor design 6. Design a complete bioreactor based on targets, constraints and physical properties and identify suitable process instrumentation for monitoring and control of bioreactors
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. :Medium Formulation, Batch and Continuous Sterilization (12 hrs) Growth Kinetics (16 hrs) Transport Phenomena in Bioreactors. Design of Bioreactors (14 hrs) Bioreactor Monitoring and Control. Product Recovery (14 hrs)
Course Description	Biochemical Engineering involves the application of Chemical Engineering principles and approaches to biologically based systems and processes. Biochemical Engineering is central to the area of environmental engineering, and to biotechnology processes which produce pharmaceuticals, fine chemicals, and genetically engineered products. The course involves a systematic and quantitative description of medium formulation and sterilization, microbial kinetics and bioreactor design, product isolation and purification, and examples of current industrial practices and processes.

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 10** **Preparation for tests 15** **HomeWorks 10** **Project 5**	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.8
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Nutritional requirements and sources.
Week 2	Cellular elemental composition and cell yields
Week 3	Microbial death kinetics. Design criterion for sterilization.
Week 4	Batch and continuous sterilization of medium. Air sterilization.
Week 5	Phases of batch growth.
Week 6	Monod kinetics.

Week 7	Midterm exam
Week 8	Volumetric rates, specific rates, and yields.
Week 9	Continuous bioreactors and bioreactor performance.
Week 10	Oxygen transport.
Week 11	Agitation and power requirements for mixing
Week 12	Bioreactor design based on oxygen demand and supply.
Week 13	Heat transfer and Solving bioreactor design problems
Week 14	Physical and chemical sensors for monitoring and control
Week 15	Cell separation
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Bioprocess Engineering: Basic Concepts, 3rd Edition. ML Shuler, F Kargi and M. DeLisa, 2017 (available at Queen's campus bookstore, or may be purchased online; may also be consulted online through Queen's Library – however only three simultaneous licences are available).	No
Recommended Texts	• Biochemical Engineering Fundamentals, JE Bailey, DF Ollis, 1986; • Bioprocess Engineering: Basic Concepts, 2nd Edition. ML Shuler and F Kargi, 2002; • Bioprocess Engineering Principles, PM Doran, 1995; • Biochemical Engineering. HW Blanch, DS Clark, 1997	No
Websites	TBD	

Ministry of Higher Education and Scientific Research - Iraq
University of Tikrit
College of Engineering
Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Chemical Engineering equipment Design II**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Tutorial** **Seminar**	
Module Code	**CHEM_ENG410**		
ECTS Credits	**5**		
SWL (hr/sem)	**125**		
Module Level	4	**Semester (s) offered**	2
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Dr. Hayder Al-Naseri	**e-mail**	h.alnasri@tu.edu.iq
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	Ph.D.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name		**e-mail**	
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Chemical Equipment Design (CHEM_ENG 403)	**Semester**	1,2
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر

Module Aims أهداف المادة الدراسية	Provide the students the capability to combine the information in the principles of chemical engineering processes (mass transfer, heat transfer, reactors, etc.) to design the equipment for these processes regarding the requirement needed.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Apply the chemical engineering processes algorithms to a range of equipment for design 2. Selection type of equipment (for the same category) depends on the preference in the operation condition which depend on the physical properties 3. Design the equipment included separation process, reactors, heating process. 4. Utilization of engineering software (Hysys or Aspen plus)
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Heat Exchanger (shell and tube) (8 hrs) • Heat Exchanger (condenser and reboiler) (4 hrs) • Separation process, distillation, absorption, and extraction (18 hrs) • Reactor design: general procedure (8 hrs)
Course Description	This subject covers the outline of projects requirements and the basic design for the equipment, heat exchangers (shell and tube, condenser, and reboiler) , separation process, and reactors

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 56** **In class tests 5** **Seminars 4**	65	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Prepartion for tests 20** **Homeworks 10**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Heat exchanger (basic calculation and terminology)
Week 2	Design heat exchanger (shell and tube)
Week 3	Design heat exchanger (condenser and reboiler)
Week 4	Distillation (basic calculation and terminology)
Week 5	Distillation design
Week 6	Distillation design
Week 7	Absorption basic calculation, and terminology
Week 8	Absorption design
Week 9	Extraction basic calculation, and terminology
Week 10	Extraction design
Week 11	Gas-solid separation (cyclone)
Week 12	Liquid-liquid separation (settlers)
Week 13	Mixing equipment
Week 14	Continues reactor
Week 15	Batch reactor
Week 16	**Final Exam**

