

Module designation	<i>AZL 231 Business and academic communication in Azerbaijani</i>
Semester(s) in which the module is taught	<i>Fall, 3rd semester</i>
Person responsible for the module	<i>Ass. Prof. Kamala Mehdiyeva</i>
Language	<i>Azerbaijani</i>
Relation to curriculum	<i>Compulsory</i>
Teaching methods	<i>lecture, seminar</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload:120 Contact hours (lecture, seminar):36 Private study including examination preparation hours: 84</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	<i>-</i>
Module objectives/intended learning outcomes	<i>Every person should always be aware of the richness and beauty of his speech, and his speech, along with his dress and manners, should be in line with today's high level. When talking about human beauty, speech culture is also considered as the most necessary factor in the complementarity of its inner and outer world. The concept of speech culture is quite broad in terms of its volume and scope. This includes the main factors determining cultural speech, literary language norms, speech ethics, the role of cultural speech in social and socio-economic development, ways and methods of acquiring speech culture, and other issues.</i>
Content	<i>Introduction to Speech Culture, Norms of Literary Language, Speech Ethics and Etiquette, Expressiveness in Speech, The Role of Language in Society, Public Speaking and Rhetoric, Improving Speech Culture, Azerbaijani Language in Modern Communication</i>
Examination forms	<i>Written exam-50% Oral exam-30% Presentations- 20%</i>
Study and examination requirements	<i>Total grade above 61</i>
Reading list	<i>Nadir Abdullayev-Fundamentals of Azerbaijani Language and Art of Speech</i>

Module designation	<i>HIST 331 History of Azerbaijan</i>
Semester(s) in which the module is taught	<i>Fall, 5th semester</i>
Person responsible for the module	<i>Assoc. Prof. Alamdar Shahverdiyev</i>
Language	<i>Azerbaijani</i>
Relation to curriculum	<i>Compulsory</i>
Teaching methods	<i>lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<i>(Estimated) Total workload:150 Contact hours (lecture, seminar):48 Private study including examination preparation, coursework preparation hours: 102</i>
Credit points	5
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<i>This course will cover History of Azerbaijan since ancient periods till nowadays, focusing on political, economic, military, agrarian, ethnic, demographic processes which happened in the history of Azerbaijan nation. Delivering to students: problems of formation of Azerbaijan nation, historical stages of statehood of Azerbaijan, we will focus on acquiring by them the skills of objective assessment of historical issues. The course will be taught through the series of seminars and lectures grouped by topics. Academic Aims of the course: Over the course of the semester the students will learn the successes and failures that Azerbaijan nation has faced through the historical evolution process and will expand their knowledge of the history and historical analysis as well as provide them with the ability to critically read the sophisticated literature of the discipline and understand it.</i>
Content	<i>Introduction to Azerbaijani History, Ancient and Medieval Azerbaijan, Formation of the Azerbaijani Nation, Statehood in Azerbaijan, Economic and Agrarian Transformations, 20th Century and Soviet Period, Modern Azerbaijan, 44-Day Patriotic War (Second Karabakh War)</i>
Examination forms	<i>Written exam-50% Coursework-20% Midterm exam-30%</i>
Study and examination requirements	<i>Total grade above 61</i>
Reading list	<i>History of Azerbaijan, Volume I (From Ancient Times to the 20th Century). Edited by Z. Bunyadov and Y. Yusifov. Baku, 1994, and other editions. Tofiq Nəcəfli, Bilal Dədəyev - History of Azerbaijan. Baku, 2015.</i>

Module designation	ENG 101 – English 1
Semester(s) in which the module is taught	<i>Year 1, Fall semester (Semester 1)</i>
Person responsible for the module	<i>Head of Department - Asif Gojayev</i>
Language	<i>English</i>
Relation to curriculum	<i>Compulsory</i>
Teaching methods	<i>Seminars, class activity, presentation, achievement tests.</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 600h = 300h extracurricular hours + 300h classroom</i> Classroom hours: <i>Seminar: 300h (20 h/week)</i> Contact hours: <i>Examination preparation, consultation, self-study = 20 h/ week</i>
Credit points	<i>20 ECTS</i>
Required and recommended prerequisites for joining the module	<i>No prerequisites, only ordinary school knowledge</i>
Module objectives/intended learning outcomes	<ul style="list-style-type: none"> • <i>Demonstrate effective reading strategies to comprehend academic and technical texts.</i> • <i>Apply appropriate academic vocabulary and grammar in written and spoken communication.</i> • <i>Produce coherent and well-structured academic writing, including essays and reports.</i> • <i>Communicate ideas effectively and confidently in academic discussions and presentations.</i> • <i>Employ listening and note-taking skills to understand academic lectures and conversations.</i> • <i>Use English language skills to comprehend and discuss topics related to science, technology, and information security.</i>
Content	<ul style="list-style-type: none"> • <i>Course orientation, diagnostic test, introduction to academic English</i> • <i>Reading comprehension – main ideas and supporting details</i> • <i>Vocabulary development – word forms, prefixes, suffixes, collocations</i> • <i>Writing skills – paragraph and essay structure</i> • <i>Listening comprehension and note-taking</i> • <i>Academic writing – reports, summaries, and essays</i> • <i>Speaking skills – pronunciation, fluency, expressing opinions</i> • <i>Academic vocabulary – STEM and IELTS-related words</i> • <i>Reading for inference and argument understanding</i> • <i>Writing portfolio – drafting, revising, and editing</i> • <i>Presentation skills – academic and technical topics</i> • <i>Integrated skills – reading, writing, listening, and speaking practice</i> • <i>IELTS practice – reading, writing, speaking, and listening tasks</i> • <i>Review and achievement test preparation</i>
Examination forms	<i>Final exam - 50%</i> <i>Achievement test - 20%</i> <i>Presentation - 10% Class activity - 10%</i> <i>Writing portfolio - 10%</i>
Study and examination requirements	<i>Student is normally expected to achieve a total mark (preexam score + exam score) of at least 61 to pass. In this case of failure, he/she will be referred or required to repeat the course the following term or year. In the case of failure, the student can also be given a chance to retake the exam. Resit Exam score (50%) +Before Exam score will remain the same (50%)</i>

Reading list	<p>Main Textbooks</p> <ol style="list-style-type: none">1. Academic Vocabulary, Amy E. Olsen – <i>Fifth Edition</i>, 20132. Barron’s Essential Words for the IELTS, Dr. Lin Lougheed – <i>Third Edition</i>, 2017 <p>Supplementary Materials</p> <ol style="list-style-type: none">3. IELTS Advantage: Writing Skills, Richard Brown & Lewis Richards – 20114. IELTS Maximiser Speaking, Alireza Memarzadeh – 20075. IELTS Made Easy – Task 1, IELTS Buddy – 20136. IELTS Made Easy – Task 2, IELTS Buddy – 2013
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Module designation	COMP 103 – Application of ICT in Engineering 1
Semester(s) in which the module is taught	Year 1, Fall semester (Semester 1)
Person responsible for the module	PhD.c Aygul Musayeva
Language	Azerbaijani
Relation to curriculum	Compulsory
Teaching methods	Lecture, laboratory works, home assignments, quizzes, presentations
Workload (incl. contact hours, self-study hours)	Total workload: 300 h = 180 h extracurricular hours + 120h classroom Classroom hours: Lecture: 60h (4 h/week) Laboratory: 60h (4 h/week) Contact hours: Examination preparation, consultation, self-study = 12 h/ week
Credit points	10 ECTS
Required and recommended prerequisites for joining the module	No prerequisites, only ordinary school knowledge
Module objectives/intended learning outcomes	Each graduated student should be able to: <ul style="list-style-type: none"> • Apply fundamental principles and methods of Computer Science to a wide range of applications • Apply mathematical and scientific reasoning to a variety of computational problems • Design, correctly implement and document solutions to significant computational problems • Work effectively in teams to design and implement solutions to computational problems • Communicate effectively, both orally and in writing • Think critically and creatively, both independently and with others • Recognize the social and ethical responsibilities of a professional working in the discipline • Adapt to new developments in the field of computer science
Content	<ul style="list-style-type: none"> • Information and information processes - Informatics and information; Measurement of information; Information structure • Information coding – Coding; Decoding; Discretization; Information measurement • Numeral systems - Positional numeral systems; Non-Positional numeral systems; Binary system; Octal numeral systems; Hexadecimal numeral system; Other numeral systems • Computer logic - Logical operations; Simplification of logical expressions; Synthesis of logical expressions; Computer logic gates • Computer algebra - Storing integers in computer memory; Storing real numbers in computer memory; Operation on real and integer numbers • Hardware - Computer classification; Computer generations; Computer element base; Memory; Processor; Input and output devices • Software - Software classification; System software; Applications • Computer networks - Network classification and topology; Local network; Internet network; IP address; WWW; Email
Examination forms	Final exam - 40% Laboratory - 20% Quizzes - 20% Presentation - 20%

Study and examination requirements	<p>Withdrawal (pass / fail) <i>This course strictly follows grading policy of the Information Technology Department. Thus, a student is normally expected to achieve more than 50% from total score during Final exam and a total mark (preexam score + exam score) of at least 61 to pass. In this case of failure, he/she will be referred to participate in Resit exam or required to repeat the course the following term or year.</i></p> <p>Requirements for successfully passing the module</p> <ol style="list-style-type: none"> 1. Attend class regularly, arrive on time, leave only when dismissed 2. Attend class with all materials required, be prepared to listen and work 3. Be well prepared for class, read all required materials, and complete all necessary preparation 4. Be attentive in class, take notes, contribute to discussion and ask intelligent questions 5. Demonstrate professional and respectful interpersonal relationships with peers and instructor: ATTITUDE COUNTS, AND whining is unacceptable 6. Take responsibility for your actions, and your results
Reading list	<p>Main Textbook:</p> <ol style="list-style-type: none"> 1. Allakhverdiyeva N.R., Namazov M.B. Computer & Information-Communication Technologies. – 2011, 159 p. (azeri+russian) 2. Allakhverdiyeva N.R. Introduction to Databases – 2011, 110 p. (azeri+russian) <p>Recommended Reading:</p> <ol style="list-style-type: none"> 1. Ron White. How Computers Work.- 2008, 465 p. 2. CompTIA A+ Complete Study Guide, 998 pp., 2016 <p>Teaching resources <i>Electronic materials placed at Baku Higher Oil School website for this course: Syllabus, PowerPoint slides, exercises, assignments, case studies, announcements, exam samples, and discussions (www.lms.bhos.edu.az).</i></p> <p>Software: Microsoft Office (Word, Excel, Power Point, Access) <i>For class presentations and discussions, the student should utilize journal and internet materials. Moreover, the course does not limit the use of learning materials available at BHOS library.</i></p>

Module designation	ENG 102 - English 2
Semester(s) in which the module is taught	<i>Year 1, Spring semester (Semester 2)</i>
Person responsible for the module	<i>Head of Department - Asif Gojayev</i>
Language	<i>English</i>
Relation to curriculum	<i>Compulsory</i>
Teaching methods	<i>Seminars, class activity, presentation, achievement tests.</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 600h = 300h extracurricular hours + 300h classroom</i></p> <p>Classroom hours:</p> <p><i>Seminar: 300h (20 h/week)</i></p> <p>Contact hours:</p> <p><i>Examination preparation, consultation, self-study = 20 h/ week</i></p>
Credit points	<i>20 ECTS</i>
Required and recommended prerequisites for joining the module	<i>No prerequisites, only ordinary school knowledge</i>
Module objectives/intended learning outcomes	<ul style="list-style-type: none"> • <i>Understand and analyze academic and semi-academic texts effectively.</i> • <i>Apply vocabulary and grammar accurately in writing and speaking.</i> • <i>Produce structured paragraphs, essays, and reports.</i> • <i>Communicate ideas clearly and confidently in oral presentations and discussions.</i> • <i>Listen actively and take accurate notes from academic audio sources.</i> • <i>Apply English skills to comprehend and discuss topics related to academic and technical contexts.</i>
Content	<ul style="list-style-type: none"> • <i>Course orientation, diagnostic test, introduction to academic English</i> • <i>Reading skills – main ideas and supporting details</i> • <i>Vocabulary development – word forms, prefixes, suffixes, collocations</i> • <i>Writing – paragraph structure and cohesion</i> • <i>Listening comprehension – main ideas and details</i> • <i>Writing – essays, reports, and summaries</i> • <i>Speaking – pronunciation, stress, intonation, and fluency</i> • <i>Academic vocabulary – STEM and IELTS-related words</i> • <i>Reading for inference, argument, and critical understanding</i> • <i>Writing portfolio – drafting, revising, and editing</i> • <i>Presentations – individual and group projects</i> • <i>Integrated skills – combining reading, writing, speaking, listening</i> • <i>IELTS practice – reading, writing, listening, speaking</i> • <i>Review and achievement test preparation</i>
Examination forms	<p><i>Final - 50% Achievement test - 20% Presentation - 10% Class activity - 10% Writing portfolio - 10%</i></p>

Study and examination requirements	<p><i>Student is normally expected to achieve a total mark (preexam score + exam score) of at least 61 to pass. In this case of failure, he/she will be referred or required to repeat the course the following term or year. In the case of failure, the student can also be given a chance to retake the exam. Resit Exam score (50%) +Before Exam score will remain the same (50%)</i></p>
Reading list	<p>Required Reading / Textbooks</p> <ol style="list-style-type: none"> 1. <i>World English 2: Real People. Real Places. Real Language, Kristin L. Johannsen & Rebecca Tarver Chase, 2nd Edition, 2015</i> 2. <i>World English 3: Real People. Real Places. Real Language, Christian Lee</i> 3. <i>Interactive Vocabulary, Amy E. Olsen, 5th Edition, 2013</i> 4. <i>First Steps in Academic Writing, Ann Hogue, 2nd Edition, 2008</i> <p>Recommended Materials</p> <ol style="list-style-type: none"> 1. <i>IELTS Advantage Writing Skills, Richard Brown & Lewis Richards, 2011</i> 2. <i>Collins Listening for IELTS, Fiona Aish & Jo Tomlinson, 2011</i> 3. <i>IELTS Maximiser Speaking, Alireza Memarzadeh, 2007</i> 4. <i>Master IELTS Visuals, Tahasoni</i>

Module designation	COMP 104 – Application of ICT in Engineering 2
Semester(s) in which the module is taught	<i>Year 1, Spring semester (Semester 2)</i>
Person responsible for the module	<i>PhD.c Aygul Musayeva</i>
Language	<i>Azerbaijani</i>
Relation to curriculum	<i>Compulsory</i>
Teaching methods	<i>Lecture, Laboratory works, Home Assignments, Quizes</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 300 h = 180h extracurricular hours + 120h classroom</i></p> <p>Classroom hours:</p> <p><i>Lecture: 45h (3 h/week)</i></p> <p><i>Laboratory: 75h (5 h/week)</i></p> <p>Contact hours:</p> <p><i>Examination preparation, consultation, self-study = 12 h/week</i></p>
Credit points	<i>10 ECTS</i>
Required and recommended prerequisites for joining the module	<i>Basic Computer Literacy, Basic Mathematics, Foundations of Programming Logic</i>
Module objectives/intended learning outcomes	<p><i>Each graduated student should be able to:</i></p> <ul style="list-style-type: none"> • <i>Explain fundamental programming concepts including data types, variables, operators, control structures, functions, and data structures.</i> • <i>Describe Python's syntax, semantics, and runtime environment.</i> • <i>Write, debug, and execute Python programs to solve basic computational problems.</i> • <i>Apply Python modules and libraries for input/output operations, file handling, and simple data processing.</i> • <i>Analyze a given problem, design an algorithmic solution, and implement it using Python.</i> • <i>Use modular programming techniques to structure code effectively.</i> • <i>Employ Integrated Development Environments (IDEs) such as VS Code, PyCharm, or Jupyter Notebook for Python programming.</i> • <i>Utilize built-in Python libraries (e.g., math, random, datetime) and understand the use of external packages via pip.</i> • <i>Document and comment Python code according to good programming practices.</i> • <i>Collaborate in small groups to develop and test simple Python applications.</i> • <i>Demonstrate the ability to learn independently by exploring Python documentation and online resources.</i> • <i>Show readiness to progress to advanced topics such as object-oriented programming, data analysis, or web development using Python.</i>

Content	<ul style="list-style-type: none"> • The basics of Python Programming - Properties of algorithms; Saving a program as a file; Writing and running programs with IDE; Variables, assignment statements and user input; Main data types (int, float, str); Arithmetic operations; Standard functions: math, random • Control statements (conditions) - The conditional if; Logical operators; Nested and chained if statement • Loops - The for-loop and range functions; Nested for loop; Formatted output; Alternative approach: f-string • More about control statements - The repetition statements; The while loop; Nested while loop • Functions – Parameters; Return values • Strings - String and its methods; A string as a function parameter and as a return value • Lists and tuples - List and its methods; A list as a function parameter and as a return value; A tuple as a function parameter and as a return value • Search and sort algorithms - Search algorithms: sequential and binary search; Sort algorithms: bubble, selection and quick sort • More about lists - Multidimensional lists: matrix
Examination forms	<p>Final Exam – 40% Laboratory works – 20 % Home Assignments – 10% Quizzes – 30 %</p> <p>Reset exam is conducted only on base of final exam part, and it is 40% of total score. Remain part is laboratory and quiz scores.</p>
Study and examination requirements	<p>Withdrawal (pass / fail) This course strictly follows grading policy of the Information Technology Department. Thus, a student is normally expected to achieve more than 50% from total score during Final exam and a total mark (preexam score + exam score) of at least 61 to pass. In this case of failure, he/she will be referred to participate in Resit exam or required to repeat the course the following term or year.</p> <p>Requirements for successfully passing the module</p> <ol style="list-style-type: none"> 1. Attend class regularly, arrive on time, leave only when dismissed 2. Attend class with all materials required, be prepared to listen and work 3. Be well prepared for class, read all required materials, and complete all necessary preparation 4. Be attentive in class, take notes, contribute to discussion and ask intelligent questions 5. Demonstrate professional and respectful interpersonal relationships with peers and instructor: ATTITUDE COUNTS, AND whining is unacceptable 6. Take responsibility for your actions, and your results

Module designation	MATH 215 Mathematics 1
Semester(s) in which the module is taught	<i>3rd semester, Fall</i>
Person responsible for the module	<i>Assoc. Prof. Khanum Jafarova</i>
Language	<i>English</i>
Relation to curriculum	<i>Compulsory</i>
Teaching methods	<i>Lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<i>(Estimated) Total workload: 180 Contact hours (lecture, tutorial): 48 Private study including examination preparation, specified in hours: 132</i>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: Develop a high level of understanding of using mathematical methods in solving different problems of engineering and science. Work cooperatively to facilitate a collegial atmosphere conducive to learning for all students in the class. Prepare for and attend each class by reading the assigned sections before class, completing homework, and participating in class discussions and team activities.</p> <p>Learning outcomes: By the end of the course, students will be able to analyze functions, limits, and continuity; compute derivatives and apply them to study function behavior; solve optimization and curve sketching problems; evaluate integrals using standard techniques; apply definite and improper integrals to real-world problems; and use calculus concepts to model and solve mathematical and engineering problems.</p>
Content	Formulae, Functions: Log and Exponential, Application of Linear and Log Functions, Introduction to Differentiation, Introduction to Integration, Statistics and Probability, Vectors
Examination forms	Written Exam, quiz
Study and examination requirements	Attend and participate in lectures/tutorials; complete quiz; pass written exam;
Reading list	Thomas' Calculus, 12 th Edition Mathematics for Engineers and Scientists 1 Handbook by HWU

