NAZARBAYEV UNIVERSITY
SCHOOL OF ENGINEERING

Department of Chemical and Materials Engineering

# Program Handbook

# BEng (Hons) Degree Program in Chemical and Materials Engineering

Academic year 2018-19

# BEng (Hons) Degree Program
# in Chemical and Materials Engineering

Full-time, Credit-based

**Program Handbook**

**(2018/19)**

Department of Chemical and Materials Engineering

# Bachelor of Engineering (Honours) Degree Program

# in

# Chemical and Materials Engineering

Full-time Credit-based

Program Booklet

2018/2019

## BEng(Hons) in CHEMICAL AND MATERIALS ENGINEERING (Full-Time)

Contents

*This Program Booklet is subject to review and changes which the Department can decide to make from time to time. Students will be informed*

Dear students,

On behalf of our Faculty and Staff, it is a pleasure and a privilege to welcome you to the Department of Chemical and Materials Engineering (ChME) at Nazarbayev University!

In particular, I wish to congratulate you for choosing to pursue the degree of Bachelor of Engineering (BEng) in ChME, an ambitious, demanding and challenging course of study. We are confident in our selection process and therefore in your own abilities to rise to the challenge. From our part, we promise that we will strive to deliver to you, in an effective and inspiring manner, a modern and interactive curriculum.

Chemical and Materials Engineering is the engineering discipline that makes extensive use of both chemical and physical transformations to achieve added value. Our profession relies on the concept of "scale-up", that is, the transition of a discovery (a new material, a new catalyst, a new molecule, a new physical phenomenon) from the laboratory to the production plant. In our times we are fortunate to be experiencing a literal explosion in new materials and new chemistries with applications in many and diverse fields, such as environmental protection and remediation, energy production and storage, hydrocarbon processing, plastics production and processing, foods, pharmaceuticals, biomedical devices and so many others. This has made Chemical Engineers Worldwide well sought after by employers and commanding top salaries; we are confident that your program of study in Chemical and Materials Engineering will make your future career prospects even brighter.

The BEng in ChME is a four-year degree program. The program is designed to provide skills and a detailed knowledge base at the undergraduate level for a career in advanced degree, industry or research, in Kazakhstan or abroad. The Program Handbook serves as a guide of the main elements and expectations of the program. I urge you to study it carefully and contact your faculty advisor. I also urge to take every opportunity to interact and get to know your Professors, their research groups and their laboratories. There is much for you to learn here; you only need to ask, try and challenge yourselves.

Once again, welcome to Nazarbayev University and the BEng-ChME program. Let’s work together to make your study here the most exciting and unforgettable period ever!

Sincerely,

Dr. Athanasios Papathanasiou

Head of the Department of Chemical and Materials Engineering

# 1. GENERAL INFORMATION

## 1.1 Cohort of Intakes and readership

This program handbook is the definitive program document for the 2018/19 cohort. Just in case any updated information is necessary after the publication of this handbook, students are requested to refer to the **https://seng.nu.edu.kz/** for the most updated information. Should there be any discrepancy between the contents of this handbook and Nazarbayev University (NU) regulations, University regulations always prevail.

## 1.2 Program Information

| | |
|---|---|
| **Title of Program** | **Bachelor of Engineering (Honors) in Chemical and Materials Engineering** |
| Host Department | Department of Chemical and Materials Engineering |
| Program Structure | Credit-based |
| Final Award | Bachelor of Engineering (Honors) in Chemical and Materials Engineering |
| Mode of Attendance | Full-time |
| Professional Recognition | The program has been designed based on the ABET accreditation requirements. |

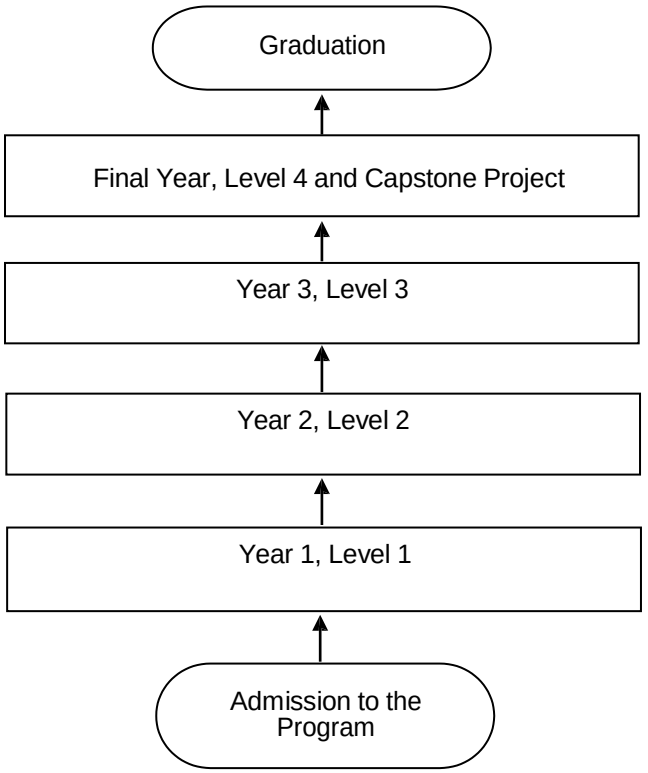
| | |
|---|---|
| Duration | Normal Year 1 Intake Full-time Mode:<br>4 years nominal, 5 years maximum |
| Total Credits for Graduation | **248** ECTS credits |

## 1.3 Modes of Study

A mode of study is characterized by the credits, courses required and the progression pattern in Year 1 to Year 4. Currently the program can only be pursued in the "Normal full-time" study mode.

Normal Full-time Mode

The students will normally pursue their study by going through Year 1, Year 2, Year 3 and Year 4 in full time and then graduate at the end of Year 4 after having satisfied all program requirements. Each year of study is split into discrete interlinked courses. The courses of earlier years can be pre-requisites to subsequent courses in later years. Some courses are common between programs.



## 2. RATIONALE, AIMS AND LEARNING OUTCOMES OF THE PROGRAM

### 2.1 Background and Rationale

The BEng program in CHME is designed to prepare students for diverse professional practice, such as:

1. Employment in local and international companies with various business profiles.
2. Self-employed entrepreneurs who can build and run their own companies.
3. Research careers in higher education institutions and research centers.
4. Government service at national and regional levels.

Data provided by the NU Career and Advising Center show that a total of 34% of the graduates of Bachelor in Chemical Engineering program pursued careers in industry, while 48% opted for graduate degrees. CHME is the engineering discipline, which makes extensive use of physico-chemical transformations, in addition to materials science, in order to achieve added value. Because all manufacturing processes involve physico-chemical transformations and processing of materials in one way or another, chemical and materials engineers are employed in virtually all manufacturing industries, from the basic chemical, materials, energy, food, pharmaceutical, biomedical and microelectronics industries to the myriad consumer products industries, as well as in petrochemical industry, which is particularly strong in Kazakhstan. The Chemical Engineering education enjoys a renaissance worldwide. In US and UK Chemical Engineering entries continuously reach ceiling numbers. The University of Manchester and Imperial College in UK, for instance, run courses at ceiling/top numbers (300 and 150 respectively) even though they have been raising entry level requirements constantly (e.g. Manchester started from 3B's 10 years ago currently to 3 A's). As better reported in US surveys, chemical engineering graduates manage to enjoy top salaries that are higher than those in computer science and/or other engineering disciplines. The field popularity is attributed to technologies for new materials, environmental and societal challenges - $CO_2$ valorization, use of waste as feedstock, circular economy, renewable energy sources (an area where NU faculty already take a leadership role), and the emergence of new chemistries to scale-up industrially (e.g., biomedical applications, industrial biotechnology etc.), scale-up being the very essence of the chemical engineer profession.

Kazakhstan is building up rapidly its physical and industrial infrastructure. While the oil and gas sectors have formed, and still form, the basis of its industrial development, downstream processing, including petrochemicals and minerals, is seen as the natural next phase in this process. Chemical and materials engineers play a central role in downstream processing. Many international companies have active operations in Kazakhstan, and it is anticipated that they will continue employing chemical and materials engineers. Other major sectors in the country are pharmaceutical products and foods,

which are potential industries for the employment of our graduates. Based on our records, recent graduates of the current chemical engineering program either pursue advanced degrees or enter into the relevant professions shortly after graduation. In addition, changes in the political, social, economic and educational systems in Kazakhstan since its independence from the Soviet Union have created the need for a new generation of entrepreneurs, technocrats and managers with a sound knowledge of modern management principles and engineering operations.

The Strategy 2050 for Kazakhstan specifically addresses educational vision in its item 4 as below:

***4. Knowledge and professional skills are key landmarks of the modern education, training and retraining system***

1. Our priorities in education:
    1) Developing engineering education system;
    2) Developing system of social responsibility in education;
    3) Modernization of teaching methods;
2. New innovative research development policy:
    1) Technology transfer;
    2) Cooperation of science and business;
    3) Roadmap of development prospective national clusters;
3. Appeal to the youth.

In order to achieve this vision, the development of advanced and novel higher education programs, which are designed based on leading scientific and pedagogical theories, is an essential prerequisite. The proposed program in CHME is designed to assist in this direction.

NU is afforded a unique position among Kazakhstan universities, being able to offer a high quality range of academic and research opportunities that apply traditional chemical and materials engineering principles and modern science to solve some of today's most pressing problems. For example, we are designing medical devices to improve human health, as well as energy storage and generation systems which can provide renewable energy in remote locations. We are using novel experimental methods and advanced scientific computing to understand nanoparticles, macromolecules, complex fluids and active surfaces. Understanding their behavior allows us to design new catalysts, polymers, electrodes and other highly specialized materials, which are all areas of high added value.

The Oil & Gas industry, especially its downstream operations, is naturally a high priority (and a top employer) of the program. As the chemical and petrochemical industries in Kazakhstan are in the early stages of developments, the program is designed so that it will be able to respond to the developing demands in those industries, specifically addressing fundamentals of chemical engineering and design, process safety, advanced scientific computing, energy markets, renewable energy sources etc. In addition,

Kazakhstan is still to attract new foreign and domestic investment in the field of high technology products including pharmaceuticals, specialty products, fine chemicals, etc. Therefore, the materials component of the proposed BEng program is expected to make a significant contribution in the growth of the nation.

The program is further guided by the growing global realization of the importance of environmental protection, sustainability and life-cycle analysis; thus offering several environmental courses (air, water and soil) mainly as electives as well as several environmental and energy-related research opportunities. Such courses help the students to understand issues of current importance, monitor them, and design processes to respond to such modern challenges.

In view of the infrastructural investments in Kazakhstan, there is no reason to suspect that engineering students will face a lack of open positions at graduate levels. Already, the School meets many visitors from industry expressing their interest in our MSc program and making presentations for our students. A further positive signal is the fact that a large number of internships, both domestic and international, are available for our students.

In summary, the proposed BEng program in CHME will:
1) Meet the demands for expertise in the petrochemical, energy, chemical, materials, pharmaceutical, healthcare and food industries taking also into account environmental protection and sustainability.
2) Enable interdisciplinary research in areas such as materials, biomedical, energy and environment, also involving other NU departments
3) Prepare students for further advanced studies as well as for careers in applied research.

## 2.2 Aims

The aims of the Program are:

The BEng program in CHME aims to provide the education and training that will enable its graduates to:

1. Excel in their chosen path in chemical or materials engineering or related fields, or through the pursuit of advanced technical or professional degrees.
2. Advance their profession through effective leadership, communication, teamwork, and through creative solution strategies to address global and societal issues.
3. Apply their engineering knowledge to contribute to the health, safety, environmental and economic well-being of their communities and corporations.
4. Be a responsible engineer/scientist, demonstrating ethical and professional responsibility, and seeking out continuing education, professional development and career advancement opportunities.

## 2.3 Relationship of Program Aims to University Mission

The mission of the University is: “To be a model for higher education reform and modern research in Kazakhstan and to contribute to the establishment of Astana as an international innovation and knowledge hub”.

The Program Aims are aligned to the University Mission.

## 2.4 University Graduate Attributes

It is NU’s educational mission to nurture competent professionals who are also critical thinkers, effective communicators, innovative problem solvers, lifelong learners, and ethical leaders. The university graduate attributes are as follows:

1) Possess an in-depth and sophisticated understanding of their domain of study;
2) Intellectually agile, curious, creative, and open-minded;
3) Thoughtful decision-makers who know to involve others;
4) Entrepreneurial, self-propelling and able to create new opportunities;
5) Fluent and nuanced communicators across languages and cultures;
6) Cultured and tolerant citizens of the world while being good citizens of their respective countries;
7) Possess high personal integrity; and
8) Prepared to take a leading role in the development of their country.

## 2.5 Learning Outcomes of the Program

On successful completion of the BEng (Hons) in Chemical and Materials Engineering program, students will be able to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.
3. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
4. Communicate effectively with a range of technical and public audiences to sell their ideas and products
5. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
6. Recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.
7. Function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.

## 2.6 Relationship of Program Learning Outcomes to Program Aims

| Program Learning Outcomes | Program Aims | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | x | | | |
| 2 | x | | x | x |
| 3 | x | | | |
| 4 | | x | x | x |
| 5 | | x | x | x |
| 6 | | x | | x |
| 7 | | x | | x |

## 2.7 Relationship of Program Learning Outcomes to University Graduate Attributes

| NU graduate attributes | **Program Learning Outcomes** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1. Possess an in-depth and sophisticated understanding of their domain of study | x | x | x | | | | |
| 2. Be intellectually agile, curious, creative and open-minded | | | | | | x | |
| 3. Be thoughtful decision makers who know how to involve others | | x | | | | | |
| 4. Be entrepreneurial. Self-propelling and able to create new opportunities | | x | | | | x | |
| 5. Be fluent and nuanced communicator across languages and cultures | | | | x | | | x |
| 6. Be cultured and tolerant citizen of the world | | | | x | | | x |
| 7. Demonstrate personal integrity | | | x | | x | | |
| 8. Be prepared to take a leading role in the development of their country | | | | | x | | x |

## 3. ADMISSION REQUIREMENTS

### 3.1 Progression from the NU Foundation Year Program (NUFYP)

Upon completion of the NUFYP, students may be eligible to continue their studies in one of the undergraduate programs at the School of Engineering. Any student who is progressed and then decides not to attend NU Undergraduate (UG) program must notify the university as quickly as possible by submitting a completed withdrawal form. NUFYP student who do not submit the withdrawal form will be automatically dismissed after a certain period.

**Unconditional progression**: Those students who satisfy the requirements for unconditional progression as described in the Criteria below are automatically eligible for progression subject to the availability of space in the program. Progression decisions are recommended by the School's Progression Committee.