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	**Chemical Engineering Design 6th Edition by R. Sinnott and G. Towler. 2020 Publisher: Pearson ISBN: 978-0-08-102599-4**	Yes
Recommended Texts	**Chemical Engineering Vol. 2, 5th Edition. By J H Harker, J R Backhurst, J.F. Richardson ISBN: 9780750644457**	Yes

Ministry of Higher Education and Scientific Research - Iraq
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Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Chemical Process Control**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 411**		
ECTS Credits	**6**		
SWL (hr/sem)	**150**		
Module Level	4	**Semester (s) offered**	2
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Dr. Thaer A. Abdulla	**e-mail**	adnan.thaer@tu.edu.iq
Module Leader's Acad. Title	Lecturer Dr.	**Module Leader's Qualification**	Ph.D.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	CHEM_ENG 404	**Semester**	1
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	• Enable students to be familiar with different control systems and their instrumentation tools. • Enable students to be familiar with different types of feedback controllers. • Enable students to understand the dynamic behavior/stability of closed loop control systems • Enable students to be familiar with different methods of controllers tuning. • Enable students to be familiar with the basics of Frequency Response Analysis • Enable students to be familiar with different methods of advance process control.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- Learn the basics of process control. 2- Choose and design the appropriate control strategy/system (feedforward, feedback or both) for a process. 3- Choose the appropriate control action (P, PI or PID) for a particular process. 4- Choose and design the appropriate control system instrumentation. 5- Analyze the dynamic response/stability of Closed-Loop Control Systems 6- Choose the appropriate method of PID controller tuning 7- Use Frequency Response Analysis for Control System Design 8- Identify different methods of advance process control
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: • Fundamentals of Process Control/Feedback Control Systems (10 hr) • Fundamentals of Control System Instrumentation (10 hr) • Dynamics behavior/Stability of Closed-Loop Control Systems (15 hr) • Fundamentals of PID Controller Design/Tuning (10 hr) • Fundamentals of Frequency Response Analysis (10 hr) • Fundamentals of Advanced Process Control (5 hr)
Course Description	This course aims to establish fundamental knowledge of process control. It starts by introducing the process control followed by explaining the Feedback Controllers and Control System Instrumentation. Dynamic Behavior/Stability of Closed-Loop Control Systems and PID Controller Tuning are also discussed in this course. Finally, Frequency Response Analysis and Advanced Process Control are introduced in this course.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8** **Laboratory 30**	90	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Preparation for tests 20** **Homework's 10**	60	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.0
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 7, 12, 15	LO# 1-3, 3-4, 5, 6-7
	Assignments	2	10% (10)	5, 7, 12, 15	LO# 1-3, 3-4, 5, 6-7
	Projects	2	10% (10)	Continuous	
	Lab./Seminars	2	10% (10)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO# 1-4
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction to Process Control
Week 2	Feedback Controllers (Introduction)
Week 3	Feedback Controllers (Basic Control Modes)
Week 4	Feedback Controllers (Dynamic Responses)
Week 5	Control System Instrumentation (Introduction)
Week 6	Control System Instrumentation (Final Control Elements)
Week 7	**Midterm Exam**
Week 8	Closed-Loop Control Systems (Block Diagram Representation and Transfer Functions)
Week 9	Closed-Loop Control Systems (Dynamic Responses)

Week 10	Closed-Loop Control Systems (Stability)
Week 11	PID Controller Design
Week 12	PID Controller Tuning
Week 13	Frequency Response Analysis (Introduction)
Week 14	Frequency Response Analysis (Bode Diagrams and Bode Stability Criterion)
Week 15	Advanced Process Control (Introduction)
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	The effect of the proportional controller gain on the offset
Week 2	Dynamic Behavior of stirred tank in series
Week 3	The Response of Thermometer
Week 4	Pressure measurement devices
Week 5	Temperature Control
Week 6	Two first-order systems in series (interacting system)
Week 7	The Response of liquid level in continuous tank
Week 8	Heating Vessel

