Ministry of Higher Education and Scientific Research
Scientific Supervision and Scientific Evaluation Apparatus
Directorate of Quality Assurance and Academic Accreditation
Accreditation Department

Academic Program and Course Description Guide

2024

Introduction:

The educational program is a well-planned set of courses that include procedures and experiences arranged in the form of an academic syllabus. Its main goal is to improve and build graduates' skills so they are ready for the job market. The program is reviewed and evaluated every year through internal or external audit procedures and programs like the External Examiner Program.

The academic program description is a short summary of the main features of the program and its courses. It shows what skills students are working to develop based on the program's goals. This description is very important because it is the main part of getting the program accredited, and it is written by the teaching staff together under the supervision of scientific committees in the scientific departments.

This guide, in its second version, includes a description of the academic program after updating the subjects and paragraphs of the previous guide in light of the updates and developments of the educational system in Iraq, which included the description of the academic program in its traditional form (annual, quarterly), as well as the adoption of the academic program description circulated according to the letter of the Department of Studies T 3/2906 on 3/5/2023 regarding the programs that adopt the Bologna Process as the basis for their work.

In this regard, we can only emphasize the importance of writing an academic programs and course description to ensure the proper functioning of the educational process.

Concepts and terminology:

Academic Program Description: The academic program description provides a brief summary of its vision, mission and objectives, including an accurate description of the targeted learning outcomes according to specific learning strategies.

Course Description: Provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the students to achieve, proving whether they have made the most of the available learning opportunities. It is derived from the program description.

Program Vision: An ambitious picture for the future of the academic program to be sophisticated, inspiring, stimulating, realistic and applicable.

Program Mission: Briefly outlines the objectives and activities necessary to achieve them and defines the program's development paths and directions.

Program Objectives: They are statements that describe what the academic program intends to achieve within a specific period of time and are measurable and observable.

Curriculum Structure: All courses / subjects included in the academic program according to the approved learning system (quarterly, annual, Bologna Process) whether it is a requirement (ministry, university, college and scientific department) with the number of credit hours.

Learning Outcomes: A compatible set of knowledge, skills and values acquired by students after the successful completion of the academic program and must determine the learning outcomes of each course in a way that achieves the objectives of the program.

Teaching and learning strategies: They are the strategies used by the faculty members to develop students' teaching and learning, and they are plans that are followed to reach the learning goals. They describe all classroom and extra-curricular activities to achieve the learning outcomes of the program.

Program Specification

University Name: Northern Technical University
College/Institute: Eng. Technical College/ Mosul
Scientific Department: Chemical and Petroleum Industries Technologies Engineering
Academic Program Name: Bachelor's degree in Eng. Technical College/ Mosul - Department of Chemical and Petroleum Industries Technologies Engineering
Final Degree Name: Bachelor in Technical Engineering
Study System: Courses System
Description Preparation Date: 27/9/2024
File Completion Date: 20/10/2024

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1. Program Vision

To be a world-leading educational in providing innovative education, advanced scientific research, and a distinguished community services that contributes to community development and achieving sustainability.

2. Program Mission

We seek to provide high-quality technical education, promote scientific research and innovation, and develop local and international partnerships to serve the community and qualify distinguished and innovative graduates, capable of meeting the needs of the labor market and contributing to sustainable development.

3. Program Objectives

A. Knowledge and Understanding

1. Graduates will have a strong foundation in engineering, sciences, and current practices of chemical and petroleum industries' technology. They will have experience in solving structured and unstructured problems using both traditional and innovative solutions.
2. Graduates will have the ability to effectively describe problems, analyze data, develop potential solutions, evaluate these solutions, and present results using their verbal, written, and electronic skills.
3. Graduates will have an understanding of the ethical and professional responsibilities of an engineer, and the impact of engineering solutions on society and the global environment.

B. Subject-specific skill

1. Transfer of problem-solving and analytical skills in contemporary operations.
2. Accelerating the provision of state-of-the-art laboratory facilities to deliver practical knowledge.

3. Designing and developing sustainable and environmentally friendly techniques with the assistance of computational skills.
4. Facilitating the ability to learn, innovate, and communicate with technological advancements for the benefit of humanity.
5. Disseminating knowledge related to intellectual property rights, ethics, professionalism, entrepreneurship, and their impact on society.

C. Emotional and Values Objectives:

1. Graduates will have a strong foundation in engineering, sciences, current chemical and petroleum industries technology practices, and engineering practices. They will possess experience in solving organized and unorganized problems using traditional and innovative solutions.
2. Graduates will be able to effectively describe the problem, analyze data, develop potential solutions, evaluate these solutions, and present the results using their oral, written, and electronic skills.
3. Graduates will understand the ethical and professional responsibilities of an engineer and the impact of engineering solutions on society and the global environment.

4. **Program Accreditation**
None

5. **Other external influences**
None

6. Program Structure

Program Structure	Number of Courses	Credit hours	Percentage	Reviews*
Institution Requirements	11	20	11.3%	Core
College Requirements	12	32	18.08%	Core and Noncore
Department Requirements	36	123	69.49%	Core and Noncore
Summer Training	2	2	1.13%	Core
Other				

* This can include notes whether the course is basic or optional.

7. Program Description (2024-2025)

Course Credit System/ Third Stage

	Course or Module Code	Course or Module Title	Course Hours		Credit	Prerequisite Courses
			Theoretical	Practical		
College requirements	TEMO 301	Applied Mathematics 1	3	—	3	
	TEMO 302	Applied Mathematics 2	3	—	—	
	TEMO 303	Systematic Training	—	—	—	
Department requirements	**TECP 301**	Heat Transfer 1	3	3	4	
	TCEP 302	Heat Transfer 2	3	3	4	**Heat Transfer 1**
	TECP 303	Mass Transfer 1	3	3	4	
	TECP 304	Mass Transfer 2	3	3	4	Mass Transfer 1
	TECP 305	Chemical Engineering Economics	2	3	3	
	TECP 306	Chemical Reaction Engineering1	3	2	4	
	TECP 307	Chemical Reaction Engineering2	3	2	4	

	TECP 308	Chemical Engineering Thermodynamics 1	3	2	4	
	TECP 309	Chemical Engineering Thermodynamics 1	3	2	4	
	TECP 310	Process Instrumentation and Control	2	3	3	
	TECP 311	Process Modeling and Simulation	2	3	3	
	TECP 312	Industrial Pollution Control	1	3	2	
Summer Training	________	___________	—		—	
Others	_______	_______	—		—	

Course Credit System/ Fourth Stage						
	Course or Module Code	**Course or Module Title**	**Course Hours**		**Credit**	**Prerequisite Courses**
			Theoretical	**Practical**		
University requirements	_______					
	TEMO 405	**Graduation Project 1**	—	—	—	
	TEMO 406	**Graduation Project 2**				
Department requirements	**TECP 403**	**Unit Operations 1**	2	3	3	

	TECP 405	**Petroleum Refinery**	2	3	3	
	TECP 404	**Unit Operations 2**	2	3	3	
	TECP 407	**Natural Gas Technology**	2	3	3	
	TECP 408	**Equipment and Plant Design 1**	1	3	2	
	TECP 409	**Equipment and Plant Design 2**	1	3	2	
	TECP 410	**Chemical Process Industries 1**	2	3	3	
	TECP 411	**Chemical Process Industries 2**	2	3	3	
	TECP 309	**Petrochemicals Technology**	1	3	2	
Summer Training	________	___________	—		—	
Others	_______	_______	—		—	

8. Expected learning outcomes of the program

Knowledge	
A1 Fundamental Principles: Demonstrate a comprehensive understanding of core chemical engineering principles, including thermodynamics, fluid mechanics, heat and mass transfer, reaction engineering, and separation processes, as applied to the chemical and petroleum industries.	**A2 Petroleum Specifics:** Possess in-depth knowledge of the upstream, midstream, and downstream sectors of the oil and gas industry, including exploration, drilling, production, refining, and petrochemical processes.
A3 Materials Science: Understand the properties, selection, and application of various materials used in chemical and petroleum equipment and infrastructure, considering corrosion, degradation, and safety.	**A4 Process Safety and Environment:** Grasp the principles of process safety management, hazard identification, risk assessment, and environmental regulations relevant to chemical and petroleum operations, including waste management and pollution control.
Skills	
B1 Problem Solving and Analysis: Apply engineering principles and analytical skills to identify, formulate, and solve complex engineering problems in chemical and petroleum processes, equipment design, and operation.	**B2 Process Design and Optimization:** Design, simulate, and optimize chemical and petroleum processes and equipment using relevant software and methodologies, considering technical, economic, and environmental constraints.
B3 Experimental Design and Data Analysis: Design and conduct experiments, analyze and interpret data, and draw sound engineering conclusions to improve processes or develop new technologies.	**B4 Troubleshooting and Operations:** Diagnose operational issues in chemical and petroleum plants, propose effective solutions, and contribute to the efficient and safe operation of industrial facilities.
B5 Information Technology Proficiency: Utilize modern engineering software, simulation tools, data analysis programs, and information systems relevant to chemical and petroleum engineering.	**B6 Teamwork and Professionalism:** Function effectively as an individual and as a member or leader in diverse and multidisciplinary teams, demonstrating professional and ethical conduct, and committing to lifelong learning.
Ethics	
C1 Ethical Responsibility: Recognize and uphold professional and ethical responsibilities in engineering practice,	**C2 Lifelong Learning:** Recognize the need for and possess the ability to engage in independent and

considering the societal and environmental impact of their work.	lifelong learning in the context of technological advancements and evolving industry standards.
C3 Global and Cultural Awareness: Appreciate the global, economic, environmental, and societal contexts of chemical and petroleum engineering, demonstrating cultural awareness and sensitivity.	**C4 – Leadership and Teamwork:** Demonstrate effective leadership, collaboration, and communication skills within multidisciplinary project teams.

9. Teaching and Learning Strategies

The Department of Chemical and Petroleum Industries Techniques Engineering is committed to employing a diverse range of teaching and learning strategies that align with our expected learning outcomes, promote active engagement, and prepare graduates to be competent, innovative, and ethically responsible professionals. These strategies are continually reviewed and updated to incorporate best practices and technological advancements relevant to the industry in Iraq and globally.