Module designation	PHYS 211-Physics 1
Semester(s) in which the module is taught	<i>3rd semester, Fall</i>

Person responsible for the module	<i>Prof. Siyavush Azakov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 180 Contact hours: 48 hours (lecture -36, tutorial-12) Self-study:132 hours (private study including exam preparation, preparation for the tests and home works)</i>
Credit points	6
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: Develop a high level of understanding of the fundamental principles of physics in Mechanics, Molecular Physics, and Thermodynamics. Develop basic laboratory skills demonstrating the application of physical principles. Work cooperatively to facilitate a collegial atmosphere conducive to learning for all students in the class. Prepare for and attend each class by reading the assigned sections before class, completing homework, and participating in class discussions and team activities.</p> <p>Learning outcomes: Students will know and will be able to explain the concepts of Mechanics, Molecular Physics and Thermodynamics and will demonstrate appropriate knowledge in the chosen track of engineering. Students will have strong physical reasoning and problem-solving skills and apply these skills to the solution of theoretical and applied problems in Mechanics, Molecular Physics and Thermodynamics. Students will be able to collect, analyze, and explain data from physics experiments in Mechanics, Molecular Physics and Thermodynamics to communicate physics concepts effectively both orally and in writing. Students will demonstrate a comprehension of physical and environmental reality by understanding how fundamental physical principles of Mechanics, Molecular Physics and Thermodynamics underlie the huge variety of natural phenomena and their interconnectedness. Students will demonstrate a comprehension of technology by understanding how things work on a fundamental level.</p>
Content	<ol style="list-style-type: none"> 1. <i>Vectors and Scalars</i> Vector & Scalar Quantities; Three Forces in Static Equilibrium; Resolving a Vector into Components 2. <i>Kinematic Relationships</i> Velocity, Speed and Acceleration; Vertical Motion; Horizontal Motion 3. <i>Mass, Force and Momentum</i> Newton's Three Laws of Motion; Weight, Reaction and Apparent Weight; Normal Force to a Horizontal Surface; Momentum and Momentum Conservation 4. <i>Circular Motion</i> Angular Velocity, Acceleration and Periodic Time; Angular Velocity and Tangential Speed; Angular Motion and Kinematic Relations 5. <i>Rotational Dynamics</i> Centripetal Acceleration and Force; Moments, Levers, Couples and Torque; Angular Momentum and Kinetic Energy

	<p>6. <i>Simple Harmonic Motion</i> Origin of General SHM Relation; Simple and Conical Pendulum; Damped Oscillations</p> <p>7. <i>Work, Heat, Energy and Power</i> Work, Kinetic and Potential Energy; Energy Conservation Principal; Renewable Energy</p>
Examination forms	<p>Written exam – 50%</p> <p>Tests – 40%</p> <p>Home works and activity—10%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete home works and tests; pass written exam
Reading list	<p>1. John D. Cutnell & Kenneth W. Johnson, <i>Physics</i>, 12th-edition, John Wiley & Sons, 2013</p> <p>2. Douglas C. Giancoli, <i>Physics for Scientists & Engineers</i>, 4th-edition, Pearson Prentice Hall, 2008</p> <p>3. David Halliday, Robert Resnick, Jearl Walker, <i>Fundamentals of Physics</i>, 10th-edition, John Wiley & Sons, 2013</p>

Module designation	CHE 203-Principles of Chemistry 1
Semester(s) in which the module is taught	3 rd semester, Fall
Person responsible for the module	Assoc Prof. Rena Abbasova, Arzu Abdullayeva
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	<p>Total workload: 210</p> <p>Contact hours: 60 hours (lecture -36, tutorial-24)</p> <p>Self-study:150 hours (private study including exam preparation, preparation for the quiz)</p>
Credit points	7
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: Prerequisite knowledge for principles of chemistry includes a solid foundation in basic mathematics, including algebra and calculus, as well as an understanding of atomic structure, chemical bonding, stoichiometry, and the periodic table.</p> <p>Learning outcomes: Students will understand and apply principles of measurement and problem-solving. They will identify the forms of matter, describe their physical properties, and understand the structure of atoms while using periodic laws to predict chemical and physical properties. Students will explore compounds, their formation, composition, and nomenclature. They will comprehend chemical equations and apply them in stoichiometric calculations. Additionally, students will understand gas behavior under ideal conditions and the properties of aqueous solutions, including acid-base</p>

	behavior. They will apply the principles of chemical equilibrium and define the chemical properties of the main group inorganic compounds. The course will also enable students to name organic compounds using IUPAC nomenclature and understand the structure and reactivity of organic molecules. Finally, students will analyze and explain the causes of environmental problems.
Content	<ol style="list-style-type: none"> <i>Principles of Chemistry</i> The Periodic table of elements; Stoichiometry ;Empirical Formula and Elemental Composition; Types of Chemical reaction in Aqueous solution <i>Atomic Structures and Orbitals</i> The Beginning of Quantum Theory; Quantum Mechanics; Periodicity in Atomic Properties <i>Molecular Shape and Chemical Bonding</i> Covalent bonding; Lewis Structure of Molecules; Molecular shape; Valence Bond Theory; Molecular Orbital (MO) Theory <i>Chemistry of the Elements of the Main Group</i> Classification of Main Group elements; Chemistry of Hydrogen; Chemistry of Halogens; Chemistry Of Chalcogens; Environmental Impact of Main Group Compounds <i>Organic Chemistry</i> Alkanes; Halogenoalkanes; Alkenes; Alcohols
Examination forms	Written exam – 85% Coursework – 15%
Study and examination requirements	Attend and participate in lectures/tutorials; complete coursework; pass written exam;
Reading list	<ol style="list-style-type: none"> Chemistry. Blackman, Bottle, Schmid, Mocerino, Wille (Wiley). 2nd Edition (2012) Organic Chemistry. Clayden, Greeves, Warren, OUP, 2nd Edition. 2012 Shriver & Atkins, Inorganic Chemistry (4th Ed.), Oxford University Press, 2005

Module designation	CHE 221-Process calculations 1
Semester(s) in which the module is taught	3 rd semester, Fall
Person responsible for the module	Dr. Rima Guliyeva
Language	English
Relation to curriculum	Compulsory
Teaching methods	Lecture, tutorial, laboratory classes
Workload (incl. contact hours, self-study hours)	Total workload: 210 Contact hours: 78 hours (lecture -36, tutorial-24, laboratory sessions- 18 Self-study:132 hours (private study including exam preparation, lab report preparation, preparation for the quiz)
Credit points	7
Required and recommended prerequisites for joining the module	-

Module objectives/intended learning outcomes	<p>Course objective: The course objectives for Process Calculations 1 include distinguishing between fundamental and derived units, recognising the SI system of units, and converting between SI and non-SI units. Students will gain fundamental knowledge of chemical reactions, moles, and concentration units. They will apply physical properties to solve chemical engineering problems, determine the physical properties of mixtures, and carry out material balance calculations on simple single-stage processes. Additionally, students will identify independent equations and variables while developing systematic problem-solving skills essential for chemical engineering applications.</p> <p>Learning outcomes: The learning outcomes for Process Calculations 1 include applying dimensional consistency and demonstrating knowledge of the mass conservation principle. Students will solve simple open-ended problems systematically, determine inert species and reactant species in excess, and distinguish between partial and vapor pressure. They will calculate average properties of mixtures, understand, and solve simple vapor-liquid equilibrium problems, and perform detailed calculations on combustion processes. Students will apply the concept of the extent of reaction, conduct material balance on simple multi-stage processes, and solve problems involving recycle streams. Additionally, they will synthesize and apply gained knowledge through laboratory experiments and data consolidation.</p>
Content	<ol style="list-style-type: none"> 1. <i>Units Conversion and Dimensional Analysis</i> Fundamental & Derived SI Units; SI Units for Chemical Engineers; Conversion factors; 2. <i>Engineering Chemistry</i> Calculations in chemistry; Limiting and excess reactants; Conversion, yield and selectivity 3. <i>Physical Properties and Gas Laws</i> Specific heat capacity; sensible and latent heat effects; phase diagrams; Gibbs phase rule; Vapour Pressure and Antoine Equation 4. <i>Material Balance on Single-Stage Systems</i> General Balance Equation; Non-Reacting Systems; Combustion Reaction Material Balances; Extent of Reaction 5. <i>Material Balance on Multi-Stage Systems</i> Multiple Units with no Recycle; Recycle without Chemical Reaction; Recycle with Chemical Reaction
Examination forms	<p>Written exam – 60%</p> <p>Quiz – 10%</p> <p>Lab reports – 30%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete quiz; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Abbott, Michael, Smith, J.M. and Van Ness, Hendrick. 2005. Introduction to Chemical Engineering Thermodynamics. 7th ed. New York: McGraw-Hill. 2. Felder, Richard M. and Rousseau, Ronald W. 2008. <i>Elementary Principles of Chemical Processes</i>. 3rd ed. India: Wiley 3. Himmelblau, David M. and Riggs, James B. <i>Basic Principles and Calculations in Chemical Engineering</i>. 2013. 8th ed. London: Pearson.

Module designation	MATH 214-Mathematics 2
Semester(s) in which the module is taught	4 th semester, Spring
Person responsible for the module	Gulush Nabadova
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	Total workload: 150 Contact hours: 48 hours (lecture -36, tutorial-12) Self-study:102 hours (private study including exam preparation, preparation for the quizzes)
Credit points	5
Required and recommended prerequisites for joining the module	MATH 215. Mathematics 1
Module objectives/intended learning outcomes	<p>Course objective: Differentiate expressions in engineering and science using the chain rule, product differentiation, quotient differentiation and implicit differentiation. Integrate expressions found in engineering and science by substitution and by parts and using partial fractions. Solve differential equations by separation of variables. Recognize the format of and manipulate complex numbers. Perform arithmetic operations on complex numbers. Perform basic algebra on matrices. Calculate the determinant of 2x2 and 3x3 systems. Formulate a linear system using matrices and vectors. Apply Gaussian elimination to solve a 2x2 linear system</p> <p>Learning outcomes: Differentiate the functions Find the Maclaurin and Taylor series of the functions. · Integrate · Find the area under a curve. · Solve simple differential equations · Find the maximum and minimum of the function. · Work with complex numbers · Solve quadratic equations · Work with matrices · Solve the system of linear equations by matrices.</p>
Content	<ol style="list-style-type: none"> 1. <i>Differentiation and Integration</i> Differentiation Revision: Chain, Product and Quotient Rules; Maclaurin and Taylor Series Approximations of Functions; Optimisation: Stationary Points, Maxima/Minima and Modelling; Modelling and Verification of Solutions in Differential Equations 2. <i>Complex Numbers</i> Arithmetic of Complex Numbers; Solving Quadratic Equations; The Argand Diagram; Polar Form of a Complex Number 3. <i>Matrices</i> Definition and Notation for Matrices; Matrix Addition and Subtraction; Matrix Multiplication; Linear Systems of Equations — Applications; The Determinant of a Matrix; The Inverse of a Matrix
Examination forms	Written exam – 50% Tests – 40%

	Home works and activity—10%
Study and examination requirements	Attend and participate in lectures/tutorials; complete quizzes and home works; pass written exam
Reading list	<ol style="list-style-type: none"> 1. Stroud K.A. Engineering mathematics; with additions by Dexter J. Booth, 5th edition, Industrial Press, Inc. New York, 2001 2. Croft A., Davison R. Mathematics for Engineers , 3rd edition, 2008 3. Mary P Attenborough, Mathematics for Electrical Engineering and Computing, 2003

Module designation	CHE 204-Principles of Chemistry 2
Semester(s) in which the module is taught	4 th semester, Spring
Person responsible for the module	Assoc. Prof. Rena Abbasova, Arzu Abdullayeva
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	<p>Total workload: 210</p> <p>Contact hours: 60 hours (lecture -36, tutorial-24)</p> <p>Self-study:150 hours (private study including exam preparation, preparation for the webtests)</p>
Credit points	7
Required and recommended prerequisites for joining the module	CHE 203 Principles of Chemistry 1
Module objectives/intended learning outcomes	<p>Course objective:</p> <p>Transition metal chemistry builds on key topics, including oxidation-reduction, chemical equilibrium, multielectron atoms, atomic properties, periodic trends, and the principles of Lewis acids and bases. Organic chemistry builds on the foundational concepts introduced in Topic 5: Introductory Organic Chemistry from the first semester. Prerequisite knowledge for physical chemistry includes calculus, algebra, differential equations, general chemistry concepts (atomic structure, stoichiometry, equilibrium, thermodynamics, gas laws), physics principles (mechanics, energy, waves), and basic laboratory skills for data analysis.</p> <p>Learning outcomes:</p> <p>This course covers a range of topics in chemistry, focusing on foundational principles and advanced concepts. Students will explore transition metal chemistry, including electronic configurations, oxidation states, d-orbital orientation, donor-acceptor bonds, complex formation, and the crystal field model for d-orbital splitting, as well as the color and magnetic properties of complexes. The properties of gases, gas laws, the ideal gas equation, and kinetic theory, along with gas diffusion and effusion, will be introduced. Thermochemistry topics include heat capacity, enthalpy, Hess's Law, and the energy changes in chemical reactions. States of matter will be examined with a focus on intermolecular forces, and the structures of liquids and solids.</p>

	Students will also study chemical equilibria, including K _p , K _c , acid base concepts, pH, buffer systems, and indicators. Organic chemistry topics include aromatic compounds, carbonyl chemistry, acyl compounds, carboxylic acids, amines, and reaction mechanisms. The course also emphasizes organic synthesis planning and execution, offering a comprehensive understanding of functional group behavior and reactivity. These objectives provide students with a broad yet detailed understanding of chemistry's core principles and applications.
Content	<ol style="list-style-type: none"> <i>Transition Metal Chemistry</i> Chemistry of transition metals; co-ordination chemistry; co-ordination number--- complex ion geometry; types of ligand; isomerism in transition metal complexes; magnetic properties of TM complexes <i>Organic Chemistry</i> Aromatic compounds; Amines; Aldehydes and Ketones; Carboxylic acids; Esters; Amides <i>Physical Chemistry</i> Gases; Chemical thermodynamics; Chemical equilibria; Solutions and solubility; Acids and bases
Examination forms	Written exam – 60% Webtests – 40%
Study and examination requirements	Attend and participate in lectures/tutorials; complete webtests; pass written exam
Reading list	<ol style="list-style-type: none"> Chemistry. Blackman, Bottle, Schmid, Mocerino, Wille (Wiley). 2nd Edition. 2012 Organic Chemistry. Clayden, Greeves, Warren, OUP, 2nd Edition. 2012 Inorganic Chemistry. Shriver & Atkins, Oxford University Press, 4th Edition, 2005. Physical Chemistry. P. Atkins, J. Paula, J. Keeler, Oxford University Press, 11th Edition, 2018.

Module designation	<i>CHE 224-Fundamentals of Biology</i>
Semester(s) in which the module is taught	<i>4th semester, Spring</i>
Person responsible for the module	<i>Guldana Hidayatli</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 150</i> <i>Contact hours: 48 hours (lecture -24, tutorial-24)</i> <i>Self-study:102 hours (private study including exam preparation, preparation for the quizzes)</i>
Credit points	5

Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: To provide Chemical Engineering students with foundational biological knowledge critical for understanding and integrating bioprocessing concepts, focusing on biological materials and methods essential in environmental safety, industrial applications, and waste management. This course acts as a prelude to advanced bioprocessing studies.</p> <p>Learning outcomes: Upon completing this course, students will be able to comprehend basic biological concepts, such as understanding cell theory, cell structure, and the fundamental differences between prokaryotic and eukaryotic cells. They will also be able to explain key cellular processes, including cell division, metabolism, and differentiation. Students will gain an understanding of bioprocess engineering applications by describing the role of microorganisms and enzymes in industrial processes like waste treatment and chemical production. They will evaluate the benefits of bioprocessing compared to traditional chemical processing methods. Furthermore, students will develop practical knowledge of biology for engineering by analyzing the interaction of microorganisms with their environment in industrial applications. They will apply biological concepts to assess plant safety, environmental protection, and waste management strategies. Lastly, the course will prepare students for advanced studies by establishing a solid knowledge base in bioprocessing and biotechnology, enabling them to pursue further education and research in these fields.</p>
Content	<ol style="list-style-type: none"> 1. <i>Introduction to Bioprocessing</i> 2. <i>Cell Biology</i> Development of the Cell Theory; Cell differentiation in multicellular organisms; Cell ultrastructures 3. <i>Taxonomy-The Diversity of Life</i> Phylogenetic tree of life; Domain Eukarya; Domain Bacteria; Domain Archaea 4. <i>Biochemistry</i> Carbohydrates; Proteins; Nucleic acids 5. <i>Metabolism</i> Metabolic pathways; Control of metabolic pathways 6. <i>Germ Theory</i> Development of the Germ Theory; Koch's postulates 7. <i>Biotechnology</i> Methods of microbiology; Upstream and Downstream Processes
Examination forms	<p>Written exam – 70%</p> <p>Quizzes – 30%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete quizzes; pass written exam
Reading list	<ol style="list-style-type: none"> 1. Biology. Campbell, Reece, Urry, Cain, Wasserman, Minorsky, Jackson (Pearson). 10th Edition. 2014 2. Molecular Biology of the Cell. Alberts, Johnson, Lewis, Raff, Roberts, Walter (Garland Science). 6th Edition. 2015 3. Essential Cell Biology. Alberts, Hopkin, Johnson, Morgan, Raff, Roberts, Walter (Garland Science). 4th Edition. 2013

Module designation	CHE 224-Fundamentals of Biology
Semester(s) in which the module is taught	4 th semester, Spring
Person responsible for the module	Guldana Hidayatli
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	Total workload: 150 Contact hours: 48 hours (lecture -24, tutorial-24) Self-study:102 hours (private study including exam preparation, preparation for the quizzes)
Credit points	5
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: To provide Chemical Engineering students with foundational biological knowledge critical for understanding and integrating bioprocessing concepts, focusing on biological materials and methods essential in environmental safety, industrial applications, and waste management. This course acts as a prelude to advanced bioprocessing studies.</p> <p>Learning outcomes: Upon completing this course, students will be able to comprehend basic biological concepts, such as understanding cell theory, cell structure, and the fundamental differences between prokaryotic and eukaryotic cells. They will also be able to explain key cellular processes, including cell division, metabolism, and differentiation. Students will gain an understanding of bioprocess engineering applications by describing the role of microorganisms and enzymes in industrial processes like waste treatment and chemical production. They will evaluate the benefits of bioprocessing compared to traditional chemical processing methods. Furthermore, students will develop practical knowledge of biology for engineering by analyzing the interaction of microorganisms with their environment in industrial applications. They will apply biological concepts to assess plant safety, environmental protection, and waste management strategies. Lastly, the course will prepare students for advanced studies by establishing a solid knowledge base in bioprocessing and biotechnology, enabling them to pursue further education and research in these fields.</p>
Content	<ol style="list-style-type: none"> 1. <i>Introduction to Bioprocessing</i> 2. <i>Cell Biology</i> Development of the Cell Theory; Cell differentiation in multicellular organisms; Cell ultrastructures 3. <i>Taxonomy-The Diversity of Life</i> Phylogenetic tree of life; Domain Eukarya; Domain Bacteria; Domain Archaea 4. <i>Biochemistry</i> Carbohydrates; Proteins; Nucleic acids 5. <i>Metabolism</i> Metabolic pathways; Control of metabolic pathways

	6. <i>Germ Theory</i> Development of the Germ Theory; Koch's postulates 7. <i>Biotechnology</i> Methods of microbiology; Upstream and Downstream Processes
Examination forms	Witten exam – 70% Quizzes – 30%
Study and examination requirements	Attend and participate in lectures/tutorials; complete quizzes; pass written exam
Reading list	1. Biology. Campbell, Reece, Urry, Cain, Wasserman, Minorsky, Jackson (Pearson). 10th Edition. 2014 2. Molecular Biology of the Cell. Alberts, Johnson, Lewis, Raff, Roberts, Walter (Garland Science). 6th Edition. 2015 3. Essential Cell Biology. Alberts, Hopkin, Johnson, Morgan, Raff, Roberts, Walter (Garland Science). 4th Edition. 2013

Module designation	CHE 290 Internship 1
Semester(s) in which the module is taught	<i>4th semester, Spring</i>
Person responsible for the module	<i>Dr. Rima Guliyeva, Dr. Rena Abbasova, Dr. Aysel Mammadova, Dr. Hajar Nabiyeva, Natavan Samadova, Garanfil Ahmadova, Arzu Abdullayeva, Aliyah Laylabashova, Alishan Alishanov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Individual meetings</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 180</i>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <ul style="list-style-type: none"> • To inform practical knowledge and skills about technologies used at the internship object plants, as well as management principles, health, safety and environment protection problems. • Acquisition of practical skills on chemical engineering part of the internship. Fulfilment final report and course tasks of the project separately. • Acquisition and enrichment of knowledge on chemical engineering. Acquisition of engineering skills as a manager of a minor section of plant while fulfilling the duties. Fulfilment final report and course tasks of the project separately. • Acquisition and enrichment of knowledge on chemical engineering. Acquisition of advanced engineering skills while fulfilling the duties as a production manager of the plant. Fulfilment final report and course tasks of the project separately. <p>Learning outcomes:</p> <ul style="list-style-type: none"> • To apply practical knowledge and skills related to plant technologies, management principles, and Health–Safety–Environment (HSE) requirements during internship activities.