UNCONDITIONAL PROGRESSION REQUIREMENTS

| | Abbreviations | Course Title | Score |
|---|---|---|---|
| | FMAT 020<br>FMAT 030<br>FMAT 040 | Foundation Statistics<br>Foundation Mathematics for Life Science (Biology & Chemistry)<br>Foundation Mathematics for Physical Science | 70 |
| **AND** | FEAP 020 | Foundation English for Academic Purposes 2 | 65 |
| **OR** | FHUM 030<br>FSCI 030<br>FPHY 030 | Foundation of Humanities & Social Sciences 2<br>Essential Biology & Chemistry 2<br>Foundation 'Physics' | 65 |

**GPA conditional progression:** Students who do not meet the requirements for unconditional progression may be progressed on a GPA conditional basis as explained below:

1) A student, whose NUFYP subject scores do not meet the minimum unconditional progression criteria but meet the criteria for conditional progression (see table on Conditional Progression GPA), may be recommended to progress on a GPA conditional basis at the discretion of the School Progression Committee;
2) Student progressed as a GPA Conditional basis must achieve a minimum GPA of 2.00 at the end of his or her first semester of undergraduate study or the student is subject to dismissal;

CONDITIONAL PROGRESSION (GPA)

| | Abbreviations | Course Title | Score |
|---|---|---|---|
| | FMAT 020 | Foundation Statistics | |
| | FMAT 030 | Foundation Mathematics for Life Science (Biology & Chemistry) | |
| | FMAT 040 | Foundation Mathematics for Physical Science | 60 |
| **AND** | FEAP 020 | Foundation English for Academic Purposes 2 | 65 |
| | FHUM 030 | Foundation of Humanities & Social Sciences 2 | |
| **OR** | FSCI 030 | Essential Biology & Chemistry 2 | |
| | FPHY 030 | Foundation 'Physics' | 60 |

As some majors are in more demand than others, the Schools have the right to limit their progression decisions based on the capacity of any individual program. Non-progressed students will be processed in accordance with University internal regulations on dismissal and withdrawal.

3.2 Direct Entry Admission Requirements

3.2.1 Admission to the undergraduate program is based on selection process

3.2.2 One of the following categories of applicants may participate in the selection process:

a) Secondary school graduates with certificate or its foreign equivalent or certificates/diploma on completion of a college or IB Diploma Program, A-level, UK Foundation Program or NIS Grade 12 Certificate;

b) Students of the final year of secondary school or its foreign equivalent, or final year college or IB Diploma Program or UK Foundation Program or NIS Grade 12 Certificate students;

c) Applicants who completed at least one academic year of an undergraduate program at a university with CGPA not less than 3.0 out of 4.0. They shall be considered for admission to the first or second year of the undergraduate program as transfer students. Transfer credits are identified by Admission committee on the basis of detailed course descriptions in accordance with the Academic Policies and Procedures for Undergraduate Schools of NU and internal rules of individual schools. The maximum number of transferable credit hours shall be 60 ECTS. No grades will be assigned to transfer courses, only credits. The grades received at the previous institution(s) will not be calculated into student's grade point average.

3.2.3 Applicants listed in 3.2.2 must meet the entry requirements with the exception of cases when:

a) An applicant is a winner/prize winner of the International Subject Olympiads awarded by gold, silver and bronze medals for the last three years. In order to participate in selection competition these candidates must submit the results of IELTS or TOEFL test and be interviewed by the Admission Committee.

The International Subject Olympiads include International Mathematics Olympiad – IMO; International Physics Olympiad – IPHO; International Chemistry Olympiad – IChO; International Biology Olympiad – IBO; International Olympiad in Informatics – IOI; International Zhautykov Olympiad in Mathematics, Physics and Informatics; and International Mendeleyev Chemistry Olympiad;

b) An applicant is a winner/prize winner of the awarded by gold and silver medals for the current academic year. In order to participate in selection competition these candidates must submit the results of IELTS or TOEFL test and be interviewed by the Admission Committee.

The Republican Olympiads include Republican Mathematics Olympiad; Republican Physics Olympiad; Republican Chemistry Olympiad; Republican Biology Olympiad; and Republican Informatics Olympiad;

c) Applicants who have successfully completed at least one academic year of an undergraduate program at a university with English language as an official language of instruction and included into the list of top 200 universities according to the Times Higher Education World University or QS World University ranking at the time of application. These candidates are exempt from submitting test reports on ACT/SAT Reasoning Test and SAT Subject test as well as IELTS/TOEFL;

d) Applicants who have been studying in English last three years at a secondary school in a country with English as an official language or in an institution with English as a primary language of instruction are exempted from submission of IELTS/TOEFL certificates.

3.2.4 The minimum requirements for graduates of secondary school (or its foreign equivalent), students of the final year of secondary school (or its foreign equivalent) and higher education institution's students are as follow:

| Minimum requirements for SAT Subject Test | Minimum requirements for IELTS and TOEFL | Minimum requirements for SAT Reasoning Test and ACT |
|---|---|---|
| SAT Subject Test – Math and Physics with at least 600 in each subject | IELTS – no less than 6.5 overall (with at least 6.0 in each sub-score) or<br>TOEFL iBT = 79-93 or<br>TOEFL PBT* = 574-599 | SAR reasoning Test – no less than 1240 (starting from March 2016). Essay is required, no minimum score<br>Or<br>ACT – composite score no less than 27. Writing part is required, no minimum score |

Note: *TOEFL PBT are admitted only from the international applicants from the countries where an official IELTS and TOEFL iBT are not available

3.2.5 The minimum requirements for graduates and current students of IB Diploma are as follow:

| Minimum requirements for IELTS and TOEFL | Minimum requirements for IB DP scores |
|---|---|
| IELTS – no less than 6.5 overall (with at least 6.0 in each sub-score) or<br>TOEFL iBT = 79-93 or TOEFL PBT* = 574-599 | Not less than 30 total score and 4, 4, 5 for 3 subjects of HL |

Note: *TOEFL PBT are admitted only from the international applicants from the countries where an official IELTS and TOEFL iBT are not available

3.2.6 The minimum requirements for scores for graduates and holders of NIS Grade 12 are as follow:

| Minimum requirements for IELTS and TOEFL | Minimum requirements for NIS Grade 12 Certificate scores |
|---|---|
| IELTS – no less than 6.5 overall (with at least 6.0 in each sub-score) or<br>TOEFL iBT = 79-93 or TOEFL PBT* = 574-599 | Not less than ABB |

Note: *TOEFL PBT are admitted only from the international applicants from the countries where an official IELTS and TOEFL iBT are not available

3.2.7 Internal Transfers between NU Schools:

After entering NU, students may discover that their initial choice of major does not correspond to their interests or intellectual abilities. Those students may seek to change their degree. NU supports these decisions by allowing internal transfers between undergraduate Schools.

Internal transfer students must bring along their educational transcripts to meet the Head of the Department which offers the program. An internal transfer student will only be accepted for transfer based on the decision of the Head of the Department which offers the program in the receiving School's. The course transfer information that details how previously completed courses will be assigned to the new degree plan must be determined if the applicant satisfies the transfer requirements. The internal transfer must be endorsed by the Dean of the receiving School. The transfer of student will become effective in the semester following approval of the application by the receiving School.

## 4. PROGRAM, COURSES, AND CREDITS

### 4.1 Program Specified Courses

Nazarbayev University has adopted the Bologna Accord and the School of Engineering therefore uses the European Credit Transfer System (ECTS). Most courses to be studied at Year 1, Year 2, Year 3 and Year 4 are of standard credit value carrying 6 ECTS each, except for some courses, such as Calculus 1, etc. which carry ECTS other than 6. A student is expected to spend about 25 to 30 hours of study per semester (inclusive of class contact and other study effort) for 1 ECTS. The following Table lists the subjects, their ECTS values, and the category they belong to (Compulsory, Optional, or Elective). All discipline-specific courses shown as compulsory are non-deferrable and must be taken in accordance to the progression pattern. The courses offered will be updated from time to time according to the need of society and the profession.

Students admitted to the program are required to complete a minimum of 248 or more ECTS to satisfy the degree requirements. However, they may choose to take additional courses beyond the basic requirements. Please refer to Section 24 for detailed information on the requirements for graduation.

| Course Code | Course Title | ECTS | Comments | Category of Courses |
|---|---|---|---|---|
| **A. Nazarbayev University Undergraduate Core Curriculum Requirements** | | | | |
| **Communicate fluently in the English Language** | | | | |
| SHSS150 | **Rhetoric and Composition** | 6 | | Compulsory |
| SHSS210 | **Technical Writing** | 6 | | Compulsory |
| **Demonstrate competence in the Kazakh Language** | | | | |
| Select 2 courses at appropriate level in Kazakh Language, Literature or Culture | | 12 | Based on diagnostic test | Compulsory |
| **Describe and interpret major events in Kazakh and Kazakhstani history** | | | | |
| HST100 | History of Kazakhstan | 6 | | Compulsory |
| **Demonstrate knowledge of the natural and social sciences** | | | | |
| ECON323 | Managerial Economics | 6 | | Compulsory |
| PHYS161 | Physics I for Scientists and Engineers | 8 | | Compulsory |
| **Apply numerical and digital literacy skills** | | | | |
| MATH161 | Calculus I | 8 | | Compulsory |
| ENG101 | Programming for Engineers | 6 | | Compulsory |
| **Apply skills in business, design and entrepreneurial thinking** | | | | |
| | Fundamentals of Entrepreneurship and Management | 6 | | Compulsory |
| **Use research skills and methods to complete projects** | | | | |
| ENG100 | Introduction to Engineering | 6 | | Compulsory |
| **Identify ethical and leadership issues and take appropriate leadership actions** | | | | |
| Select 1 among 3 SHSS offered courses on Ethics | | 6 | | Compulsory |

| Course Code | Course Title | ECTS | Comments | Category of Courses |
|---|---|---|---|---|
| **B. Common/shared Courses** | | | | |
| ENG103 | Engineering Materials II | 6 | | Compulsory |
| PHYS162 | Physics II for Scientists and Engineers | 6 | | Compulsory |
| MATH162 | Calculus 2 | 8 | | Compulsory |
| ENG200 | Differential Equations and Linear Algebra | 6 | | Compulsory |
| ENG201 | Applied Statistics | 6 | | Compulsory |
| ENG202 | Numerical Methods in Engineering | 6 | | Compulsory |
| ENG400 | Capstone project | 12 | | Compulsory |

| Course Code | Course Title | ECTS | Comments | Category of Courses |
|---|---|---|---|---|
| **C. Discipline-Specific Requirement** | | | | |
| CHME200 | Basic Principles and Calculations in Chemical | 6 | | Compulsory |
| CHME222 | Inorganic and Analytical Chemistry | 6 | | Compulsory |
| CHME203 | Organic and Polymer Chemistry | 6 | | Compulsory |
| CHME201 | Chemical Engineering Thermodynamics | 6 | | Compulsory |
| CHME202 | Fluid Mechanics | 6 | | Compulsory |
| CHME302 | Instrumental Methods of Analysis for Engineers | 6 | | Compulsory |
| CHME300 | Heat and Mass Transfer | 6 | | Compulsory |
| CHME301 | Applied Mathematics for Process Design | 6 | | Compulsory |
| CHME305 | Chemical Engineering Lab I | 6 | | Compulsory |
| CHME303 | Separation Processes | 6 | | Compulsory |
| CHME304 | Chemical Reaction Engineering | 6 | | Compulsory |
| CHME401 | Chemical Engineering Lab II | 6 | | Compulsory |
| CHME402 | Materials Chemistry | 6 | | Compulsory |
| CHME400 | Process Design and Simulation | 6 | | Compulsory |
| CHME403 | Chemical Process Control and Safety | 6 | | Compulsory |
| | | | | |
| | | | | |
| **D. Discipline-Specific Requirement (Research)** | | | | |
| ENG300 | Interdisciplinary Design Project | 6 | | Elective |
| ENG301 | Research Practice | 6 | | Elective |
| | | | | |

| Course Code | Course Title | ECTS | Comments | Category of Courses |
|---|---|---|---|---|
| **E. Discipline-Specific Requirement (Specialization areas and electives)** | | | | |
| **Specialization Area: Chemical Engineering** | | | | |
| CHME450 | Atmospheric Chemistry and Physics | 6 | | Elective |
| CHME351 | Environment and Development | 6 | | Elective |
| CHME352 | Process Design for Environmental Applications | 6 | | Elective |
| CHME451 | Advanced Process Simulation | 6 | | Elective |
| CHME452 | Industrial Wastewater Treatment and Reclamation | 6 | | Elective |
| CHME453 | Multiphase Systems | 6 | | Elective |
| CHME454 | Advanced Transport Phenomena | 6 | | Elective |
| CHME455 | Heterogeneous Reactor Engineering | 6 | | Elective |
| CHME456 | Colloids and Surface Science | 6 | | Elective |
| CHME457 | Advanced Chemical Process Safety and Risk Modeling | 6 | | Elective |
| **Specialization Area: Materials Engineering** | | | | |
| CHME353 | Electrochemical Engineering | 6 | | Elective |
| CHME458 | Corrosion Protection in Oil and Gas Industry | 6 | | Elective |
| CHME459 | Biomechanics | 6 | | Elective |
| CHME421 | Tissue Engineering | 6 | | Elective |
| CHME460 | Polymer Processing and Rheology | 6 | | Elective |
| CHME461 | Powder Technology | 6 | | Elective |

4.2 Kazakh Language Policy Requirements

Beginning students will be given the stage 1, diagnostic KAZTEST during student orientation. This test will be administered to students free of charge. Based on the results of their diagnostic KAZTEST, students will be placed either in the basic, intermediate or advanced Kazakh courses. Every student must pass a minimum of 12 ECTS (two 6 ECTS courses) in the NU UG Core Curriculum at the appropriate level in Kazakh Language, Literature or Culture before graduation.

## 5. NORMAL PROGRESSION PATTERN

A student must obtain at least a D grade to pass a course offered in SEng. Students will need to determine the passing grade for courses offer by other schools.

| **Year 1** | |
|---|---|
| **Semester 1 (34 ECTS)** | **Semester 2 (34 ECTS)** |
| HS100 History of Kazakhstan | Kazakh I |
| MATH 161 Calculus I with Labs | MATH 162 Calculus II with Labs |
| PHYS 161<br>Physics I for Scientists and Engineers with Labs | ENG 103 Engineering Materials II |
| ENG 101 Programming for Engineers | PHYS 162<br>Physics II for Scientists and Engineers with Labs |
| ENG 100 Introduction to Engineering | SHSS 150 Rhetoric & Composition |
| **Year 2** | |
| **Semester 1 (30 ECTS)** | **Semester 2 (30 ECTS)** |
| CHME 200 Basic Principles and Calculations in Chemical Engineering | Selection of one of the following three courses:<br>PHIL210 Ethics<br>PHIL211 Practical Ethics<br>PHIL 212 Ethical Reasoning |
| ENG 200<br>Differential Equations & Linear algebra | ENG 202<br>Numerical Methods in Engineering |
| CHME 222 Inorganic and Analytical Chemistry | ENG 201 Applied Statistics |
| CHME 201 Chemical Engineering Thermodynamics | CHME 202 Fluid Mechanics |
| SHSS 210 Technical Writing | CHME 203 Organic and Polymer Chemistry |
| **Year 3** | |
| **Semester 1 (30 ECTS)** | **Semester 2 (30 ECTS)** |
| Fundamentals of Entrepreneurship and Management | ECON 323 Managerial Economics |
| CHME 302 Instrumental Methods of Analysis for Engineers | CHME 303 Separation Processes |
| CHME 300 Heat and Mass Transfer | CHME 304 Chemical Reaction Engineering |
| CHME 301 Applied Mathematics for Process Design | CHME 305 Chemical Engineering Lab 1 |
| Elective 1 | ENG 301 Interdisciplinary Design Project (ENG 300 IDP) or Research Practice |
| **Year 4** | |
| **Semester 1 (30 ECTS)** | **Semester 2 (30 ECTS)** |
| ENG 400 Capstone Project | CHME 402 Materials Chemistry |
| CHME 400 Process Design and Simulation | CHME 403 Chemical Process Control and Safety |
| CHME 401 Chemical Engineering Lab 2 | ENG 400 Capstone Project |
| KAZ 264 – Language and Ethnicity | Elective 3 |
| Elective 2 | Elective 4 |

**Total Number of Credits: 248 ECTS**

Note 1: The study pattern for the courses is indicative only. Students may take these courses according to their own schedule. They are recommended to consult their Academic Advisor for guidance and planning if necessary.