I. Student-Centered and Active Learning Approaches:

1. **Problem-Based Learning (PBL):**
    - **Strategy:** Present students with real-world chemical and petroleum engineering problems (e.g., optimizing a distillation column, troubleshooting a refinery unit, designing a sustainable waste treatment process for an oil field) as the starting point for learning.
    - **Implementation:** Students work in small groups to identify learning needs, research solutions, apply theoretical knowledge, and present their findings. This fosters critical thinking, research skills, and teamwork.

2. **Project-Based Learning (PjBL):**
   - **Strategy:** Engage students in extended projects that require them to design, develop, and present solutions to complex engineering challenges, often integrating multiple course concepts.
   - **Implementation:** Examples include designing a small-scale processing unit, developing a safety protocol for a specific operation, or simulating a drilling process. This culminates in practical application of knowledge and development of project management skills.
3. **Case Study Analysis:**
   - **Strategy:** Utilize real-life industrial incidents, successes, and challenges within the chemical and petroleum sectors.
   - **Implementation:** Students analyze case studies to understand decision-making processes, identify root causes of failures, evaluate ethical dilemmas, and propose alternative solutions. This enhances analytical and problem-solving skills in a practical context.
4. **Flipped Classroom Model:**
   - **Strategy:** Students engage with lecture content (e.g., videos, readings) outside of class, freeing up in-class time for active learning activities, discussions, and problem-solving sessions.
   - **Implementation:** In-class sessions focus on applying concepts through exercises, group work, and addressing student queries, leading to deeper understanding and immediate feedback.
5. **Interactive Lectures and Discussions:**
   - **Strategy:** Move beyond traditional one-way lectures by incorporating polling, Q&A sessions, think-pair-share activities, and

open discussions to encourage student participation and immediate clarification of concepts.

II. Technology-Enhanced Learning:

6. **Simulation Software and Modeling:**
    - **Strategy:** Integrate industry-standard simulation software (e.g., Aspen HYSYS, PRO/II, AutoCAD Plant 3D, DrillSIM) to model, analyze, and optimize chemical processes, refinery operations, and drilling scenarios.
    - **Implementation:** Students gain hands-on experience in process design, optimization, and troubleshooting in a virtual environment, bridging the gap between theory and practice.
7. **Virtual Reality (VR) / Augmented Reality (AR) Tools:**
    - **Strategy:** Explore and utilize VR/AR applications for visualizing complex plant layouts, safety training simulations (e.g., emergency shutdown procedures), and virtual field trips to inaccessible industrial sites.
    - **Implementation:** This provides immersive learning experiences that enhance spatial understanding and practical skills without physical risk.
8. **Online Learning Platforms (LMS):**
    - **Strategy:** Utilize a robust Learning Management System (e.g., Moodle, Google Classroom) to deliver course materials, facilitate online discussions, administer quizzes, and provide timely feedback.
    - **Implementation:** This supports blended learning, provides flexibility, and organizes learning resources efficiently.

9. **Data Analytics and AI Tools:**
    - **Strategy:** Introduce students to basic data analytics tools (e.g., Python, R, Excel advanced functions) and concepts of Artificial Intelligence (AI) and Machine Learning (ML) relevant to process optimization, predictive maintenance, and reservoir characterization.
    - **Implementation:** This prepares students for the data-driven future of the chemical and petroleum industries.

III. Practical and Experiential Learning:

10. **Well-Equipped Laboratories:**
    - **Strategy:** Provide access to state-of-the-art laboratories for experiments in fluid mechanics, heat transfer, chemical reactions, separations, materials testing, and petroleum characterization.
    - **Implementation:** Hands-on experiments reinforce theoretical concepts, develop experimental design skills, and foster data analysis and interpretation abilities.
11. **Workshops and Practical Sessions:**
    - **Strategy:** Conduct regular workshops focusing on specific industry techniques, equipment operation, safety protocols, and software applications.
    - **Implementation:** These sessions offer focused, hands-on training that complements traditional lab work.
12. **Industrial Internships and Field Trips:**
    - **Strategy:** Facilitate mandatory or elective internships with local and regional chemical plants, refineries, oil and gas companies, and service providers. Organize frequent field trips to industrial facilities.
    - **Implementation:** This exposes students to real-world operations, corporate culture, safety practices, and provides invaluable networking opportunities.

13. **Guest Lecturers and Industry Mentors:**

- **Strategy:** Invite experienced engineers, managers, and specialists from the chemical and petroleum industries to deliver guest lectures, share insights, and mentor students.
- **Implementation:** This provides students with current industry perspectives, trends, and career advice.

IV. Assessment and Feedback:

14. **Formative and Summative Assessment:**

- **Strategy:** Employ a balanced approach including continuous assessment (quizzes, assignments, lab reports, project work) and summative assessments (midterms, final exams) to monitor student progress and evaluate overall learning.
- **Implementation:** Diverse assessment methods cater to different learning styles and provide multiple opportunities for students to demonstrate their understanding.

15. **Constructive Feedback:**

- **Strategy:** Provide timely, specific, and actionable feedback on assignments, lab reports, and projects to guide student learning and improvement.
- **Implementation:** Feedback focuses on helping students understand their strengths and areas for development, promoting a growth mindset.

16. **Peer and Self-Assessment:**

- **Strategy:** Incorporate opportunities for students to assess their own work and the work of their peers, using clear rubrics.
- **Implementation:** This develops critical evaluation skills, fosters a sense of responsibility, and encourages deeper engagement with learning criteria.

V. Professional Development and Soft Skills Integration:

17. **Communication Skills Development:**
    - **Strategy:** Integrate opportunities for students to enhance their oral and written communication skills through presentations, technical reports, and group discussions.
    - **Implementation:** This is often embedded within project-based learning and case studies, with emphasis on clear and concise technical communication.
18. **Teamwork and Leadership Training:**
    - **Strategy:** Design group projects and assignments that require collaboration, conflict resolution, and shared responsibility.
    - **Implementation:** Encourage students to take on leadership roles within group tasks and provide feedback on team dynamics.
19. **Ethical Reasoning and Professionalism:**
    - **Strategy:** Integrate discussions on engineering ethics, professional conduct, safety culture, and sustainability throughout the curriculum, often through case studies and real-world dilemmas.
    - **Implementation:** This fosters a strong sense of professional responsibility and ethical decision-making.
20. **Lifelong Learning Mindset:**
    - **Strategy:** Encourage independent learning, critical evaluation of information sources, and awareness of emerging technologies and industry trends.
    - **Implementation:** This includes assigning research tasks, promoting participation in seminars, and emphasizing the dynamic nature of engineering knowledge.

10. Evaluation methods

I. Student Learning Assessment (Formative & Summative)

These methods evaluate individual student progress and achievement of course and program learning outcomes throughout their studies.

1. **Exams and Quizzes:**
   - **Description:** Traditional written exams (midterms, finals) and shorter quizzes to assess theoretical knowledge, problem-solving abilities, and understanding of core concepts.
   - **Stage:** All stages (Foundation, Intermediate, Advanced).
   - **Purpose:** Summative assessment of knowledge retention and application.
2. **Laboratory Reports and Practical Assessments:**
   - **Description:** Evaluation of students' ability to design experiments, collect and analyze data, interpret results, and communicate findings effectively through detailed lab reports. Practical assessments measure hands-on skills in operating equipment and conducting procedures.
   - **Stage:** All stages, particularly crucial in practical courses (e.g., Unit Operations Lab, Drilling Fluids Lab).
   - **Purpose:** Formative and summative assessment of practical skills, data analysis, and technical writing.
3. **Homework Assignments and Problem Sets:**
   - **Description:** Regular assignments designed to reinforce learning, apply concepts to varied problems, and develop independent problem-solving skills.
   - **Stage:** All stages.
   - **Purpose:** Formative assessment, providing continuous feedback on understanding and identifying areas for improvement.

4. **Projects (Individual and Group):**
    - **Description:** Design projects, research projects, case studies, and simulations, often culminating in written reports and oral presentations. This includes capstone design projects in the final year.
    - **Stage:** Intermediate to Advanced stages, with the capstone project in the final year.
    - **Purpose:** Summative assessment of integrated knowledge application, teamwork, communication, and critical thinking skills, directly linked to program outcomes.
5. **Presentations (Oral and Poster):**
    - **Description:** Evaluation of students' ability to effectively communicate technical information, research findings, and project outcomes to an audience.
    - **Stage:** Intermediate to Advanced stages, especially in project-based courses.
    - **Purpose:** Assessment of communication skills and ability to articulate complex ideas.
6. **Rubrics:**
    - **Description:** Detailed scoring guides used for evaluating complex assignments, projects, lab reports, and presentations. Rubrics clearly define performance expectations for various learning outcomes.
    - **Stage:** All stages, particularly for performance-based assessments.
    - **Purpose:** Ensure consistent and objective grading, provide clear feedback to students, and facilitate mapping to program learning outcomes.

7. **Quizzes on Simulation Software/Tools:**
    - **Description:** Practical tests within simulation environments to assess proficiency in using industry-standard software for process design, modeling, or analysis.
    - **Stage:** Intermediate to Advanced stages.
    - **Purpose:** Formative and summative assessment of computational and technical tool proficiency.

II. Course-Level Evaluation

These methods assess the effectiveness of individual courses and the teaching performance of faculty.

8. **Course Evaluations/Surveys (Student Feedback):**
    - **Description:** Anonymous surveys administered to students at the end of each course to gather feedback on course content, teaching methods, instructor effectiveness, workload, and learning environment.
    - **Stage:** End of each course.
    - **Purpose:** Inform instructors for course improvement and provide input for faculty performance reviews.
9. **Peer Review of Teaching:**
    - **Description:** Faculty colleagues observe each other's teaching, review course materials, and provide constructive feedback.
    - **Stage:** Periodically for all faculty members.
    - **Purpose:** Enhance teaching quality and share best practices.
10. **Analysis of Student Performance Data:**
    - **Description:** Review of aggregated student performance data (e.g., average grades, pass rates, performance on specific learning outcomes) across different course offerings to identify trends and areas for curricular adjustment.