	<ul style="list-style-type: none"> • To demonstrate practical skills in chemical engineering operations and independently complete the final internship report and assigned course project tasks • To enrich theoretical and practical chemical engineering knowledge through performing technical duties and managing minor sections of plant operations when assigned. • To develop advanced engineering competencies by participating in production management activities and fulfilling higher-level operational responsibilities at the plant. • To analyze, document, and communicate engineering tasks, operational data, and internship results in a structured and professional manner. • To integrate technical, managerial, and safety-related knowledge for solving practical industrial problems with appropriate engineering judgment.
Content	<p>Working as an operator in accordance with his/her experience and specialty.</p> <p>Working as the intern, operator or engineer assistant at the technical department. Fulfilment of the internship program on chemical engineering specialization. Collection, classification and analysis of data in order to fulfil the tasks of final reports and practical course project separately.</p> <p>Fulfilment of the internship program on chemical engineering specialization. Collection, systematization and analysis of all data in order to fulfil separate tasks of final tests and real course project.</p> <p>Fulfilment of the internship program on chemical engineering specialization. Collection, systematization and analysis of materials in order to fulfil final report and course tasks of the project separately.</p>
Examination forms	<p>Internship Performance - 15%</p> <p>Attendance - 15%</p> <p>Technical report - 40%</p> <p>Presentation - 30%</p>
Study and examination requirements	<p>Students taking internship should observe regulations covering organization of labour, health, safety and environmental protection at the enterprise; observe the instructions given by internship managers and requirements of internship programme; fulfil the assignments being involved in invention and rationalization activities of the enterprise;</p>
Reading list	<ol style="list-style-type: none"> 1. S. A Mustafayev, Y.N. Gahramanli. Initial oil processing technology. Manual for the faculties of technical profile higher schools. Baku, 2014, 452 p. 2. V.M. Abbasov, N.F.Janibeyov, H.J. Ibrahimov, S.R. Hajiyeva, S.A. Mammadkhanova, M.M. Abbasov. The main oil and chemical products and their production process. Manual, 'Science' publishing house, Baku, 2014, 316 page 3. V.M. Abbasov, H.J. Ibrahimov, S.R. Hajiyeva, S.A. Mammadkhanova, E. Sh. Abdullayev, F.A. Amirov, Chemistry and technology of petroleum processing. Manual, 'Science' publishing house, Baku, 2014, 408 page 4. A.H.Hasanov, M.K. Mammadov, M.J. Ibrahimova, M.N. Amiraslanova, R.V. Aliyeva, Chemistry and technology of monomers, manual, Baku, 2014, 480 page 5. N.A. Plate., E. V. Slivinski, Basics of chemistry and technologies of monomers, Science publishing house, 2002, 715 p. USSR, M., Chemistry, 1995, 304 p

Module designation	MATH 315-Differential equations
Semester(s) in which the module is taught	5 th semester, Fall
Person responsible for the module	Gulush Nabadova
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	Total workload: 180 Contact hours: 48 hours (lecture -36, tutorial-12) Self-study:132 hours (private study including exam preparation, preparation for the midterm)
Credit points	6
Required and recommended prerequisites for joining the module	MATH 214
Module objectives/intended learning outcomes	<p>Course objective:</p> <p>To provide all students the tools necessary to succeed in their pursuit of a high level of understanding of the principles of solving differential equations of the first and second order, optimization problems, differentiation, and integration of functions of two or more variables,</p> <p>To provide all students with an atmosphere conducive to learning the principles of mathematics.</p> <p>To provide sufficient feedback to students, enabling them to gauge their progress towards achieving their goal in learning the principles of mathematics.</p> <p>To facilitate student learning using appropriate activities, appropriate technology, and the illustration of mathematical applications in the real world.</p> <p>Learning outcomes:</p> <p>Students will know and will be able to solve the first and second order differential equations and apply their knowledge in solving application engineering problems.</p> <p>The students will be able to find partial derivatives of the functions of two or more variables, to determine their stationary points and classify them as maxima, minima, and saddle points. They will demonstrate appropriate knowledge in solving optimization problems.</p> <p>They will also learn how to calculate double integrals, interchange the order of integration, rewrite the double integral from Cartesian coordinates to polar coordinates. They will understand the applications of double integrals: volume, average values, mass, and center of mass.</p> <p>Students will have strong mathematical reasoning and problem-solving skills and apply these skills to the solution of theoretical and applied problems in Engineering.</p> <p>Students will demonstrate a comprehension of technology by understanding how things work on a fundamental level.</p>
Content	<ol style="list-style-type: none"> 1. Introduction to Ordinary Differential Equations 2. Homogeneous, Linear, Constant-Coefficient, 2nd-Order ODEs 3. Inhomogeneous Linear ODEs 4. Partial Differentiation 5. Maxima and Minima 6. Taylor Series and Linear Approximation

	<p>7. <i>Multiple Integrals</i></p> <p>8. <i>Double Integrals: Applications and Polar Coordinates</i></p>
Examination forms	<p>Written exam – 70%</p> <p>Midterm – 25%</p> <p>Activity – 5%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete midterm; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Stroud K.A. <i>Engineering mathematics</i>; with additions by Dexter J. Booth, 5th edition, Industrial Press, Inc. New York, 2001(available in BHOS library) 2. Croft A., Davison R. <i>Mathematics for Engineers</i>, 3rd edition, 2008 (available in BHOS library) 3. Mary P Attenborough, <i>Mathematics for Electrical Engineering and Computing</i>, 2003 (available in BHOS library) 4. Anton Howard, <i>Calculus with analytic geometry</i>, 1992

Module designation	CHE 321-Introduction to Chemical Engineering
Semester(s) in which the module is taught	5 th semester, Fall
Person responsible for the module	<i>Dr Sevda Zargarova</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 210</i></p> <p><i>Contact hours: 72 hours (lecture -36, tutorial-36)</i></p> <p><i>Self-study:138 hours (private study including exam preparation, preparation for the quiz and spreadsheet assignment)</i></p>
Credit points	7
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective:</p> <p>Prerequisite knowledge includes engineering mathematics, mass and energy balances for closed and open systems, and a solid understanding of thermodynamics, including the ideal gas law, non-ideal gas behavior, and Gibb's Phase Rule. Students should be familiar with the non-flow energy equation, steady-flow energy equation, and Bernoulli's equation, as well as how to use charts, tables, and dimensionless groups. A basic understanding of engineering chemistry, thermodynamic and transport properties, and the ability to read block and process flow diagrams are also necessary for solving practical problems in this field.</p> <p>Learning outcomes:</p> <p>Students will be able to apply methods for solving material balances in single and multiple unit operations. They will use mathematical procedures for process calculations involving thermodynamic changes and solve sensible and latent heat balance problems. Students will demonstrate a basic understanding of key unit operations in the process industry and grasp essential terminology used in process engineering drawings. These skills will</p>

	enable them to approach real-world problems in chemical and process engineering, contributing to the design, analysis, and optimization of industrial processes.
Content	<ol style="list-style-type: none"> 1. <i>Review of Units</i> Mole Concept, Concentration Units, Mass concentration and Mass fraction, Wet and Dry-basis 2. <i>SINGLE and MULTI-PHASE SYSTEMS</i> Review of Ideal gas law, Real gas behavior, Vapour-liquid equilibrium, Vapor-solid equilibrium, Gibbs Phase rule 3. <i>Thermodynamic Principles</i> System, Surrounding, Boundary & State; Closed and Open Systems and Processes; Relation between Enthalpy and Internal Energy; THE NON-FLOW ENERGY EQUATION; STEADY-FLOW ENERGY EQUATION; STEAM TABLE PROBLEMS 4. <i>INTRODUCTION to THERMAL ENERGY</i> Modes of Heat Transfer; Heat transfer by conduction; Heat transfer by convection; Heat transfer by radiation 5. <i>CASE STUDIES</i> Production Of Chlorinated Polyvinyl Chloride; Removal Of SO₂ From Flue Gas; Steam Reforming 6. <i>KINETIC THEORY of GASES</i> The Gas Laws; Kinetic Theory Of Gases; Non-Ideal Gas Behaviour; Gas Mixtures
Examination forms	Written exam – 70% Spreadsheet assignments – 15% Quiz – 15%
Study and examination requirements	Attend and participate in lectures/tutorials; complete spreadsheet assignments and quiz; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Perry, Robert H. and Green, Don W. 2008. Perry's Chemical Engineers' 2. Abbott, Michael, Smith, J.M. and Van Ness, Hendrick. 2005. Introduction to Chemical Engineering Thermodynamics. 7th ed. New York: McGraw-Hill. 3. Felder, Richard M. and Rousseau, Ronald W. 2008. <i>Elementary Principles of Chemical Processes</i>. 3rd ed. India: Wiley 4. Himmelblau, David M. and Riggs, James B. <i>Basic Principles and Calculations in Chemical Engineering</i>. 2013. 8th ed. London: Pearson.

Module designation	<i>PETE 315-Fundamentals of fluid mechanics</i>
Semester(s) in which the module is taught	<i>5th semester, Fall</i>
Person responsible for the module	<i>Prof. Fuad Valiyev</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial, laboratory sessions</i>

Workload (incl. contact hours, self-study hours)	<i>Total workload: 180</i> <i>Contact hours: 72 hours (lecture -36, tutorial-24, laboratory sessions-12)</i> <i>Self-study:108 hours (private study including exam preparation, report preparation and preparation for the quiz)</i>
Credit points	6
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: This course aims to introduce the topic of fluid mechanics covering fundamental theory of fluid flow, fluid statics and its use in selecting equipment suitable for fluid conveying. Group based practical laboratory-based sessions using dedicated examples supported by computer-based spreadsheet work serve to illustrate the practical significance of the theory developed in online environment.</p> <p>Learning outcomes: Demonstrate a thorough understanding of fluid statics and fluid dynamics, with application to chemical and process industries. Relate pressure drop and flowrate in pipe flows; be able to calculate flow rates in channel flows. Demonstrate an understanding of the principles and limitations of current flow metering systems. Demonstrate an understanding of the different choices available in pump selection for process applications and be able to specify in detail a centrifugal pump for a given duty. Apply mathematical analysis to fundamental fluid flow problems. Demonstrate competence in the practical application of fluid flow theory. Demonstrate an industrial awareness of equipment to convey and measure the flow of liquids and gases. Demonstrate experience in working with fluid conveying and measuring equipment.</p>
Content	<ol style="list-style-type: none"> 1. <i>INTRODUCTION AND FLUID STATICS</i> Hydrostatic Pressure Theorems; Manometers; Surface Tension And Wettability 2. <i>FLUID DYNAMICS</i> Conservation Of Mass; Conservation Of Energy; Laminar And Turbulent Flow; Laminar Flow In A Circular Pipe; Turbulent Flow in a Pipe 3. <i>FRICTIONAL PRESSURE LOSS AND FLOW MEASUREMENT</i> Pressure Loss Through Straight Pipe; Pressure Loss Through Pipe Fittings; Flow Measurement; 4. <i>PUMPING SYSTEMS AND PUMP SIZING</i> Types Of Pump Or Turbine; Pump Characteristics; Pump Sizing 5. <i>NON-NEWTONIAN FLUIDS</i> Mathematical Models; Fitting A Model To Experimental Data; Engineering Equations For Power Law Fluids
Examination forms	Written exam – 60% Laboratory reports – 30% Group Project – 10%
Study and examination requirements	Attend and participate in lectures/tutorials; complete reports and quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. J.M. Coulson, J.F. Richardson, Chemical Engineering Volume 1 2. J.F. Douglas, J.M. Gasiorek, J. A. Swaffield, Fluid Mechanics

Module designation	CHE 331-Chemical thermodynamics
Semester(s) in which the module is taught	5 th semester, Fall
Person responsible for the module	Dr Aysel Mammadova
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	Total workload: 180 Contact hours: 48 hours (lecture -36, tutorial-12) Self-study:132 hours (private study including exam preparation, preparation for the quiz)
Credit points	6
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: The general objective of this course is to introduce students to the fundamental concepts of chemical thermodynamics, related electrochemistry, and introduce chemical kinetics. Additionally, the course introduces chemical kinetics, exploring how reaction rates are influenced by various factors such as concentration, temperature, time, and other variables. Students will learn to analyze how these factors affect the speed of chemical reactions and how to quantify them. Finally, the course will examine more complex reactions, including enzyme-catalyzed reactions and chain and branched-chain reactions.</p> <p>Prerequisite knowledge: · Principles of Chemistry · Chemical Reactivity</p> <p>Learning outcomes: This course aims to provide students with a deep understanding of the fundamental principles of thermodynamics and their applications in chemical and physical processes. Students will demonstrate insight into heat and work and their relationship to energy changes in both physical and chemical processes. They will also apply standard enthalpies of formation to calculate reaction enthalpies, thereby understanding how energy is released or absorbed during chemical reactions. Additionally, students will appreciate the significance of the second law of thermodynamics, recognizing that it dictates the course of all spontaneous physical and chemical changes. They will understand that this law also allows for the determination of absolute entropies, which are crucial for understanding the spontaneity and direction of processes. The course will also introduce the application of thermodynamic concepts to electrochemical systems, bridging the gap between chemical thermodynamics and electrochemistry. Students will learn to define and measure rates of chemical reactions, allowing them to analyze the speed at which reactions occur under various conditions.</p>
Content	<p>1. CHEMICAL THERMODYNAMICS Thermodynamics and Reaction Kinetics; Energy, Work and Heat; Expansion: reversible and irreversible work; First Law of Thermodynamics; The Second Law of Thermodynamics; GIBBS FREE ENERGY AND PHYSICAL EQUILIBRIUM; The solid-liquid boundary; The liquid-vapour boundary</p>

	<p>2. <i>INTRODUCTORY CHEMICAL KINETICS</i> Rate of Reaction, accounting for stoichiometry; Order of Reaction; Differential / Integrated Rate Laws; EFFECT OF TEMPERATURE ON REACTION RATE;</p> <p>3. <i>THERMODYNAMICS OF MIXTURES AND SOLUTIONS</i> Le Chatelier's Principle; Chemical Potential of Liquids; Real mixtures: deviations from Raoult's Law; Chemical potential of non-ideal liquid mixture; Temperature – Composition Diagrams; Boiling point elevation; Freezing point depression; Electrochemical cells</p>
Examination forms	Written exam – 75% Quiz – 25%
Study and examination requirements	Attend and participate in lectures/tutorials; complete quizzes; pass written exam;
Reading list	Physical Chemistry P.W. Atkins

Module designation	MATH 314-Linear algebra
Semester(s) in which the module is taught	6 th semester, Spring
Person responsible for the module	Gulush Nabadova
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	Total workload: 120 Contact hours: 48 hours (lecture -36, tutorial-12) Self-study:72 hours (private study including exam preparation, preparation for the quiz)
Credit points	4
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: Develop a high level of understanding of using mathematical methods in solving different problems of engineering and science. Work cooperatively to facilitate a collegial atmosphere conducive to learning for all students in the class. Prepare for and attend each class by reading the assigned sections before class, completing homework, and participating in class discussions and team activities.</p> <p>Learning outcomes: Students will know and will be able to find Laplace transforms, to solve differential equations by using Laplace transforms, to solve geometry problems on lines and planes and will demonstrate appropriate knowledge in operations with matrices and applications of matrices in solving the systems of equations, to solve the systems of differential equations by using eigenvalues and eigenvectors. Students will have strong mathematical reasoning and problem solving skills and apply these skills to the solution of theoretical and applied problems in Engineering. Students will demonstrate a comprehension of technology by understanding how things work on a fundamental level.</p>
Content	1. <i>The Laplace Transform</i>

	<p>Laplace transforms of some simple functions; Properties of the Laplace transform; The Inverse Laplace Transform; Finding inverses using the first shift theorem</p> <ol style="list-style-type: none"> 2. <i>Solution of Differential Equations Using Laplace Transforms</i> Constant-Coefficient Linear Differential Equations; Differential Equations and the Dirac Delta Function; Systems of Differential Equations; Summary of Laplace transforms 3. <i>Geometry</i> Vector addition; Scalar product; Vector product; Lines in Three Dimensions; Equations of a Plane; Parametric representation of a plane; Parallel planes and the angle between two planes 4. <i>Vector Differentiation</i> Differentiation of Vectors; Gradient of a Scalar Function 5. <i>Systems of Linear Equations</i> Linear Equations and Elementary Row Operations; Gaussian Elimination: General Case 6. <i>Matrices</i> Vectors and Matrices; Inverse Matrices; Determinants 7. <i>Eigenvalues and Eigenvectors</i> Diagonalisation; Systems of Linear Differential Equations
Examination forms	Written exam – 60% Quiz – 40%
Study and examination requirements	Attend and participate in lectures/tutorials; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Stroud K.A. Engineering mathematics; with additions by Dexter J. Booth, 5th edition, Industrial Press, Inc. New York, 2001(available in BHOS library) 2. Croft A., Davison R. Mathematics for Engineers , 3rd edition, 2008 (available in BHOS library) 3. Mary P Attenborough, Mathematics for Electrical Engineering and Computing, 2003 (available in BHOS library) 4. Anton Howard, Calculus with analytic geometry, 1992