## 6. CURRICULUM MAP

Alignment of Courses with Program Learning Outcomes:

| | **Program Learning Outcomes** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **A. NAZARBAYEV UNIVERSITY UNDERGRADUATE CORE CURRICULUM REQUIREMENTS[(1)]** | | | | | | | |
| **Communicate fluently in the English Language** | | | | | | | |
| English (2 Courses) | | | | X | | | X |
| **Demonstrate competence in the Kazakh Language** | | | | | | | |
| Kazakh (2 Courses) | | | | X | | | |
| **Describe and interpret major events in Kazakh and Kazakhstani history** | | | | | | | |
| HST 100 History of Kazakhstan | | | | X | X | X | |
| **Demonstrate knowledge of the natural and social sciences** | | | | | | | |
| Managerial Economics | | X | | | X | | X |
| PHYS161 Physics I for Scientists and Engineers | X | X | X | | | | |
| **Apply numerical and digital literacy skills** | | | | | | | |
| MATH161 Calculus I | X | | | | | X | |
| Programming for Engineers | X | X | | | | X | |
| **Apply skills in business, design and entrepreneurial thinking** | | | | | | | |
| Fundamentals of Entrepreneurship and Management | | | | X | X | X | X |
| **Use research skills and methods to complete projects** | | | | | | | |
| ENG100 Introduction to Engineering | X | X | X | X | X | X | X |
| **Identify ethical and leadership issues and take appropriate leadership actions** | | | | | | | |
| Select 1 among 3 SHSS offered courses on Ethics | | | | X | | | |
| **B. COMMON/SHARED COURSES** | | | | | | | |
| ENG101 Engineering Materials I | X | | X | | | X | |
| PHYS161 Physics II for Scientists and Engineers | X | X | X | | | | |
| MATH162 Calculus 2 | X | | | | | X | |
| ENG200 Differential Equations and Linear Algebra | X | X | X | | | | |
| ENG202 Numerical Methods in Engineering | X | X | X | | | X | |
| ENG201 Applied Statistics | X | X | X | | X | | |
| ENG400 Capstone project | X | X | X | X | X | X | X |
| ENG300 Interdisciplinary Project | X | X | X | X | X | X | X |

| | **Program Learning Outcomes** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **C. DISCIPLINE-SPECIFIC REQUIREMENTS (INCLUDING ELECTIVES)** | | | | | | | |
| CHME 200 Basic Principles and Calculations in Chemical Engineering | x | x | | x | x | x | |
| CHME 222 Inorganic and Analytical Chemistry | x | x | x | x | | | |
| CHME 203 Organic and Polymer Chemistry | x | x | x | x | | x | x |
| CHME 201 Chemical Engineering Thermodynamics | x | x | x | | x | x | |
| CHME 202 Fluid Mechanics | x | x | x | x | x | x | x |
| CHME 302 Instrumental Methods of Analysis for Engineers | x | x | x | x | x | | |
| CHME 300 Heat and Mass Transfer | x | x | x | x | x | x | x |
| CHME 301 Applied Mathematics for Process Design | x | x | x | x | x | x | x |
| CHME 305 Chemical Engineering Lab I | x | | x | x | | | x |
| CHME 303 Separation Processes | x | | x | | | | |
| CHME 304 Chemical Reaction Engineering | x | | x | x | | | x |
| CHME 401 Chemical Engineering Lab II | x | | x | x | | | x |
| CHME 402 Materials Chemistry | x | x | x | x | x | x | x |
| CHME 400 Process Design and Simulation | x | x | | x | x | x | |
| CHME 403 Chemical Process Control and Safety | x | | x | x | x | x | x |
| ENG 301 Research Practice | x | x | x | x | | | x |
| CHME450 Atmospheric Chemistry and Physics | x | x | x | x | x | x | x |
| CHME351 Environment and Development | x | x | x | x | x | | x |
| CHME 352 Process Design for Environmental Applications | x | x | x | | | | |
| CHME 451 Advanced Process Simulation | x | x | | x | x | x | x |
| CHME 452 Industrial Wastewater Treatment and Reclamation | x | x | | | | | |
| CHME 453 Multiphase Systems | x | x | x | | x | x | x |
| CHME 454 Advanced Transport Phenomena | x | x | x | | | x | |
| CHME 455 Heterogeneous Reactor Engineering | x | | x | x | | | x |
| CHME 456 Colloids and Surface Science | x | x | x | | x | x | x |
| CHME 457 Advanced Chemical Process Safety and Risk Modeling | x | x | | | x | x | |
| CHME 353 Electrochemical Engineering | x | x | x | x | x | x | x |
| CHME 458 Corrosion Protection in Oil and Gas Industry | x | x | x | | x | x | x |
| CHME 459 Biomechanics | x | x | | x | x | | x |
| CHME 421 Tissue Engineering | x | x | x | x | x | x | x |
| CHME 460 Polymer Processing and Rheology | x | x | x | | x | x | x |
| CHME 461 Powder Technology | x | x | x | x | x | x | x |

## 7. CAPSTONE PROJECT

The Capstone Project is a 2-semester common course for all engineering programs which spans across the fall and spring semesters of the same academic year. The importance of the Capstone project is reflected in the total number of credits it carries, being 12 ECTS which are equivalent to two standard-sized courses.

One of the important features of the Capstone Project is “learning by doing”. It is intended to be a platform for the students to develop their intellectual and innovative abilities and to give them the opportunities to integrate and apply the knowledge and analytical skills gained in previous stages of study. It should also provide students with opportunities to develop their problem-solving skills and communication skills. The process from concept to final implementation and testing, through problem identification and the selection of appropriate solutions will be practiced by the students.

### 7.1 Capstone Project Management

Normally a group of students will be assigned one project under the supervision of an academic staff member so that they will work independently and collaboratively to achieve the project objectives. Students may work on different aspects of a project. The group size may increase for a larger-scale project or a more complex project.

The assignment of projects is expected to be completed at the beginning of the fall semester in the final year of study. Guidelines for Capstone Project are given to students at the beginning of the final year.

### 7.2 Capstone Project Assessment

Assessment of the Capstone Project focuses in three main areas: project reports, oral presentations and work done over the whole project period. Assessment will be done by a team of staff including the project supervisor.

## 8. DEPARTMENTAL BEng. PROGRAM COMMITTEE

8.1 The composition of the Departmental BEng. Program Committee is decided by the Head of Department with the approval of the Dean. The Committee is responsible for program performance monitoring, review, and enhancement.

8.2 The Departmental BEng. Program Committee will regularly collect the course portfolios, program statistics and conduct surveys of students and other key stakeholders on the relevance, delivery, quality and the standards of the courses. The Committee will analyze the collected data and recommend areas for improvement taking into consideration the adequacy of resources, learning and teaching approaches, best practices, as well as the local and global trends. The Committee will also oversee the implementation of recommendations to improve the program.

8.3 The Departmental BEng. Program Committee is responsible for the program portfolio for each academic year including the annual program monitoring report.

## 9. STUDENT STATUS, ACADEMIC CALENDAR, POLICIES AND PROCEDURES

The program currently only accepts full-time students.

The program operates on the basis of an academic year divided into three academic periods: the regular fall and spring semesters and a summer term (if offered). Depending on public holidays, the fall semester and spring semester should have up to fourteen weeks for studies with two weeks for end-of-semester examinations. The School does not normally offered summer terms. Summer terms at NU are generally eight weeks.

The official NU Academic Calendar, Course Schedules, Final Examinations Schedule, and Policies and Procedures are available online at the Office of the Registrar website (https://registrar.nu.edu.kz/). It is the responsibility of the students to familiarize themselves with the following Policies and Procedures:

1) Academic Policies and Procedures for Undergraduate Programs
2) Regulations on Leave of Absence for Undergraduate and Foundation Year Program
3) Policy and Procedures on the Fifth Year of Undergraduate Study
4) Undergraduate Attendance policy and Procedures
5) Regulation on Dismissal and Voluntary Withdrawal for Undergraduate and Foundation Year Program Students
6) Graduation policy and Procedure for Undergraduate and Graduate Programs

Induction and orientation week takes place at the beginning of the fall semester to allow new students to adapt to the program requirements. New students are expected to familiarize themselves with the layout of the buildings, location of the staff offices, lecture theatres, laboratories, and other teaching facilities during the orientation.

## 10. COURSE REGISTRATION AND WITHDRAWAL

10.1 In addition to program registration, students need to register for courses at specified periods prior to the commencement of a semester. NU has an online course registration system. Students are notified by email from the Office of the Registrar of the dates for the registration period.

10.2 NU uses a priority registration system that ensures students in their last year of undergraduate study will have the first opportunity to register for classes. Students are notified, via email from the Office of the Registrar, of the dates for the registration period.

10.3 A student is waitlisted when the course they have attempted to register for is full. When a place in the course becomes available the top student in the waitlist is registered in the course and notified by email. Once the waitlist period ends, the student will have time to register for alternate courses before the end of the "add" deadline. Students must register for courses by the end of the first week of class in the fall or spring semester, and by the end of the second day of classes during the summer term (if offered).

10.4 An add/drop period will also be scheduled by the Office of the Registrar for each semester and during the summer term (if offered). The add/drop period can be found in the Academic Calendar. For courses not available for online registration, students must complete the add/drop form available from the Office of the Registrar.

10.6 Students who failed to attend the first week of any class for which they have completed registration and appear on the class roster can be dropped from the course by the administrators.

10.7 Students may apply for withdrawal of their registration on a course after the add/drop period, if they have a genuine need to do so. The application should be made on the Course Withdrawal form available from the Office of the Registrar. The course withdrawal deadline can be found in the Academic Calendar.

10.8 The pre-requisite requirements of a course must have been fulfilled before a student registers for that course. However, the pre-requisite requirements of a course can be waived under exceptional circumstances by submitting a completed Requisite override form available from the Office of the Registrar. If the pre- requisite course concerned forms part of the requirements for award, the course has to be passed in order to satisfy the graduation requirements for the program concerned, despite the waiving of the pre-requisite.

## 11. STUDY LOAD

11.1 For students following the progression pattern specified for their program, they have to take the number of credits and courses, as specified in this Program Handbook, for each semester. Students cannot drop those courses assigned by the department unless prior approval has been given by the department.

11.2 The normal study load is about 30 ECTS credits in a regular fall or spring semester. The maximum study load to be taken by a student in a regular fall or spring semester is 36 ECTS credits, unless exceptional written permission is given by the Dean and from the Vice-Provost for Academic Affairs. The maximum study load to be taken by a student in a summer term (if offered) is 12 ECTS credits, unless exceptional written permission is given by the Dean and from the Vice-Provost for Academic Affairs. For such cases, students are reminded that the study load approved should not be taken as grounds for academic appeal.

11.3 The minimum load for a full-time student in any given regular fall or spring semester is 24 ECTS credits of coursework that count toward graduation. Under exceptional circumstances, a student may be permitted to enroll for fewer than 24 ECTS credits if written permission is received from the Dean and from the Vice-Provost for Academic Affairs.

11.4 To help improve the academic performance of students on academic probation (the meaning of “academic probation” can be found in Section 19.2), these students will not be allowed to take 36 ECTS or more during their probation period in the fall and spring semesters.

11.5 Students who have obtained approval to pace their studies and students on program without any specified progression pattern who wish to take more than the normal course load in a fall or spring semester should seek advice from the Department concerned before the selection of courses.

11.6 Students are required to be present at the beginning of the semester and to remain until the semester is completed.

## 12. COURSE EXEMPTION AND CLASS ATTENDANCE

There is no course exemption policy for this program. In exceptional cases, students may substitute courses in the curriculum (including the mandatory Nazarbayev University Undergraduate Core Curriculum Requirements' courses) with other courses, if written permission is given by the Head of Department and the Dean.

12.1 All students are expected to attend all classes at the University. Penalties as stated in the course policies will be applied if attendance falls below 80% of scheduled classes. At the start of the semester, each instructor is responsible for clearly communicating the course attendance policies and/or School attendance policies. Faculty has right to lower grades or initiates a drop/withdrawal from a course if there is a violation of the attendance policies. Students should be mindful of the course policies and make sure they completely understand the consequences of missing classes (either excuse or unexcused).

12.2 Excused absence is when a student misses classes for one of the following documented reasons: personal illness; family emergency; school approved absence such as conference, Olympiad, or other academic events. All medical certificates must be endorsed by the NU doctors and recorded by the Department of Student Affairs. Only the instructors may approve a student's request to be absent from class. Students should get the appropriate "excuse" forms available from the School Office and submit the completed forms to each course instructor for approval for each missed class. In the event of a dispute, the matter may be reported to the Vice dean for Academic Affairs or equivalent official of the School. The determination of the Vice Dean or equivalent School official shall be final.

12.3 Unexcused absence occurs when a student deliberately misses a class with no reasons.

12.4 Students are responsible for monitoring their own attendance. Students who exceed the maximum number of absences in the current and previous semester will not be eligible for University sponsored study abroad programs or University sponsored events.

## 13. CREDIT TRANSFER

13.1 Students may transfer credits for recognized previous studies which will be counted towards meeting the requirements for award. Transferred credits may be counted towards more than one award. The granting of credit transfer is a matter of academic judgment. The student should provide a detailed course syllabus showing the topics covered and assessment tasks which were completed for each course and a certified official transcript with the number of credits and the grade or final assessment in the course. Unless the course is a language course all language of instruction must be in English. To ascertain the academic standing of the institution offering the previous studies, the Department might need to request the institutions concerned to provide more information.

13.2 Transfer credit is not given for courses in which the student earned lower than C grade (or its equivalent). Grades earned at other universities are not included in computing the student's CGPA at NU. All transfer credits will be annotated as such on the student's NU transcript.

13.3 The maximum number of transferable credits is 60 ECTS credits. Discretion may be made with approval of the Dean for a student who was on an approved Academic Mobility program.

13.4 Certain types of credit cannot be transferred to the NU, including but not limited to the credits awarded by higher education institutions for noncredit courses, workshops, and seminars offered by other higher education institutions as part of continuing education programs.

13.5 The transfer decision and final judgement are made by the relevant Department or if there is no relevant Department by the School. The School will decide the number of credits to be transferred, and if appropriate the level of the course and the course equivalent.

13.6 Transfer credits at the time of admission can only be granted for courses taken in the preceding two academic years.