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	**Available in the Library?**
Required Texts	Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle, Process Dynamics and Control (PDC), 4th edition, John Wiley and Sons, New York (2017)	No
Recommended Texts	Coughanewr D.P., Process System Analysis & Control, 3rd edition, McGraw Hill, New York (2009)	Yes

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Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	**Petroleum Refining II**	**Module Delivery**	
Module Type	**Core**	**Theory** **Lecture** **Seminar**	
Module Code	**CHEM_ENG 409**		
ECTS Credits	**5**		
SWL (hr/sem)	**125**		
Module Level	4	**Semester (s) offered**	2
Min number of students	15	**Max number of students**	100
Administering Department	Chemical Engineering	**College**	Engineering
Module Leader	Prof. Dr. Aysar T. Jarullah	**e-mail**	a.t.jarullah@tu.edu.iq
Module Leader's Acad. Title	Professor	**Module Leader's Qualification**	Ph.D.
Module Tutor	None	**e-mail**	None
Peer Reviewer Name		**e-mail**	
Review Committee Approval	01/06/2023	**Version Number**	1.0

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	Petroleum Refining I (CHEM_ENG 402)	**Semester**	-
Co-requisites module	None	**Semester**	-

Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر	
Module Aims أهداف المادة الدراسية	The context in which the world's petroleum refining industry operates will be thoroughly addressed in this course of study, emphasizing the importance of this sector to the world's financial system. Additionally, this module aims to equip students with the knowledge and abilities necessary for the exploration, development, production, and transportation of fuel oil and oil products for several petroleum processing, as well as information on the formation of hydrocarbons with respect to the petroleum refining industry, and the facilities and operations needed for these activities.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	**At the end of this course, the student will be able to:** 1. Describe the catalytic operations including the FCC unit (process and calculations) and yield correlations. 2. Advise how the hydrotreating and hydrocracking processes are described and operated, the roles, descriptions and calculations. 3. Provide full details of catalytic dewaxing, catalytic reforming, coke deposition, processes technologies and calculations. 4. Describe the isomerization and alkylation processes (process and calculations) with the performance of such operations. 5. Knowledge about the chemical treatment of petroleum products based on several traditional methods in addition to oil products (manufacture and properties 6. Enable for finding the best way of blending different intermediate products from the refinery in order to adjust the product characterizations. 7. Identify the safety and environmental aspects in refining, wastes in refinery units beside estimation the fugitive emissions generated by refinery equipment.
Indicative Contents المحتويات الإرشادية	**Indicative content includes the following:** • Catalytic Operations (Processes and calculations) - (FCC, HDC, HDT, Catalytic Reforming, Isomerization, Alkylation, Dewaxing) (**15 hrs**) • Chemical Treatment of Oil Products (**3 hrs**) • Lubricating Oils (Specifications, Production Process, Calculations) (**6 hrs**) • Solvent Refining processing (**6 hrs**) • Oil Products and product bending (**9 hrs**) • Safety and Environmental Aspects in Refining (**3 hrs**)
Course Description	This course presents a comprehensive introduction to petroleum refining technology and calculations. The focus is on transportation fuels refineries. The program includes overview catalytic operations, fluid catalytic cracking, hydrocracking, hydrotreating, catalytic reforming, isomerization, alkylation and catalytic dewaxing). Also, describing the lubricating oils (specifications, production process and calculations), solvent refining processes and oil products productions with the main properties and specifications and operations, and product blending. Finally, this course will take into accounts the safety and environmental aspects in refining industries.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	**The learning and teaching strategy is made to** address the essential background information and analytical methods connected to upstream activities in the refined petroleum sectors as well as the essential background information and analytical methods linked to refining processes. As well as, enable students to consolidate their knowledge and put it into practice using a variety of carefully chosen practical issue scenarios that call for the use of key oil refining techniques.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 43** **In class tests 2** **Seminars 5**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 35** **Preparation for tests 20** **HomeWorks 10**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	5% (5)	4, 9, 11, 13	LO #1, 2, 3, and 4
	Assignments	6	20% (20)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	2	5% (5)	Continuous	
Summative assessment	**Midterm Exam**	2	20% (20)	7	LO # 1-4
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Catalytic Operations, Fluidized Catalytic Cracking process
Week 2	Hydrotreating process
Week 3	Hydrocracking process
Week 4	Catalytic dewaxing process and catalytic reforming process
Week 5	coke deposition and Isomerization process
Week 6	Alkylation process
Week 7	**Midterm exam**
Week 8	Chemical Treatment of Petroleum Products
Week 9	Oil Products, manufacture and properties (LPG and gasoline)
Week 10	Oil Products, manufacture and properties (kerosene and jet fuel, Diesel oil, fuel oil and asphalt/bitumen)
Week 11	Oil Products, manufacture and properties (lubricating oils)
Week 12	Product blending (RVP blending and Flash point blending)
Week 13	Product blending (pour point blending and aniline point blending)
Week 14	Product blending (viscosity blending and gasoline octane number blending)
Week 15	Safety and environmental aspects in refining, wastes in refinery units and fugitive emissions
Week 16	**Final Exam**