- **Stage:** Annually or per semester.
- **Purpose:** Identify challenging topics, assess the effectiveness of teaching strategies, and inform curriculum revisions.

III. Program-Level Evaluation (Quality Assurance and Continuous Improvement)

These methods assess the overall effectiveness of the program in meeting its educational objectives and learning outcomes.

11. **Program Learning Outcomes (PLO) Assessment:**
    - **Description:** Direct and indirect methods to measure the attainment of predefined program learning outcomes (e.g., those aligning with ABET criteria or national standards).
    - **Direct Measures:**
        - **Capstone Project Evaluation:** Rubrics used to assess PLO attainment in the final year project.
        - **Embedded Assessments:** Specific questions or tasks within course exams/assignments designed to assess particular PLOs.
        - **Exit Exams/Comprehensive Exams:** Standardized tests for graduating students covering core program knowledge.
    - **Indirect Measures:**
        - **Student Exit Surveys/Interviews:** Gather perceptions of graduating students on their learning experience and preparedness.
        - **Alumni Surveys:** Gather feedback from graduates on the relevance of their education to their careers, satisfaction, and areas for improvement.

- **Employer Surveys:** Obtain feedback from employers on the competencies and preparedness of graduates from the program.
- **Internship Supervisor Evaluations:** Feedback from industry professionals supervising student internships on student performance and skills.

  - **Stage:** Primarily at the advanced stages and post-graduation.
  - **Purpose:** Crucial for accreditation, continuous quality improvement, and ensuring graduates meet industry expectations.

12. **Curriculum Review and Mapping:**
  - **Description:** Periodic review of the entire curriculum to ensure coherence, logical progression of topics, avoidance of redundancies, and alignment with industry needs and program objectives. This often involves mapping course learning outcomes to program learning outcomes.
  - **Stage:** Biannually or triannually.
  - **Purpose:** Maintain currency and relevance of the curriculum.

13. **Industrial Advisory Board (IAB) Meetings:**
  - **Description:** Regular meetings with an external advisory board composed of industry experts, alumni, and potentially government representatives.
  - **Stage:** Annually or bi-annually.
  - **Purpose:** Gather external perspectives on industry trends, required graduate competencies, curriculum relevance, and opportunities for collaboration, directly informing program improvement.

14. **Faculty Meetings and Retreats:**
   - **Description:** Dedicated sessions for faculty to discuss program strengths, weaknesses, opportunities, and threats (SWOT analysis), review assessment data, and plan for continuous improvement.
   - **Stage:** Regularly throughout the academic year.
   - **Purpose:** Foster internal collaboration and collective responsibility for program quality.
15. **Accreditation Self-Studies and Visits:**
   - **Description:** Comprehensive self-assessment reports prepared by the department outlining its objectives, outcomes, curriculum, faculty, facilities, and assessment processes, followed by visits from external accreditation bodies (e.g., national accreditation bodies, or international bodies like ABET if sought).
   - **Stage:** Periodically, as required by accreditation cycles (e.g., every 3-6 years).
   - **Purpose:** External validation of program quality and adherence to recognized standards.
16. **Graduate Employment Data and Tracer Studies:**
   - **Description:** Tracking the employment rates, types of positions, and career progression of graduates.
   - **Stage:** Ongoing, post-graduation.
   - **Purpose:** Assess the market relevance of the program and the employability of its graduates.

11. Faculty

Faculty Members

Academic Rank	Specialization		Special Requirements/Skills (if applicable)	Number of the teaching staff	
	General	Special		Staff	Lecturer
Prof	Chemical engineering	Chemical engineering		1	
Assist. Prof	Chemistry science	Chemical industries / Physical chemistry		2	
Lecturer	Chemical engineering / Chemistry science	Chemical engineering / Biochemical engineering / physical chemistry		3	
Assist. Lecturer	Chemistry science / Petroleum engineering / Computer science / Electronic and communication engineering	Chemical industries / Organic chemistry / Petroleum engineering /			

Professional Development

Mentoring new faculty members

The institution adopts a structured and systematic mentoring process to support new, visiting, full-time, and part-time faculty members in their transition into the academic environment. The process is designed to foster professional integration, pedagogical competence, and alignment with institutional values and quality standards. The mentoring program includes the following components:

Orientation and Induction Program: All new faculty members attend a mandatory orientation at the beginning of their appointment. This includes an introduction to the institution's mission,

academic policies, curriculum framework, teaching and learning strategies, research expectations, and administrative procedures. **Teaching Support and Peer Observation:** New faculty are encouraged to participate in peer observation cycles, where they attend and are observed during classroom sessions. Constructive feedback is provided to help them improve their teaching practices. Participation in workshops on instructional design, outcome-based education (OBE), and technology-enhanced learning is also supported. **Regular Review Meetings:** Monthly review sessions are held between the Head of department and the new faculty to track progress, discuss challenges, and ensure integration into academic and research activities. These meetings are documented and reported to the scientific committee to monitor mentoring effectiveness. **Professional Development Plan:** Each new faculty member develops an individualized professional development plan. This plan outlines short-term and long-term goals for teaching, research, and service.
Professional development of faculty members
The institution implements a continuous professional development plan that includes training in modern teaching and learning strategies, assessment of learning outcomes, use of digital tools and simulation software, and participation in national and international conferences. Faculty are also encouraged to engage in research and community service to enhance their academic profiles.

12. Acceptance Criterion

Admission to the Chemical and Petroleum Industries Techniques Engineering program is primarily granted through centralized admission for graduates of the scientific branch of secondary education, in accordance with the annual requirements and minimum grade thresholds set by the Ministry of Higher Education. Additionally, a limited percentage of top-ranking graduates from technical institutes, as well as a defined percentage of graduates from the industrial branch of vocational secondary schools, may be accepted through direct admission as determined by the Ministry. These candidates must fulfill the academic and administrative requirements stipulated by the institution and relevant regulatory authorities.

13. The most important sources of information about the program
1. The college's official website 2. Program handbook and curriculum guide 3. Academic advisors and department office 4. Ministry of Higher Education portal 5. Orientation sessions and brochures

14. Program Development Plan
The program is reviewed periodically through feedback gathered from key stakeholders, including faculty members, students, alumni, and industry partners. The review process incorporates benchmarking with national and international engineering programs, analysis of graduate performance and employability, as well as continuous updates based on technological advancements. In line with this process, the department is also committed to the development of educational laboratories and field training facilities, aiming to enhance the practical and applied aspects of the curriculum and ensure a modern learning environment that aligns with contemporary engineering education standards. All such initiatives and activities are documented in the department's strategic plan, which was formally approved by the Department Council and the College Deanery at the beginning of the current academic year, reflecting the department's commitment to academic quality and sustainable development.

Program Skills Outline

				Required program Learning outcomes											
Year/Level	Course Code	Course Name	Basic or optional	Knowledge				Skills				Ethics			
				A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4
Level Three	TEMO 301	Applied Mathematics 1	Support	√					√						√
	TEMO 302	Applied Mathematics 2	Support	√					√						√
	TECP 303	Summer Training	Basic	√					√			√			
	TECP 301	Heat Transfer 1	Core	√					√				√		
	TECP 302	Heat Transfer 2	Core	√					√			√			
	TECP 303	Mass Transfer 1	Core	√					√				√		
	TECP 304	Mass Transfer 2	Core	√					√				√		
	TECP 306	Reactor Design 1	Core	√					√			√			
	TECP 307	Reactor Design 2	Core	√					√			√			
	TECP 308	Chemical Engineering Thermodynamics 1	Core	√					√			√			
	TECP 309	Chemical Engineering Thermodynamics 1	Core	√					√			√			
	TECP 310	Process Instrumentation and Control	Core	√					√			√			
	TECP 311	Process Modeling and Simulation	Core	√					√				√		
	TECP 312	Industrial and Environmental Pollution Control	Core	√					√				√		

Program Skills Outline															
				Required program Learning outcomes											
Year/Level	**Course Code**	**Course Name**	**Basic or optional**	**Knowledge**				**Skills**				**Ethics**			
				A1	**A2**	**A3**	**A4**	**B1**	**B2**	**B3**	**B4**	**C1**	**C2**	**C3**	**C4**
Level Four	TEMO 405	Graduation Project 1	Support	√					√						√
	TEMO 406	Graduation Project 2	Support	√					√						√
	TECP 403	Unit Operations 1	Core	√					√			√			
	TECP 405	Petroleum Refinery	Core	√					√				√		
	TECP 404	Unit Operations 2	Core	√					√			√			
	TECP 407	Natural Gas Technology	Core	√					√				√		
	TECP 408	Equipment and Plant Design 1	Core	√					√				√		
	TECP 409	Equipment and Plant Design 2	Core	√					√				√		
	TECP 410	Chemical Industries 1	Core	√					√			√			
	TECP 411	Chemical Industries 2	Core	√					√			√			
	TECP 309	Petrochemicals Industries	Core	√					√			√			

Course Description Form

1. Course Name:
Applied Mathematics 1
2. Course Code:
TEMO 301
3. Semester / Year:
First semester – Third year
4. Description Preparation Date:
1 / 9/ 2024
5. Available Attendance Forms:
In-person – mandatory
6. Number of Credit Hours (Total) / Number of Units (Total)
3 hours / 3 units
7. Course administrator's name (mention all, if more than one name)
Name: Raid Abdulhadi Abdulqader ALAbdullah Email: raid.alabdullah@ntu.edu.iq
8. Course Objectives

Course Objectives	• **Enable students to understand and use calculus techniques chemical engineering.** • **Develop skills in solving mathematical problems related to changes in chemical and physical systems.** • **Enhance the ability to deal with mathematical models of chemical reactions and thermal systems.**

9. Teaching and Learning Strategies

Strategy	**1-Problem-Driven Approach (Engineering Context):** • **Strategy:** Introduce mathematical concepts by first presenting real-world chem or petroleum engineering problems that require these concepts for their solution • **Implementation:** For example, introducing differential equations through modeling of chemical reactor kinetics or fluid flow in pipelines; using linear alge for mass and energy balances in complex separation processes. **2-Case Studies from Industry:** • **Strategy:** Utilize simplified or actual case studies from the chemical and petrole industries to illustrate the application of mathematical principles.