13.7 Credit for courses taken at institutions outside NU subsequent to admission can only be granted by prior written approval from the relevant Department, or if there is no relevant Department from the School Admissions Committee.

13.8 Credits earned in other higher education institutions during the time spent at NU shall be processed in accordance with appropriate internal regulations of NU.

13.9 Credit transfer can be applicable to credits earned by students through studying at an overseas institution under an approved Academic Mobility program. Students should, before they go abroad for the approved Academic Mobility program, seek prior approval from the program offering Department (who will consult the course offering Departments as appropriate) on their study plan and credit transferability. As with all other credit transfer applications, the Departments concerned should scrutinize the syllabuses of the courses which the students are going to take at the overseas institution, and determine their credit transferability based on academic equivalence with the corresponding courses on offer at the NU, and the comparability of the

grading systems adopted by NU and the overseas institution. The transferability of credits and the suitability for allowing grades to be carried over must be determined and communicated to students before they go abroad for the approved Academic Mobility program.

13.10 For credit transfer of retaken courses, the grade attained in the last attempt should be taken in the case of credit transfer with grade being carried over. Students applying for credit transfer for a course taken in other institutions are required to declare that the course grade used for claiming credit transfer was attained in the last attempt of the course in their previous studies. If a student fails in the last attempt of a retaken course, no credit transfer should be granted, despite the fact that the student may have attained a pass grade for the course in the earlier attempts.

13.11 Students will not be granted credit transfer for a course which they have attempted and failed in their current study.

## 14. LEAVE OF ABSENCE

Periods of time during which a student is on an approved leave of absence from the University shall not be included in the calculation of time limitations for stipends. When granting a leave of absence to a student, whose tuition is funded through the state or University, his/her right for an educational grant will be retained. Funding and tuition fees will be paused for the period of the leave of absence, except for funding of stipends, which are established by the procedures of the paying state stipend to the students who have been granted a leave on medical grounds. The funding and tuition fees will be resumed after the end of a leave of absence.

A leave of absence will not be considered for approval in the following cases:

1) If the application is submitted during the examination period;
2) If a student has been scheduled for dismissal in the light of poor academic performance, inadequate progress toward degree, or for disciplinary reasons.

If a student has an outstanding “Incomplete” at the time he or she is granted leave of absence, the period for completion of that “Incomplete” may be extended for the period of the leave of absence with the written approval of the faculty member who granted the “Incomplete” and the Dean.

A student who requests a leave of absence shall submit an application form provided by the Office of the Registrar. A leave of absence may be granted by the Dean, the Vice President for Student Affairs, and the Vice Provost for Academic Affairs. The student’s leave of absence will become effective upon the Provost’s signature of the order, which shall indicate the dates of beginning and termination of the leave of absence and its grounds. Copy of the order is given to the student, along with a document stating their academic status at the time of leaving and the conditions they will be under upon their return from leave of absence. If the student was enrolled in classes prior to the approval of the leave of absence, no grades will be awarded for the interrupted semester and all courses will be marked with a “Withdrawal” (“W”). The grant of the a leave of absence will be recorded on the student’s transcript.

### 14.1 Leave of Absence - Medical.

Students may request for leave of absence when extraordinary circumstances such as illness or injury prevent the student from continuing classes and incompletes or other arrangements with the instructors are not possible. Medical leave of absence policy covers both physical and mental health conditions, including pregnancy and maternity.

A leave of absence can be granted to a student on the grounds of a medical certificate confirmed by a qualified medical officers consulting commission created in accordance with legislation of the Republic of Kazakhstan for a period from 6 to 12 months, except that in the case of tuberculosis a leave may be granted for a period of 1 to 2 years and in the case of maternity a leave of absence may be granted for a period of up to 2 years. A second leave of absence on medical grounds shall not be granted to a student. A student may request a leave of absence on medical grounds by submitting an application to the Department of Student Affairs for validation, along with an original medical certificate issued by the Medical Authority. When returning from a leave of absence granted on medical grounds a student shall submit an application to the Office

of the Registrar no less than 20 working days prior to beginning of the academic period they wish to return, and in cases other than pregnancy/maternity leave, he/she will submit a medical certificate of an appropriate Medical Authority approving the student's return to the University. Students returning from pregnancy/maternity leave shall submit birth certificate of the child or other relevant document(s).

14.2 Leave of Absence - Immediate Family Member.

Students may be granted for leave of absence based on change in social or economic status affecting an immediate family member (immediate member means a parent, spouse, dependent child, sibling, or grandparent). In order to grant a leave of absence based on circumstances of an immediate family member, the University may request to present evidence of a direct impact on the student's ability to continue with his or her program of study. If requested, such evidence shall be submitted to the Dean, who shall review and forward copies of such documentation to the Vice President for Student Affairs and International Cooperation and the Vice Provost for Academic Affairs. When returning from a leave on non-medical grounds a student shall submit an application to the Office of the Registrar not less than 45 days prior to the beginning of the semester in which they wish to return.

14.3 Leave of Absence - Other.

A student may be granted a leave of absence from the University for a period of up to one year for reasons other than a medical condition or event affecting an immediate family member if the following conditions met:

1) No leave of absence may be granted under this section for any undergraduate student prior to the completion of the first year of his or her studies;
2) No leave of absence may be granted under this section for any student who is currently on probation, and has had Category B disciplinary actions;
3) No leave of absence may be granted under this section for any student who is behind in credit hours;
4) A leave of absence under this section shall be granted only to a student with high academic performance GPA 3.0 and above;
5) A leave of absence under this section will be granted only on a determination by the Dean that such leave will not be detrimental to the student's ability to complete the program.

To apply for a leave of absence under this section, a student is required to submit documentation demonstrating the purpose of the leave and the activities in which he or she expects to participate during the leave period. In the event that a proposed leave includes a period of employment with a company, the supporting documentation submitted in advance must include a letter of invitation from the

employing company and a copy of the corporate registration or other documentation of the company's operations. When returning from a leave on non-medical grounds a student shall submit an application to the Office of the Registrar not less than 45 days prior to the beginning of the semester in which they wish to return. At the end of the leave period, the student will be required to submit a report detailing his or her activities during the leave period to the Dean and a letter from a supervisor or equivalent individual(s) attesting to the accuracy of the student's report and evaluating the student's performance during the leave period. In the event the student's activities during the period of leave include employment, he or she is required to submit relevant documentation demonstrating uninterrupted employment for the prescribed period. Violation of the terms of this section will be treated as non-academic misconduct under the University's Student Code of Conduct and Disciplinary Procedures.

## 15. PRINCIPLES OF ASSESSMENT

15.1 Assessment of learning and assessment for learning are both important for assuring the quality of student learning. Assessment of learning is to evaluate whether students have achieved the intended learning outcomes of the courses that they have taken and have attained the overall learning outcomes of the academic program at the end of their study at a standard appropriate to the award. Appropriate methods of assessment that align with the intended learning outcomes will be designed for this purpose. The assessment methods will also enable teachers to differentiate students' different levels of performance within courses. Assessment for learning is to engage students in productive learning activities through purposefully designed assessment tasks.

15.2 Assessment will also serve as feedback to students. The assessment criteria and standards will be made explicit to students before the start of the assessment to facilitate student learning, and feedback provided will link to the criteria and standards. Timely feedback will be provided to students so that they are aware of their progress and attainment for the purpose of improvement.

15.3 The course results based on the assessments are examined by the Exam Board at the end of each semester. The Exam Board will review, discuss and finalize progression and completion.

## 16. ASSESSMENT METHODS

16.1 Students' performance in a course can be assessed at the discretion of the course coordinator by a variety of assessment activities, including examinations, tests, assignments, projects, laboratory work, field exercises, presentations and other forms of classroom participation. Assessment activities which involve group work should include some individual components therein, i.e. the contribution made by each student in a group effort shall be determined and assessed separately, and this can result in different grades being awarded to students in the same group.

16.2 The course learning outcomes, assessment activities, and the weighting of each activity in the overall course grade will be clearly stated in the course specifications. The course learning outcomes should be assessed by appropriate assessment activities, in line with the outcome-based approach.

16.3 At the beginning of each semester, the course coordinator will inform students of the details of the methods of assessments to be used within the assessment framework as specified in the course specifications.

16.4 Students who did not participate in assessment activities will be awarded zero mark. When there are extenuating circumstances, the students must provide documentary evidence and apply for excuse absence (refer to Section 12). Depending on the circumstances, the course instructor may for cases of approved excused absence:

1) Set a new date (or deadline) for the students to retake or submit the missed assessment activity;

2) Decide on alternative means to compensate for the missed assessment activity.

Applications for excuse absence so that students can participate in missed assessment activity will not be accepted 7 calendar days after the original assessment activity date.

16.5 Course instructors have the right not to accept and/or deduct marks for late submission of assessment elements. These course policies should be stated in the course specifications. At the beginning of each semester, the course coordinator must inform students of the course policies.

## 17. COURSE RESULTS

17.1 Course instructors, in respect of the course they teach, have sole responsibilities for marking and grading students' coursework and examinations scripts. Assessment elements (including final examinations) will be graded by a clear marking scheme (set by the course instructor) which is non-negotiable. Timely feedback of assessment will be given to students as soon as possible (e.g. not later than a month), and in any case, before the final examination/assessment. In this regard, course instructors will be accountable to the Head of Department, to ensure that all forms of assessment, including the students' coursework and examination scripts, are correctly marked and graded where appropriate. Course instructors will avoid administrative errors at all times, and submit the grades to the Office of the Registrar according to the schedule set in the academic calendar. To ensure consistency and uniformity for a common course taught by different course instructors, meetings can be arranged amongst them before the examination papers are set or before the marking is done.

17.2 Course grades should be reviewed and finalized by the Department before being formally released to students and submitted to the Exam Board.

## 18. BOARD OF EXAMINERS

18.1 The authority for approving the overall results of students rests with the Exam Board. The Exam Board will meet at the end of each semester (except for Summer Term - students who are eligible to graduate after the completion of Summer Term courses will be processed in the beginning of the fall semester). The Exam Board is responsible for making:

(i) A decision on the classification of awards to be granted to each student on completion of the program;

(ii) A decision on progression, academic probation, and dismissal cases; and

(iii) A decision on cases with extenuating circumstance.

18.2 These decisions are made by the Exam Board at the end of each semester in the light of the standard of student achievement appropriate to the award to which the program is designed to lead, the aims of the program, the students' performance on the program in previous years, the general assessment regulations of the University, the specific program regulations, and good practice established in the University and elsewhere.

18.3 The Exam Board will not attempt to change the grades for any student in any course nor condone failures.

18.4 Students shall be formally notified of decisions affecting them after the Exam Board meeting except for those whose cases require endorsement by the Provost Office.

## 19. PROGRESSION / ACADEMIC PROBATION / DISMISSAL

19.1 The Exam Board shall, at the end of each semester (except for Summer Term - students who are eligible to graduate after the completion of Summer Term courses will be processed in the beginning of the fall semester), determine whether each student is

(i) Eligible for progression towards an award; or

(ii) Eligible for an award; or

(iii) Required to be dismissed from the program.

19.2 At the conclusion of every semester, each student's Grade Point Average (GPA) (see Section 23) and rate of progress toward degree are calculated by the Office of the Registrar and academic standing is determined for students seeking Bachelor degrees according to the following criteria:

1) Good Academic Standing – A student having a Cumulative Grade Point Average (CGPA) of 2.0 or above and a GPA in the current semester of 2.0 or above is considered to be in good academic standing;

2) Academic warning – A student will receive notice of academic warning if his/her academic performance is deemed to be unsatisfactory. A student may receive an academic warning after the mid-semester status reports, which are required from all course instructors in all courses to help identify and assist students who may need additional guidance (Mid-semester grading will be based on Satisfactory (S) – i.e. A student who is at a minimum C or above with excellent attendance; or Non Satisfactory (NS) – i.e. Any student who is at a C- or below with attendance problems, and other problems that may keep the student from successfully completing the courses. Notification of academic warning will be sent by the Office of the Registrar to the student, the School's Vice Dean of Academic Affairs and the student's advisor. A student will be advised to limit their social activities and may not be considered for NU sponsored travel.

3) Academic probation – A student who fails to maintain Good Academic Standing based on GPA will be placed on Academic Probation. At the end of one semester of academic probation, students are subject to dismissal from NU if they have not achieved the necessary conditions to return to Good Academic Standing. In exceptional cases, the Dean may recommend to extend academic probation for a second semester based on evidence of improvement, overall academic progress, the student's potential to return to Good Academic Standing and eventually to graduate on time. The recommendations must be submitted to the Vice Provost for Academic Affairs indicating the grounds for the recommendation. The final decision on extension of the academic probation for another semester is made by the Vice Provost for Academic Affairs. Under no circumstances may a student be on academic probation more than two consecutive semesters or for more than three semesters in total.

19.3 Grades received during Summer Term may also affect a student's academic standing.

19.4 The Dean will receive a probation report at the end of each semester from the Office of the Registrar. Students will receive notification from the Office of the Registrar informing them of any change in their academic standing

19.5 Students are required to remain for four years of study as an undergraduate student to ensure they graduate pursuant to graduation requirements as specified in the internal regulations of NU.

19.6 NU expects students to complete their degree requirements within four years (subject to the Policy on Fifth Year Study and other internal regulations of NU). To complete a degree in four years, students must average 30 ECTS per semester (including transfer credits and summer courses). Any students who falls 30 or more ECTS credits behind this rate of completion will be subject to dismissal from NU. The Office of the Registrar shall submit a list of students who are 30 or more ECTS credits behind satisfactory progress toward satisfactory progress toward a degree to the Dean, who shall make a recommendation to the Provost. The total credits are tallied by counting all credits earned from coursework as well as credits transferred into NU. Attempted credits are calculated by tallying the credits for every course on a student's transcript including transfer credit, graded courses, and courses that were graded AW, W, F, or I.

19.7 Students may be considered for the fifth year of study if they are unable to meet graduation requirements by the end of the last semester of their final year and are expected to be able to complete their degree with one additional year of study. At the end of the spring semester, as soon as is practicable after the receipt of final grades, the Office of the Registrar will send each School a list of the fourth year students who will not satisfy the requirements for graduation. The Vice Dean for Academic Affairs or equivalent in each School, in consultation with academic advisors and Department Chairs, will complete a form indicating the specific courses in which the student is to be enrolled during his or her fifth year. This form must be submitted to the Office of the Registrar by the stipulated deadline. The Office of the Registrar shall send a letter to the student's parent informing them that the student is eligible for a fifth year of study at cost, identifying the list of courses in which the student will be required to enroll during a fifth year of study, and indicating the current cost per credit of fifth year study at the University. The letter will contain an acceptance form. Upon timely return of the acceptance form the student will be enrolled as a fifth year student in the specific courses indicated in the letter. When the student is enrolled, the Office of the Registrar shall forward a copy of the letter and the acceptance form to the Bursar's Office. The Bursar's Office shall generate a billing statement and payment contract which will be sending to the student. The Bursar's Office shall be responsible for the execution and registration of the contract. When the contract is executed, the Bursar's Office will send it to the Office of the Registrar for inclusion in the student's permanent file. A student enrolled into a fifth year will receive an academic schedule for each semester of the fifth year based on the list of required courses identified in the letter from the Office of the Registrar. The fifth year student is not allowed to change this schedule, drop or add courses, or withdraw from this set schedule. All academic requirements for graduation must be completed within the fall and spring

semester of the fifth year. A sixth year will not be considered under any circumstances. If a student has not completed their program of study by May of the fifth year, they will not graduate from the University or receive a diploma. They will receive a letter of attendance on approved letterhead. The school will ensure that each fifth year student meets regularly with their academic advisor. During their fifth year of study, fifth year student may be provided with accommodation on campus, depending on availability. Fifth year students will be charged an accommodation fee if they choose to live on campus.