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	**Fundamentals of Petroleum Refining. Fahim, M.A.; Al-Shahhaf, T.A. and Elkilani, A.S., 2009, Elsevier. ISBN: 9780444527851**	Yes
Recommended Texts	**3- Characterization and Properties of Petroleum Fractions. Riazi, M. R. 2005, ASTM International. ISBN: 978-0803133617** **4- Practical Advances in Petroleum Processing. Hsu, Ch.s. and Robinson, P.R., 2007, Springer. ISBN: 9780387257891**	No
Websites	https://www.elsevier.com/books/fundamentals-of-petroleum-refining/fahim/978-0-444-52785-1 https://www.google.iq/books/edition/Characterization_and_Properties_of_Petro/F5QWBjLDNVkC?hl=en&gbpv=1&dq=Characterization+and+Properties+of+Petroleum+Fractions&printsec=frontcover	

	Ministry of Higher Education and Scientific Research - Iraq University of Tikrit College of Engineering Department of Chemical Engineering	

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Chemical Reactor II**			**Module Delivery**	
Module Type	**Core**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	**CHEM_ENG 408**				
ECTS Credits	**5**				
SWL (hr/sem)	**125**				
Module Level	4		**Semester (s) offered**	2	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Saba A. Gheni		**e-mail**	ghenis@tu.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Safaa M. R. Ahmed		**e-mail**	safaamohamed@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	Reactor Design I (CHEM_ENG 401)	**Semester**	1,2
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	To develop strong concepts of engineering theory and design as applied in the context of nonisothermal reactors. Specify and size the most common industrial multiple reactions systems to achieve production goals for processes involving homogeneous or heterogeneous reaction systems with a focus on reduction of accidents and incidents by inherently safe design of the reactors.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Demonstrate competence in the fundamental concepts of chemical non isothermal reaction engineering for single and multiple reactions. 2. Apply these concepts for the design and analysis of industrial reactors. 3. Design and analyze chemical reactors under steady state and transient operations. 4. Utilization of engineering softwares such as Polymath, Matlab, and COMSOL in problem solving and optimization.		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Adiabatic operation of reactors (8 hrs) • Nonisothermal reactor operation and design (20 hrs) • Multiple reactions and reactor selection (12 hrs) • Multiple steady states in CSTRs (8 hrs) • Inherantly safe design of reactors (4 hrs) • Case studies from current/classic literature in chemical engineering on reactor runaway (2 hrs)		
Course Description	This course aims to establish fundamental knowledge of chemical reactor design and engineering. Presentation of the course starts by introducing the chemical reaction engineering algorithm and then utilizes it to solve problems in steady state isothermal reactors. Elementary and non elementary reactions are discussed. Catalytic reactions are also introduced.		
Learning and Teaching Strategies استراتيجيات التعلم والتعليم			
Strategies	The learning and teaching **strategy** is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques, and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.		

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Preparation for tests 20** **HomeWorks 15**	65	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
Week 1	Introduction -General energy balance equations on reactors
Week 2	Energy Balance, Adiabatic Reactors, batch and CSTR
Week 3	Energy Balance, Adiabatic Reactors, PFR and PBR
Week 4	Energy Balance, Adiabatic Reactors, PFR and PBR Cont'd
Week 5	Reactors with Heat Exchange, Non-Isothermal Steady State
Week 6	Reactors with Heat Exchange, Non-Isothermal Steady State, Cont'd