	• **Implementation:** Analyze how calculus is used to optimize distillation colu design, or how statistics are applied in quality control of petroleum products. 3- **Visualizing Mathematical Concepts with Engineering Analogies:** • **Strategy:** Use physical and chemical phenomena as analogies to explain abst mathematical concepts. • **Implementation:** For instance, visualizing integration as the accumulation of m in a tank, or derivatives as reaction rates.

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Understand the concept of differential and integral calculus and its importance in chemical engineering.	Introduction to Calculus.	Theoretical (lecture and interactive activities)	Tests and participatio
Second	3	Understand the concept of derivative and apply differentiation rules such as product and quotient.	Derivatives and differential equations	Theoretical (lecture and interactive activities)	Tests and participatio
Third	3	Implicit differentiation and inverse differentiation Using implicit differentiation and solving inverse differentiation problems	Derivatives and differential equations	Theoretical (lecture and interactive activities)	Tests and participatio
Forth	3	Apply differentiation to problems of velocity, acceleration, and time rates.	Derivatives Applications - Velocity and Acceleration	Theoretical (lecture and interactive activities)	Tests and participatio
Fifth	3	Indefinite integrals and integration rules Understand the basics of integration and apply the basic rules of integration.	Integration	Theoretical (lecture and interactive activities)	Tests and participatio
Sixth	3	Calculate and interpret definite integrals in the context of chemical engineering	Limited integration	Theoretical (lecture and interactive activities)	Tests and participatio
Seventh	3	Use integration to calculate areas under curves and volumes of solids	Integration Applications	Theoretical (lecture and interactive activities)	Tests and participatio

Eighth	3	Applications of differentiation in multiple variables, such as surface curves	Calculus in multiple variables	Theoretical (lecture and interactive activities)	Tests and participatio
Ninth	3	Introduction to ordinary differential equations and their engineering applications.	Ordinary Differential Equations (ODEs).	Theoretical (lecture and interactive activities)	Tests and participatio
Tenth	3	Solve differential equations using the method of separation of variables	Methods of solving differential equations (variable (separation	Theoretical (lecture and interactive activities)	Tests and participatio
Eleventh	3	Applications of differential equations in chemical reactions and dynamic systems	Applications of differential equations in chemical systems	Theoretical (lecture and interactive activities)	Tests and participatio
Twelfth	3	Introduction to partial differential equations and their applications	Partial Differential Equations (PDEs)	Theoretical (lecture and interactive activities)	Tests and participatio
Thirteenth	3	Introduction to partial differential equations and their applications	Partial Differential Equations (PDEs)	Theoretical (lecture and interactive activities)	Tests and participatio
Fourteenth	3	Use mathematical series to solve differential equations	Solving differential equations using series	Theoretical (lecture and interactive activities)	Tests and participatio
Fifteenth	3	e mathematical series to solve differential equations	Solving differential equations using series	Theoretical (lecture and interactive activities)	Tests and participatio

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	
Main references (sources)	Calculus: Early Transcendentals" James Stewart "
Recommended books and references (scientific journals, reports…)	Elementary Differential Equations and Boundary Value Problems" by William E. Boyce and Richard C. DiPrima
Electronic References, Websites	

Course Description Form

13. Course Name:	
Applied Mathematics 2	
14. Course Code:	
TEMO 302	
15. Semester / Year:	
Second semester – Third year	
16. Description Preparation Date:	
1 / 9/ 2024	
17. Available Attendance Forms:	
In-person – mandatory	
18. Number of Credit Hours (Total) / Number of Units (Total)	
3 hours / 3 units	
19. Course administrator's name (mention all, if more than one name)	
Name: Raid Abdulhadi Abdulqader ALAbdullah Email: raid.alabdullah@ntu.edu.iq	
20. Course Objectives	
Course Objectives	• **Solving and analyzing advanced differential equations (partial and ordinary) and their application in chemical engineering** • **Use techniques such as Laplace transforms and Fourier analysis to solve dynamical systems and chemical reactions.** • **Application of numerical and theoretical solutions to problems of heat conduction, fluid flow, and diffusion equations.**
21. Teaching and Learning Strategies	
Strategy	**1-Problem-Driven Approach (Engineering Context):** • **Strategy:** Introduce mathematical concepts by first presenting real-world chem or petroleum engineering problems that require these concepts for their solution • **Implementation:** For example, introducing differential equations through modeling of chemical reactor kinetics or fluid flow in pipelines; using linear alge for mass and energy balances in complex separation processes.

	2-**Case Studies from Industry**: • **Strategy**: Utilize simplified or actual case studies from the chemical and petrole industries to illustrate the application of mathematical principles. • **Implementation**: Analyze how calculus is used to optimize distillation colu design, or how statistics are applied in quality control of petroleum products. 3- **Visualizing Mathematical Concepts with Engineering Analogies**: • **Strategy**: Use physical and chemical phenomena as analogies to explain abst mathematical concepts. • **Implementation**: For instance, visualizing integration as the accumulation of m in a tank, or derivatives as reaction rates.

22. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Review the concepts of first and second level ordinary differential equations and solve them using traditional methods	Review of Ordinary Differential Equations Levels 1 and 2.	Theoretical (lecture and interactive activities)	Tests and participatio
Second	3	Understand and solve homogeneous and non-homogeneous linear differential equations using the private complement method.	Second order linear differential equations with homogeneous and non-homogeneous solutions	Theoretical (lecture and interactive activities)	Tests and participatio
Third	3	Apply the methods of indeterminate coefficients and the difference method .to solve ordinary differential equations	Derivatives and differential equations	Theoretical (lecture and interactive activities)	Tests and participatio
Forth	3	Understand and solve Cauchy- Euler equations using linear transformations and their applications in chemical engineering	Derivatives Applications - Velocity and Acceleration	Theoretical (lecture and interactive activities)	Tests and participatio
Fifth	3	Apply Laplace transforms to solve ordinary differential equations and interpret solutions in physical and engineering contexts	Laplace Transforms.	Theoretical (lecture and interactive activities)	Tests and participatio

Sixth	3	Apply Laplace transforms to solve ordinary differential equations and interpret solutions in physical and engineering contexts	Laplace Transforms	Theoretical (lecture and interactive activities)	Tests and participatio
Seventh	3	Apply Laplace transforms to solve ordinary differential equations and interpret solutions in physical and engineering contexts	Laplace Transforms	Theoretical (lecture and interactive activities)	Tests and participatio
Eighth	3	Solving linear systems using Laplace transform and its applications in the analysis of chemical systems.	Using Laplace Transform in Linear Systems	Theoretical (lecture and interactive activities)	Tests and participatio
Ninth	3	Understand Fourier series and analysis and use it to solve partial differential equations.	Fourier series and Analysis.	Theoretical (lecture and interactive activities)	Tests and participatio
Tenth	3	Solve differential equations using the method of separation of variables	Methods of solving differential equations (variable (separation	Theoretical (lecture and interactive activities)	Tests and participatio
Eleventh	3	Applications of differential equations in chemical reactions and dynamic systems	Applications of differential equations in chemical systems	Theoretical (lecture and interactive activities)	Tests and participatio
Twelfth	3	Introduction to partial differential equations and their applications	Partial Differential Equations (PDEs)	Theoretical (lecture and interactive activities)	Tests and participatio
Thirteenth	3	Introduction to partial differential equations and their applications	Partial Differential Equations (PDEs)	Theoretical (lecture and interactive activities)	Tests and participatio
Fourteenth	3	Use mathematical series to solve differential equations	Solving differential equations using series	Theoretical (lecture and interactive activities)	Tests and participatio
Fifteenth	3	e mathematical series to solve differential equations	Solving differential equations using series	Theoretical (lecture and interactive activities)	Tests and participatio

23. Course Evaluation	
Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc	
24. Learning and Teaching Resources	
Required textbooks (curricular books, if any)	
Main references (sources)	Calculus: Early Transcendentals" James Stewart "
Recommended books and references (scientific journals, reports…)	Elementary Differential Equations and Boundary Value Problems" by William E. Boyce and Richard C. DiPrima
Electronic References, Websites	

Course Description Form

25. Course Name:	
Heat Transfer 1	
26. Course Code:	
TECP 301	
27. Semester / Year:	
First semester – Third year	
28. Description Preparation Date:	
1 / 9/ 2024	
29. Available Attendance Forms:	
In-person – mandatory	
30. Number of Credit Hours (Total) / Number of Units (Total)	
Theoretical hours 3 Practical hours 2 / 4 units	
31. Course administrator's name (mention all, if more than one name)	
Name: Rafie Rushdy Mohammed Email: rafie.rushdy@ntu.edu.iq	
32. Course Objectives	
Course Objectives	**This course aims to provide students with a comprehensive understanding of the principles of heat transfer and its various types, including conduction, convection, and radiation. It also aims to develop skills in analysis and practical application of theories and principles related to heat transfer in different systems, enabling them to solve engineering problems related to the design and evaluation of energy systems**
33. Teaching and Learning Strategies	
Strategy	• **Understand basic concepts: Enable students to understand the different modes of heat transfer.** • **Applying Mathematical Equations: Enhance students' ability to use mathematical equations to solve heat transfer problems** • **Thermal Systems Analysis: Enable students to analyze differentheat transfer systems and provide appropriate solutions**

34. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method

First	3	Understanding the basic patterns of heat transfer	Introduction to Heat Transfer	Theoretical (lecture and interactive activit + Practical	Tests and participation
Second	3	Applying simple conduction equations	Introduction to Heat Transfer conduction.	Theoretical (lecture and interactive activities)	Tests and participation
Third	3	Solve problems in different systems of conduction	Introduction to Heat Transfer conduction.	Theoretical (lecture and interactive activities)	Tests and participation
Forth	3	Analysis of conducti systems under steady conditions	Introduction to Heat Transfer conduction.	Theoretical (lecture and interactive activities)	Tests and participation
Fifth	3	nalysis of conductio n systems under steady conditions	Introduction to Heat Transfer conduction.	Theoretical (lecture and interactive activities)	Tests and participation
Sixth	3	Application of unstable conduction concepts	Introduction to Heat Transfer conduction.	Theoretical (lecture and interactive activities)	Tests and participation
Seventh	3	Forced heat transfer convection	Convection heat transfer.	Theoretical (lecture and interactive activities)	Tests and participation
Eighth	3	Types of heat transfer forced convection	Convection heat transfer.	Theoretical (lecture and interactive activities)	Tests and participation
Ninth	3	Natural heat transfer convection	Convection heat transfer.	Theoretical (lecture and interactive activities)	Tests and participation
Tenth	3	Comparison between forced and natural convection	Convection heat transfer.	Theoretical (lecture and interactive activities)	Tests and participation
Eleventh	3	Radiation heat transfer	The Basic Theory Application of Stefan-Boltzmann law in radiation problems	Theoretical (lecture and interactive activities)	Tests and participation
Twelfth	3	Application of heat transfer	Heat transfer at ambient conditions Systems analysis in different environments	Theoretical (lecture and interactive activities)	Tests and participation
Thirteenth	3	Industrial application heat transfer	Practical case studies from industry	Theoretical (lecture and interactive activities)	Tests and participation

Fourteenth	3	Comparison of heat transfer in different materials	Heat transfer in solids and liquids	Theoretical (lecture and interactive activities)	Tests and participation
Fifteenth	3	Comprehensive assessment of the knowledge gained throughout the course	Comprehensive review and final exam	Theoretical (lecture and interactive activities)	Tests and participation

35. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

36. Learning and Teaching Resources

Required textbooks (curricular books, if any)	David P. DeWitt. and"Fundamentals of H and Mass Transfer" - Frank P.
Main references (sources)	"Heat Transfer: A Practical Approach" - Yu Çengel
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	MIT Open Course Ware - Heat and M Transfer

Course Description Form

37. Course Name:	
Heat Transfer 2	
38. Course Code:	
TECP 302	
39. Semester / Year:	
Second semester – Third year	
40. Description Preparation Date:	
1 / 9/ 2024	
41. Available Attendance Forms:	
In-person – mandatory	
42. Number of Credit Hours (Total) / Number of Units (Total)	
Theoretical hours 3 Practical hours 2 / 4 units	
43. Course administrator's name (mention all, if more than one name)	
Name: Rafie Rushdy Mohammed Email: rafie.rushdy@ntu.edu.iq	
44. Course Objectives	
Course Objectives	**This course aims to provide a comprehensive understanding of the principles of heat transfer in engineering applications, with emphasis on the design of heat exchangers, condensation and boiling reactions, and radiation. It also seeks to develop the skills necessary to analyze and design heat transfer systems efficiently, enabling students to deal with engineering challenges in the fields of energy and manufacturing**
45. Teaching and Learning Strategies	
Strategy	• **Understanding Types of Heat Exchangers: Enable students to identify the different types and their properties** • **Applying Equations in Design: Enhance students' ability to use equations to calculate the performance of heat exchangers** • **Analyzing Condensation and Boiling Reactions: Develop skills in .analyzing dynamic processes related to condensation and boiling** • **Understanding Radiation Properties: Enhance understanding of.how radiation affects the design of furnaces and heating systems.**

46. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Heat Exchangers: Types and Characteristics	Learn about the characteristics of different types of .exchanges	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Heat Exchangers: Types and Characteristics	Learn about the characteristics of different types of .exchanges	Theoretical (lecture and interactive activities)	Tests and participatic
Third	3	Heat transfer coefficient.	Applying equations to calculate the heat transfer coefficient	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Temperature differences in heat exchangers	Analyze how temperature differences affect .performance	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Heat Exchanger Traditional Methods	Perform design calculations using .traditional methods	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	method in NTU exchanger design	NTU :Heat Exchanger Design Method	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Understanding condensation dynamics and condenser design Calculations	Condensation: Basic Principles	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Analysis of condensation properties in glossy Films	Condensation in glossy films	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Application of concepts in boiling and analysis of different systems	Boiling: Types and Systems	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Perform calculations for different boiling .systems	Boiling in basins and boiling flow calculations	Theoretical (lecture and interactive activities)	Tests and participatic
Eleventh	3	Understanding radiation properties and their impact on Design	Radiation: Basic Properties	Theoretical (lecture and interactive activities)	Tests and participatic
Twelfth	3	Furnace design analysis and temperature Relationships	Furnace Design: Principles and Applications	Theoretical (lecture and interactive activities)	Tests and participatic
Thirteenth	3	Study of the effect of radiation properties	Non-black body radiation	Theoretical (lecture and interactive	Tests and participatic

		on the performance of objects		activities)	
Fourteenth	3	Case studies of heat exchangers in industry	Applications of heat exchangers in industry	Theoretical (lecture and interactive activities)	Tests and participatic
Fifteenth	3	Comprehensive assessment of the knowledge gained throughout the course	Comprehensive review and final exam	Theoretical (lecture and interactive activities)	Tests and participatic

47. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

48. Learning and Teaching Resources

Required textbooks (curricular books, if any)	David P. DeWitt. and"Fundamentals of H and Mass Transfer" - Frank P.
Main references (sources)	"Heat Transfer: A Practical Approach" - Yu Çengel
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	MIT Open Course Ware - Heat and M Transfer

Course Description Form

49. Course Name:	
Mass Transfer 1	
50. Course Code:	
TECP 303	
51. Semester / Year:	
First semester – Third year	
52. Description Preparation Date:	
1 / 9/ 2024	
53. Available Attendance Forms:	
In-person – mandatory	
54. Number of Credit Hours (Total) / Number of Units (Total)	
Theoretical hours 3 Practical hours 2 / 4 units	
55. Course administrator's name (mention all, if more than one name)	
Name: Rafie Rushdy Mohammed Email: rafie.rushdy@ntu.edu.iq	
56. Course Objectives	
Course Objectives	**The course aims to enable students to understand mass transfer processes, analyze and apply diffusion laws in multicomponent systems, and learn how to calculate mass transfer coefficients under different flow conditions. It also focuses on the study of diffusion resistances and the application of unsteady transport in complex engineering and chemical problems**
57. Teaching and Learning Strategies	
Strategy	• Understand the basic principles of concentrations, velocities, and .mass fluxes • Application of Fick's law and calculation of diffusion coefficient in .binary gases • Understanding diffusion in multicomponent systems and applying .Maxwell's law • .Know the factors affecting diffusion in liquids • .Understand the mechanisms of diffusion in solids • .Application of film theories to calculate mass transfer coefficients • Calculate mass transfer resistances and intermediate .concentrations

58. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Understand the basics of mass transfer, concentrations, velocities, and mass and mole fluxes	Basic Concepts in Mass Transfer Processes	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Apply Fick's first law to understand concentration gradients and their effect on diffusion	First law of inertia and its applications	Theoretical (lecture and interactive activities) +Practical	Tests and participatic
Third	3	Apply diffusion laws in binary.gas mixtures and calculate the diffusion coefficient	Diffusion in binary gas mixtures	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Understanding diffusion in systems with isothermal flows and static layers	Diffusion of molecules and the static layer	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Use empirical relationships to calculate and correct the diffusion coefficient in.gases.	Calculate and correct the diffusion coefficient	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	Understand diffusion in multi-component systems and apply Maxwell's Law	Diffusion in multicomponent mixtures	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Apply relationships to calculate the effective diffusion coefficient in complex gaseous systems	Calculating effective diffusion in complex systems	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Understand diffusion in liquids and calculate the factors affecting	Diffusion in Fluids: Theories and Applications	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Identify the mechanisms of diffusion in solids and their practical applications	Diffusion mechanisms in solids	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Understand the mechanisms of transition across the phase boundary between the . gaseous and liquid	Diffusion across phase boundaries and its applications	Theoretical (lecture and interactive activities)	Tests and participatic

		phases			
Eleventh	3	Apply film theory to calculate diffusion in two-phase systems	Understanding and Applying Film Theory	Theoretical (lecture and interactive activities)	Tests and participatic
Twelfth	3	Apply the film theorem to calculate transition resistances in complex systems	Application of the two-film theory of diffusion	Theoretical (lecture and interactive activities)	Tests and participatic
Thirteenth	3	Calculate mass transfer coefficient in laminar and turbulent flows	Calculation of mass transfer coefficient in flows	Theoretical (lecture and interactive activities)	Tests and participatic
Fourteenth	3	Calculate mass transfer resistances in the two phases and determine intermediate concentrations	Calculate the diffusion resistances in both phases	Theoretical (lecture and interactive activities)	Tests and participatic
Fifteenth	3	Apply the previous concepts to solve real problems in industrial systems	Examples and practical applications of mass transfer	Theoretical (lecture and interactive activities)	Tests and participatic

59. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

60. Learning and Teaching Resources

Required textbooks (curricular books, if any)	David P. DeWitt. and“Fundamentals of H and Mass Transfer” - Frank P.
Main references (sources)	"Heat Transfer: A Practical Approach" - Yu Çengel
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	MIT Open Course Ware - Heat and M Transfer

Course Description Form

1. Course Name:
Mass Transfer 2
2. Course Code:
TECP 304
3. Semester / Year:
Second semester – Third year
4. Description Preparation Date:
1 / 9/ 2024
5. Available Attendance Forms:
In-person – mandatory
6. Number of Credit Hours (Total) / Number of Units (Total)
Theoretical hours 3 Practical hours 2 / 4 units
7. Course administrator's name (mention all, if more than one name)
Name: Rafie Rushdy Mohammed Email: rafie.rushdy@ntu.edu.iq
8. Course Objectives

Course Objectives	**To provide students with a comprehensive understanding of the basic concepts of mass transfer in various systems (gases, liquids, and solids), with emphasis on industrial applications. The course aims to enable students to analyze and solve transfer problems associated with various chemical processes such as absorption and distillation**

9. Teaching and Learning Strategies

Strategy	• **Understand the basic principles of concentrations, velocities, and** • **Understand the basic concepts of mass transfer, concentrations, .and flows** • **Application of Fick's first law and analysis of diffusion in gases, .liquids and solids** • **Calculate diffusion resistances and mass transfer coefficients in .different flows** • **Analysis of chemical reactions accompanying mass transfer in .unstable systems** • **Understand general separation techniques such as absorption, .distillation and efficiency analysis**