Module designation	<i>PETE 340-Fundamentals of engineering thermodynamics</i>
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	<i>Prof. Siyavush Azakov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 150</i> <i>Contact hours: 60 hours (lecture -36, tutorial-24)</i> <i>Self-study:90 hours (private study including exam preparation, preparation for the quiz)</i>
Credit points	5

Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: The First Law of Thermodynamics for closed systems with non-flow processes states that energy cannot be created or destroyed, only transferred, or converted. In open systems, the First Law includes the work done by the system on the surroundings and heat added or removed. Volume work, fluid work, and shaft work can be differentiated algebraically using P-V diagrams. Steady flow refers to constant fluid properties, while unsteady flow involves changing conditions. Adiabatic reversible processes for open and closed systems follow the same path. The steady-flow energy equation includes kinetic and potential energy terms, applying to throttling processes and multi-stage compression.</p> <p>Learning outcomes: Have a thorough understanding first and second laws of thermodynamics. Apply thermodynamic principles to cyclic heat & work processes. Understand the differences between ideal and nonideal systems. Understand thermodynamic equilibrium and the driving force for spontaneous processes. Demonstrate competence in numerical graphical and problem-solving skills in a range of areas associated with thermodynamics. Apply mathematical theory to analyze thermodynamic problems. Gain experience in finding and using thermodynamic properties. Work on specific technical problems and demonstrate proper use of the appropriate tools to solve problems. Demonstrate a wider appreciation of the science and technology via independent learning</p>
Content	<ol style="list-style-type: none"> 1. <i>CLOSED SYSTEMS & PROCESSES</i> First Law For Closed Systems; Isothermal Process; Isobaric Process; Isochoric Process; Adiabatic Process; Polytropic Process 2. <i>OPEN SYSTEMS</i> Isothermal Reciprocating Compressor – Zero Clearance Volume; Ideal Gas Shaft Work Ideal Gas, Adiabatic Compression; First Law For Open Systems; Adiabatic And Reversible Processes 3. <i>THROTTLING & MULTI-STAGE COMPRESSION</i> Joule-Thomson Expansion; J-T Effect And Vdw Attractive And Repulsive Components; Multi-Stage Gas Compression 4. <i>THE SECOND LAW OF THERMODYNAMICS</i> <i>Thermodynamic Cycles; Thermal Efficiency; The Kelvin-Planck Statement; The Clausius Statement; Reverse Heat Engines</i> 5. <i>ENTROPY</i> <i>The Principle Of Increasing Entropy; The Second Law And Gibbs Free Energy; Entropy Change – General Expression</i> 6. <i>CHEMICAL REACTIONS</i> <i>Extent Of Reaction & Stoichiometry; Gibbs Free Energy; Temperature Dependence Of The Equilibrium Constant; Determination Of The Equilibrium Constant At Different Temperatures</i>
Examination forms	Written exam – 70% Quiz – 30%
Study and examination requirements	Attend and participate in lectures/tutorials; complete quizzes; pass written exam;

Reading list	<ol style="list-style-type: none"> 1. Smith, J.M., van Ness, H.C., Abbott, M.M., Introduction to Chemical Engineering Thermodynamics, 7th Ed., 2000: McGraw-Hill. 2. Eastop, T.D., McConkey, A., Applied Thermodynamics for Engineering Technologists, 5th. Ed., 1996, Prentice-Hall. 3. Perry, Robert H. and Green, Don W. 2008. Perry's Chemical Engineers' Handbook. 8th Ed. New York: McGraw-Hill.
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Module designation	PETE 318-Heat transfer processes
Semester(s) in which the module is taught	6 th semester, Spring
Person responsible for the module	Prof. Fuad Valiyev
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial, laboratory sessions
Workload (incl. contact hours, self-study hours)	Total workload: 150 Contact hours: 72 hours (lecture -36, tutorial-24, laboratory session-12) Self-study:78 hours (private study including exam preparation, report writing, preparation for the quiz)
Credit points	5
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective: This course aims to introduce the topic of heat transfer covering fundamental theory of heat modes such as conduction, convection, and radiation. Group based practical laboratory-based sessions using dedicated examples supported by computer based spreadsheet work serve to illustrate the practical significance of the theory developed in the classroom environment.</p> <p>Learning outcomes: Demonstrate a thorough understanding of heat transfer modes, with application to chemical and process industries. Demonstrate an understanding of the principles and limitations of heat transfer equipment. Demonstrate an understanding of the different choices available in heat exchanger selection for process applications and be able to specify in detail a shell and tube heat exchanger load. Apply mathematical analysis to fundamental heat transfer problems. Demonstrate competence in the practical application of heat transfer theory. Demonstrate experience in working with heat transfer equipment.</p>
Content	<ol style="list-style-type: none"> 1. <i>Introduction to Heat Transfer</i> Thermal Equilibrium; Zeroth Law of Thermodynamics; Modes of Heat Transfer; Process Heat Transfer; Laminar and Turbulent Flow 2. <i>Thermal Conduction</i> Conduction Through a Plane Wall; Conduction Through a Composite Wall; Conduction Through a Composite Cylinder; Conduction Through a Boundary Layer 3. <i>Convection and Radiation</i> Lagging; Resistances; Film Heat Transfer Coefficient; Radiation 4. <i>Heat Transfer Equipment</i>

	<p>Double Pipe (Concentric Tube) Heat Exchanger; Mean Driving Force; Practical Heat Exchangers; Heat Exchanger Basics; Heat Exchanger Design; Number of Heat Transfer Units (NTU) Method</p> <p>5. <i>Heat Exchanger Design</i></p> <p>Hydraulic Mean Diameter; Mean Temperature Difference in Multi Tube-Side Pass Exchangers; Shell and Tube Heat Exchanger; Film Heat Transfer Coefficient; Heat Transfer in Vessels Using Jackets and Coils; Transient Heat Transfer; Lumped Capacitance</p> <p>6. <i>Boiling and Condensation</i></p> <p>Condenser Theory & Design; Reboiler Theory & Design; Boiling Heat Transfer; Design of Reboiler; Thermosyphon Reboilers; Kettle Reboilers</p>
Examination forms	<p>Written exam – 60%</p> <p>Laboratory reports – 30%</p> <p>Activity–10%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete laboratory reports; pass written exam
Reading list	<p>1. J.M. Coulson, J.F. Richardson, Chemical Engineering Volume 1</p> <p>2. J. M. Coulson, J.F. Richardson, Chemical Engineering Volume 6</p> <p>3. John H. Lienhard, A Heat Transfer Textbook: Fourth Edition, 4th Edition</p> <p>4. Process Engineering C – Textbook of Heriot Watt University</p>

Module designation	CHE 364-Process Design 1
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	<i>Arzu Abdullayeva</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, consultation hours, VBA tutorials</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 180</i></p> <p><i>Contact hours: 48 hours (lecture -24, tutorial-24)</i></p> <p><i>Self-study: 132 hours (private study including report writing, preparation for the VBA assignment, preparation for presentation)</i></p>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objective:</p> <p>General Objective of the Course: To develop capabilities in Synthesis Analysis of chemical processes and apply them in a design problem. Specific Objectives of the Course: To develop important time management skills, how to work in groups and how to meet both group and individual project deadlines. To experience delivering a project brief to a group that evaluates both the merits of the design itself, as well as the strategy adopted to tackle the overall design problem. To build background for the student's further studying special disciplines on chemical engineering.</p> <p>Learning outcomes:</p> <p>To develop research and technical report writing skills. To develop personal initiative and the ability to find, sift, sort, and assess information and data</p>

	from many different sources. Be skilled at solving problems by applying their numerical, Computational, analytical, and technical skills, using appropriate tools. Apply knowledge gained from other courses to prepare overall process. Flowsheets and heat and material balance tables. Apply knowledge gained from other courses to design individual items of equipment such as pipelines, pumps, and heat exchangers.
Content	<ol style="list-style-type: none"> 1. <i>PROJECT OVERVIEW</i> 2. <i>COURSEWORK COMPONENTS</i> 3. <i>Development of Flow Diagram-Task 1</i> 4. <i>Material & Energy Balance Table-Task 2</i> 5. <i>Pump and Pipeline Specification-Task 3</i> 6. <i>Heat Exchanger Sizing-Task 4</i> 7. <i>Safety, P&ID and Environmental-Task 5</i> 8. <i>Group Presentations-Task 6</i> 9. <i>Written Report-Task 7</i> 10. <i>Report Format</i> 11. <i>Information Resources</i>
Examination forms	Final written report – 65% Visual Basic Programming assignment – 30% Group presentation–5%
Study and examination requirements	Attend and participate in lectures/tutorials; complete final report; complete assignment, deliver group presentation
Reading list	<ol style="list-style-type: none"> 1. Perry, Robert H. and Green, Don W. 2008. <i>Perry's Chemical Engineers' Handbook</i>. 8th ed. New York: McGraw-Hill. 2. Sinnott, R.K. 1993. <i>Coulson and Richardson's Chemical Engineering</i>, Volume 6, <i>Chemical Engineering Design</i>. 2nd ed. Oxford: Elsevier Butterworth-Heinemann. 3. The Quality Assurance Agency for Higher Education (QAA), Gloucester, UK, 2014

Module designation	<i>CHE 390 Internship 2</i>
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	<i>Dr. Rima Guliyeva, Dr. Rena Abbasova, Dr. Aysel Mammadova, Dr. Hajar Nabiyeva, Natavan Samadova, Garanfil Ahmadova, Arzu Abdullayeva, Aliyah Laylabashova, Alishan Alishanov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Individual meetings</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 180</i>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	Course objectives: <ul style="list-style-type: none"> • To inform practical knowledge and skills about technologies used at the internship object plants, as well as management principles, health, safety and environment protection problems.

	<ul style="list-style-type: none"> • Acquisition of practical skills on chemical engineering part of the internship. Fulfilment final report and course tasks of the project separately. • Acquisition and enrichment of knowledge on chemical engineering. Acquisition of engineering skills as a manager of a minor section of plant while fulfilling the duties. Fulfilment final report and course tasks of the project separately. • Acquisition and enrichment of knowledge on chemical engineering. Acquisition of advanced engineering skills while fulfilling the duties as a production manager of the plant. Fulfilment final report and course tasks of the project separately. <p>Learning outcomes:</p> <ul style="list-style-type: none"> • To apply practical knowledge and skills related to plant technologies, management principles, and Health–Safety–Environment (HSE) requirements during internship activities. • To demonstrate practical skills in chemical engineering operations and independently complete the final internship report and assigned course project tasks • To enrich theoretical and practical chemical engineering knowledge through performing technical duties and managing minor sections of plant operations when assigned. • To develop advanced engineering competencies by participating in production management activities and fulfilling higher-level operational responsibilities at the plant. • To analyze, document, and communicate engineering tasks, operational data, and internship results in a structured and professional manner. • To integrate technical, managerial, and safety-related knowledge for solving practical industrial problems with appropriate engineering judgment.
Content	<p>Working as an operator in accordance with his/her experience and specialty.</p> <p>Working as the intern, operator or engineer assistant at the technical department. Fulfilment of the internship program on chemical engineering specialization. Collection, classification and analysis of data in order to fulfil the tasks of final reports and practical course projects separately.</p> <p>Fulfilment of the internship program on chemical engineering specialization. Collection, systematization and analysis of all data in order to fulfil separate tasks of final tests and real course project.</p> <p>Fulfilment of the internship program on chemical engineering specialization. Collection, systematization and analysis of materials in order to fulfil final report and course tasks of the project separately.</p>
Examination forms	<p>Internship Performance - 15%</p> <p>Attendance - 15%</p> <p>Technical report - 40%</p> <p>Presentation - 30%</p>
Study and examination requirements	<p>Students taking internship should observe regulations covering organization of labour, health, safety and environmental protection at the enterprise; observe the instructions given by internship managers and requirements of internship programme; fulfil the assignments being involved in invention and rationalization activities of the enterprise;</p>

Reading list	<ol style="list-style-type: none"> 1. S. A Mustafayev, Y.N. Gahramanli. Initial oil processing technology. Manual for the faculties of technical profile higher schools. Baku, 2014, 452 p. 2. V.M. Abbasov, N.F. Janibeyov, H.J. Ibrahimov, S.R. Hajiyeva, S.A. Mammadkhanova, M.M. Abbasov. The main oil and chemical products and their production process. Manual, 'Science' publishing house, Baku, 2014, 316 page 3. V.M. Abbasov, H.J. Ibrahimov, S.R. Hajiyeva, S.A. Mammadkhanova, E. Sh. Abdullayev, F.A. Amirov, Chemistry and technology of petroleum processing. Manual, 'Science' publishing house, Baku, 2014, 408 page 4. A.H. Hasanov, M.K. Mammadov, M.J. Ibrahimova, M.N. Amiraslanova, R.V. Aliyeva, Chemistry and technology of monomers, manual, Baku, 2014, 480 page 5. N.A. Plate., E. V. Slivinski, Basics of chemistry and technologies of monomers, Science publishing house, 2002, 715 p. USSR, M., Chemistry, 1995, 304 p
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Module designation	CHE 441 Chemical reaction engineering
Semester(s) in which the module is taught	<i>7th semester, Fall</i>
Person responsible for the module	<i>Dr. Hajar Nabiyeva</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, seminar</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 210 Contact hours (lecture, seminar, laboratory): 60 Private study including examination preparation, specified in hours: 150</i>
Credit points	<i>7</i>
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> • Engineering chemistry. • Foundation level Chemistry (or equivalent). • Fundamentals of material balance. • Stoichiometry.
Module objectives/intended learning outcomes	<p>Course objectives: This module is aimed at applying knowledge of chemical reaction rates to the sizing and operation of chemical reactors. Students apply stoichiometry, reaction kinetics and chemical equilibrium to different types of chemical reactions. They also develop an understanding of how a chemical reactor would work or is working, learn to apply the methods for sizing 'ideal' reactors for different reaction types, and achieve and understanding of the basics of 'non-ideal' flow and their application in sizing of 'non-ideal' reactors.</p> <p>Learning outcomes: Students will be able to define conversion and understand its significance in chemical reactions, including its role in measuring the extent of reaction. They will be able to derive concentration expressions for constant volume systems, ensuring the correct application of stoichiometric coefficients. Students will also gain a deep understanding of Arrhenius' Law and how it links temperature to the rate constant of a reaction. They will be able to determine the units of the rate constant and understand their dependence on the reaction order. In terms of chemical equilibrium, students will be able to determine the chemical equilibrium for reactions of any order (n-order reactions). The course will explore the</p>

	objectives and requirements of reactor design. Students will also learn how to determine and verify the order of reaction experimentally. Students will develop an understanding of the operation of continuous reactors, focusing on flow dynamics and their effect on reaction rates and product yield. The course will cover the complexities of multi-phase reactions, emphasizing mass transfer, phase interactions, and how these factors influence reactor design. Finally, students will compare ideal and non-ideal flow models and understand how deviations from ideal flow conditions affect reactor performance and design choices. Apply steady state initial conditions to a system and then define deviation variables. Understand the transfer function for an interacting system. Identify the main characteristics of different types of controller and their application
Content	<ol style="list-style-type: none"> 1. Stoichiometry, Chemical Kinetics and Chemical Equilibrium 2. Batch Reactors 3. Continuous Reactors 4. Multiple Reactions 5. Non-Ideal Flow
Examination forms	2 laboratory reports – 25 % Written Exam – 75%
Study and examination requirements	Attend and participate in lectures/tutorials; complete laboratory session; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. O. Levenspiel, Chemical Reaction Engineering (3rd ed.), 1998. 2. A.R. Cooper and G.V. Jeffreys, Chemical Kinetics and Reactor Design, 1971. 3. J.M. Smith, Chemical Engineering Kinetics (3rd ed.), 1980. 4. J.M. Coulson & J.F. Richardson, Chemical Engineering Vol. 6 (3rd ed.), 1999. R.H. Perry and D. Green, Perry's Chemical Engineers' Handbook (7th ed.), 1997. 5. H. Scott Fogler, Elements of Chemical Reaction Engineering (5th ed.), 2016.

Module designation	CHE 441 Chemical reaction engineering
Semester(s) in which the module is taught	<i>7th semester, Fall</i>
Person responsible for the module	<i>Dr. Hajar Nabiyeva</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, seminar</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 210 Contact hours (lecture, seminar, laboratory): 60 Private study including examination preparation, specified in hours: 150</i>
Credit points	<i>7</i>
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> • Engineering chemistry. • Foundation level Chemistry (or equivalent). • Fundamentals of material balance. • Stoichiometry.
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>This module is aimed at applying knowledge of chemical reaction rates to the sizing and operation of chemical reactors. Students apply stoichiometry, reaction kinetics and chemical equilibrium to different types of chemical</p>

	<p>reactions. They also develop an understanding of how a chemical reactor would work or is working, learn to apply the methods for sizing 'ideal' reactors for different reaction types, and achieve an understanding of the basics of 'non-ideal' flow and their application in sizing of 'non-ideal' reactors.</p> <p>Learning outcomes:</p> <p>Students will be able to define conversion and understand its significance in chemical reactions, including its role in measuring the extent of reaction. They will be able to derive concentration expressions for constant volume systems, ensuring the correct application of stoichiometric coefficients. Students will also gain a deep understanding of Arrhenius' Law and how it links temperature to the rate constant of a reaction. They will be able to determine the units of the rate constant and understand their dependence on the reaction order. In terms of chemical equilibrium, students will be able to determine the chemical equilibrium for reactions of any order (n-order reactions). The course will explore the objectives and requirements of reactor design. Students will also learn how to determine and verify the order of reaction experimentally. Students will develop an understanding of the operation of continuous reactors, focusing on flow dynamics and their effect on reaction rates and product yield. The course will cover the complexities of multi-phase reactions, emphasizing mass transfer, phase interactions, and how these factors influence reactor design. Finally, students will compare ideal and non-ideal flow models and understand how deviations from ideal flow conditions affect reactor performance and design choices. Apply steady state initial conditions to a system and then define deviation variables. Understand the transfer function for an interacting system. Identify the main characteristics of different types of controller and their application</p>
Content	<ol style="list-style-type: none"> 1. Stoichiometry, Chemical Kinetics and Chemical Equilibrium 2. Batch Reactors 3. Continuous Reactors 4. Multiple Reactions 5. Non-Ideal Flow
Examination forms	<p>2 laboratory reports – 25 %</p> <p>Written Exam – 75%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete laboratory session; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. O. Levenspiel, Chemical Reaction Engineering (3rd ed.), 1998. 2. A.R. Cooper and G.V. Jeffreys, Chemical Kinetics and Reactor Design, 1971. 3. J.M. Smith, Chemical Engineering Kinetics (3rd ed.), 1980. 4. J.M. Coulson & J.F. Richardson, Chemical Engineering Vol. 6 (3rd ed.), 1999. R.H. Perry and D. Green, Perry's Chemical Engineers' Handbook (7th ed.), 1997. 5. H. Scott Fogler, Elements of Chemical Reaction Engineering (5th ed.), 2016.