Week 7	Midterm exam
Week 8	Multiple reactions and related design preferences: Consecutive
Week 9	Multiple reactions and related design preferences: Competitive
Week 10	Multiple reactions and related design preferences: Complex
Week 11	Multiple reactions and reactor selection
Week 12	Multiple steady states in CSTR-single reactions
Week 13	Multiple steady states in CSTR-multiple reactions
Week 14	Inherantly safe design of reactors
Week 15	Case studies on reactor runaway accidents
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	**Elements of Chemical Reaction Engineering 6th Edition by H. Scott Fogler. 2020 Publisher: Pearson ISBN: 9780135486252**	Yes
Recommended Texts	**Chemical Reaction Engineering, 3rd Edition. By Octave Levenspiel. 1999, John Wiley & Sons, 1998 ISBN: 978-0-471-25424-9**	No
Websites	http://umich.edu/~elements/5e/lectures/index.html	

Ministry of Higher Education and Scientific Research - Iraq
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Department of Chemical Engineering

MODULE DESCRIPTOR

وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Sustainable Energy**			**Module Delivery**	
Module Type	**Elective**			**Theory** **Lecture** **Tutorial** **Practical** **Seminar**	
Module Code	CHEM_ENG 412				
ECTS Credits	**4**				
SWL (hr/sem)	**100**				
Module Level	4		**Semester (s) offered**	2	
Min number of students	15		**Max number of students**	100	
Administering Department	Chemical Engineering		**College**	Engineering	
Module Leader	Dr. Saba A. Gheni		**e-mail**	ghenis@tu.edu.iq	
Module Leader's Acad. Title	Professor		**Module Leader's Qualification**	Ph.D.	
Module Tutor	None		**e-mail**	None	
Peer Reviewer Name	Dr. Safaa M. R. Ahmed		**e-mail**	safaamohamed@tu.edu.iq	
Review Committee Approval	01/06/2023		**Version Number**	1.0	

Relation With Other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	**None**	**Semester**	-
Co-requisites module	None	**Semester**	-
Module Aims, Learning Outcomes, Indicative Contents and Brief Description أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية مع وصف مختصر			
Module Aims أهداف المادة الدراسية	Improve energy efficiency from source to use and measure and correct energy market failures. Facilitate economic integration and cooperation and promote sustainable development to reduce energy and carbon intensities. Also, minimize the impact of the energy sector on the environment from source to use and ensure that energy production. Innovate constructively across the board in the organization of society, industry, and government.		
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. To understand topics related to energy resources, methods for conversions from one form of energy to another, and future prospects on energy. 2. To understand our energy challenges, traditional energy resources and the advantages and disadvantages of various energy resources, including renewable energy sources. 3. To understand the principles of operation of various electric power plants, energy conversion systems, e.g., fossil, biomass, nuclear powered plants, hydroelectric, etc. 4. To cover basic science and engineering concepts and principles (e.g., mass transport, thermodynamics, catalysis, bioengineering, modeling, etc.) pertinent to energy and renewable energy applications for sustainable future (e.g., conversion of renewable resources to synthetic fuels; energy conversion techniques; solar, wind, biomass, geothermal, hydro-electric, wave and tidal energy technologies; bioenergy technologies for conversion of biomass into fuels; etc.). 5. To highlight thermodynamics concepts and chemistries that can lead to improved power densities, efficiencies and emissions in power generating systems and green energy resources; chemical reactor designs that can lead to better energy resources; processes as related to combustion and combustion thermodynamics, reaction kinetics and combustion transport, chain reactions, ignition, quenching, etc. 6. Topics related to energy supply options and/or that can affect decision making: solar, biomass, and geothermal resources, nonconventional fuels from heavy oils, tar sands, natural gas hydrates, and shale-oil, etc. - Topics on catalysts and biocatalysts, catalyst improvement, and reactor engineering that can decrease energy consumptions or produce energy sources..		
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Introduction, Energy Basics and Technical Performance (2 hrs) • Fossil Fuels / Energy and environmental impact with geothermal impact (6 hrs) • Bioenergy (8 hrs)		