10. Course Structure					
Week	**Hours**	**Required Learning Outcomes**	**Unit or subject name**	**Learning method**	**Evaluation method**
First	3	Understand the basics of concentrations, velocities, and mass and mole .flows	Introduction to Mass Transfer	Theoretical (lecture and interactive activit + Practical	Tests and participatio
Second	3	Apply Fick's law to calculate diffusion in gaseous systems	Introduction to Mass Transfer	Theoretical (lecture and interactive activities) +Practical	Tests and participatio
Third	3	Calculate the diffusion .coefficient in binary gases	Diffusion in binary gas mixtures	Theoretical (lecture and interactive activities)	Tests and participatio
Forth	3	Apply Maxwell's Law to calculate effective diffusion in multi-component systems	Mass transfer in multicomponent systems	Theoretical (lecture and interactive activities)	Tests and participatio
Fifth	3	Understand the mechanisms of .diffusion in solids and their industrial applications	Diffusion in fluids and its applications	Theoretical (lecture and interactive activities)	Tests and participatio
Sixth	3	Analyze unsteady mass transfer with chemical reactions	Unsteady mass transfer	Theoretical (lecture and interactive activities)	Tests and participatio
Seventh	3	Understand the basic mechanisms of separation processes such as absorption and abstraction	General separation techniques	Theoretical (lecture and interactive activities)	Tests and participatio
Eighth	3	Design packed columns and calculate mass transfer rates	Absorption packed bed columns	Theoretical (lecture and interactive activities)	Tests and participatio
Ninth	3	Calculate the number of trays and the efficiency of columns	Absorption in tray towers	Theoretical (lecture and interactive activities)	Tests and participatio
Tenth	3	Understand the laws of partial pressure and apply them in distillation processes	Simple distillation	Theoretical (lecture and interactive activities)	Tests and participatio
Eleventh	3	Calculate the number of plates required and apply recovery ratios	Fractional distillation	Theoretical (lecture and interactive activities)	Tests and participatio
Twelfth	3	Calculate the trays required in multi-component distillation	Multi-component distillation	Theoretical (lecture and interactive activities)	Tests and participatio
Thirteenth	3	Design distillation columns and calculate	Distillation column and tray design	Theoretical (lecture and interactive	Tests and participatio

		their efficiency		activities)	
Fourteenth	3	Apply the acquired knowledge .in the design of industrial separation systems	Projects and practical applications	Theoretical (lecture and interactive activities)	Tests and participatio
Fifteenth	3	Solve different types of questions	Review and final exam	Theoretical (lecture and interactive activities)	Tests and participatio

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	**"Mass Transfer: Principles and Applications"** - A Selvam
Main references (sources)	**"Diffusion: Mass Transfer in Fluid Systems"** - E Cussler
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	MIT Open Course Ware - Heat and Mass Transfer

Course Description Form

13. Course Name:	
Reactor Design 1	
14. Course Code:	
TECP 306	
15. Semester / Year:	
First semester – Third year	
16. Description Preparation Date:	
1 / 9/ 2024	
17. Available Attendance Forms:	
In-person – mandatory	
18. Number of Credit Hours (Total) / Number of Units (Total)	
Theoretical hours 3 Practical hours 2 / 4 units	
19. Course administrator's name (mention all, if more than one name)	
Name: Haider Ismael Ibrahim Email: haideralkarawi@ntu.edu.iq	
20. Course Objectives	
Course Objectives	**The course aims to provide students with a deep understanding of the fundamentals of chemical reactions and their applications in the chemical and petroleum industries. Emphasis will be placed on the design of chemical reactors, reaction analysis, and conversion rates, helping students understand how to achieve the highest production efficiency within safety and quality standards in chemical plants**
21. Teaching and Learning Strategies	
Strategy	• **Understand the basic principles of chemical reactions and their classification (homogeneous and heterogeneous reactions)** • **Analyze chemical equations and calculate reaction rates** • **Design of different chemical reactors (PFR ,CSTR ,Batch) and determine the appropriate sizes.** • **Apply various analytical techniques to study chemical reactions in reactors** • **Calculate conversion rates and possible improvements in production.** • **Evaluate the effect of temperature, pressure and concentration on reaction rates.**

22. Course Structure					
Week	**Hours**	**Required Learning Outcomes**	**Unit or subject name**	**Learning method**	**Evaluation method**
First	3	Introduction to chemical Engineering Kinetics	Chemical Engineering Kinetics	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Basic Concepts in Chemical Kinetics: Reaction Rate and Types of Chemical Reactions	Chemical Engineering Kinetics	Theoretical (lecture and interactive activities) +Practical	Tests and participatic
Third	3	Differential analysis of chemical reactions	Reaction order methods	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Integrated analysis of chemical reactions	Reaction order methods	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Effect of temperature on reaction rate: Arrhenius equation	Isothermal and nonisothermal reaction	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	Multi-step reactions and multiple reaction pathways	Types of reactions	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Design of Ideal Chemical Reactors: Fixed Reactor and Continuous Reactor	Reactor design equation	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Ideal flow reactors: perfect flow reactor	Reactor design equation	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Comparing different reactors and choosing the best one	Types of reactors	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Effect of mixing and conversion in non-ideal reactors	Non-ideal reactors	Theoretical (lecture and interactive activities)	Tests and participatic
Eleventh	3	Design of reactors for first and second order reactions	Design equation depends of order types	Theoretical (lecture and interactive activities)	Tests and participatic
Twelfth	3	Fundamentals and Applications	Gas-Liquid Interactions	Theoretical (lecture and interactive activities)	Tests and participatic
Thirteenth	3	Principles and Models	Heterogeneous Interactions:	Theoretical (lecture and interactive activities)	Tests and participatic
Fourteenth	3	Experimental data analysis	Chemical kinetics	Theoretical (lecture and interactive activities)	Tests and participatic
Fifteenth	3	Application problem solving	Comprehensive review	Theoretical (lecture and interactive activities)	Tests and participatic

23. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

24. Learning and Teaching Resources

Required textbooks (curricular books, if any)	"Scott Fogler. "Elements of Chemical React Engineering," 5th Edition. Prentice Hall, 2016
Main references (sources)	Octave Levenspiel. "Chemical React Engineering," 3rd Edition. John Wiley & Sons, 19
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**https://www.learncheme.com Proposed development plan**

Course Description Form

25. Course Name:	
Reactor Design 2	
26. Course Code:	
TECP 307	
27. Semester / Year:	
Second semester – Third year	
28. Description Preparation Date:	
1 / 9/ 2024	
29. Available Attendance Forms:	
In-person – mandatory	
30. Number of Credit Hours (Total) / Number of Units (Total)	
Theoretical hours 3 Practical hours 2 / 4 units	
31. Course administrator's name (mention all, if more than one name)	
Name: Haider Ismael Ibrahim Email: haideralkarawi@ntu.edu.iq	
32. Course Objectives	
Course Objectives	**The objective of this course is to provide students with a basic and integrated understanding of chemical kinetics and chemical reactor design. The course aims to develop students' ability to analyze and interpret chemical reactions, design appropriate reactors, and understand the effect of different operating conditions on reaction rates and conversion. The course focuses on the application of engineering and chemical principles to the design and operation of homogeneous and heterogeneous reactors, enabling students to make informed decisions**
33. Teaching and Learning Strategies	
Strategy	• **Understand the basic principles of chemical reactions and their classification (homogeneous and heterogeneous reactions)** • **Analyze chemical equations and calculate reaction rates** • **Design of different chemical reactors (PFR ,CSTR ,Batch) and determine the appropriate sizes.** • **Apply various analytical techniques to study chemical reactions in reactors** • **Calculate conversion rates and possible improvements in production.** • **Evaluate the effect of temperature, pressure and concentration on reaction rates.**

34. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Introduction to chemical Engineering Kinetics	Understand the importance of chemical kinetic engineering and . the roles of reactors in industry	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Basic Concepts in Chemical Kinetics: Reaction Rate and Types of Chemical Reactions	Identify the relationship between concentration and reaction rate . and classify reactions	Theoretical (lecture and interactive activities) +Practical	Tests and participatic
Third	3	Differential analysis of chemical reactions	Use differential methods to determine reaction rates and . analyze reaction data	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Integrated analysis of chemical reactions	Apply integral equations to determine half-life and analyze . systems	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Effect of temperature on reaction rate: Arrhenius equation	Understand the effect of temperature on reaction rate . using the Arrhenius equation	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	Multi-step reactions and multiple reaction pathways	Kinetic analysis of multistep and multipath reactions	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Design of Ideal Chemical Reactors: Fixed Reactor and Continuous Reactor	Identify the types of ideal reactors and calculate the conversion in each type	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Ideal flow reactors: perfect flow reactor	Understand the working principle of full flow and piston reactors . and calculate residence time	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Comparing different reactors and choosing the best one	Evaluating the performance of reactors and selecting the optimal reactor for a specific . application	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Effect of mixing and conversion in non-	Analysis of the effects of non-	Theoretical (lecture and interactive	Tests and participatic

		ideal reactors	ideal mixing on reactor . performance	activities)	
Eleventh	3	Understand the mechanisms of gaseous and liquid reactions and design appropriate reactors .	Calculate reaction rate and convert design to simple . reactors	Theoretical (lecture and interactive activities)	Tests and participatio
Twelfth	3	Application of theoretical models to determine interaction regions . in heterogeneous systems	Gas-Liquid Interactions	Theoretical (lecture and interactive activities)	Tests and participatio
Thirteenth	3	Analyze experimental data using mathematical methods to . determine kinetics	Heterogeneous Interactions:	Theoretical (lecture and interactive activities)	Tests and participatio
Fourteenth	3	Comprehensive review and application problem solving that . combines concepts and models	Chemical kinetics	Theoretical (lecture and interactive activities)	Tests and participatio
Fifteenth	3	Understand the mechanisms of gaseous and liquid reactions and design appropriate reactors .	Comprehensive review	Theoretical (lecture and interactive activities)	Tests and participatio

35. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

36. Learning and Teaching Resources

Required textbooks (curricular books, if any)	"Scott Fogler. "Elements of Chemical Reaction Engineering," 5th Edition. Prentice Hall, 2016
Main references (sources)	Octave Levenspiel. "Chemical Reaction Engineering," 3rd Edition. John Wiley & Sons, 1999
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**https://www.learncheme.com Proposed development plan**