Module designation	CHE 445 Process simulation
Semester(s) in which the module is taught	7 th semester, Fall

Person responsible for the module	<i>Dr. Rima Quliyeva</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, seminar</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 90 Contact hours (lecture, seminar): 24 Private study including examination preparation, specified in hours: 66</i>
Credit points	<i>3</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives: Develop competence in using Aspen HYSYS and Aspen Plus software for modeling and simulating chemical processes in a realistic industrial context. Provide students with practical knowledge of chemical process behavior through flowsheeting, sensitivity analysis, and optimization tools. Build students' ability to interpret simulation results and make informed engineering decisions. Encourage a step-by-step, analytical approach to process modeling—starting from problem definition to model validation. Foster independent learning and efficient time management through project-based simulation exercises.</p> <p>Learning outcomes: Gain hands-on experience with Aspen HYSYS and Aspen Plus by simulating real-world chemical processes such as distillation, absorption, extraction, and heat exchange systems. Develop data analysis and process design skills by working on example-based simulations involving material and energy balances. Strengthen skills in software-aided process troubleshooting and optimization. Enhance communication and teamwork through group simulation projects and presentations. Interpret and evaluate simulation results critically, understanding the limitations and assumptions behind simulation models. Apply process simulation tools for decision-making in plant design and operation scenarios.</p>
Content	
Examination forms	Quiz – Written Exam –
Study and examination requirements	Attend and participate in lectures/seminars; complete quizzes; pass written exam;
Reading list	1.

Module designation	<i>CHE 449 Business intelligence, safety and sustainability</i>
Semester(s) in which the module is taught	<i>7th semester, Fall</i>
Person responsible for the module	<i>Guldana Hidayatli</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture</i>

Workload (incl. contact hours, self-study hours)	<i>Total workload: 180</i> <i>Contact hours (lecture): 36</i> <i>Private study including examination preparation, specified in hours: 144</i>
Credit points	6
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives: This course introduces students to the interdisciplinary concepts of economics, safety risk management, and sustainability in engineering. It covers principles of economic appraisal, health and safety risk management strategies, and sustainable development. Through this course, students will develop a comprehensive understanding of how business decisions, safety protocols, and sustainability practices intersect in engineering processes to achieve cost-effective, safe, and environmentally responsible solutions.</p> <p>Learning outcomes: Upon successful completion of this course, students will be able to understand economic principles by recognizing the components of investment and operational decisions. They will analyze cash flows, cash return profiles, and financial appraisals for engineering projects, applying techniques such as ROI, NPV, and IRR for economic evaluation. Students will also evaluate health and safety risks by differentiating between hazards and risks, understanding their implications in engineering, and conducting risk evaluations using tools like risk matrices and Pareto principles. They will identify and implement effective occupational and process risk control measures to ensure safety. In addition, students will implement sustainable practices by understanding the principles of sustainability and their application in industrial contexts. They will apply life cycle assessment techniques to measure environmental impact and develop strategies to achieve sustainable development in engineering projects. Finally, students will integrate ethics and management into their professional practice by comprehending the role of ethical decision-making in engineering and applying project and human resource management strategies to ensure efficiency and effective team collaboration</p>
Content	<ol style="list-style-type: none"> 1. Economics 2. Health and safety risk management 3. Sustainability 4. Ethics 5. Human resource management 6. Marketing 7. Project management
Examination forms	Interm report – 30% Presentation – 10 % Written Exam – 60 %
Study and examination requirements	Attend and participate in lectures; complete interim report; provide presentation; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Perry, R. H., & Green, D. W. (2008). Perry's Chemical Engineers' Handbook. 2. Mannan, S. (2012). Lees' Loss Prevention in the Process Industries. 3. Smith, J. M. (2005). Introduction to Chemical Engineering Thermodynamics.

	4. Supplementary Readings: Journal articles, online resources, and case studies provided during the course.
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Module designation	CHE 447 Separation processes 1
Semester(s) in which the module is taught	<i>7th semester, Fall</i>
Person responsible for the module	<i>Garanfil Ahmadova</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial, laboratory</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 210 Contact hours (lecture, tutorial, laboratory): 60 Private study including examination preparation, specified in hours: 150</i>
Credit points	<i>7</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <ul style="list-style-type: none"> • Familiarize the chemical engineering students with the fundamental principles of Separation Processes. • Improve your fundamental knowledge of engineering principles. • Fully understand key concepts of separation processes including equilibrium stages, reflux, efficiency and mass transport effects. • Understand how separation work, and to further develop your ability to apply basic principles to the solution of specific problems. • Acquaint the students with the common characteristics and fundamental principles of the separation processes. <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Understand the concept of vapor-liquid equilibrium • Understand relative volatility • Calculate the equilibrium coefficient • Understand bubble point and dew point • Understand and be able to use the McCabe-Thiele approach for binary systems. • Calculate the reflux ratio, total and minimum reflux • Understand the effect of feed condition, side streams and multiple feeds. • Understand the binary batch distillation • Understand the steps involved for a distillation column design • Understand graphical representation of liquid-liquid extraction with an immiscible solvent • Determine number of stages necessary for liquid-liquid extraction with an immiscible solvent • Understand the concept of mass transfer and molecular diffusion

	<ul style="list-style-type: none"> Understand the concept of absorption process
Content	<ol style="list-style-type: none"> Introduction to distillation Distillation of binary mixtures Distillation column design Liquid-liquid extraction
Examination forms	Laboratory session - 25% Written Exam - 75 %
Study and examination requirements	Attend and participate in lectures/tutorials; complete laboratory session; pass written exam;
Reading list	<ol style="list-style-type: none"> Richardson, J.F. Harker, J.H. Backhurst, J. R. (2002). Coulson and Richardson's Chemical Engineering Volume 2 - Particle Technology and Separation Processes (5th Edition). Elsevier. Sinnott, R. K. (2005). Coulson and Richardson's Chemical Engineering Volume 6 - Chemical Engineering Design (4th Edition). McCabe, W.L. Smith, J.C. and Harriott, P. (1993). Unit Operations of Chemical Engineering, 5th edition, McGraw-Hill International. Treybal, R. E. (1981). Mass Transfer Operations, 3rd edition, McGraw-Hill International. Geankoplis, C. J. (1993). Transport Processes and Unit Operations, 3rd edition, Prentice-Hall International, London Seader, J.D. Henley, E.J. and Harriott, P. (2010). Separation Process Principles, (3rd edition), John Wiley & Sons, Inc., USA

Module designation	CHE 448 Separation processes 2
Semester(s) in which the module is taught	8 th semester, Spring
Person responsible for the module	Dr. Hajar Nabiyeva
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial, laboratory
Workload (incl. contact hours, self-study hours)	Total workload: 210 Contact hours (lecture, tutorial, laboratory): 60 Private study including examination preparation, specified in hours: 150
Credit points	7
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> Separation Processes 1 Introduction to Chemical Engineering Math
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>The general objective of this course is to provide students with the fundamental principles of separation processes. The specific objectives aim to equip students with the skills and knowledge necessary to perform basic design calculations for selected unit operations. Additionally, the course will help students understand the underlying principles of evaporation and its application in various industrial processes. Students will also grasp the principles of drying, including its significance and various applications in</p>

	<p>chemical engineering. Furthermore, they will learn to evaluate and interpret the key characteristics of particle systems</p> <p>Learning outcomes: This course covers a range of essential topics related to separation processes, with a focus on evaporation, drying, and particle technology. Students will gain the ability to recognize different types of evaporators and understand various evaporator configurations and components. They will also learn how to calculate the evaporator economy and understand key design parameters for evaporators. The course delves into the drying of solid materials in both batch and continuous modes, exploring the differences between indirect and direct heating methods. Students will become familiar with the design parameters of drying equipment and learn how to calculate the drying rate for both batch and continuous dryers. Additionally, the course emphasizes the importance of particle technology. Students will understand concepts such as drag force and how particle size and shape influence particle properties. They will also be able to calculate or estimate terminal velocity and drag coefficients for both spherical and non-spherical particles. The concept of sedimentation will be explored, along with the calculation of different properties related to flow in packed beds. Finally, students will gain a solid understanding of the principles of solid-fluid separation, which is critical for optimizing separation processes in various engineering applications.</p>
Content	<ol style="list-style-type: none"> 1. Evaporation 2. Drying 3. Particle technology
Examination forms	Laboratory session - 25% Written Exam - 75 %
Study and examination requirements	Attend and participate in lectures/tutorials; complete laboratory session; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Richardson, J.F. Harker, J.H. Backhurst, J.R.. (2002). Coulson and Richardson's Chemical Engineering Volume 2 - Particle Technology and Separation Processes (5th Edition). Elsevier 2. Sinnott, R.K.. (2005). Coulson and Richardson's Chemical Engineering Volume 6 - Chemical Engineering Design (4th Edition).Elsevier 3. Schweitzer, P.A. (1988). Handbook of Separation Techniques for Chemical Engineers, (2nd Edition), McGraw-Hill 4. McCabe, W.L. Smith, J. C. Harriott, P..(2005). Unit Operations of Chemical Engineering, (7th Edition), McGraw-Hill 5. Rhodes, M.. (2008) Introduction to Particle Technology (2nd Edition) Wiley

Module designation	CHE 472 Process design 2
Semester(s) in which the module is taught	<i>8th semester, Spring</i>
Person responsible for the module	<i>Dr. Rima Guliyeva</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial, laboratory</i>

Workload (incl. contact hours, self-study hours)	<i>Total workload: 150</i> <i>Contact hours (meeting): 24</i> <i>Private study including examination preparation, specified in hours: 126</i>
Credit points	5
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> • Process Engineering A – Fluid Mechanics. • Process Engineering B – Thermodynamics. • Process Engineering C – Heat Transfer. • Separation Processes A – Distillation, Mass Transfer, and Separation. • Business Awareness, Safety and Sustainability.
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>Development of professional competence in the design of manufacturing plants using appropriate science and chemical engineering tools in creative and innovative fashion. Explanation of how to approach problems in a circumspect way, spending time allocating targets and identifying constraints, rather than rushing headlong into detailed action. Demonstration of a capability to apply knowledge and understanding of essential facts to create manufacturing processes. Demonstration of good time-planning skills and self-learning capacity with a view to improving their Performance.</p> <p>Learning outcomes:</p> <p>Develop practical skills and active learning techniques through information/data gathering by literature surveys, personal communications, laboratory-based work, and development and/or use of computer software. Develop transferable skills such as problem solving, communication, working with others, effective use of general IT facilities, and information retrieval. Demonstrate an ability to produce small running HYSYS and Aspen Plus flowsheets, while appreciating the power and limitations of these tools. Show leadership skills in managing individual and group-based activities, balancing individual needs against group needs.</p>
Content	<ol style="list-style-type: none"> 1. Design Project 2. Computer Aided Process Design
Examination forms	<p>Assignment 1 – Individual HYSYS Assignments – 60 %</p> <p>Assignment 2 – Individual Aspen – 40%</p> <p>The design project (part 2) contributes 35% to Process Design B</p> <p>There is no exam component to the design</p>
Study and examination requirements	Attend and participate class/consultation; submission of Group final report; group presentation
Reading list	<ol style="list-style-type: none"> 1. Chemical Process Equipment Selection and Design, J.R. Couper et al, 2nd ed., Elsevier, 2005 660.283COU 2. Plant design and economics for chemical engineers, M.S. Peters & K.D. Timmerhaus, 4th ed., McGraw Hill, 1991, 660.28PET 3. Perry's Chemical Engineers' Handbook, R.H. Perry (ed), 7th ed., McGraw Hill, 1998, 660.28PER A guide 4. Perry, Robert H. and Green, Don W. 2008. Perry's Chemical Engineers' Handbook. 8th ed. New York: McGraw-Hill. 2. Sinnott, R.K. 1993. Coulson and Richardson's Chemical Engineering, Volume 6, Chemical Engineering Design. 2nd ed. Oxford: Elsevier Butterworth-Heinemann.

	<p>3. Product and Process Design, W.D. Seider et al, John Wiley, 2004, 660.281SEI. Chapters 16 (Economics) and 22 (Reports & Presentations) may be useful.</p> <p>4. Chemical Process Equipment Selection and Design, J.R. Couper et al, 2nd ed., Elsevier, 2005 660.283COU</p> <p>5. Plant design and economics for chemical engineers, M.S. Peters & K.D. Timmerhaus, 4th ed., McGraw Hill, 1991, 660.28PET</p> <p>6. Perry's Chemical Engineers' Handbook, R.H. Perry (ed), 7th ed., McGraw Hill, 1998, 660.28PER A guide</p>
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Module designation	CHE 444 Multiphase thermodynamics
Semester(s) in which the module is taught	<i>8th semester, Spring</i>
Person responsible for the module	<i>Shahin Oruchov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, seminar</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 180 Contact hours (lecture, seminar): 48 Private study including examination preparation, specified in hours: 132</i>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>To provide the necessary tools to help engineers design and operate processes and unit operations in chemical engineering and engineering chemistry. To teach effectively fundamental concepts such as enthalpy, entropy, fugacity, free energy, and chemical potential. To teach students how to set up and solve thermodynamics problems. To learn how to apply the principles of chemical reaction equilibrium and phase equilibrium to the calculation of complex separation processes. To learn how to apply the principles of chemical reaction equilibrium and phase equilibrium to the calculation of complex separation processes.</p> <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Identify and differentiate between the potentials for heat transfer, work transfer and interphase mass transfer. • Define the chemical potential, the fugacity and the fugacity coefficient and write down relationships between them • Identify and differentiate nomenclature for mixture property, pure component properties and partial molar properties. • Define the apportioning rule, the recombination rule and the Gibbs-Duhem rule for partial molar properties. • Define the Lewis-Randall Rule and Dalton's Law. • Explain the gamma-phi approach to VLE, used for polar systems and compare and contrast with the phi-phi approach to VLE, used for non-polar systems. • Sketch P-T-x-y diagram and show how P-x-y and T-x-y diagrams are related to the three dimensional P-T-x-y surface.

	<ul style="list-style-type: none"> • Differentiate between chemical conversion and rate of reaction. • Define the extent of reaction and show how it can be used to carry out a material balance within a chemical reactor. • Define activity and the equilibrium constant. • Write down expressions for enthalpy change and Gibb's free energy change of reaction. • Sketch a P-T and a P-V diagram for pure fluids. Identify critical point and sketch the shape of various isotherms in relation to the two-phase envelope.
Content	<ol style="list-style-type: none"> 1. Pure species phase equilibrium 2. Vle for non-polar mixtures 3. Vle for polar liquid mixtures 4. Vapour-liquid equilibrium, liquid-liquid equilibrium and miscibility 5. Chemical equilibrium 6. Volumetric behaviour of real fluids and solids
Examination forms	Courswork – 25 % Written Exam – 75%
Study and examination requirements	Attend and participate in lectures/tutorials; complete coursework; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. J.R. Howell, R.O. Buckius. Fundamentals of Engineering Thermodynamics. McGrawHill, SI ed., 1987. 2. M.J. Moran, H.N. Shapiro. Fundamentals of Engineering Thermodynamics. Wiley 2 ed., 1993. 3. R.E. Sonntag, C. Borgnakke. Fundamentals of Thermodynamics. Wiley, 5th ed., 1998. 4. S.I. Sandler. Chemical and Engineering Thermodynamics. Wiley, 3rd ed., 1999. 5. Smith, J.M., van Ness, H.C., Abbott, M.M., Introduction to Chemical Engineering Thermodynamics. McGraw-Hill. 7th ed., 2005. 6. M.D. Koretsky, Engineering and Chemical Thermodynamics, Wiley, 2nd ed., 2013.

Module designation	CHE 454 Process modelling
Semester(s) in which the module is taught	8 th semester, Spring
Person responsible for the module	Dr. Sevda Zargarova
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, seminar
Workload (incl. contact hours, self-study hours)	Total workload: 180 Contact hours (lecture, seminar): 36 Private study including examination preparation, specified in hours: 144
Credit points	6
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	Course objectives:

	<p>To implement a control loop, individual elements required include sensors, controllers, actuators, and feedback mechanisms. Control strategies like open-loop, closed-loop, proportional-integral-derivative (PID), and adaptive control differ in their use of feedback and response characteristics. A Laplace Transform is a mathematical tool that converts functions from the time domain to the frequency domain, with key theorems like linearity and time-shifting. An input forcing function influences system behavior, and inverse transforms can derive output changes. Systems are modeled using linear differential equations. Interacting systems depend on each other's states, while non-interacting systems operate independently. Complex block diagrams can be simplified step-by-step for clarity.</p> <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Understand measuring devices, final control elements, controllers and discuss their functionality within the framework of a control loop. • Solve ODE using Laplace transforms and use a standard table of transforms to find input-output equation in terms of transformed variables. • Derive the transfer function for a first-order ODE. Identify the output behavior to a step forcing function and derive characteristic parameters • Apply steady state initial conditions to a system and then define deviation variables. • Understand the transfer function for an interacting system. • Identify the main characteristics of different types of controller and their application
Content	<ol style="list-style-type: none"> 1. Introduction & elements for process control. 2. Odes and laplace transforms 3. Process modelling 4. Interactions between systems and block diagrams 5. Design of process control systems
Examination forms	<p>Courswork/quiz – 25 % Witten Exam – 75%</p>
Study and examination requirements	Attend and participate in lectures/tutorials; complete coursework; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Textbook : Process Modelling 2. H. Baron. <i>The Oil & Gas Engineering Guide</i>, Editions TECHNIP, Paris, 2010. 3. C.A. Smith, A. Corripio. <i>Principles and Practice of Automatic Process Control</i>, Wiley, 3rd edition, 2006. 4. D.E. Seborg, T.F. Edgar, D.A. Mellichamp, F.J. Doyle. <i>Process Dynamics and Control</i>. Wiley, 3rd edition, 2011. 5. G. Stephanopoulos Chemical Process Control. <i>An Introduction to Theory and Practice</i>. Prentice Hall, Englewood Cliffs, New Jersey, 1984.