## 20. APPEAL OF GRADES

All students have the right to appeal any grade that they have received that they believe is in error. The error must be based on one of the following criteria:

1) Error in calculation
2) Error in application of the class grade policy as presented in the course specifications
3) Incorrect entry of the grade into the database
4) Incomplete marking of an assessment

In the case of an exam, a student must first consult with the course instructor as soon as the grade is available and announced to the students. The student should review his or her corrected, graded final exam in the presence of a faculty within the stipulated period set by the course coordinator. No viewing is allowed after the stipulated period. If any error is found, the student should complete a “Grade appeal” form and submit it to the course coordinator. The School will set the official deadline for the appeal process. Late appeals will not be accepted.

Upon receipt of the “Grade appeal” form, the course coordinator can accept or deny the request. If there is insufficient ground for the grade appeal, the instructor can deny the request. However, if a student’s grade has been assigned incorrectly due to technical or procedural error, or miscalculation of grade, the course coordinator should complete a “Grade change” form from the Office of the Registrar. This form must be signed by the course instructor and the Dean. No grades can be changed after a degree has been granted.

If a student is dissatisfied with the outcome from the course coordinator, he or she may appeal to the Dean or Vice Dean, who shall consult with the course coordinator before making a decision. The decision of the Dean or Vice Dean shall be final. All grade changes must be resolved by the end of the first week of the next semester.

## 21. RETAKING OF COURSES

21.1 Any student who receives a grade that would prevent academic progress in his or her program of study may enroll to retake that course. The total number of times a student may retake a course is limited to three retake attempts. Students are not permitted to retake a course if it has already been passed for the purpose of improving the awarded grade.

21.2 All retake attempts will remain in the student record and on the transcript, and will be counted to semester's GPA, semester CPGA, semester's earned credits, semester's attempted credits and total attempted credits. Only the last retake will be counted in the final CGPA and total earned credits.

21.3 The summer term is short and the instructors of courses if offered can decide on the course policy, mode of delivery, and assessment requirements. If retake courses are offered in the summer term, a student cannot participate in more than two retake courses.

## 22. EXCEPTIONAL CIRCUMSTANCES

*Absence from an assessment component*

22.1.1 Students who are absent without permission from any form of assessment or who do not submit coursework for assessment will be awarded a mark of zero for that assessment unless the course instructor determines that there are extenuating circumstances. When there are extenuating circumstances, it is the student responsibility to provide documentary evidence in accordance to established University and School procedures and inform the course instructors as soon as possible prior to the assignment of the final grades. Depending on the circumstances, the instructor may set a new date for the students to resubmit or retake the missed assessments (refer to Section 16).

22.1.2 All medical documents must be verified by the NU doctors and endorsed by the Department of Student Affairs.

22.1.3 Any student who cannot take the examination as scheduled is required to submit his/her application for late assessment in writing to the Head of Department offering the course, within five working days from the date of the examination, together with any supporting documents. Decisions of applications for late assessment and the means for such late assessments shall be made by the Head of Department after consultation with the course coordinator.

*Assessment to be completed (Incomplete grade)*

22.2 When a student has completed a substantial portion of the requirements for a course but, due to extenuating circumstances, is unable to complete all requirements, the course instructor may assign a temporary grade of "Incomplete". An "Incomplete" grade can be given only on the basis of a written prior agreement between the student and the instructor and approved by the Head of Department and the Dean. The agreement will describe the additional work that is expected and the terms under which it is to be completed. The date for completion of work is to be determined by the course instructor, but all work is to be completed no later than the end of the following semester (including summer semester if appropriate)

22.3 When the work or examination that is required under an "Incomplete" agreement is completed, the course instructor shall request a change of the "I" grade to the appropriate grade for the course, at which time the grade of "I" will be removed from the student's transcript.

22.4 An "I" grade can also be applied to a student who cannot take part in a final examination in a course because of personal health problems, or that of immediate family. A new deadline will be set by the course instructor for the completion of the final examination.

22.5 An "I" has no grade points and is not included in the calculation of GPA.

22.6 A grade of Incomplete that is not completed by the end of the subsequent semester automatically reverts to the grade indicated in the agreement between the course instructor and the student. If no grade is indicated in the agreement and the instructor does not submit a change of grade request, the "Incomplete" grade will revert to an "F". In no case shall a student be granted a degree while there are unresolved Incompletes in the student's record.

*Withdrawal*

22.7 Withdrawal from courses will be permitted up to the date indicated in the Academic Calendar for the year in which the withdrawal occurs. A student will not be allowed to withdraw from a course in which he/she had taken a grade of "W" in a previous semester.

22.8 A withdrawal from a course is effective upon the student's submission of a completed Withdrawal Form to the Office of the Registrar.

22.9 A student who takes a Leave of Absence during a semester will automatically be withdrawn from all courses.

*Other particular circumstances*

22.10 A student's particular circumstances may influence the procedures for assessment but not the standard of performance expected in assessment.

## 23. GRADING

23.1 Assessment grades shall be awarded on a criterion-referenced basis. The following Common Grading Scale is applied to all NU undergraduate programs:

| ***Letter grade*** | ***%*** | ***Quality Point*** | ***Explanation*** |
|---|---|---|---|
| A | 95-100 | 4 | Excellent, exceeds the highest standards in the assignment of course |
| A- | 90-94.9 | 3.67 | Excellent, meets the highest standards for the assignment or course |
| B+ | 85-89.9 | 3.33 | Very good, meets the high standards for the assignment or course |
| B | 80-84.9 | 3.00 | Good, meets most of the standards for the assignment or course |
| B- | 75-79.9 | 2.67 | More than adequate; shows some reasonable command of the material |
| C+ | 70-74.9 | 2.33 | Acceptable; meets basic standards for the assignment or course |
| C | 65-69.9 | 2.00 | Acceptable; meets some of the basic standards for the assignment or course |
| C- | 60-64.9 | 1.67 | Acceptable; while falling short of meeting basic standards in several areas |
| D+ | 55-59.9 | 1.33 | Minimally acceptable; falling short of meeting many basic standards |
| D | 50-54.9 | 1.00 | Minimally acceptable; lowest passing grade |
| F | 0-49.9 | 0 | Failing; very poor performance |

'F" is a course failure grade, whilst all others ('D' to 'A') are course passing grades. No credit will be earned if a course is failed.

*Semester GPA*

23.2 At the end of each semester, a semester Grade Point Average (GPA) will be computed based on the grade point of all the courses taken in the semester. For each course, the grade point is determined by multiplying the number of credits with the numeric quality point based on the obtained grade for that course. The sum of the grade points is then divided by the total credits for all the courses taken in the semester as follows:

$$\text{GPA} = \frac{\sum_{n} \text{Course Credit Value} \times \text{Course Quality Point}}{\sum_{n} \text{Course Credit Value}}$$

where *n* = number of courses (inclusive of failed courses) taken by the student in the semester.

In addition, the following courses will be excluded from the semester GPA calculation:

(i) Transferred courses
(ii) Incomplete courses
(iii) Withdrawn courses

Figure 1: example of the semester GPA calculation

| **Courses** | **Credits (ECTS)** | **Letter Grade** | **Quality Point** | **Credit value multiply by Quality Point** |
|---|---|---|---|---|
| Course 1 | 8 | A | 4.00 | 8X4=32 |
| Course 2 | 6 | B+ | 3.33 | 6X3.33=19.98 |
| Course 3 | 6 | C- | 1.67 | 6X1.67=10.02 |
| Course 4 | 6 | F | 0 | 6X0=0 |
| Course 5 | 6 | B | 3.00 | 6X3=18.00 |
| | Total = 32 | | | Total = 80 |
| | | Semester GPA = | | 80/32 = 2.5 |

23.3 GPA's will be calculated for each Semester including the Summer Term. This Semester GPA will be used to determine students' eligibility to progress to the next Semester alongside with the 'cumulative GPA'. The Semester GPA calculated for the Summer Term will also be used for this purpose

*Annual GPA*

23.4 At the end of each academic year, an annual Grade Point Average (GPA) will be computed based on the grade point of all the courses taken in the academic year (excluding the summer term). For each course, the grade point is determined by multiplying the number of credits with the numeric quality point based on the obtained grade for that course. The sum of the grade points is then divided by the total credits for all the courses taken in the academic year.

In addition, the following courses will be excluded from the yearly GPA calculation:

(i) Transferred courses
(ii) Incomplete courses
(iii) Withdrawn courses

23.5 GPA's will be calculated for each academic year excluding the Summer Term. This annual GPA will be used to determine Dean's list. Students who have taken at least 60 ECTS and obtained an annual GPA of greater or equal to 3.8 based on the fall and spring semesters grades in the academic year and did not have any misconduct will be recommended for the Dean's lists, which are commendations to undergraduate students of excellence.

*Cumulative GPA*

23.6 At the end of every semester, a Cumulative Grade Point Average (CGPA) will be computed based on the grade point of all the courses taken from the start of the program in residence at the University (including the summer term). For each course, the grade point is determined by multiplying the number of credits with the numeric quality point based on the obtained grade for that course. The total cumulative grade points are then divided by the total graded credits for all the courses taken from the start of the program in residence at the University.

23.7 For courses which have been retaken, only the grade point obtained in the final attempt will be included in the CGPA calculation. The CGPA is an indicator of overall performance at graduation, and is capped at 4.0.

*Administrative Grades*

23.8 The following University-wide administrative grade notations apply to all undergraduate programs:

| Grades | Comments |
|---|---|
| P/F | A grade of P (pass) or F (Fail) may be reported for students who are permitted to take a course on a P/F grading basis rather than receiving a letter grade. Classes may only be taken on a P/F basis with the approval of the course instructor and the Dean. A "P" will not be used in calculating the student's GPA or CGPA; an "F" grade will be used in calculating the GPA and CGPA. The pass is equivalent to a C- or above |
| AU | Audited courses are recorded on the transcript with the notation "AU". Audited courses are not included in the calculation of the GPA, attempted credit, or earned credit. The grade "AU" is automatic. The course instructor cannot assign any other grade. Audited courses do not receive credit, cannot be counted towards graduation requirements, do not satisfy prerequisites and cannot be transferred. |
| I | Incomplete |
| IP | This grade is assigned at the end of the first term of a year-long class if the student has made adequate progress up to that point. It will be changed to reflect the class grade for both semesters of study at the end of the year. |
| W | Withdrawal |
| AW | Administrative Withdrawal. This grade indicates that a student has been ordered withdrawn from a course based on:<br>• Disciplinary grounds, following the procedures and standards specified in the internal regulations of NU<br>• Non-payment of tuition where appropriate following the procedures and standards specified in the internal regulations of NU |
| AD | Administrative Drop – An administrative drop occurs when a student has failed to attend the first week of any class for which they have completed registration and appear on the class roster. This process is initiated by the appropriate School to which the course belongs |

## 24. GRADUATION REQUIREMENTS FOR BEng (HONS) IN CHEMICAL AND MATERIALS ENGINEERING PROGRAM

All students qualifying for a 4-year Full-time Undergraduate Degree offered from fall 2018 onward must meet the following specific graduation requirements of their chosen program of study:

(i) Complete successfully a minimum of 248 ECTS composed of courses as specified in the program curriculum;

(ii) Obtain at least a C- grade for the Capstone Project;

(iii) Earn a CGPA of 2.00 or above at graduation.

24.1 It is the student's responsibility to ensure that all requirements for graduation are fulfilled in a timely fashion. The student should consult his/her academic advisor to determine whether the requirements have been met and, if not, what the student must do to meet the requirement.

24.2 The Office of the Registrar will send the list of students who meet graduation requirements, including their CGPA's and completed courses, to the Dean, who will approve each individual student and then t=return the list to the Office of the Registrar.

24.3 The Registrar will review all information, based on the recommendation of the Dean, and verify the list of students for graduation.

24.4 The list of recommended and verified students will be submitted to the Provost for final approval.

## 25. AWARD CLASSIFICATION

25.1 An undergraduate student is eligible for honors designation and will receive "red" diplomas, if he/she meets one of the following criteria:

1) his/he completed academic record equal to 4.00 CGPA. Such student qualifies for the category "Distinction";
2) his/he completed academic record equal to 3.90 CGPA and above (CGPA at graduation >= 3.90) .calculated after excluding student(s) eligible for the category "Distinction". Such student qualifies for the category "Summa Cum Laude";
3) his/he completed academic record equal to 3.80 CGPA and above (CGPA at graduation >= 3.80) .calculated after excluding student(s) eligible for the category "Distinction" and "Summa Cum Laude". Such student qualifies for the category "Magna Cum Laude";

25.2 Any courses passed after the graduation requirement has been met will <u>not</u> be taken into account in the grade point calculation for award classification.

## 26. END-OF-SEMESTER AND FINAL EXAMINATIONS

*End-of-Semester Period*

26.1 The End-of-Semester period is a time of reduced social and extracurricular activity, starting with the last week of classes and continuing through the final examination period. In this period, students concentrate on academic work and prepare for the final examinations.

26.2 The following rules govern the conduct of classes during the End-of-Semester period:

1) During this time course instructors should neither make extraordinary assignments nor announce additional course meetings to "catch-up" in course presentations that have fallen behind. Course instructors may choose to conduct optional review sessions and to suggest other activities that might seem appropriate for students preparing for final examinations. Review sessions should be scheduled for optimal attendance, and a serious effort should be made by course instructors to accommodate students who are unable to attend a scheduled review session.

2) No graded homework assignments, mandatory quizzes, or examinations should be given during the last week of classes except:

   a) in classes, where graded homework assignments or quizzes are routine parts of the instruction process, or

   b) in classes with laboratories, where the final examination will not test the laboratory component. In such a case, the laboratory sessions during the week preceding examination period may be used to examine students on that aspect of the course

   c) Take-home examinations, given in place of the officially scheduled in-class examination, may be distributed in the week preceding the final examination period

   d) During the End-of-Semester period, no course instructor may schedule any extracurricular musical, dramatic, or athletic events involving compulsory student participation, nor may students be asked to attend any meetings of committees

*Final Examinations*

26.3 No other coursework, including laboratory or studio work, will be due during the final examination period unless it is assigned in advance and in lieu of the course's final examination.

26.4 All scheduled final examinations, or equivalent final graded exercises, are held at the end of the semester during NU's official final examination period. Final papers or other assignments that are assigned in lieu of a final examination will be due during the NU's final examination period.