Course Description Form

37. Course Name:	
Chemical Engineering Thermodynamics 1	
38. Course Code:	
TECP 308	
39. Semester / Year:	
First semester – Third year	
40. Description Preparation Date:	
1 / 9/ 2024	
41. Available Attendance Forms:	
In-person – mandatory	
42. Number of Credit Hours (Total) / Number of Units (Total)	
Theoretical hours 3 Practical hours 2 / 4 units	
43. Course administrator's name (mention all, if more than one name)	
Name: Ali Younis Hamid Email: alim7791ntu@ntu.edu.iq	
44. Course Objectives	
Course Objectives	**The Chemical Engineering Thermodynamics 1 course aims to provide students with a deep understanding of the basic concepts in thermodynamics related to fluid properties, basic thermodynamic laws, and thermodynamic property relationships. It also helps students apply these concepts to flow processes and analyze thermal power generation systems**
45. Teaching and Learning Strategies	
Strategy	• **Understand the properties of pure fluids and apply equations .of state** • **Understanding the second law of thermodynamics and its .applications** • **Analyze thermodynamic properties using tables and .diagrams** • **.Application of thermodynamics to fluid flow processes** • **Understanding and analyzing thermal power generation cycles**

46. Course Structure					
Week	**Hours**	**Required Learning Outcomes**	**Unit or subject name**	**Learning method**	**Evaluation method**
First	3	Understand the volume properties of pure fluids and analyze the Ferrel and Cubic equations	Volume properties of pure fluids - Review of the Ferrel equation and the cubic equation of state	Theoretical (lecture and interactive activit + Practical	Tests and participatio
Second	3	Apply the equations of general state to gases and liquids and analyze their behavior	Equations of state of gases and liquids and their analysis	Theoretical (lecture and interactive activities) +Practical	Tests and participatio
Third	3	Understand the second law of thermodynamics and the Carnot engine principle	The Second Law of Thermodynamics - Concepts and Carnot Engine	Theoretical (lecture and interactive activities)	Tests and participatio
Forth	3	Calculation of ideal and lost work and thermal balance applications	Thermal equilibrium and calculation of ideal work and lost work	Theoretical (lecture and interactive activities)	Tests and participatio
Fifth	3	Analysis of thermodynamic (ΔH, ΔS, properties relationships ΔU, ΔG).	Thermodynamic properties (ΔH, relationships and their ΔS, ΔU, ΔG) analysis	Theoretical (lecture and interactive activities)	Tests and participatio
Sixth	3	Understand the residual properties and analysis of two-phase systems	Residual properties of fluids and analysis of two-phase systems	Theoretical (lecture and interactive activities)	Tests and participatio
Seventh	3	Use thermodynamic tables and diagrams to analyze properties	Use thermodynamic tables and diagrams to analyze fluids	Theoretical (lecture and interactive activities)	Tests and participatio
Eighth	3	Analysis of compressible fluid flow through nozzles and pipes	Compressible fluids flow through nozzles and pipes	Theoretical (lecture and interactive activities)	Tests and participatio
Ninth	3	Understand the process of throttling and its effect on fluid properties	The suffocation process and its effect on fluid properties	Theoretical (lecture and interactive activities)	Tests and participatio
Tenth	3	Application of thermodynamics to the analysis of compressors and turbines	Analysis of compressors and turbines using thermodynamics	Theoretical (lecture and interactive activities)	Tests and participatio
Eleventh	3	Understand the Rankine cycle and analyze its efficiency in energy conversion	Rankine cycle for energy conversion and analysis of its efficiency	Theoretical (lecture and interactive activities)	Tests and participatio
Twelfth	3	Analysis of internal combustion engines (Otto and Diesel) and	Internal combustion engines: Otto cycle . and diesel engine	Theoretical (lecture and interactive activities)	Tests and participatio

		their cycles			
Thirteenth	3	Understand the principle of gas turbines and Brayton cycle	Gas turbines and the Brayton cycle	Theoretical (lecture and interactive activities)	Tests and participatic
Fourteenth	3	Analysis of thermal power generation and cooling cycles	Generation of thermal energy from various sources and cooling cycles	Theoretical (lecture and interactive activities)	Tests and participatic
Fifteenth	3	Application of thermal concepts in power systems analysis projects	Application projects and analysis of thermal energy systems	Theoretical (lecture and interactive activities)	Tests and participatic

47. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

48. Learning and Teaching Resources

Required textbooks (curricular books, if any)	**Smith, JM, Van Ness, HC, and Abbott, MM** *Introduction to Chemical Engineering Thermodynamics* , McGraw-Hill, 7th Edition.
Main references (sources)	**Moran, MJ, and Shapiro, HN** *Fundamentals of Engineering Thermodynamics* , Wiley, 8th Edition.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**Khan Academy - Thermodynamics Section**

Course Description Form

1. Course Name:
Chemical Engineering Thermodynamics 2
2. Course Code:
TECP 309
3. Semester / Year:
Second semester – Third year
4. Description Preparation Date:
1 / 9/ 2024
5. Available Attendance Forms:
In-person – mandatory
6. Number of Credit Hours (Total) / Number of Units (Total)
Theoretical hours 3 Practical hours 2 / 4 units
7. Course administrator's name (mention all, if more than one name)
Name: Ali Younis Hamid Email: alim7791ntu@ntu.edu.iq
8. Course Objectives

Course Objectives	**The Chemical Engineering Thermodynamics 2 course aims to provide students with a deep understanding of the basic concepts in thermodynamics related to fluid properties, basic thermodynamic laws, and thermodynamic property relationships. It also helps students apply these concepts to flow processes and analyze thermal power generation systems**

9. Teaching and Learning Strategies	
Strategy	• **Understand the properties of pure fluids and apply equations .of state** • **Understanding the second law of thermodynamics and its .applications** • **Analyze thermodynamic properties using tables and .diagrams** • **.Application of thermodynamics to fluid flow processes** • **Understanding and analyzing thermal power generation cycles**

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Understand the volume properties of pure fluids and analyze the Ferrel and Cubic equations	Volume properties of pure fluids - Review of the Ferrel equation and the cubic equation of state	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Apply the equations of general state to gases and liquids and analyze their behavior	Equations of state of gases and liquids and their analysis	Theoretical (lecture and interactive activities) +Practical	Tests and participatic
Third	3	Understand the second law of thermodynamics and the Carnot engine principle	The Second Law of Thermodynamics - Concepts and Carnot Engine	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Calculation of ideal and lost work and thermal balance applications	Thermal equilibrium and calculation of ideal work and lost work	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Analysis of thermodynamic (ΔH, ΔS, properties relationships ΔU, ΔG).	Thermodynamic properties (ΔH, relationships and their ΔS, ΔU, ΔG) analysis	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	Understand the residual properties and analysis of two-phase systems	Residual properties of fluids and analysis of two-phase systems	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Use thermodynamic tables and diagrams to analyze properties	Use thermodynamic tables and diagrams to analyze fluids	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Analysis of compressible fluid flow through nozzles and pipes	Compressible fluids flow through nozzles and pipes	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Understand the process of throttling and its effect on fluid properties	The suffocation process and its effect on fluid properties	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Application of thermodynamics to the analysis of compressors and turbines	Analysis of compressors and turbines using thermodynamics	Theoretical (lecture and interactive activities)	Tests and participatic
Eleventh	3	Understand the Rankine cycle and analyze its efficiency in energy conversion	Rankine cycle for energy conversion and analysis of its efficiency	Theoretical (lecture and interactive activities)	Tests and participatic
Twelfth	3	Analysis of internal combustion engines (Otto and Diesel) and	Internal combustion engines: Otto cycle . and diesel engine	Theoretical (lecture and interactive activities)	Tests and participatic

		their cycles			
Thirteenth	3	Understand the principle of gas turbines and Brayton cycle	Gas turbines and the Brayton cycle	Theoretical (lecture and interactive activities)	Tests and participatic
Fourteenth	3	Analysis of thermal power generation and cooling cycles	Generation of thermal energy from various sources and cooling cycles	Theoretical (lecture and interactive activities)	Tests and participatic
Fifteenth	3	Application of thermal concepts in power systems analysis projects	Application projects and analysis of thermal energy systems	Theoretical (lecture and interactive activities)	Tests and participatic

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	**Smith, JM, Van Ness, HC, and Abbott, MM** *Introduction to Chemical Engineering Thermodynamics* , McGraw-Hill, 7th Edition.
Main references (sources)	**Moran, MJ, and Shapiro, HN** *Fundamentals of Engineering Thermodynamics* , Wiley, 8th Edition.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**Khan Academy - Thermodynamics Section**

Course Description Form

1. Course Name:
Process Instrumentation and Control
2. Course Code:
TECP 310
3. Semester / Year:
First semester – Third year
4. Description Preparation Date:
1 / 9/ 2024
5. Available Attendance Forms:
In-person – mandatory
6. Number of Credit Hours (Total) / Number of Units (Total)
Theoretical hours 3 Practical hours 2 / 4 units
7. Course administrator's name (mention all, if more than one name)
Name: Azzam Isam Abdulkareem Email: azzam.esam@ntu.edu.iq
8. Course Objectives

Course Objectives	**Studying the dynamic characteristics of open engineering systems in the fields of chemical engineering and petroleum refining with the aim of formulating the transfer function and analyzing the system response to design and select the closed loop control scheme, in addition to analyzing closed systems to select a control scheme that ensures the stability of the station's operation under stable.conditions**

9. Teaching and Learning Strategies

Strategy	• **Study of the dynamic analysis of chemical processes to determine . the systems under different operating conditions** • **. Understand the formulation of the transfer function for the system** • **. Testing and selection of critical variables in processes** • **. Develop open-ended problem solving skills and work in teams** • **Enhance the ability to analyze closed systems and system . response under different operating conditions** • **Construct a transfer function for a closed system according to different schemes.**