Module designation	CHE 490 Internship 3
Semester(s) in which the module is taught	8 th semester, Spring

Person responsible for the module	<i>Dr. Rima Guliyeva, Dr. Rena Abbasova, Dr. Aysel Mammadova, Dr. Hajar Nabiyeva, Natavan Samadova, Garanfil Ahmadova, Arzu Abdullayeva, Aliyah Laylabashova, Alishan Alishanov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Individual meetings</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 180</i>
Credit points	6
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <ul style="list-style-type: none"> • To inform practical knowledge and skills about technologies used at the internship object plants, as well as management principles, health, safety and environment protection problems. • Acquisition of practical skills on chemical engineering part of the internship. Fulfilment final report and course tasks of the project separately. • Acquisition and enrichment of knowledge on chemical engineering. Acquisition of engineering skills as a manager of a minor section of plant while fulfilling the duties. Fulfilment final report and course tasks of the project separately. • Acquisition and enrichment of knowledge on chemical engineering. Acquisition of advanced engineering skills while fulfilling the duties as a production manager of the plant. Fulfilment final report and course tasks of the project separately. <p>Learning outcomes:</p> <ul style="list-style-type: none"> • To apply practical knowledge and skills related to plant technologies, management principles, and Health–Safety–Environment (HSE) requirements during internship activities. • To demonstrate practical skills in chemical engineering operations and independently complete the final internship report and assigned course project tasks • To enrich theoretical and practical chemical engineering knowledge through performing technical duties and managing minor sections of plant operations when assigned. • To develop advanced engineering competencies by participating in production management activities and fulfilling higher-level operational responsibilities at the plant. • To analyze, document, and communicate engineering tasks, operational data, and internship results in a structured and professional manner. • To integrate technical, managerial, and safety-related knowledge for solving practical industrial problems with appropriate engineering judgment.
Content	<p>Working as an operator in accordance with his/her experience and specialty.</p> <p>Working as the intern, operator or engineer assistant at the technical department. Fulfilment of the internship programme on chemical engineering specialization. Collection, classification and analysis of data in order to fulfil the tasks of final reports and practical course project separately.</p>

	<p>Fulfilment of the internship programme on chemical engineering specialization. Collection, systematization and analysis of all data in order to fulfil separate tasks of final tests and real course project.</p> <p>Fulfilment of the internship programme on chemical engineering specialization. Collection, systematization and analysis of materials in order to fulfil final report and course tasks of the project separately.</p>
Examination forms	<p>Internship Performance - 15%</p> <p>Attendance - 15%</p> <p>Technical report - 40%</p> <p>Presentation - 30%</p>
Study and examination requirements	<p>Students taking internship should observe regulations covering organization of labour, health, safety and environmental protection at the enterprise; observe the instructions given by internship managers and requirements of internship programme; fulfil the assignments being involved in invention and rationalization activities of the enterprise;</p>
Reading list	<ol style="list-style-type: none"> 1. S. A Mustafayev, Y.N. Gahramanli. Initial oil processing technology. Manual for the faculties of technical profile higher schools. Baku, 2014, 452 p. 2. V.M. Abbasov, N.F.Janibeyov, H.J. Ibrahimov, S.R. Hajiyeva, S.A. Mammadkhanova, M.M. Abbasov. The main oil and chemical products and their production process. Manual, 'Science' publishing house, Baku, 2014, 316 page 3. V.M. Abbasov, H.J. Ibrahimov, S.R. Hajiyeva, S.A. Mammadkhanova, E. Sh. Abdullayev, F.A. Amirov, Chemistry and technology of petroleum processing. Manual, 'Science' publishing house, Baku, 2014, 408 page 4. A.H.Hasanov, M.K. Mammadov, M.J. Ibrahimova, M.N. Amiraslanova, R.V. Aliyeva, Chemistry and technology of monomers, manual, Baku, 2014, 480 page 5. N.A. Plate., E. V. Slivinski, Basics of chemistry and technologies of monomers, Science publishing house, 2002, 715 p. USSR, M., Chemistry, 1995, 304 p

Module designation	CHE 541 Unit operations
Semester(s) in which the module is taught	<i>7th semester, Fall</i>
Person responsible for the module	<i>Ravan Karimli, Shahin Oruchov</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, tutorial</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 210</i></p> <p><i>Contact hours (lecture, tutorial): 72</i></p> <p><i>Private study including examination preparation, specified in hours: 138</i></p>
Credit points	<i>7</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>Unit Operations A course comprises two sections: Advanced Distillation and Process Control.</p> <p>Advanced Distillation General Objective of the Course:</p>

- To cover further aspects of separation processes concentrating on multicomponent and complex (non-ideal) distillation processes;
- To provide insight into the design and operation of distillation systems and complications of multicomponent distillation process;
- Make design decisions by specifying multiphase separation equipment. Simulation of distillation using industry standard software (Aspen HYSYS) is an essential part of this course. Specific Objectives of the Course:
 - Understand the difference between binary and multicomponent distillation;
 - Understand the key equations and shortcut method for the multicomponent distillation column design;
 - Know how to work out shortcut distillation design using HYSYS software;
 - Identify how to choose distillation operating conditions such as pressure and temperature;
 - Understand the major concepts of distillation columns' sequencing.

Process Control General Objective of the Course:

- To teach fundamentals of control systems, mathematical modelling of the system, the structure of an industrial control system, how enhanced control systems work and how they can be used to improve process operation.
- Specific Objectives of the Course:
 - Understand the concept of time response, frequency response of the system and the basics of stability analysis of the system;
 - Be able to determine the response of different order systems for various step inputs, determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.

Learning outcomes:

The expected outcomes upon the course completion are described below:

Advanced Distillation

- Understand principles of binary and multiphase distillation;
- Use simplified shortcut and rigorous procedures for the design and modelling of multicomponent distillation;
- Perform steady-state simulation in process design software (e.g. Aspen HYSYS);
- Understand how variation of process variables (e.g. pressure) can affect the performance of the distillation system;
- Grasp principles of sequencing distillation columns for efficient separation of components;
- Be aware of various complex distillation methods (e.g. extractive, azeotropic and reactive distillation) and their applications.

Process Control

- Explain and derive transfer functions for the Proportional (P), Integral (I) and Derivative (D) controller action items;
- Derive closed-loop transfer functions for both disturbances and setpoint changes;
- Explain how a cascade control works and how to outline and tune the controllers;
- Explain the difference between feedforward and feedback control, give examples, sketch P&IDs and draw block diagrams;
- Differentiate between the types of control systems located at each level and alarm priorities;

	<ul style="list-style-type: none"> Outline the structure of an industrial control system and identify its physical location; Identify, sketch and design energy balance control schemes; Explain how enhanced control systems work, and how these systems can be used to improve process operation.
Content	<p>Advanced Distillation:</p> <ol style="list-style-type: none"> Binary Distillation Multi component Distillation Operation Conditions & Sequencing of Columns Advanced Separation Processes <p>Process Control:</p> <ol style="list-style-type: none"> Control ii element; feedback control revisited Control ii element; stability analysis and tuning Control ii element; enhanced control Control ii element; process control system design Control ii element; plantwide controls
Examination forms	2 Coursework - 20% Written Exam - 80 %
Study and examination requirements	Attend and participate in lectures/tutorials; complete courseworks; pass written exam;
Reading list	<ol style="list-style-type: none"> C.A. Smith, A. Corripio, Principles and Practice of Automatic Process Control, Wiley, 3rd edition, 2006. D.E. Seborg, T.F. Edgar, D.A. Mellichamp, F.J. Doyle, Process Dynamics and Control, Wiley, 3rd edition, 2011. M King, Process Control. A Practical Approach, Wiley (2011). B.W. Bequette, Process Control. Modeling, Design and Simulation, Prentice Hall (2003).

Module designation	CHE 543 Process safety and sustainability
Semester(s) in which the module is taught	7 th semester, Fall
Person responsible for the module	Emilya Ahmadova
Language	English
Relation to curriculum	Mandatory
Teaching methods	Lecture, tutorial
Workload (incl. contact hours, self-study hours)	Total workload: 210 Contact hours (lecture): 48 Private study including examination preparation, specified in hours: 162
Credit points	7
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>Understand process fires, explosions, and their technical aspects. Estimate Infra-Red radiation from pool fires. Grasp Inherently Safer Design (ISD) concepts and barriers. Learn reliability, probability, and perform failure and hazard rate calculations. Differentiate maintenance strategies. Understand safety management systems and apply them practically. Use risk assessment techniques like HAZOP, LOPA, fault/event trees, and quantitative risk assessment. Recognize sustainability's role in Chemical and Petroleum</p>

	<p>Engineering, including Industrial Ecology, Industrial Symbiosis, and Environmental Management Systems. Embrace cradle-to-grave liability and Practical Sustainable Development, highlighting sustainable processing and advantages of eco-friendly approaches</p> <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Be aware of and understand major safety management systems and requirements for accreditation • Be aware of the regulatory framework regarding safety and environmental protection • Be aware of the responsibilities of Chemical Engineers to Sustainable Development, and what this means in practice • Understand the limitations of prevailing business strategy for sustainable development • Be aware of the main tools available for safety, environmental and sustainability management, their limitations and advantages • Be able to carry out a systematic identification of hazards and evaluation of risks in an industrial context • Understand tolerability of risk and also various liabilities associated with safety and environmental protection • Understand the compilation of environmental policy documents for a business or company • Apply critical thinking to the real issues involved in environmental management • Create the outline of a sustainable development strategy for a processing operation or business activity
Content	<ol style="list-style-type: none"> 1. Process Fires and Explosions 2. Inherently Safer Design and Reliability 3. Safety Management 4. Process Risk Assessment 5. Introduction to Sustainability 6. Measuring Sustainability
Examination forms	<p>Courswork (20% HSE + 10% Sustainability) - 30%</p> <p>Written Exam - 70 %</p>
Study and examination requirements	Attend and participate in lectures; complete courseworks; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Health and Safety Executive (2015). Safe use and handling of flammable liquids HSG140, 2nd edition 2. T. A. Kletz (2010). Process Plants: A Handbook for Inherently Safer Design, 2nd Edn, Taylor and Francis Ltd, London, United Kingdom. 3. T. A. Kletz (2009). What went wrong 4th edn, Gulf Professional Publishing, Houston, USA 4. T. A. Kletz (2001). Hazop and Hazan, 4th edn, IChemE, UK 5. Frank P. Lees (2012a). Reliability Engineering. In: Loss Prevention in the Process Industries, 4th Edn., Vol. 1, Chapter 7, Butterworth Heinemann, Oxford, United Kingdom 6. Frank P. Lees (2012b). Failure and Event Data. In: Loss Prevention in the Process Industries, 4th Edn., Vol. 3, Appendix 14, Butterworth Heinemann, Oxford, United Kingdom 7. Health and Safety Executive (2013). Managing for Health and Safety, HSG65, 3rd Edn., HSE Books, HSE, Sudbury, United Kingdom. 8. F. Crawley, M. Preston and B. Tyler (2008). HAZOP: Guide to Best Practice, 2nd Edn., Institution of Chemical Engineers (IChemE), Rugby, United Kingdom.

	<p>9. Frank P. Lees (2012). Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, Volume 1&2, 4thEdn., Butterworth Heinemann, Reed Educational and Professional Publishing, Oxford, United Kingdom.</p> <p>10. Rogers,P.P., Jalal, K. F., Boyd, J. A. (2006) An Introduction to Sustainable Development. The Continuing Education Division, Harvard University and Glen Educational Foundation</p> <p>11. Khalili, N.R. (2011) Practical Sustainability from Grounded Theory to Emerging Strategies. (1sted.). New York: Palgrave Macmillan</p>
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Module designation	MACD 581 Safety, health and civil protection
Semester(s) in which the module is taught	<i>7th semester, Fall</i>
Person responsible for the module	<i>Prof. Kanan Yusif-zada</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Lecture, seminar</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 90 Contact hours (lecture/seminar): 24 Private study including examination preparation, specified in hours: 66</i>
Credit points	<i>3</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <p>The goal in teaching the subject: “Fundamentals of civil defense and medical aid”: Students will get general knowledge on urgent and emergency circumstances. They will be informed on the state system for urgent circumstances, learn how to act in urgent and emergency circumstances, and learn to use protective means, learn about rescue and first medical aid procedures.</p> <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Understand the role and objectives of civil defense in urgent and emergency circumstances, organization of civil defense services and forces, building such services and forces and their duties. • Understand the principles and methods of protection of population in urgent and emergency circumstances • To master fundamental medical knowledge and be able to provide practically first medical aid in urgent and emergency circumstances
Content	<ol style="list-style-type: none"> 1. Classification of urgent and emergency circumstances in war and peaceful period, 2. General questions of civil defense, impact of urgent and emergency circumstances. 3. In urgent and emergency circumstances protection methods of population
Examination forms	<p>Attendance – 10 %</p> <p>Presentation – 40%</p> <p>Written Exam – 50 %</p>

Study and examination requirements	Attend and participate in lectures/seminar; provide presentation; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Electronic material placed at Baku Higher Oil School site for this course: Syllabus, PowerPoint slides, assignments, discussions, articles 2. http://www.ipieca.org/publication/managing-health-field-operations-oil-and-gas-activities 3. Emergency safety and first aid handbook. http://www.ddm.gov.bt/download/Emergency 4. Prof. Dr. K.Yusif-zada. Semi-Public Hospital Management (www.amazon.com)

Module designation	CHE 545 Research project
Semester(s) in which the module is taught	7 th semester, Fall
Person responsible for the module	Dr. Sevda Zargarova, Dr. Rima Guliyeva, Dr. Aysel Mammadova, Dr. Hajar Nabiyeva, Natavan Samadova, Garanfil Ahmadova, Arzu Abdullayeva
Language	English
Relation to curriculum	Mandatory
Teaching methods	Individual meetings
Workload (incl. contact hours, self-study hours)	Total workload: 210 Contact hours (individual meetings): 36 Private study including examination preparation, specified in hours: 174
Credit points	7
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <ul style="list-style-type: none"> • Plan and conduct an independent research project in the chemical engineering field. • Communicate their research results orally to an audience of their peers. • Analyse experimental data using appropriate statistical methods. • Present a detailed written report. • To build background for the student's further studying special disciplines in chemical engineering <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Think independently • Ability to apply knowledge of basic science and engineering fundamentals • Use critical reasoning and analysis with supporting evidence from literature. • Develop skills in identifying, collating, analysing and commenting on scientific literature. • Ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member • Communicate findings and conclusions to others.
Content	<ol style="list-style-type: none"> 1. Choice of Project 2. Writing a Literature Review 3. Assessment Procedure 4. Guidelines for Final Reports

	<p>5. Timetable</p> <p>6. Marking Scheme</p>
Examination forms	<p>Oral presentation – 20 %</p> <p>Final report – 80 %</p>
Study and examination requirements	Attend and participate in regular meetings; provide oral presentation; submit a final report
Reading list	<p>1. Electronic material placed at Baku Higher Oil School site for this course: Syllabus, PowerPoint slides, assignments, discussions, articles</p> <p>2. http://www.ipieca.org/publication/managing-health-field-operations-oil-and-gas-activities</p> <p>3. Emergency safety and first aid handbook. http://www.ddm.gov.bt/download/Emergency</p> <p>4. Prof. Dr. K.Yusif-zada. Semi-Public Hospital Management (www.amazon.com)</p>

Module designation	CHE 547 Design project 2
Semester(s) in which the module is taught	<i>9th semester, Fall</i>
Person responsible for the module	<i>Rima Guliyeva, Azar Salimov, Qerenfil Ehmedova, Ruslan Abishov, Ravan Karimli, Emiliya Ahmadova, Fatmeyizahra Nabizade</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Individual meetings</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 180</i></p> <p><i>Contact hours (individual meetings): 36</i></p> <p><i>Private study including examination preparation, specified in hours: 144</i></p>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-
Module objectives/intended learning outcomes	<p>Course objectives:</p> <ul style="list-style-type: none"> • Develop professional competence in the design of manufacturing plants using appropriate science and chemical engineering tools in creative and innovative fashion. • Explain how to approach problems in a circumspect way, spending time allocating targets and identifying constraints, rather than rushing headlong into detailed action. • Demonstrate a capability to apply knowledge and understanding of essential facts to create manufacturing processes. • Demonstrate good time-planning skills and self-learning capacity with a view to improving their performance. <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Develop practical skills and active learning techniques through information/data gathering by literature surveys, personal communications, laboratory-based work, and development and/or use of computer software. • Develop transferable skills such as problem solving, communication, working with others, effective use of general IT facilities, and information retrieval. • Demonstrate an ability to produce small running HYSYS and Aspen Plus flow sheets, while appreciating the power and limitations of these tools.

	<ul style="list-style-type: none"> Show leadership skills in managing individual and group-based activities, balancing individual needs against group needs.
Content	<ol style="list-style-type: none"> Design a major item of a process. Explore a secondary topic. Submit an individual report that will be assessed for the degree. Make a contribution to a group report. Complete a poster submission.
Examination forms	Poster presentation – 15 % Interim group report – 10% Final group report – 75 %
Study and examination requirements	Attend and participate in regular meetings; provide a poster presentation; submit interim and final reports
Reading list	<ol style="list-style-type: none"> Chemical Engineering” Vol. 6, Chemical Engineering Design, Coulson, Richardson and Sinnott. Butterworth-Heinmann. Product and Process Design Principles: Synthesis, Analysis, and Evaluation”. Seider, Seader and Lewin. Wiley. Applied Process Design for Chemical and Petrochemical Plants” Vols. 1, 2, and 3. Ludwig. Perry’s Chemical Engineering Handbook, McGraw Hill. “Process Control: designing processes and control systems for dynamic performance”, Marlin. McGraw Hill.

Module designation	<i>CHE 548 Design project 2</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	<i>Rima Guliyeva, Azar Salimov, Qerenfil Ehmedova, Ruslan Abishov, Ravan Karimli, Emiliya Ahmadova, Fatmeyizahra Nabizade</i>
Language	<i>English</i>
Relation to curriculum	<i>Mandatory</i>
Teaching methods	<i>Individual meetings</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 180</i> <i>Contact hours (individual meetings): 36</i> <i>Private study including examination preparation, specified in hours: 144</i>
Credit points	<i>6</i>
Required and recommended prerequisites for joining the module	-

<p>Module objectives/intended learning outcomes</p>	<p>Course objectives:</p> <ul style="list-style-type: none"> • Develop professional competence in the design of manufacturing plants using appropriate science and chemical engineering tools in creative and innovative fashion. • Explain how to approach problems in a circumspect way, spending time allocating targets and identifying constraints, rather than rushing headlong into detailed action. • Demonstrate a capability to apply knowledge and understanding of essential facts to create manufacturing processes. • Demonstrate good time-planning skills and self-learning capacity with a view to improving their performance <p>Learning outcomes:</p> <ul style="list-style-type: none"> • Develop practical skills and active learning techniques through information/data gathering by literature surveys, personal communications, laboratory-based work, and development and/or use of computer software. • Develop transferable skills such as problem solving, communication, working with others, effective use of general IT facilities, and information retrieval. • Demonstrate an ability to produce small running HYSYS and Aspen Plus flowsheets, while appreciating the power and limitations of these tools. • Show leadership skills in managing individual and group-based activities, balancing individual needs against group needs.
<p>Content</p>	<p>Individual project focusing on application of fundamental chemical engineering principles to process. Design: mass, heat and energy transfer, control, safety, environment. Group based project dealing with the technical design of a process facility. Individual reporting on a technical aspect of the project. Utilisation of a range of solution methodologies (process simulation and mathematical modelling tools)</p>
<p>Examination forms</p>	<p>Presentation – 20 % Individual Technical Report – 70% Individual contribution as assessed by the Supervisor (organization and work, management, attendance, communication, involvement, discussions, engagement, effort, responsibility, etc.) – 10 %</p>
<p>Study and examination requirements</p>	<p>Attend and participate in regular meetings; provide a presentation; submit technical report</p>
<p>Reading list</p>	<ol style="list-style-type: none"> 1. Chemical Engineering” Vol. 6, Chemical Engineering Design, Coulson, Richardson and Sinnott. Butterworth-Heinmann. 2. Product and Process Design Principles: Synthesis, Analysis, and Evaluation”. Seider, Seader and Lewin. Wiley. 3. Applied Process Design for Chemical and Petrochemical Plants” Vols. 1, 2, and 3. Ludwig. 4. Perry’s Chemical Engineering Handbook, McGraw Hill. 5. “Process Control: designing processes and control systems for dynamic performance”, Marlin. McGraw Hill.