26.5 The final exam schedule is generated by the Office of the Registrar. The date, time and venue of the final exam should not be changed. No student shall be required to

take more than two scheduled final examinations that take place within a single calendar day. Students who find conflicts in their final examinations should seek to resolve these with the course instructors involved at the time the final examination schedule is posted. Course instructors are encouraged to be accommodating whenever possible. If a course instructor refuses to accommodate a conflict in a situation where a student is scheduled for more than two final examinations on the same calendar day, the student may appeal to the Dean.

26.6 On the day of the final exam, a student who is sick or has extenuating conditions that can affect the performance may apply for deferred assessment and should not sit for the exam. Once he/she sits for the exam, the student cannot appeal the grade based on medical and extenuating condition grounds (refer to Sections 20 and 22).

26.7 Students with a disability, dyslexia or other diseases can apply for special assessment arrangements in their final exams. Notification of special requirements must be made by the student to the course instructor at least three working days prior to the final exam. If the student did not apply for special assessment arrangements and sit for the exam, they cannot appeal the grade based on medical or extenuating condition grounds (refer to Sections 20 and 22).

26.8 Any student shall be permitted to review his or her corrected, graded final examination in the presence of a faculty or staff member within the stipulated period set by the course coordinator. If any error is found, the student should appeal (refer to Section 20).

*Student Examination Conduct*

26.9 Students are expected to arrive at the examination room on time.

26.10 Student will be required to present a current NU student identity card when entering an examination hall, and to display this card on their desks during the examination.

26.11 All rules concerning the administration of the examination will be explained to the students before the start of the examination. Students are required to observe all instructions given by examiners, supervisors, proctors, or other officials responsible for the conduct of the examinations.

26.12 The following rules apply to all examinations:

1) Talking to anyone other than the proctor in the examination room is not permitted.
2) The presence of any illegal items (unless permitted by the examination) will be grounds for charges of academic misconduct and immediate expulsion from the examination, and a grade of “F” on that examination. These items include but are not limited to cell phones or any text messaging devices.
3) Students must stop working at the end of the time allowed for the examination. Continuing to work on the examination after the allowed time is considered cheating.

26.13 Communicating answers to other students is as serious as receiving answers. Students who assist others are subjects to disciplinary actions and penalties.

## 27. ACADEMIC MISCONDUCT

27.1 All academic misconduct will be processed in accordance to the NU Student Code of Conduct and Disciplinary Procedures.

27.2 All disciplinary actions against students' misconducts will be recorded in students' records.

27.3 Students who have committed disciplinary offences (covering both academic and non-academic related matters) will be put on 'disciplinary probation'. The student will lose the stipend during the 'disciplinary probation'.

27.4 Students with two academic misconducts will be recommended for dismissal.

27.5 Students with records of academic misconduct will not be considered for University funded activities including student trips and overseas summer mobility programs.

27.6 The University reserves the right to withhold the issuance of any certificate of study to a student who has unsettled matters with the University, or who is subject to disciplinary action.

## 28. COURSE SPECIFICATIONS

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| **Course Code and Title** | **Rhetoric and Composition (SHSS 150)** |
| *Course Descriptor* | This course familiarizes students with the skills and process involved in writing an academic research paper. With a focus on the steps of the writing process, students will complete two major research papers, while practicing skills in summarizing, paraphrasing, and citation. In addition to the mechanics of writing, the course emphasizes the development of critical thinking skills through reading, response, and discussion. Another goal of the course is to increase students' oral communication skills through both class discussion and presentations. Finally, SHSS 150 focuses on helping students develop an original and distinctive writing voice, one that allows synthesis of personal experience, opinion, and reading. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Accurately paraphrase short passages while writing a concise summary of an article or book chapter.<br>2. Critically and thoughtfully engage with academic texts through class discussions, writing summaries and responses, and through oral presentations.<br>3. Write a logical, well-organized, and coherent research essay of 5-7 pages with correct citations (minimum of five sources) and sophisticated vocabulary. |

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| **Course Code and Title** | **MATH 161 Calculus 1** |
| *Course Descriptor* | This course covers limits and continuity as well as differentiation and integration of polynomial, rational, trigonometric, logarithmic, exponential and algebraic function. The application areas include slope, velocity, extrema, area, and volume. |
| *Course LOs* | Upon the completion of this course, students are expected to be able to examine and utilize the following notions and methods.<br>1. Use both the limit definition and rules of differentiation to differentiate functions.<br>2. Sketch the graph of a function using asymptotes, critical points, the derivative test for increasing/decreasing functions, and concavity.<br>3. Apply differentiation to solve applied max/min problems.<br>4. Apply differentiation to solve related rates problems.<br>5. Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.<br>6. Apply integration to compute arc lengths, and areas between two curves.<br>7. Use L'Hospital's rule to evaluate certain indefinite forms. |

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|---|---|
| **Course Code and Title** | **PHYS161 Physics I for Scientists and Engineers** |
| *Course Descriptor* | This is an introductory calculus-based course covering Mechanics, Mechanical Waves and Thermodynamics. The students will learn to identify fundamental laws of mechanics and thermodynamics in everyday phenomena and to apply these laws to solving basic physics problems and to describing laboratory experiments. |
| *1. Course LOs* | 1. Think critically and scientifically by applying physics concepts, including from other classes<br>2. The student will gain knowledge and develop the skills to understand, set-up and solve qualitatively physics problems for the basic topics.<br>3. The student will learn the appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in topics listed above.<br>4. The student will improve his/her communicating skills related to this |

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| | course via the reading the textbook and additional materials, doing homework problems, writing laboratory reports and doing optional in-class presentation.<br>5. The student will collect and analyze data and/or information from external sources.<br>6. The student will prepare coherent reports based on the accepted standards presented in class.<br>7. The student will meet the deadlines developing effective learning habits and discipline necessary to promote life-long learning. |
| **Course Code and Title** | **ENG 101 Programming for Engineers** |
| *Course Descriptor* | This is an introductory course for programming essential for Engineering undergraduate study. The module would focus on the development of programming skills that can be directly applied to solve engineering problems where the computer is part of the system, or is used to model a physical or logical system.<br>This module introduces programming as a tool for solving engineering problems through C and Java programming languages. This is an introductory course providing foundational programming to Chemical, Mechanical, Civil and Electrical Engineers.<br>Topics covered include:<br>1) Introduction to computers and programming<br>2) Variables in C, assignment statements, and arithmetic expressions<br>3) Input/output operations and functions<br>4) Operators: rules of operator precedence<br>5) Flow of Control, if-else, switch, while, for, do<br>6) Structured programming<br>7) Arrays & Pointers<br>8) Dynamic Memory Allocation<br>9) Elementary programming in Java<br>10) Methods in Java<br>11) Methods and Arrays in Java<br>12) Objects and Classes |
| *Course LOs* | At the end of the module the learner will be expected to be able to:<br>1. Develop programming solutions to open ended engineering problems.<br>2. Infer alternate solutions to programming problems.<br>3. Develop software specifically using C and Java programming languages.<br>4. Apply knowledge of programming to solve practically relevant engineering problems.<br>5. Use the object oriented concepts to write optimal and efficient codes. |
| **Course Code and Title** | **ENG 100 Introduction to Engineering** |
| *Course Descriptor* | This course introduces students to the foundation and fundamental principles required to become analytical, detail-oriented, and productive engineers. The students will also gain an overview of what engineers do and of the various areas of specialization. Important topics for the engineering profession such as research in engineering, communications, and safety are also introduced. Additionally, students will work together in interdisciplinary groups to research, design, fabricate, test, and deploy a complete engineering project. Through lectures, laboratory practicum and project work, the students will become familiar with the following topics: - Overview of the Engineering Discipline - Engineering Communications - Research Skills - Occupational Health & Safety - Drafting and 3D Modelling - Fundamental Dimensions and Units - Manufacturing (3D Printing and/or others) - Material & Chemical Properties - Hydraulics and Fluids management - Programming - AC/DC circuits |
| *Course LOs* | By the end of the course the student will be expected to be able to: |

1) Explain many of the different specializations of the engineering profession. Be in a position to apply basic research skills in engineering;
2) Program electronic components (e.g., microcontrollers such as Arduino Uno, Raspberry Pi) for sensor components, controllers, and actuators for an engineering system;
3) Design & Visualize engineering components & systems using 3D CAD modelling software;
4) Describe & Apply manufacturing processes for engineering components (e.g. via 3D printing);
5) Explain & Use hydraulics and fluid mechanics properties for fluid processes. Design Assemble and Test engineering systems;
6) Explain various safety issues typical for an engineering environment & Apply safety precautions as required;
7) Apply hands-on approaches to troubleshooting electrical/mechanical/civil/chemical engineering systems. Devise effective teamwork practices for problem solving.

**Course Code and Title** **History of Kazakhstan HST 100**

*Course Descriptor*

This course is a history of the territories which today make up Kazakhstan, from the Mongol conquests to the collapse of the USSR. The course combines a thematic approach with a chronological structure. We will examine two interrelated aspects of the history of the lands that today make up Kazakhstan. Firstly, we will analyze how authority was asserted, recognized, and challenged over the past few centuries. How did modern states emerge? What were the limits of state control over society and culture? What role did religious and national identities play in bringing political communities together and in tearing them apart? Who paid the costs of political and economic modernization? Secondly, we will study the usage of land and other natural resources. How did people assert the right to use land? What tensions did land usage and the exploitation of natural resources cause? What were the economic and environmental effects of land usage?

*Course LOs*

A) Knowledge

1. Knowledge of the basic moments in Kazakhstani history from the post-Mongol period onwards, with a particular focus on the themes of authority and land usage.
2. Basic understanding of key historiographical debates relating to the study of Kazakhstan.
3. Understanding and ability to deploy key concepts relating to the study of Kazakhstani history, including ‘nation’ and ‘class’.

B) Academic skills

1. Ability to analyze a range of primary sources chosen by the instructor, paying particular attention to their context, genre, and authorship.
2. Ability to identify the question, thesis, and methods of a scholarly work in the field of history with the instructor’s guidance.
3. Appreciation of the diversity of scholarly approaches to the study of the past.
4. Ability to extract and systematize information from selected primary and secondary sources.
5. Ability to formulate a thesis and to structure an analytical in-class essay in response to an essay question provided by the instructor.
6. Ability to lead a group discussion on a historical topic
7. Ability to take selective notes on expert presentations, seminars, and readings.

C) Other skills

1. Ability to collaborate with peers in source leadership and in other

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|---|---|
| | classwork.<br>2. Ability to moderate discussion in a medium-sized group.<br>3. Ability to intervene in class in front of a medium audience of peers.<br>4. Self-discipline and self-motivation. |

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|---|---|
| **Course Code and Title** | **MATH 162 Calculus II** |
| *Course Descriptor* | This course covers transcendental functions, advanced integration techniques, improper integrals, area and arc length in polar coordinates, infinite series, power series and Taylor's theorem. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Explain the different specializations of the engineering profession. Be in a position to apply basic research skills in engineering.<br>2. Program electronic components (e.g., microcontrollers such as Arduino Uno, Raspberry Pi) for sensor components, controllers, and actuators for an engineering system.<br>3. Design & Visualize engineering components & systems using 3D CAD modelling software.<br>4. Describe & Apply manufacturing processes for engineering components (e.g. via 3D printing).<br>5. Explain & Use hydraulics and fluid mechanics properties for fluid processes. Design, Assemble and Test engineering systems.<br>6. Explain various safety issues typical for an engineering environment & Apply safety precautions as required.<br>7. Apply hands-on approaches to troubleshooting electrical/mechanical/civil/chemical engineering systems. Devise effective teamwork practices for problem solving. |

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| **Course Code and Title** | **ENG 103 Engineering Materials II** |
| *Course Descriptor* | The module covers the fundamentals of materials science and engineering. These include the understanding of the material structure from the atomic to micro to macro levels. The effects of the structure and the processing techniques on the material properties will be discussed. These concepts will be illustrated using methods to allow students to utilize the knowledge for materials selection in common engineering applications. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Explain the influence of microscopic structure or defects on material properties.<br>2. Describe the processing and applications of common engineering materials including polymers, biomaterials, metals & their alloys.<br>3. Conduct appropriate destructive and non-destructive tests to determine properties of materials.<br>4. Describe the mechanisms leading to malfunction. |

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| **Course Code and Title** | **PHYS 162 Physics II for Scientists and Engineers** |
| *Course Descriptor* | This is an introductory calculus-based course covering Electricity, Magnetism and elements of Optics. The students will learn to identify fundamental laws in everyday electromagnetic phenomena and to apply these laws to solving basic physics problems and to describing laboratory experiments. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Think critically and scientifically by applying physics concepts, including from other classes.<br>2. The student will gain knowledge and develop the skills to understand, set-up and solve qualitatively physics problems for the basic topics.<br>3. The student will learn the appropriate mathematical techniques and |

concepts to obtain quantitative solutions to problems in topics listed above.
4. The student will improve his/her communicating skills related to this course via the reading the textbook and additional materials, doing homework problems, writing laboratory reports and doing optional in-class presentation.
5. The student will collect and analyze data and/or information from external sources.
6. The student will prepare coherent reports based on the accepted standards presented in class.
7. The student will meet the deadlines developing effective learning habits and discipline necessary to promote life-long learning.

| **Course Code and Title** | **Kazakh I** |
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| *Course Descriptor* | In this course, students will develop or continue to develop advanced linguistic competencies in four areas: listening, reading, writing and speaking. They will work with materials for level B2 and learn to give opinions on different topics, analyze the text, compare statistical data and write an essay. Hence they will learn vocabulary and grammar appropriately each theme. Furthermore they will additionally learn new terms demonstrating Kazakh culture in this course. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Discuss issues on topics included in the syllabus, give detailed answers and provide an opinion on the topics;<br>2. Formulate main idea and report on the texts for upper-intermediate level;<br>3. Synthesize info and arguments from a number of sources;<br>4. Critically analyze and evaluate papers for general public with consideration of principles of unity, coherence, tone, persona, purpose, methods;<br>5. Follow the discussion on matters related to their field and understand in detail the points given prominence by the speaker;<br>6. Make a descriptive and comparative report/diagram/chart;<br>7. Argue with good grammatical control without much sign of having to restrict what they want to say;<br>8. Make well-structured project presentation with introduction, main body, conclusion and reference;<br>9. Make own judgement in planning, problem solving and make a decision in different social and cultural situations. |

| **Course Code and Title** | **SHSS 210 Technical Writing** |
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| *Course Descriptor* | This course presents students with practical information about communicating in different kinds of workplace environments and professional and technical discourse communities. This course highlights the key characteristics of technical writing and emphasizes the importance of planning, drafting, and revising texts. Students will analyze and produce common technical writing genres, and react to rhetorical situations each genre presents, including issues of audience, organization, visual design, style, and the production of texts. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Identify and understand the structures and functions of the primary genres of technical writing.<br>2. Analyze and adapt to the constraints of specific rhetorical situations, including audiences.<br>3. Purposes, modality, and use.<br>4. Integrate tables, figures, and other images into documents.<br>5. Produce and present technical documents, including research reports, that are accessible to non-specialist audiences and demonstrate the ethical use of sources and appropriate citation conventions. |