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Understanding open linear : systems and formulating the transfer function	Feedback control	Theoretical (lecture and interactive activit + Practical	Tests and participatio
Second	3	Understanding open linear : systems and formulating the transfer function	Dynamic behavior of a second order system (system (under damping	Theoretical (lecture and interactive activities) +Practical	Tests and participatio
Third	3	Response analysis of first-order systems in engineering applications	flow rate control	Theoretical (lecture and interactive activities)	Tests and participatio
Forth	3	Response analysis of first-order systems in engineering applications	Control the liquid level in the tank	Theoretical (lecture and interactive activities)	Tests and participatio
Fifth	3	Understanding the Response of First Order Systems When Working in Sequence	Control the liquid level in the tank	Theoretical (lecture and interactive activities)	Tests and participatio
Sixth	3	Understanding the response of first-order systems when working in series2	pressure control	Theoretical (lecture and interactive activities)	Tests and participatio
Seventh	3	Analysis of the response of second-order and time-delay systems	pressure control	Theoretical (lecture and interactive activities)	Tests and participatio
Eighth	3	Analysis of the response of second-order and time-delay systems	Dynamic behavior of a second order system (over-(damped system	Theoretical (lecture and interactive activities)	Tests and participatio
Ninth	3	Understanding the components of closed linear systems and designing the transfer function	Dynamic behavior of a second order system (over-(damped system	Theoretical (lecture and interactive activities)	Tests and participatio
Tenth	3	Understanding the components of closed linear systems and designing the transfer function	Dynamic behavior of a second order system (over-(damped system	Theoretical (lecture and interactive activities)	Tests and participatio
Eleventh	3	Analysis of the properties and stability of closed systems	Dynamic behavior of a wetted system (thermal systems)	Theoretical (lecture and interactive activities)	Tests and participatio
Twelfth	3	Analysis of the properties and stability of closed	Dynamic behavior of a wetted system (thermal systems)	Theoretical (lecture and interactive activities)	Tests and participatio

		systems			
Thirteenth	3	Application of frequency response methods to system design and control	Temperature : control	Theoretical (lecture and interactive activities)	Tests and participatio
Fourteenth	3	Application of frequency response methods to system design and control	controlpH	Theoretical (lecture and interactive activities)	Tests and participatio
Fifteenth	3	Application of frequency response methods to system design and control	Water treatment unit control	Theoretical (lecture and interactive activities)	Tests and participatio

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Coughanowr, D.R., and LeBlanc, S., Process Systems Analysis and Control, McGraw-Hill, 3rd .edition, 2018
Main references (sources)	Stephanopoulos, G., *Chemical Process Control-An Introduction to Theory and Practice* , Prentice-Hall, New Jersey, 2016
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**coursera.org**

Course Description Form

1. Course Name:
Process Modeling and simulation
2. Course Code:
TECP 311
3. Semester / Year:
First semester – Third year
4. Description Preparation Date:
1 / 9/ 2024
5. Available Attendance Forms:
In-person – mandatory
6. Number of Credit Hours (Total) / Number of Units (Total)
Theoretical hours 3 Practical hours 2 / 4 units
7. Course administrator's name (mention all, if more than one name)
Name: Safa Senan Mahmod Email: safa.senan@ntu.edu.iq
8. Course Objectives

Course Objectives	**The Process Modeling and Simulation course aims to introduce students to the fundamentals of mathematical modeling of industrial processes and their analysis through simulation techniques. Students learn how to build mathematical models of process systems, analyze their behavior under different operating conditions, and use simulation tools to make design and optimization decisions.**

9. Teaching and Learning Strategies

Strategy	• **.Understand the basic principles of industrial process modeling** • **Ability to formulate mathematical models representing chemical .and engineering systems** • **.Process analysis using numerical simulation techniques** • **Use software tools to simulate processes in industrial .environments** • **Understanding the interactions between different variables in .multivariable systems** • **Ability to validate mathematical models by comparing results with .experimental data** • **Application of simulation techniques in process improvement and**

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	Understand the concept and importance of industrial process modeling and its role in improving performance	Introduction to Process Modeling – Definition and Importance of Modeling	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Identify the differential equations used to describe dynamic systems	Differential equations for dynamic systems	Theoretical (lecture and interactive activities) +Practical	Tests and participatic
Third	3	Ability to formulate mathematical models for various chemical processes	Formulating mathematical models of chemical processes	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Distinguish between linear and nonlinear systems and analyze their behavior	Analysis of linear and nonlinear systems	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Application of differential equation solving methods in solving process modeling problems	Methods of solving differential equations and their applications in modeling	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	Use of software tools dedicated to process modeling in systems analysis	Use of software tools in process modeling	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Application of process modeling in the field of chemical engineering and analysis of model results	Process modeling applications in chemical engineering	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Analyze system response over time using time simulation techniques	Time simulation and time response analysis	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Understand how to model multivariable systems and analyze interactions between them	Modeling of multivariable systems	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Simulation and analysis of series and parallel flow systems	Simulation of series and parallel flow systems	Theoretical (lecture and interactive activities)	Tests and participatic
Eleventh	3	Use simulation to improve process performance and	Using simulation tools to improve	Theoretical (lecture and interactive activities)	Tests and participatic

		analyze efficiency	processes		
Twelfth	3	A. Analysis of the stability of systems and application of control techniques in mathematical models	Stability analysis and control of systems	Theoretical (lecture and interactive activities)	Tests and participatic
Thirteenth	3	Validate mathematical models by comparing results with experimental data	A. Validate models and evaluate performance	Theoretical (lecture and interactive activities)	Tests and participatic
Fourteenth	3	Apply advanced modeling and simulation skills to solve complex problems	Advanced applications for process modeling and simulation	Theoretical (lecture and interactive activities)	Tests and participatic
Fifteenth	3	Implementing applied projects to simulate advanced processes and extracting improvement strategies	Advanced application and simulation projects	Theoretical (lecture and interactive activities)	Tests and participatic

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Marlin, T. E. Process Control: Designing Processes and Control Systems for Dynamic Performance
Main references (sources)	Bequette, B.W. Process Dynamics: Modeling, Analysis and Simulation, Prentice Hall, .2013
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**coursera.org**

Course Description Form

1. Course Name:
Industrial and Environmental Pollution Control
2. Course Code:
TECP 312
3. Semester / Year:
Second semester – Third year
4. Description Preparation Date:
1 / 9/ 2024
5. Available Attendance Forms:
In-person – mandatory
6. Number of Credit Hours (Total) / Number of Units (Total)
Theoretical hours 2 Practical hours 2 / 3 units
7. Course administrator's name (mention all, if more than one name)
Name: Taha Ibrahim Anwer Email: taha.anwer@ntu.edu.iq
8. Course Objectives

Course Objectives	**This course aims to provide students with the basic knowledge and practical skills to identify sources of industrial pollution and analyze their environmental impact, as well as apply pollution control strategies and techniques to reduce negative impacts on the environment and public health. The course focuses on air emission control techniques, wastewater treatment, and solid waste management, with a focus on environmental laws and regulations related to industrial pollution**

9. Teaching and Learning Strategies

Strategy	• **Understand the basic principles of industrial process modeling** • **Identifying sources of industrial pollution and their environmental and health impact** • **Analysis of the environmental impacts of pollution on natural .resources and population** • **Application of air emission control, wastewater treatment, and solid .waste management technologies** • **Compliance with local and international environmental laws related to industrial pollution** • **Evaluating and improving control systems in industrial facilities to ensure pollution reduction**

	• **Sustainable environmental resource management planning to reduce environmental impacts**

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
First	3	They are the concept of industrial pollution and its different types	Introduction to industrial pollution and its types	Theoretical (lecture and interactive activit + Practical	Tests and participatic
Second	3	Identifying sources of air pollution and analyzing its impact on the environment and health	Air Pollution: Sources and Effects	Theoretical (lecture and interactive activities) +Practical	Tests and participatic
Third	3	Application of technologies to reduce air emissions in industries	Air Emission Control Technologies	Theoretical (lecture and interactive activities)	Tests and participatic
Forth	3	Assessing sources of water pollution and understanding treatment strategies	Water Pollution: Sources and Treatment Methods	Theoretical (lecture and interactive activities)	Tests and participatic
Fifth	3	Use of industrial wastewater treatment technologies according to environmental standards	Industrial wastewater treatment	Theoretical (lecture and interactive activities)	Tests and participatic
Sixth	3	Design effective plans for industrial solid waste management	Industrial Solid Waste Management	Theoretical (lecture and interactive activities)	Tests and participatic
Seventh	3	Applying recycling practices to reduce industrial waste	Recycling technologies in industry	Theoretical (lecture and interactive activities)	Tests and participatic
Eighth	3	Analysis of the impact of chemical pollution on public health and the environment	Chemical pollution and its impact on public health	Theoretical (lecture and interactive activities)	Tests and participatic
Ninth	3	Understanding the sources of thermal and radioactive pollution and their environmental effects	Thermal and radioactive pollution in industry	Theoretical (lecture and interactive activities)	Tests and participatic
Tenth	3	Compliance with environmental laws and regulations related to industrial pollution	International and local environmental legislation to control pollution	Theoretical (lecture and interactive activities)	Tests and participatic
Eleventh	3	Analysis of the role of renewable energy in	The role of renewable energy in	Theoretical (lecture and interactive	Tests and participatic

		reducing industrial pollution	reducing industrial pollution	activities)	
Twelfth	3	Applying the concepts of circular economy and sustainability in industry	Sustainability and Circular Economy Technologies in Industry	Theoretical (lecture and interactive activities)	Tests and participatio
Thirteenth	3	Conducting environmental impact assessments for industrial projects	Environmental Impact Assessment of Industrial Projects	Theoretical (lecture and interactive activities)	Tests and participatio
Fourteenth	3	Developing strategies for managing environmental risks in major industries	Environmental Risk Management in Major Industries	Theoretical (lecture and interactive activities)	Tests and participatio
Fifteenth	3	Analysis of case studies of innovative solutions in industrial pollution control	Case Studies: Innovative Solutions for Industrial Pollution Control	Theoretical (lecture and interactive activities)	Tests and participatio

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	Herman Steyn. andJohn Nicholas by"Engineering Management
Main references (sources)	Harold by "Project Management: A Systems Approach to Planning, Scheduling, and Controlling" Kerzner.
Recommended books and references (scientific journals, reports…)	
Electronic References, Websites	**coursera.org**