Module designation	CHE 582 Oil and gas processing
Semester(s) in which the module is taught	10th semester, Spring
Person responsible for the module	Dr. Aysel Mammadova (Section A) Narmin Abdullazade (Section B)
Language	English
Relation to curriculum	Mandatory
Teaching methods	Individual meetings
Workload (incl. contact hours, self-study hours)	Total workload: 180 Contact hours (lecture, tutorial): 60 Private study including examination preparation, specified in hours: 120
Credit points	6
Required and recommended prerequisites for joining the module	-

Module objectives/intended learning outcomes

Course objectives:

Oil and gas processing course consist of section A and B:

- To teach students so that they will be able to integrate key science and engineering principles to address the technological challenges of the petroleum and natural gas industry.
- To discuss the nature of gas hydrates and explain the necessary conditions for their formation.
- To list and discuss the methods used to remove gas hydrate blockages and the various ways of inhibiting hydrate formation.
- To describe and explain the different types of scale deposits that can occur during oil and gas production.
- To explain how scale formation is prevented, removed and inhibited in oilfield processing equipment.
- To describe the nature of wax and their chemical structures
- List and describe the available methods for wax control and removal.
- Describe the link between emulsions and asphaltenes and the methods of emulsifying and de-emulsifying.
- Search for chemicals suitable for removal of asphaltene deposits.
- To describe and identify the issues surrounding the behavior of hydrocarbon oil and gas in the Reservoirs
- To discuss the background into operations that affect the production oil and gas
- To describe typical issues that affect operation of systems and treatment facilities used in the oil and gas industry
- To perform technical level preliminary design calculations for a range of key unit operations
- To build background for the student's further studying special disciplines on chemical engineering.

Learning outcomes:

- What are gas hydrates; Methods of their prediction and mitigation
- What are scales; How scale formation is prevented, removed and inhibited
- What are waxes; Wax deposition mechanisms and control
- What are asphaltenes; Characteristics of asphaltenes
- The various ways that oil and gas accumulations can form into underground reservoirs.
- Water injection and gas injection systems and identify the best offshore pressure maintenance approach.
- Draw block diagrams and explain gas treatment, oil treatment and produced water treatment surface facilities.
- Provide an overview of three-phase separator operation and how to select the number of stages and their operating conditions.
- Outline surface crude oil/gas/produced water surface treatment facilities typically needed for offshore installations.
- Design and solve calculations involving gravity two-phase and three-phase separators.
- Overview history of offshore surface treatment and the development of Floating

Content	<ol style="list-style-type: none"> 1. Gas hydrates 2. Oilfield scale 3. Wax deposition 4. Asphaltenes
Examination forms	<p>Section A:</p> <p>Quiz – 10 %</p> <p>Final written exam – 30 %</p> <p>Section B:</p> <p>2 Quiz – 10 %</p> <p>Final written exam – 50 %</p>
Study and examination requirements	Attend and participate in regular meetings; provide a poster presentation; submit interim and final reports
Reading list	<ol style="list-style-type: none"> 1. Sloan, E. D., "Clathrate Hydrates of Natural Gases", 3rd ed., Marcel Dekker Inc., New York, (2008). 2. Breen, P.J. and Downs, H.H.: "The Use of Adsorption Thermodynamics in the Development of Scale Inhibitors for High Barium Content Oilfield Brines", Royal Society of Chemistry Publication - Chemicals in the Oil Industry: Developments and Applications, Edited by P.H Ogden, 1991. 3. Cowan, J. C. and Weintritt, D. J.: "Water Formed Scale Deposits" Gulf Publishing Company. Texas., 1976. 4. L.P. Dake, Fundamentals of Reservoir Engineering, Elsevier. 1978 5. L.P. Dake, The Practice of Reservoir Engineering, Elsevier. 1994. 6. Arnold, K. and Stewart, M. Surface Production Operations, Volume 1: Design of Oil Handling Systems and Facilities, 2nd Edition, Gulf Publishing Company, Houston, Texas, USA, 1998. 7. Coulson & Richardson's Chemical Engineering, Volume 2: Particle Technology and Separation Processes, 4th Edition, Butterworth Heinemann, 1999. 8. Maddox, R. N. and Morgan, J. Gas Conditioning and Processing, Volume 4: Gas Treating and Sulfur Recovery, 4th Edition, Campbell Petroleum Series, Oklahoma, USA, 1998, et al. (full list is given in the course notes)

Module designation	<i>CHE 599 – Graduation work</i>
Semester(s) in which the module is taught	<i>Year 5, Spring semester (Semester 10)</i>
Person responsible for the module	Supervisors of Chemical Engineering Department
Language	<i>English</i>
Relation to curriculum	<i>Compulsory</i>

Teaching methods	<ul style="list-style-type: none"> - <i>Supervised individual or team project work</i> - <i>Weekly or bi-weekly progress meetings with supervisor</i> - <i>Independent research, design, and implementation</i>
Workload (incl. contact hours, self- study hours)	<p><i>Total workload: 300 h = 300 h extracurricular hours</i></p> <p>Classroom hours:</p> <p>-</p> <p>Contact hours:</p> <p><i>Project preparation, consultation, self-study = 25 h/ week</i></p>
Credit points	<i>10 ECTS</i>
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> • <i>Completion of all core Chemical Engineering courses</i>
Module objectives/intended learning outcomes	<p><i>Course objectives:</i></p> <p><i>Develop professional competence in the design of manufacturing plants using appropriate science and chemical engineering tools in creative and innovative fashion.</i></p> <p><i>Explain how to approach problems in a circumspect way, spending time allocating targets and identifying constraints, rather than rushing headlong into detailed action.</i></p> <p><i>Demonstrate a capability to apply knowledge and understanding of essential facts to create manufacturing processes.</i></p> <p><i>Demonstrate good time-planning skills and self-learning capacity with a view to improving their performance</i></p> <p><i>Learning outcomes:</i></p> <p><i>Develop practical skills and active learning techniques through information/data gathering by literature surveys, personal communications, laboratory-based work, and development and/or use of computer software.</i></p> <p><i>Develop transferable skills such as problem solving, communication, working with others, effective use of general IT facilities, and information retrieval.</i></p> <p><i>Demonstrate an ability to produce small running HYSYS and Aspen Plus flowsheets, while appreciating the power and limitations of these tools.</i></p> <p><i>Show leadership skills in managing individual and group-based activities, balancing individual needs against group needs.</i></p>

ELECTIVE COURSES – BLOCK 1

Module designation	<i>CHE 342 Introduction to electrochemistry and corrosion</i>
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Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture): 24 Private study including examination preparation, quizzes hours: 96</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> • Principles of Chemistry • Chemical Thermodynamics • Mathematics for Engineers
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with fundamental knowledge of electrochemical principles and their relevance to corrosion phenomena. It introduces key corrosion mechanisms, influencing factors, and electrochemical methods used to analyze material degradation. The course also seeks to develop students' ability to assess corrosion behavior and apply appropriate prevention and control strategies. Overall, it equips students with the foundational understanding needed to address corrosion challenges in engineering systems.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain basic electrochemical concepts and describe major corrosion mechanisms. They will gain the ability to apply electrochemical techniques, interpret corrosion data, and evaluate material performance under various conditions. Students will also be capable of proposing suitable corrosion mitigation strategies for engineering applications. Additionally, they will develop the competence to communicate technical findings and make informed decisions using electrochemical principles.</p>

Content	<ol style="list-style-type: none"> 1. Fundamentals of Electrochemistry: Electrode potentials, Nernst equation, electrochemical cells, and thermodynamics of electrochemical reactions. 2. Electrochemical Kinetics: Reaction rates, overpotentials, Butler–Volmer equation, and factors affecting electrochemical processes. 3. Corrosion Science: Classification of corrosion types (uniform, galvanic, pitting, crevice, intergranular, SCC) and mechanisms behind material degradation. 4. Environmental and Material Factors: Influence of temperature, pH, oxygen content, alloy composition, and microstructure on corrosion behavior. 5. Electrochemical Methods in Corrosion Analysis: Polarization techniques, electrochemical impedance spectroscopy (EIS), corrosion rate determination, and data interpretation. 6. Corrosion Prevention and Control: Coatings, inhibitors, material selection, cathodic and anodic protection, and design principles to minimize corrosion.
Examination forms	<p>3 Quiz – 30 %</p> <p>Written Exam – 70 %</p>
Study and examination requirements	Attend and participate in lectures, complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Bard, A. J., & Faulkner, L. R. – Electrochemical Methods: Fundamentals and Applications. 2. Jones, D. A. – Principles and Prevention of Corrosion. 3. Schwartz, M. – Principles of Electrochemistry.

Module designation	<i>CHE 352 Chemical technologies</i>
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	-----

Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture): 24</i> <i>Private study including examination preparation, quizzes hours: 96</i>
Credit points	4
Required and recommended prerequisites for joining the module	<ul style="list-style-type: none"> • Principles of Chemistry • Chemical Thermodynamics •
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to introduce students to the fundamental principles, processes, and industrial applications of modern chemical technologies. It provides an overview of key chemical production routes, process flows, and the transformation of raw materials into valuable chemical products. The course also equips students with an understanding of operational parameters, safety considerations, and sustainability aspects in chemical technology. Overall, it prepares students to analyze, evaluate, and optimize chemical processes within industrial environments.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain major chemical production processes and their technological foundations. They will gain the ability to interpret process flow diagrams, evaluate process parameters, and assess the efficiency and sustainability of chemical operations. Students will also be capable of identifying key challenges in chemical manufacturing and proposing improvement approaches. Additionally, they will develop the competence to communicate technological analyses and apply chemical engineering principles in industrial process contexts.</p>
Content	<ol style="list-style-type: none"> 1. Overview of Chemical Industries: Classification of chemical sectors, raw materials, industrial feedstocks, and the role of chemical technologies in modern industry. 2. Fundamental Chemical Production Processes: Unit operations and unit processes, reaction pathways, and technological principles behind large-scale chemical synthesis. 3. Process Flow Diagrams and Technological Schemes: Interpretation of block diagrams, PFDs, and typical flowsheets used in chemical manufacturing. 4. Production Technologies of Key Chemicals: Technologies for producing petrochemicals, polymers, fertilizers, inorganic chemicals, and specialty chemicals. 5. Process Parameters, Operation, and Control: Reaction conditions, catalysts, energy integration, process optimization, and safety considerations in technological systems. 6. Sustainability and Innovation in Chemical Technologies: Green chemistry principles, waste minimization, energy efficiency, and emerging trends in chemical production

Examination forms	Quiz – 15 % Presentation-15% Witten Exam – 70 %
Study and examination requirements	Attend and participate in lectures; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Smith, R. – Chemical Process: Design and Integration. 2. Geankoplis, C. J. – Transport Processes and Separation Process Principles. 3. Austin, G. T., & Shreve, R. N. – Shreve’s Chemical Process Industries.

Module designation	<i>CHE 372 Environmental chemistry and technology</i>
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture): 24</i> <i>Private study including examination preparation, quizzes hours: 96</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	

<p>Module objectives/intended learning outcomes</p>	<p>Course Objectives: This course aims to provide students with foundational knowledge of chemical processes affecting the environment and the technologies used to monitor, control, and remediate environmental pollution. It introduces principles of environmental chemistry, including the behavior of pollutants in air, water, and soil, as well as the impact of human activities on ecosystems. The course also emphasizes analytical techniques, treatment methods, and sustainable practices for mitigating environmental hazards. Overall, it equips students with the skills to evaluate environmental problems and apply technological solutions in industrial and societal contexts.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the chemical principles governing environmental processes and pollutant behavior. They will gain the ability to assess and monitor environmental pollution using analytical and technological methods. Students will also be capable of proposing appropriate treatment, remediation, and pollution prevention strategies for air, water, and soil systems. Additionally, they will develop the competence to communicate technical findings and integrate environmental considerations into engineering and industrial decision-making.</p>
<p>Content</p>	<ol style="list-style-type: none"> 1. Fundamentals of Environmental Chemistry: Chemical composition of air, water, and soil; chemical cycles and interactions in natural systems. 2. Pollutant Types and Sources: Organic and inorganic pollutants, heavy metals, pesticides, and emerging contaminants. 3. Environmental Processes and Fate of Pollutants: Transport, transformation, and bioaccumulation in ecosystems. 4. Analytical Techniques in Environmental Chemistry: Sampling, spectroscopic, chromatographic, and electrochemical methods for pollutant detection. 5. Environmental Treatment Technologies: Water and wastewater treatment, air pollution control, soil remediation, and solid waste management. 6. Sustainability and Environmental Protection: Pollution prevention, green chemistry approaches, regulatory frameworks, and risk assessment.
<p>Examination forms</p>	<p>Quiz – 15 % Presentation-15% Written Exam – 70 %</p>
<p>Study and examination requirements</p>	<p>Attend and participate in lectures; complete quizzes; pass written exam;</p>
<p>Reading list</p>	<ol style="list-style-type: none"> 1. Manahan, S. E. – Environmental Chemistry. 2. Metcalf & Eddy – Wastewater Engineering: Treatment and Resource Recovery. 3. Reckhow, K. H. – Environmental Chemical Processes.

Module designation	<i>CHE 382 Sustainable business and entrepreneurship</i>
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture): 24 Private study including examination preparation, quizzes hours: 96</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	<i>Basic Economics and Business Principles; Introduction to Management; General Awareness of Sustainability Issues</i>

<p>Module objectives/intended learning outcomes</p>	<p>Course Objectives: This course aims to introduce students to the principles of sustainable business practices and the entrepreneurial mindset required to create innovative, environmentally and socially responsible ventures. It explores the integration of sustainability into business strategy, operations, and value creation. The course also provides students with tools to identify market opportunities, develop business models, and assess the economic, social, and environmental impact of business decisions. Overall, it equips students with the knowledge and skills to develop sustainable business solutions and launch entrepreneurial initiatives.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the concepts of sustainability and their application in business and entrepreneurship. They will gain the ability to identify opportunities for sustainable ventures and design business models that balance economic, social, and environmental considerations. Students will also be capable of evaluating the impact of business strategies on stakeholders and implementing sustainable practices within organizational contexts. Additionally, they will develop the competence to communicate business ideas effectively and make informed entrepreneurial decisions.</p>
<p>Content</p>	<ol style="list-style-type: none"> 1. Introduction to Sustainability in Business: Principles of sustainable development, corporate social responsibility (CSR), and triple bottom line approach. 2. Entrepreneurship Fundamentals: Entrepreneurial mindset, opportunity recognition, innovation, and business model development. 3. Sustainable Business Models: Circular economy, green business models, and integrating environmental and social values into strategy. 4. Financial and Strategic Planning for Sustainable Ventures: Funding, investment evaluation, risk assessment, and performance metrics. 5. Marketing, Operations, and Supply Chain Sustainability: Sustainable product design, responsible sourcing, and eco-friendly operations. 6. Case Studies and Emerging Trends: Successful sustainable businesses, social entrepreneurship, and global trends in sustainable innovation.
<p>Examination forms</p>	<p>Quiz – 15 % Presentation-15% Written Exam – 70 %</p>
<p>Study and examination requirements</p>	<p>Attend and participate in lectures; complete quizzes; pass written exam;</p>
<p>Reading list</p>	<ol style="list-style-type: none"> 1. Elkington, J. – Cannibals with Forks: The Triple Bottom Line of 21st Century Business. 2. Osterwalder, A., & Pigneur, Y. – Business Model Generation. 3. Schaltegger, S., Hansen, E. G., & Lüdeke-Freund, F. – Sustainable Entrepreneurship and Business.

Module designation	<i>CHE 312 Zero waste circular economy</i>
Semester(s) in which the module is taught	<i>6th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture): 24 Private study including examination preparation, quizzes hours: 96</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	<i>General Chemistry and Materials Science; Fundamentals of Economics and Business; Analytical and Problem-Solving Skills</i>

<p>Module objectives/intended learning outcomes</p>	<p>Course Objectives: This course aims to introduce students to the concepts and principles of zero waste and circular economy, emphasizing sustainable resource management and waste minimization. It explores strategies for designing products, processes, and systems that reduce environmental impact while promoting economic and social value. The course also provides students with practical tools for implementing circular solutions across industries and communities. Overall, it equips students with the knowledge and skills to contribute to a sustainable, circular economy through innovative practices and responsible decision-making.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the key concepts of zero waste and circular economy and their relevance to sustainability. They will gain the ability to analyze resource flows, identify waste reduction opportunities, and design circular solutions for products and processes. Students will also be capable of evaluating the environmental, social, and economic impacts of circular strategies. Additionally, they will develop the competence to propose and implement sustainable solutions that foster a closed-loop, resource-efficient economy.</p>
<p>Content</p>	<ol style="list-style-type: none"> 1. Introduction to Zero Waste and Circular Economy: Definitions, principles, and global relevance for sustainability. 2. Material and Resource Flows: Lifecycle thinking, resource efficiency, and product lifecycle assessment. 3. Design for Circularity: Eco-design, sustainable materials, and strategies to minimize waste in production and consumption. 4. Waste Management Strategies: Reduction, reuse, recycling, recovery, and industrial symbiosis approaches.
<p>Examination forms</p>	<p>Quiz – 15 % Presentation-15% Written Exam – 70 %</p>
<p>Study and examination requirements</p>	<p>Attend and participate in lectures; complete quizzes; pass written exam;</p>
<p>Reading list</p>	<ol style="list-style-type: none"> 1. Murray, A., Skene, K., & Haynes, K. – The Circular Economy: An Interdisciplinary Exploration of the Concept and Application. 2. Stahel, W. R. – The Circular Economy: A User’s Guide. 3. Lacy, P., Long, J., & Spindler, W. – The Circular Economy Handbook: Realizing the Circular Advantage.

ELECTIVE COURSES – BLOCK 2

Module designation	<i>CHE 502 Nanotechnology</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture- 24; seminar-12): 36 Private study including examination preparation, quizzes hours: 84</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	<i>General Chemistry and Materials Science; Physics</i>

<p>Module objectives/intended learning outcomes</p>	<p>Course Objectives: This course aims to introduce students to the fundamental principles and applications of nanotechnology across various scientific and engineering fields. It covers the structure, properties, and behavior of materials at the nanoscale, as well as techniques for characterization and manipulation of nanomaterials. The course also explores emerging nanotechnologies in areas such as energy, environment, medicine, and materials engineering. Overall, it equips students with the knowledge and skills to understand, design, and evaluate nanoscale systems and their technological applications.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the unique properties of nanomaterials and the physical, chemical, and biological principles underlying their behavior. They will gain the ability to apply nanofabrication and characterization techniques to analyze nanoscale materials and devices. Students will also be capable of evaluating the potential applications and risks associated with nanotechnology in various industries. Additionally, they will develop the competence to integrate nanotechnological solutions into research and engineering projects responsibly and innovatively.</p>
<p>Content</p>	<ol style="list-style-type: none"> 1. Introduction to Nanotechnology: Definitions, historical development, nanoscale phenomena, and interdisciplinary relevance. 2. Structure and Properties of Nanomaterials: Size-dependent physical, chemical, optical, and mechanical properties. 3. Nanofabrication Techniques: Top-down and bottom-up approaches, self-assembly, lithography, and chemical synthesis. 4. Characterization Methods: Microscopy (SEM, TEM, AFM), spectroscopy, X-ray techniques, and surface analysis. 5. Applications of Nanotechnology: Energy, electronics, medicine, environmental remediation, and advanced materials. 6. Safety, Ethics, and Emerging Trends: Nanotoxicology, environmental impact, regulation, and future directions in nanoscience.
<p>Examination forms</p>	<p>Quiz – 30%</p> <p>Written Exam – 70 %</p>
<p>Study and examination requirements</p>	<p>Attend and participate in lectures; complete quizzes; pass written exam;</p>
<p>Reading list</p>	<ol style="list-style-type: none"> 1. Cao, G. – Nanostructures & Nanomaterials: Synthesis, Properties & Applications. 2. Kelsall, R. W., Hamley, I. W., & Geoghegan, M. – Nanoscale Science and Technology. 3. Bhushan, B. – Springer Handbook of Nanotechnology.