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| **Course Code and Title** | **ENG 200 Engineering Mathematics - Differential Equations & Linear algebra** |
| *Course Descriptor* | An introduction to ordinary differential equations and linear algebra. Topics covered include<br>a) Differential equations of first- and second-order;<br>b) Series solution of differential equations;<br>c) Laplace transforms and its application to the solution of initial value problems;<br>d) Some of the important special functions;<br>e) Linear algebra applications. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Solve first- and second-order differential equations analytically using standard techniques.<br>2. Model simple physical situations encountered in engineering using first- and second-order differential equations.<br>3. Use Laplace transform techniques to solve first- and second-order initial value problems.<br>4. Recognise a number of the higher transcendental functions of mathematics.<br>5. Solve second-order linear differential equations using series solutions.<br>6. Find general solutions to linear algebraic equation systems.<br>7. Use Mathematica for both calculus and linear algebraic applications. |

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| **Course Code and Title** | **PHIL 210 Ethics** |
| *Course Descriptor* | This course will focus on the philosophical study of ethics. It will peruse questions such as 'How do we acquire moral knowledge?', 'What kind of life is a good life?', 'Is ethics relative or universal?' and 'Is ethics an expression of human sentiment or is it a kind of knowledge?' 'Why should I be moral?', 'Can morality survive without religion?', 'What is wrong with slavery?". The courses aims are, first, to help you to understand philosophical arguments, and, second, to encourage you to reflect on ethical questions. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Hone skills at reason giving and providing arguments<br>2. Engaging with novel ideas, exploring intellectual problems in depth, and writing clearly<br>3. The development of intellectual virtues, such as open-mindedness, intellectual courage, fairmindedness, intellectual charity, and inquisitiveness. |

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| **Course Code and Title** | **PHIL 211 Practical Ethics** |
| *Course Descriptor* | Practical Ethics will draw on research in moral psychology, applied ethics, and virtue theory which have brought to light that environments sometimes have a profound impact on people's moral behavior. The course will help students understand the factors that influence moral and immoral behavior in both others and themselves and help them understand how environments, social structures and cultures can be designed in order to promote moral behavior. It will also consider issues like whether such "moral engineering" is morally justifiable. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Apply theoretical models to real world scenarios in the pursuit of promoting moral behavior.<br>2. Identify environmental factors that can lead to moral failures and successes in individuals, groups, and organizations.<br>3. To propose changes that could be made in order to promote better moral behavior. |

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| **Course Code and Title** | **PHIL 212 Ethical Reasoning** |
| *Course Descriptor* | To become a truly good person one must learn to think and reason ethically whenever faced with a diversity of problematic situations and practical matters in private and public life. This course on ethical reasoning integrates ethical questions from other courses into an intellectual pattern that guides students through the maze of circumstances in which skills to reason well and morally right often prove critical. Learning the essentials of rational argument, critical thinking and nature of social decisions gives students vital advantages to evaluate problematic situations, formulate arguments and to create novel problem-solving methods that can resolve moral dilemmas and alleviate value-laden tensions. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Evaluate the nature of ethically problematic situations.<br>2. Identify sustainable strategies to avoid hazardous social and cognitive biases and other factors that degrade our thoughts, cultures and societies, groups, and organizations.<br>3. Create novel problem-solving methods that can resolve moral dilemmas and alleviate value-laden tensions. |

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| **Course Code and Title** | **ENG 202 Numerical Methods in Engineering** |
| *Course Descriptor* | This course will introduce students to various numerical techniques currently used by practicing engineers and to give them a sound underpinning knowledge of the workings of these techniques. How computer programs aid in the use of numerical methods will also be demonstrated. |
| *Course LOs* | At the end of the course the learner will be expected to be able to:<br>1. Solve systems of linear equations using numerical methods.<br>2. Compute quadratures using numerical methods.<br>3. Solve ordinary and partial differential equations using numerical methods.<br>4. Analyze a mathematical problem and determine which numerical technique to use to solve it.<br>5. Apply logical commands in coding a mathematical problem in algorithmic form.<br>6. Incorporate MATLAB and Mathematica into numerical solutions. |

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| **Course Code and Title** | **ENG 201 Applied Statistics** |
| *Course Descriptor* | This course provides an introduction to basic probability theory and statistics. Topics include sample spaces, events, classical and axiomatic definition of probability, conditional probability, independence, expectation and conditional expectation, variance, distributions of discrete and continuous random variables, joint distributions, central limit theorem, descriptive statistics, confidence interval estimation, and hypothesis testing. |
| *Course LOs* | After successfully completing this course, the students will be able to:<br>1. Describe various interpretations of probability and the difference between discrete random variables.<br>2. List important continuous and discrete distributions.<br>3. Compute descriptive statistics and summarize a dataset.<br>4. Compute confidence intervals and conduct hypothesis tests.<br>5. Use software for basic statistical analysis. |

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| **Course Code and Title** | **Fundamentals of Entrepreneurship and Management** |
| *Course Descriptor* | This course introduces students to the fundamentals of entrepreneurship. It covers topics including opportunity identification, idea generation, building business models and plans, to presenting ideas. We will discuss |

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| | the role of entrepreneurial activity in Kazakhstan's economy. The course is a guide to high-growth entrepreneurship, combining theoretical frameworks with cases and practice-oriented exercises. |
| *Course LOs* | By the end of the course the student will be expected to:<br>1. Comprehend basic concepts of the entrepreneurial process.<br>2. Comprehend basic tools for the analysis of the entrepreneurial process.<br>3. Apply those concepts as part of a working team in the development, reporting and presentation of a business plan. |

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| **Course Code and Title** | **KAZ 264 Language and Ethnicity** |
| *Course Descriptor* | Developed for the «C1» level, this course is intended for studying an ethnos through language units preserved in its vocabulary. During this course, the students will study and analyze ethnocultural lexis (words, word combinations, fixed phrases, proverbs, historical texts). By means of these analysis, they will learn about perceptions, psychology, character, and preferences of the Kazakh people.<br>The students are going to identify and analyze extralinguistic factors that have influenced the formation of national cultural lexis. As a result, they will have learned that the national lexis can provide information about the nation and also the ways to analyze it. Besides, the knowledge of identifying national cultural peculiarities that the students are going to gain in this course can be used in their study of other languages.<br>As course materials, the students are going to read oral literature and ethnographic texts and work with ethnolinguistic, etymology and dialect dictionaries. |
| *Course LOs* | 1. To develop and use the norms of intellectual language competences through understanding the connection between the language and national mentality and culture.<br>2. To use the national perceptions and knowledge for personal development, preparation of qualitative proposals and effective decision-making.<br>3. To be skilled to use interlanguage communication principles as a tool of development business responsibility.<br>4. To learn using the national values as a source of information and creative source of development the business responsibility.<br>5. To develop skills in analyzing deeper national cultural layers of the Kazakh language, using it in different social and cultural situations. |

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| **Course Code and Title** | **ECON 323 Managerial Economics** |
| *Course Descriptor* | The goal of this course is to learn how to apply microeconomic principles and quantitative tools to managerial decisions. It covers issues like demand analysis, production and cost analysis, and pricing strategy. By doing so, this course helps students develop strategies and tools for solving a wide variety of issues and problems that managers face. Students who successfully complete this course are expected to make an accurate evaluation of external business environment and create value within various organizational settings. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Make an accurate evaluation of external business environment.<br>2. Create value within various organizational settings. |

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| **Course Code and Title** | **ENG 400 Capstone Project** |
| *Course Descriptor* | The capstone project is the culminating experience of the student's engineering program and provides students with the opportunity to apply and integrate their knowledge and skills gained from earlier years. This is achieved in a context of a year-long and substantial engineering project related to the student's discipline area. Students will take the responsibility |

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| | to organize, plan and carry-out the various tasks required for successful completion of the project. Wherever possible, projects will be sourced from industry partners. Projects may be undertaken by individual students or in small teams.<br>At the completion of the unit, students will hand over their project deliverables and present project outcomes in a report as well as end-of-semester oral presentation and defense. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Evaluate and perform survey to propose an open design or research problem<br>2. Extensively criticize and apply Engineering research methods to evaluate feasibility of a diverse set of solutions.<br>3. Design, interpret, and invent to meet design specifications of a real-life engineering problem.<br>4. Effectively develop and construct project implementation plans.<br>5. Produce and develop a well written capstone project report and project presentation.<br>6. Prove ability to communicate effectively with all stakeholders in an ethical and professional manner and confidently defend ideas and proposals to the project client and university audiences. |

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| **Course Code and Title** | **ENG 301/ ENG 300 Interdisciplinary Design Project / Research Practice** |
| *Course Descriptor* | In this course students work in interdisciplinary teams toward a holistic approach to design projects; including problem definition, design proposal, implementation and critical evaluation. The course explores design research and practice within social and economic contexts; including the ethical, cultural, and environmental impacts of design decisions, intellectual property considerations, and aspects of appropriate professional conduct. The course will focus on tools and skill sets that are particularly important for succeeding in a design project, including planning, teamwork, project management, and design reporting. Where possible, it is expected that the projects will include an industrial partner, who will provide realistic industrial problems and support them with necessary guidance and resources. This course requires students form and work in groups of 5 or more in size. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Apply the knowledge acquired in earlier courses in the study of a complex design problem<br>2. Identify the requirements, which have to be fulfilled by possible solutions (‘designs’) to solve the earlier identified design problem<br>3. Develop solutions for a complex design problem. These solutions should be well argued, if the data allow, also quantified and applicable in practice (by the final customer, if available)<br>4. Present and defend team results<br>5. Perform teamwork in such a way that the project goals are fulfilled<br>6. Effectively manage a project |

**Discipline Subject Course**

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| **Course Code and Title** | **CHME 200 Basic Principles and Calculations in Chemical Engineering** |
| *Course Descriptor* | This course is designed to introduce the Chemical Engineering students the basic chemical engineering concepts and methods of system analysis. The topics in this course will include introduction to engineering calculations, process and process variable, fundamentals of material balances, single- and multi-phase systems, and energy balances related to reactive and non-reactive systems. Some case studies of chemical process industries will also be analyzed in more details. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Explain basic concepts associated with chemical processes and apply unit conversion.<br>2. Analyze processes as systems, where inputs and outputs are in balance as a whole.<br>3. Perform material balance for single- and multi-phase systems.<br>4. Perform energy balance within reactive and non-reactive systems.<br>5. Apply accumulated knowledge into real systems of chemical industries. |

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| **Course Code and Title** | **CHME 222 Inorganic and Analytical Chemistry** |
| *Course Descriptor* | Introduction to the fundamental concepts of inorganic and analytical chemistry such as atomic structure, classification of compounds and chemical bonding to be followed by a rigorous approach to chemical thermodynamics and kinetics, and basics of quantitative and qualitative analytical chemistry. It is expected that students have a working knowledge of differential and integral calculus or equivalent. |
| *Course LOs* | By the end of the course the student will be able to:<br>1. Explain the basic principles of inorganic chemistry.<br>2. Describe the basics of some analytical chemistry methods.<br>3. Design an appropriate methodology and produce usable results.<br>4. Draw logical conclusions and explain the accuracy and limitations of the methods used. |

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| **Course Code and Title** | **CHME 203 Organic and Polymer Chemistry** |
| *Course Descriptor* | This module deals primarily with the basic principles to understand the structure and reactivity of organic molecules, including physical shape, stereochemistry and reactivity of common organic molecules, and covers the basic principles of polymer chemistry and processing. The module primarily deals with the basic principles of organic molecules structure, classification, nomenclature and reactivity. Emphasis is on substitution and elimination reactions and chemistry of various functional groups, and basic concepts of organic synthesis, classification of polymers and general considerations; polymerization and its mechanisms; description of properties; polymer and composites technology and applications, degradation and stabilization of polymers. Laboratory works designed in accordance with the above content and aims will be conducted. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Describe the basic principles of organic chemistry.<br>2. Explain the notions of chemical reactivity.<br>3. Explain the geometries and structures of carbon based compounds, the tetravalence of carbon atoms, and the local geometries that result from sp, sp2, and sp3 hybridization.<br>4. Identify the common and important functional groups in organic compounds, composition and structures of hydrocarbon compounds and geometric isomerism, organic chemistry reaction mechanisms: substitution, elimination, and addition reactions, structures, and reactions of alkanes, alkenes, alkynes, alcohols, and aromatic compounds.<br>5. Describe the basic principles of polymer chemistry and processing, mechanisms of polymerization and related processes. |

| **Course Code and Title** | **CHME 201 Chemical Engineering Thermodynamics** |
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| *Course Descriptor* | The course covers phase equilibrium problems and modeling, the concepts of chemical potential and fugacity, flash calculations, interpretation of experimental data and selection of appropriate models to describe thermodynamics of mixtures with multiple phases and chemical reaction equilibrium. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Estimate physical and thermodynamic properties of pure substances and mixtures using fundamental thermodynamic equations<br>2. Describe the concepts of chemical potential, fugacity, and activity coefficients.<br>3. Utilize phase equilibrium diagrams.<br>4. Select the appropriate models and equations of state (hereinafter - EoS) for calculating phase equilibria.<br>5. Perform flash calculations. |

| **Course Code and Title** | **CHME 202 Fluid Mechanics** |
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| *Course Descriptor* | Engineering is becoming increasingly international and competitive and customers are expecting products of high quality and reliability. Knowledge of Fluid Mechanics is critical for any engineer involved in the design of processes. After completion of this module students will gain an understanding and expertise in the use of dimensional analysis, integral form of linear and angular momentum equations, calculation of complex fluid flow systems, flows around immersed bodies and free-surface flows. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Apply the basic principles of static and fluid systems on the systems.<br>2. Apply dimensional analysis and similarity solutions under problems of scaling and selection of equipment.<br>3. Solve basic fluid flow problems.<br>4. Determine flow rate, pressure drops and required pump characteristics for the typical system consisting of tanks, vessels, pipes, pumps and fitting elements.<br>5. Assess the impact of the fluid flow characteristics on the rate of mixing processes and chemical reactions. |

| **Course Code and Title** | **CHME 302 Instrumental Methods of Analysis for Engineers** |
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| *Course Descriptor* | This course is designed as a broad base introduction to analytical instrumentation techniques for the measurement of different chemical, physical, properties of compounds and materials (composition, structure, etc.). Fundamentals and applications of various modern analytical and measurement techniques will be discussed, as well as principles of operation. The lectures focus on chemical and physical principles which are used during analytical measurements. Approaches to improve accuracy, precision and sensitivity will be discussed as well. The course will highlight specific applications in Chemical Engineering. The course has a laboratory ("hands-on") component, during which the students will perform analyses by themselves, utilizing GC (gas chromatography) and HPLC (liquid chromatography), and possible NMR and MS as well. Students may have a chance to learn about other instruments related to material, environmental and biomedical sciences. The lectures will follow a well-known textbook. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Operate analytical instruments.<br>2. Evaluate the outcome of analytical measurements. |