	• Geothermal Energy and Nuclear Energy (6 hrs) • Solar Energy (6 hrs) • Hydroelectric Energy (4 hrs) • Wind, Ocean Wave, Tide, Current, and Thermal Energy Conversion (6 hrs) • Energy Carriers and Fuel Cells (6 hrs) • Energy Management (6 hrs) • Energy Economics (6 hrs)
Course Description	This course is intended to give mainly but not exclusively an engineering and scientific perspective about conventional energy resources, energy challenges and our endeavors on the development of future, sustainable, clean and renewable energy sources.
Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	A sustainable energy strategy is an action plan with measurable milestones that combines energy efficiency, energy conservation, and ideally, the replacement of fossil fuels with renewable energy sources such as solar or wind generated energy. Such strategies aren't just for large global companies.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 50** **In class tests 2** **Seminars 8**	60	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.0
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 10** **Preparation for tests 10** **HomeWorks 10** **Project 10**	40	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.3
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	100		

Module Evaluation تقييم المادة الدراسية					
		Time (hr)	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	2	10% (10)	5, 10, 12, 14	LO #1, 2, 3, and 4
	Assignments	6	18% (18)	2, 4, 6, 8, 10, 12	LO # 1, 2, 3, 4, 5 and 6
	Seminars	3	12% (12)	Continuous	
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Energy Basics and Technical Performance - Forms of Energy - Reviews of Engineering Concepts Pertinent to Energy - Some Basic Thermodynamics and Thermodynamic Analysis - Rate Processes in Energy Conversions - Sustainability Metrics and Measure of Sustainability - Systems Analysis Approaches - Energy Efficiency, Production Rates, Estimation and Evaluation
Week 2	Introduction: Past, Present and Future Energy Use - Global Energy Reserves - World Energy Consumption and Demand and Challenges - Renewable versus Non-Renewable Energy Sources - Clean and Sustainable Energy - Estimation and Evaluation of Energy Resources - Future outlook
Week 3	- Introduction - Fossil Fuel Energy Base - Harvesting and Energy Products - Principles for Evaluating Fossil Energy Technology
Week 4	Environmental, Geopolitical, Sociological and Economical Impacts of Fossil Fuel Use - Thermal Pollution - Chemical Pollution - Particulate Pollution - Greenhouse Effect - Climate Change - Carbon Sequestration and Carbon Cycle - Geopolitical, Social and Economical Impacts
Week 5	Bioenergy - Biomass Sources - Advantages and Benefits - Available technologies and Challenges - Feedstock Collection and Transport Methods - Feedstock Pre-Processing and Treatment Methods - Biomass conversion technologies (Thermo-chemical, Combustion Gasification, Pyrolysis technology, Trans-Esterification, etc.)
Week 6	- Biochemical Conversion (Enzymatic Hydrolysis, Fermentation) - Recent Advances and Applications of Bioenergy technology
Week 7	**Midterm exam**
Week 8	Geothermal Energy and Nuclear Energy - Physics and Chemistry on Geothermal and Nuclear Energy Sources - Reactor Technology - Future prospects - Fuel Sources and Fuel Cycle
Week 9	Solar Energy and Solar Photovoltaics - Solar-Thermal Energy - Materials for Solar Energy Conversions - Solar Photovolatics or Solar Cells - PV Integration, Resources and Future Prospects - Grid-Connected PV systems - Environmental Impacts and Safety
Week 10	Hydroelectric Energy - Principles of Hydropower Technology - Turbine Design - Types of Plants - Utilization and Economics - Environmental Impacts and Other Challenges
Week 11	Wind, Ocean Wave, Tide, Current, and Thermal Energy Conversion - Wind Resources - Wind Turbines and Power Generating Systems - Energy from Tides and Waves and Economic Prospects - Current Status and Prospects
Week 12	Energy Carriers and Fuel Cells - Electric Power, Hydrogen Fuel, and Others - Fuel Cells - Hydrogen as Energy Carrier
Week 13	Energy Management - Storage (Batteries, Capacitors and Supercapacitors, etc.) - Transportation - Energy Distribution
Week 14	Energy Economics and Industrial and Commercial Energy Usage Technical and Economical assessment of Renewable Energy Technology - Energy Associated with Reactors and Catalysis
Week 15	- Environmental Impact Assessments and Sustainability Issues - Energy Efficient Building systems - Future Prospects, Research and Design Projects
Week 16	**Final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	Sustainable Energy, (SI) Edition, 2015, by Richard A. Dunlap, Cengage Learning.	No
Recommended Texts	Renewable energy: Power for a Sustainable Future, by Godfrey Boyle, 2004, Oxford University press, Oxford, UK	No
Websites	TBD	

APPENDIX:

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:				

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.