Module designation	<i>CHE 504 Fundamentals of industrial waste management</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture- 24; seminar-12): 36 Private study including examination preparation, quizzes hours: 84</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	Environmental Science Basics; Fundamentals of Engineering
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with foundational knowledge of industrial waste generation, characterization, and management strategies. It explores the environmental, economic, and regulatory aspects of waste treatment and disposal, emphasizing sustainable practices. The course also introduces technologies and methods for minimizing, recycling, and safely treating industrial waste streams. Overall, it equips students with the skills to analyze industrial waste problems and implement effective, environmentally responsible solutions.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the sources, types, and characteristics of industrial waste. They will gain the ability to assess environmental impacts and select appropriate waste treatment and disposal methods. Students will also be capable of designing strategies for waste minimization, recycling, and resource recovery. Additionally, they will develop the competence to apply regulatory and sustainability principles in managing industrial waste in industrial and research settings.</p>

Content	<ol style="list-style-type: none"> 1. Introduction to Industrial Waste: Types, sources, and composition of industrial waste in different sectors. 2. Environmental and Health Impacts: Effects of industrial waste on air, water, soil, and human health. 3. Waste Characterization and Quantification: Sampling, physical, chemical, and biological analysis of waste streams. 4. Waste Treatment Technologies: Physical, chemical, and biological treatment methods for solid, liquid, and gaseous wastes. 5. Waste Minimization and Recycling: Resource recovery, material reuse, industrial symbiosis, and zero-waste strategies. 6. Regulations, Standards, and Sustainability:
Examination forms	<p>Quiz – 30%</p> <p>Written Exam – 70 %</p>
Study and examination requirements	Attend and participate in lectures; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Bhide, A. D., & Bhide, S. V. – Industrial Waste Management: Theory and Practices. 2. Kerry, A., & Drew, G. – Industrial Waste Treatment Handbook.

Module designation	<i>CHE 522 Petrochemical processes and technology</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>

Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture- 24; seminar-12): 36</i> <i>Private study including examination preparation, quizzes hours: 84</i>
Credit points	4
Required and recommended prerequisites for joining the module	Principles of Chemistry 1 and 2; Introduction to Chemical Engineering
Module objectives/intended learning outcomes	<p>Course Objectives: To provide students with a comprehensive understanding of the industrial processes and technologies involved in the production of key petrochemical products derived from oil and natural gas. The course emphasizes the principles of process design, reaction mechanisms, and technological developments in the petrochemical industry. To introduce the major petrochemical building blocks (ethylene, propylene, benzene, toluene, xylene, etc.) and their industrial production pathways. To analyze key conversion processes such as steam cracking, catalytic reforming, alkylation, and polymerization. To explore downstream product manufacturing including plastics, synthetic fibers, and resins.</p> <p>Learning outcomes: Identify and explain the primary feedstocks and petrochemical building blocks used in the industry. Describe and compare major industrial processes such as steam cracking, catalytic reforming, aromatic extraction, alkylation, and polymerization. Analyze reaction pathways and mechanisms involved in the transformation of hydrocarbons into petrochemical products. Interpret process flow diagrams (PFDs) and identify the key equipment units used in petrochemical plants. Evaluate the operating conditions, yields, and selectivity of various petrochemical processes. Discuss the production routes for common petrochemical products such as ethylene, propylene, styrene, polyethylene, polypropylene, and BTX aromatics. Assess economic, safety, and environmental aspects of petrochemical technologies. Explore emerging trends in the petrochemical industry, such as bio-based feedstocks, carbon capture, and process intensification.</p>

Content	<ol style="list-style-type: none"> 1. Introduction to Petrochemical Industry 2. Unit operations in petrochemical processes 3. Ethylene Production 4. Low-Density Polyethylene (LDPE) Production 5. High-Density Polyethylene (HDPE) Production 6. Polypropylene Production 7. Methanol Production 8. Urea Production 9. Four Major Petrochemical Processes 10. Future Trends and Sustainability in Petrochemicals
Examination forms	<p>Quiz – 30%</p> <p>Presentation – 20%</p> <p>Written Exam – 50 %</p>
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. "Petrochemical Processes" – F. B. Petlyuk 2. "Handbook of Petrochemicals Production Processes" – Robert A. Meyers 3. "Petrochemical Process Technology" – I. D. Mall 4. "Unit Operations of Chemical Engineering" – Warren L. McCabe, Julian C. Smith, Peter Harriott

Module designation	<i>CHE 510 Fundamentals of Bioprocess Engineering</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>

Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture- 24; seminar-12): 36</i> <i>Private study including examination preparation, quizzes hours: 84</i>
Credit points	4
Required and recommended prerequisites for joining the module	Fundamentals of Biology; Chemical Reaction Engineering; Chemical Thermodynamics
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to introduce students to the principles and practices of bioprocess engineering, focusing on the design, operation, and optimization of biological production systems. It covers the integration of biological, chemical, and engineering principles in the production of bioproducts such as enzymes, biofuels, and pharmaceuticals. The course also explores bioreactor design, microbial kinetics, and process scale-up. Overall, it equips students with the knowledge and skills to analyze, design, and optimize bioprocesses in industrial and research settings.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the fundamental concepts of bioprocess engineering, including microbial growth kinetics and mass transfer phenomena. They will gain the ability to design and analyze bioreactors and assess the performance of biological production systems. Students will also be capable of applying process control, scale-up, and optimization principles to bioprocesses. Additionally, they will develop the competence to integrate biological and engineering knowledge to solve practical problems in biotechnology and industrial fermentation.</p>
Content	<ol style="list-style-type: none"> 1. Introduction to Bioprocess Engineering: Overview of bioprocesses, industrial applications, and role of bioprocess engineers. 2. Microbial Growth and Kinetics: Growth models, substrate utilization, and product formation in microbial systems. 3. Bioreactor Design and Operation: Types of bioreactors, mixing, aeration, mass and heat transfer considerations. 4. Downstream Processing: Separation, purification, and recovery of biological products. 5. Process Control and Scale-Up
Examination forms	Quiz – 30% Written Exam – 70 %
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;

Reading list	<ol style="list-style-type: none"> 1. Shuler, M. L., & Kargi, F. – Bioprocess Engineering: Basic Concepts. 2. Doran, P. M. – Bioprocess Engineering Principles. 3. Bailey, J. E., & Ollis, D. F. – Biochemical Engineering Fundamentals.
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ELECTIVE COURSES – BLOCK 3

Module designation	<i>CHE 506 Green and sustainable chemical process engineering</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture- 24; seminar-12): 36</i> <i>Private study including examination preparation, quizzes hours: 84</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	Mathematics and Analytical Skills; Introduction to Chemical Engineering; Principles Of Chemistry

<p>Module objectives/intended learning outcomes</p>	<p>Course Objectives: This course aims to introduce students to the principles of green chemistry and sustainable chemical process engineering, emphasizing environmentally responsible design and operation of chemical processes. It covers strategies for minimizing waste, reducing energy consumption, and optimizing the use of renewable resources in chemical production. The course also explores process intensification, life cycle assessment, and sustainable process design tools. Overall, it equips students with the knowledge and skills to develop and implement chemical processes that are safe, efficient, and environmentally sustainable.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the core principles of green chemistry and sustainable process engineering. They will gain the ability to evaluate chemical processes for environmental impact, resource efficiency, and safety. Students will also be capable of designing and optimizing chemical processes using sustainable strategies, including process intensification and waste minimization. Additionally, they will develop the competence to integrate sustainability considerations into chemical engineering decision-making and industrial applications.</p>
<p>Content</p>	<ol style="list-style-type: none"> 1. Introduction to Green Chemistry and Sustainability: Principles, objectives, and relevance in chemical engineering. 2. Environmental Impact of Chemical Processes: Waste generation, energy consumption, and pollutant formation in industrial processes. 3. Sustainable Process Design: Process intensification, energy efficiency, renewable feedstocks, and eco-friendly solvents. 4. Life Cycle Assessment (LCA): Tools and methods for evaluating environmental impacts of chemical products and processes.
<p>Examination forms</p>	<p>Quiz – 30%</p> <p>Written Exam – 70 %</p>
<p>Study and examination requirements</p>	<p>Attend and participate in lectures, seminars; complete quizzes; pass written exam;</p>
<p>Reading list</p>	<ol style="list-style-type: none"> 1. Anastas, P. T., & Warner, J. C. – Green Chemistry: Theory and Practice. 2. Ferro, M., & Sheldon, R. A. – Green and Sustainable Chemical Engineering.

Module designation	<i>CHE 514 Catalysis and catalytic processes</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture- 24; seminar-12): 36 Private study including examination preparation, quizzes hours: 84</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	Introduction to Chemical Engineering; Principles of Chemistry; Materials Science
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with fundamental knowledge of catalysis, including the principles, mechanisms, and applications of catalytic processes in chemical industries. It covers the design and operation of catalytic reactors, the role of catalysts in enhancing reaction rates and selectivity, and the impact of reaction conditions on catalytic performance. The course also explores heterogeneous, homogeneous, and enzymatic catalysis, as well as emerging catalytic technologies. Overall, it equips students with the skills to analyze, design, and optimize catalytic processes for industrial and research applications.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the fundamental principles of catalysis and the mechanisms underlying catalytic reactions. They will gain the ability to evaluate catalytic performance and select appropriate catalysts for specific reactions. Students will also be capable of designing catalytic reactors and optimizing reaction conditions to achieve high efficiency and selectivity. Additionally, they will develop the competence to integrate catalytic solutions into chemical processes and to analyze their industrial and environmental implications.</p>

Content	<ol style="list-style-type: none"> 1. Introduction to Catalysis 2. Catalytic Reaction Mechanisms 3. Heterogeneous Catalysis 4. Homogeneous and Enzymatic Catalysis 5. Catalytic Reactor Design and Operation
Examination forms	<p>Quiz – 30%</p> <p>Written Exam – 70 %</p>
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Smith, J. M., & Van Ness, H. C. – Introduction to Chemical Engineering Thermodynamics 2. Ertl, G., Knözinger, H., Schüth, F., & Weitkamp, J. – Handbook of Heterogeneous Catalysis

Module designation	<i>CHE 516 Fundamentals of Biochemical Engineering</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120 Contact hours (lecture- 24; seminar-12): 36 Private study including examination preparation, quizzes hours: 84</i>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	Principles of Chemistry; Mathematics and Analytical Skills; Fundamentals of Biology
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with foundational knowledge of biochemical engineering, focusing on the integration of biological, chemical, and engineering principles in bioprocesses. It covers microbial growth, enzyme kinetics, bioreactor design, and downstream processing for the production of bioproducts such as pharmaceuticals, biofuels, and food ingredients. The course also emphasizes process scale-up, optimization, and sustainability considerations in biochemical production. Overall, it equips students with the skills to analyze, design, and optimize biochemical processes in industrial and research settings.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the fundamental principles of biochemical engineering, including microbial and enzymatic kinetics. They will gain the ability to design and analyze bioreactors and evaluate the performance of biochemical production systems. Students will also be capable of applying downstream processing, scale-up, and process optimization principles. Additionally, they will develop the competence to integrate biochemical engineering concepts into the development of sustainable and efficient bioprocesses.</p>
Content	<ol style="list-style-type: none"> 1. Introduction to Biochemical Engineering 2. Microbial and Enzyme Kinetics 3. Bioreactor Design and Operation 4. Downstream Processing
Examination forms	<p>Quiz – 30%</p> <p>Written Exam – 70 %</p>
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;

Reading list	<ol style="list-style-type: none"> 1. Doran, P. M. – Bioprocess Engineering Principles. 2. Shuler, M. L., & Kargi, F. – Bioprocess Engineering: Basic Concepts. 3. Bailey, J. E., & Ollis, D. F. – Biochemical Engineering Fundamentals.
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Module designation	<i>CHE 516 Fundamentals of Biochemical Engineering</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture- 24; seminar-12): 36</i> <i>Private study including examination preparation, quizzes hours: 84</i>
Credit points	4
Required and recommended prerequisites for joining the module	Principles of Chemistry; Mathematics and Analytical Skills; Fundamentals of Biology
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with foundational knowledge of biochemical engineering, focusing on the integration of biological, chemical, and engineering principles in bioprocesses. It covers microbial growth, enzyme kinetics, bioreactor design, and downstream processing for the production of bioproducts such as pharmaceuticals, biofuels, and food ingredients. The course also emphasizes process scale-up, optimization, and sustainability considerations in biochemical production. Overall, it equips students with the skills to analyze, design, and optimize biochemical processes in industrial and research settings.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the fundamental principles of biochemical engineering, including microbial and enzymatic kinetics. They will gain the ability to design and analyze bioreactors and evaluate the performance of biochemical production systems. Students will also be capable of applying downstream processing, scale-up, and process optimization principles. Additionally, they will develop the competence to integrate biochemical engineering concepts into the development of sustainable and efficient bioprocesses.</p>

Content	<p>1.Introduction to Biochemical Engineering</p> <p>2.Microbial and Enzyme Kinetics</p> <p>3.Bioreactor Design and Operation</p> <p>4.Downstream Processing</p>
Examination forms	<p>Quiz – 30%</p> <p>Witten Exam – 70 %</p>
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Doran, P. M. – Bioprocess Engineering Principles. 2. Shuler, M. L., & Kargi, F. – Bioprocess Engineering: Basic Concepts. 3. Bailey, J. E., & Ollis, D. F. – Biochemical Engineering Fundamentals.

Module designation	<i>CHE 516 Fundamentals of Biochemical Engineering</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<p><i>Total workload: 120</i></p> <p><i>Contact hours (lecture- 24; seminar-12): 36</i></p> <p><i>Private study including examination preparation, quizzes hours: 84</i></p>
Credit points	<i>4</i>
Required and recommended prerequisites for joining the module	Principles of Chemistry; Mathematics and Analytical Skills; Fundamentals of Biology

Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with foundational knowledge of biochemical engineering, focusing on the integration of biological, chemical, and engineering principles in bioprocesses. It covers microbial growth, enzyme kinetics, bioreactor design, and downstream processing for the production of bioproducts such as pharmaceuticals, biofuels, and food ingredients. The course also emphasizes process scale-up, optimization, and sustainability considerations in biochemical production. Overall, it equips students with the skills to analyze, design, and optimize biochemical processes in industrial and research settings.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to explain the fundamental principles of biochemical engineering, including microbial and enzymatic kinetics. They will gain the ability to design and analyze bioreactors and evaluate the performance of biochemical production systems. Students will also be capable of applying downstream processing, scale-up, and process optimization principles. Additionally, they will develop the competence to integrate biochemical engineering concepts into the development of sustainable and efficient bioprocesses.</p>
Content	<ol style="list-style-type: none"> 1. Introduction to Biochemical Engineering 2. Microbial and Enzyme Kinetics 3. Bioreactor Design and Operation 4. Downstream Processing
Examination forms	<p>Quiz – 30%</p> <p>Written Exam – 70 %</p>
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1) Doran, P. M. – Bioprocess Engineering Principles. 2) Shuler, M. L., & Kargi, F. – Bioprocess Engineering: Basic Concepts. 3) Bailey, J. E., & Ollis, D. F. – Biochemical Engineering Fundamentals.

Module designation	<i>CHE 518 Green chemical engineering</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>
Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>

Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture- 24; seminar-12): 36</i> <i>Private study including examination preparation, quizzes hours: 84</i>
Credit points	4
Required and recommended prerequisites for joining the module	Principles of Chemistry; Mathematics and Analytical Skills; Environmental Science Basics
Module objectives/intended learning outcomes	Course Objectives: This course aims to introduce students to the principles of green chemical engineering, focusing on designing chemical processes that minimize environmental impact while maximizing efficiency. It covers strategies such as green synthesis, energy-efficient operations, renewable feedstocks, and waste minimization. The course also explores life cycle assessment, sustainable process design, and emerging green technologies. Overall, it equips students with the knowledge and skills to develop chemical processes that are environmentally responsible, economically viable, and sustainable. Learning outcomes: Upon successful completion of the course, students will be able to explain the core concepts of green chemistry and green chemical engineering. They will gain the ability to evaluate chemical processes for sustainability, energy efficiency, and environmental impact. Students will also be capable of designing and optimizing chemical processes using green strategies and renewable resources. Additionally, they will develop the competence to integrate sustainability principles into industrial process design and decision-making.
Content	1. Introduction to Green Chemical Engineering 2. Sustainable Process Design 3. Green Synthesis and Catalysis 4. Waste Minimization and Pollution Prevention
Examination forms	Quiz – 30% Written Exam – 70 %
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;
Reading list	1. Anastas, P. T., & Warner, J. C. – Green Chemistry: Theory and Practice. 2. Ferro, M., & Sheldon, R. A. – Green and Sustainable Chemical Engineering. 3. Smith, R. – Chemical Process Design and Integration.

Module designation	<i>CHE 508 Energy generation and utilization</i>
Semester(s) in which the module is taught	<i>10th semester, Spring</i>

Person responsible for the module	-----
Language	<i>English</i>
Relation to curriculum	<i>Elective</i>
Teaching methods	<i>Lecture</i>
Workload (incl. contact hours, self-study hours)	<i>Total workload: 120</i> <i>Contact hours (lecture- 24; seminar-12): 36</i> <i>Private study including examination preparation, quizzes hours: 84</i>
Credit points	4
Required and recommended prerequisites for joining the module	Fundamentals of Thermodynamics; Physics
Module objectives/intended learning outcomes	<p>Course Objectives: This course aims to provide students with a thorough understanding of energy generation systems, focusing on vapor and gas power cycles, internal combustion engines, and refrigeration systems. It emphasizes the impact of operating conditions on thermal efficiency and introduces methods to enhance cycle performance. The course also covers deviations of actual cycles from idealized models and develops students' ability to apply the first and second laws of thermodynamics to optimize energy conversion systems. Overall, it equips students with the skills to analyze, evaluate, and improve the performance of thermal energy systems in practical applications.</p> <p>Learning outcomes: Upon successful completion of the course, students will be able to define and calculate performance measures for vapor, gas, and internal combustion cycles. They will understand the operation, advantages, and limitations of Carnot, Rankine, superheated Rankine, and reheated Rankine cycles, as well as open and closed feedwater preheaters. Students will be able to analyze gas turbine cycles, including Carnot and Joule cycles, and apply concepts such as intercooling, reheating, and recuperation to improve performance. Additionally, they will be capable of explaining the operation of Otto, Diesel, and mixed cycles, as well as vapor compression cycles and combined heat and power systems, using thermodynamic diagrams and performance metrics.</p>
Content	<ol style="list-style-type: none"> 1. Carnot Cycle 2. Rankine Cycle 3. Reheat Cycle 4. Regenerative Cycle 5. Joule Cycle; The Otto Cycle ; Mixed Cycle 6. Combined Heat and Power; Process Integration

Examination forms	Quiz – 10% Coursework-20% Witten Exam – 70 %
Study and examination requirements	Attend and participate in lectures, seminars; complete quizzes; pass written exam;
Reading list	<ol style="list-style-type: none"> 1. Rogers, G.F.C., Mayhew, Y.R., Engineering Thermodynamics Work and Heat Transfer, 4th. Ed., 1996, Pearson Education. 2. Eastop, T.D., McConkey, A., Applied Thermodynamics for Engineering Technologists, 5th. Ed., 1996, Prentice-Hall. 3. Sonntag, R.E., Borgnakke, C., Van Wylen, G.J., Fundamentals of Thermodynamics, 6th. Ed., 2002, Wiley. 4. Smith J.M, Van Ness,H.C, Introduction to Chemical Engineering Thermodynamics, McGraw Hill.