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| | 3. Design improved methodologies for instrumental analysis.<br>4. Comprehend potential importance of analytical methods and data.<br>5. Present the results in writing and orally. |

| **Course Code and Title** | **CHME 300 Heat and Mass Transfer** |
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| *Course Descriptor* | This course provides students with a fundamental principles and equations governing heat and mass transfer to establish a framework for design, control and optimization of unit operations referred to chemical engineering practice. The major focus of this course is three basic mechanisms of heat transfer (conduction, convection, and radiation) and mass transfer processes controlled by diffusion or convection. Furthermore, simultaneous heat and mass transfer cases will be included into a consideration. The course will also serve developing of engineering models especially when integrating multi-discipline subjects. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Classify typical equipment and processes in which control of the heat or mass transfer constitutes a dominant factor.<br>2. Select the basic experimental techniques to determine heat and mass transfer rates.<br>3. Apply the appropriate model for the selected heat and mass problem, solve the appropriate equations and<br>4. Find the key factors for the design of heat and mass transfer equipment.<br>5. Select and size the most appropriate heat exchanger type for a specific task. |

| **Course Code and Title** | **CHME 301 Applied Mathematics for Process Design** |
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| *Course Descriptor* | This course covers analytical and numerical methods for modeling physical and chemical processes with a focus on chemical and materials engineering applications. The major topics in this course will include solution of ordinary differential equations, boundary value problems, partial differential equations, parameter estimation and optimization. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Compute the solution of initial and boundary value problems for ordinary differential equations describing the heat/mass transfer combined with chemical reaction.<br>2. Solve analytically or numerically the basic partial differential equations arising in chemical and materials process design.<br>3. Determine parameters in mathematical models using experimental data.<br>4. Apply optimization techniques to obtain optimal design parameters. |

| **Course Code and Title** | **CHME 305 Chemical Engineering Lab I** |
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| *Course Descriptor* | The course is to provide laboratory experience in several important chemical/materials engineering unit operations involving momentum, heat and mass transfer. The course includes the design of experiment, its experimental execution, analysis of obtained data, report writing as well as development of skills in oral presentation and teamwork. The topics covered include: Chemical Engineering Thermodynamics; Heat Transfer; Environmental engineering; Instrumental analysis; Fluid mechanics. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Translate theoretical knowledge into experimental design.<br>2. Use experimental and analytical equipment.<br>3. Design experiments using factorial design methods.<br>4. Write professional technical reports.<br>5. Work in groups and to present technical results verbally. |

| **Course Code and Title** | **CHME 303 Separation Processes** |
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| *Course Descriptor* | Separation Processes a core subject in chemical engineering education. It provides fundamental knowledge in operation and designing of several processes used for separation of gases, liquids and solids from mixtures. Separation Processes course cover the fundamentals of mass transfer operations, i.e. equilibrium-stage and rate (diffusional) processes that involve liquid, gaseous and solid phases as well as the principles of mechanical processes. Topics include continuous distillation, adsorption/ion exchange, solid-liquid extraction, liquid-liquid extraction and selected mechanical separation processes as filtration and clarification/sedimentation. Computer labs and laboratory experiments compliment the lectures part of the course. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Analyze appropriate mass transfer separation processes involving fluid and solid phases using experimental, tabulated, literature and other numerical data.<br>2. Justify the selection of appropriate equipment for mass transfer separation processes involving fluid and solid phases in process plants.<br>3. Design separation systems using computer modelling or specialized software. |

| **Course Code and Title** | **CHME 304 Chemical Reaction Engineering** |
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| *Course Descriptor* | Chemical Reaction Engineering is the core subject in chemical engineering education. It provides fundamental knowledge in operation and designing of chemical reactors. The technical knowledge obtained in this course can be applied to most chemical industries. Specifically, this course covers the topics of rate laws and stoichiometry, mass & energy balances, conversion and reactor sizing, isothermal reactor design, multiple reactor sequences, design for multiple reactions, autocatalytic reactions, catalytic and non-catalytic heterogeneous reaction systems. Emphasis is given on algorithm development and problem solving. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Interpret kinetic data and expressions.<br>2. Size the most appropriate reactor type for a specific task.<br>3. Define the most effective reactor sequence.<br>4. Relate the flow regime with the efficiency of a reactor for multiple reactions.<br>5. Articulate a chemical reaction engineering project in front of an audience. |

| **Course Code and Title** | **CHME 401 Chemical Engineering Lab II** |
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| *Course Descriptor* | The course is to provide laboratory experience in several important chemical/materials engineering core subjects. The course includes the design of experiment, its experimental execution, analysis of obtained data, report writing as well as development of skills in oral presentation and teamwork. The topics covered include: Separation processes; Chemical reaction engineering; Instrumental analysis; Heat transfer; Fluid Mechanics. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Translate theoretical knowledge into experimental design.<br>2. Operate experimental and analytical equipment.<br>3. Design experiments using factorial design methods.<br>4. Write professional technical reports.<br>5. Present technical results verbally as a team. |

| **Course Code and Title** | **CHME 400 Process Design and Simulation** |
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| *Course Descriptor* | This course focuses on the development of process flowsheet, their implementation into commercial software and their use for process evaluation. The course starts with a brief review of applied chemical engineering thermodynamics focusing on process simulation thermodynamics. The students will be trained on selecting a proper thermodynamic model for a given process or a mixture of compounds. The principles for process design including synthesis of separation and reaction systems will be discussed. A novel approach in modeling separation units namely "Rate-Based Model" is introduced to the students. Then, several unit operation models (mixers and splitters, pressure change units, heat exchangers, phase separation, distillation columns, chemical reactors) are presented, with focus on their use for solving rating and design problems. The sequential-modular approaches to simulation of the entire flowsheet are discussed and some troubleshooting methods to deal with convergence failures for Design Spec, Calculator Blocks and Recycle streams are presented. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Select the most suitable thermodynamic models for predicting mixture phase equilibrium.<br>2. Design the concept a process using Enhanced Distillation concept, Distillation/Extraction Ternary Diagram, Rate-Based model for reactive absorption and reactive distillation, and catalytic reactors.<br>3. Build a simulation model of an entire chemical process including material recycle and perform convergence troubleshooting.<br>4. Critique the key design variables and suggest design changes, with the aim of individual unit operation and process optimization.<br>5. Present technical results verbally and in written as a team. |

| **Course Code and Title** | **CHME 403 Chemical Process Control and Safety** |
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| *Course Descriptor* | To ensure safe and normal chemical process operations, dynamic responses of process systems and the related risks need to be well studied and understood. The very basic objective of this course is to train future chemical engineers to be aware of these issues for safer, cleaner, and automatic processes operations. This course would train the students about the theory and application of control systems and safety in different fields of chemical and oil and gas engineering. The course aims to provide a detailed understanding of basic control theories, safety and risk concepts, hazard identification, risk modeling and simulation, fire and explosion modeling, exposure modeling, basic design of instrumentation and control for process safety, and more recent advancement in the field of risk and reliability engineering. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Describe the basic terms and definition in safety and risk, and process control.<br>2. Explain layers of protection, i.e., basic process control systems, alarms, safety instrumented systems, physical protection, and emergency responses in the domain of chemical process engineering.<br>3. Describe the fire and explosion modeling and exposure modeling approaches.<br>4. Utilize the methodologies for analysis, optimization and design of simple process control systems.<br>5. Apply basic control engineering theories, risk-based approaches, and reliability concepts to design safe and reliable chemical process systems.<br>6. Present a design project in front of audience in the related domain. |

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| **Course Code and Title** | **CHME 402 Materials Chemistry** |
| *Course Descriptor* | This course presents our contemporary knowledge of inorganic, organic and nano-based materials, with emphasis on structure/property relationships. The aim is to provide sufficient breadth and depth coverage of the rapidly evolving field of materials science, particularly materials chemistry. Materials chemistry will be categorized as: Solid state chemistry (e.g. crystalline and amorphous solids, crystalline unit cells, crystallography), Metals (e.g., metallic structures, magnetism, Fe-C materials (steel), and shape-memory alloys), Semiconductors (e.g., silicon wafers, photovoltaics and fabrication of integrated circuits), Polymeric materials (e.g., mechanisms of polymerization, polymer additives such as flame retardants, and new developments like self-repairing polymers), and Nanomaterials (e.g., one- and two-dimensional nanostructures (graphene)). Applications will be taken from the latest scientific literature. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Appraise newly acquired knowledge to evaluate and prioritize engineering problems related to synthesis and chemistry of materials.<br>2. Create inventive methods to improve or optimize chemical processes, aiming at enhanced properties and performances of the materials which are produced.<br>3. Critically evaluate contemporary issues related to materials science/chemistry.<br>4. Explain the impact of established and new developments in materials science/chemistry in a global, economic, environmental and societal context.<br>5. Present the results in writing and orally |

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| **Course Code and Title** | **CHME 450 Atmospheric Chemistry and Physics** |
| *Course Descriptor* | This course will cover the evolution of the atmosphere from its initial formation to its natural background condition to its current state perturbed by human activities; the chemistry of the carbon, nitrogen, and sulfur cycles; tropospheric gas-phase chemistry; tropospheric heterogeneous chemistry; stratospheric chemistry; and characterization of the atmospheric aerosol and its role in heterogeneous reactions and materials transport. The course will detail the chemistry and physics of current atmospheric pollution issues, including urban smog, acid rain, global warming, stratospheric ozone depletion, visibility, and indoor air quality. The course strongly incorporates research into teaching and is tied with its laboratory and field measurements. The laboratory and field measurements help the students to learn about gas and aerosol instrumentations and their applications on indoor/outdoor air monitoring and conduct research in this field. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Justify atmospheric processes both conceptually and mathematically using physical chemistry, notably kinetics, thermodynamics and transport phenomena principles.<br>2. Asses the qualitative and quantitative changes to the atmospheric environment induced by anthropogenic activities.<br>3. Explain the underlying science of key environmental issues such as stratospheric ozone depletion, acid rain, tropospheric smog, and global warming.<br>4. Operate aerosol and gas instrumentations.<br>5. Report their research findings in the form of a research article and present them to peers. |

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| **Course Code and Title** | **CHME 351 Environment and Development** |
| *Course Descriptor* | A discussion on the greenhouse effect without considering the matter of energy would be incomplete; a review of nuclear energy without looking at waste disposal solutions would be insufficient. Above all, addressing |

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| | environmental issues without examining the interpretation, content, and context of development would be futile. In this course, human activities and their ongoing and dialectic interactions with the environment are presented. Through the use of recent data and case studies, the connection between human development and the associated reactions in the environment are examined along with engineering solutions proposed to achieve a harmonic coexistence of man and nature. Sustainable development, related research findings, and the relevant international environmental policies are recurring topics throughout. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Describe the main principles of environmental legislation.<br>2. Relate human activities with environmental problems and propose proper solutions.<br>3. Show relevance of extraterrestrial environment phenomena with Earth ones.<br>4. Explain the various interpretations of the development concept as well as alternative pathways to sustainable development.<br>5. Articulate a project in front of an audience. |

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| **Course Code and Title** | **CHME 352 Process Design for Environmental Applications** |
| *Course Descriptor* | In this course, three important heterogeneous processes, namely, adsorption, ion exchange and catalysis, are presented along with their environmental applications. The course is design to extend the students' knowledge on the heterogeneous diffusion-driven fluid-solid operations and then focus on their environmental applications in gaseous emissions and wastewater treatment. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Describe air and water pollution phenomena.<br>2. Design catalytic systems for air pollution control.<br>3. Develop adsorption and ion exchange systems for wastewater treatment. |

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| **Course Code and Title** | **CHME 353 Electrochemical Engineering** |
| *Course Descriptor* | This course is designed for both undergraduate and graduate engineering students and engineers, and will cover aspects of the electrochemical cell (EC), its theory and applications; major industrial electrochemical processes (electrolytic production of metals, corrosion protection and batteries). This course will also enable students to gain hands on experience in experiments in corrosion protection, batteries, fuel cells and electrolysis. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Design relevant systems and processes though obtained knowledge.<br>2. Applying electrochemical calculations and experimental skills for related industrial and research tasks.<br>3. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions. |

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| **Course Code and Title** | **CHME 451 Advanced Process Simulation** |
| *Course Descriptor* | The objective of this course is to introduce special topics in process simulation to chemical engineering students to perform the simulation and optimization of complex chemical plants. The content of this course would be applicable to different chemical industries such as petrochemical, oil and gas. The course utilizes a state of the art commercial software, Aspen |

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| | Plus that is implemented in chemical industries to prepare the students to be involved in real industrial design projects. The course starts with detailed discussions and practice on applied chemical engineering thermodynamics engaged with process simulation at an advanced level including discussions on advanced equation of state models, binary interaction parameters, data regression and electrolyte systems. Then a hierarchy for process optimization including energy optimization using Aspen Energy Analyzer module, exchanger design using Aspen Exchanger Design and Rating module and cost analysis using Aspen Economic Analyzer module will be presented. At the end, simulation of solids in Aspen Plus will be presented. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Perform data regression to tune thermodynamic model parameters for electrolyte and non-electrolyte systems.<br>2. Design cost optimized shell and tube heat exchangers/ condensers and reboilers using available commercial software.<br>3. Modify the existing flowsheet heat exchanger network to minimize energy consumption using energy analyzing software.<br>4. Select final plant design by performing total plant cost estimation for various design options.<br>5. Present technical results verbally and in written form. |

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| **Course Code and Title** | **CHME 452 Industrial Wastewater Treatment and Reclamation** |
| *Course Descriptor* | The increasing energy demand over the past decades has resulted in a corresponding growth and expansion in the production and processing of crude petroleum and natural gas. The proliferation of such large scale industrial complexes combined with the increasingly stringent environmental legislation underscores the need for a dedicated course on petroleum refining water/wastewater use and management. This is an environmental engineering course designed for chemical engineers and is designed to provide the fundamentals of pollution control for tomorrow's chemical engineer with focus on petroleum refineries. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Explain the implications of pollution on water bodies<br>2. Appraise different types of refinery water and wastewater.<br>3. Critique best available techniques for water pollution prevention and wastewater reclamation, including sludge management.<br>4. Justify the selection of technologies for petroleum refineries.<br>5. Conceptually design wastewater treatment processes<br>6. Evaluate alternative wastewater treatment schemes using specialized software. |

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| **Course Code and Title** | **CHME 453 Multiphase Systems** |
| *Course Descriptor* | The course will establish the principles of flow and heat transfer in gas/liquid systems and the principles of design methods. The course aims the application of the appropriate basic principles, engineering models and equations of multi-phase systems to the analysis of the industrial problems, particularly, in oil & gas technologies. Also this course implies modeling of gas/liquid flow with aid of multiphase flow simulator. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Discriminate flow pattern and hydraulic resistance for typical gas-liquid flows.<br>2. Compare the basic principles, engineering models and equations of gas-liquid flows to apply the most relevant one for a given situation.<br>3. Evaluate conditions for critical flux and other effects associated with boiling and condensations.<br>4. Simulate the gas/liquid system with the aid of multiphase flow |

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| | simulator.<br>5. Perform basic calculations on pipelines and wellbores. |

| **Course Code and Title** | **CHME 454 Advanced Transport Phenomena** |
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| *Course Descriptor* | The course aims to provide an in depth knowledge of heat, mass and momentum transport that is necessary in assessing, analyzing and developing typical chemical engineering and environmental technologies. The course focuses on modeling momentum, heat & mass transfer processes using analytical and numerical solutions of the partial differential equations of transport phenomena. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Assess the similarities between the transport processes and the effect of properties of the media on the overall process.<br>2. Develop the model of selected transport phenomena and obtain analytical or numerical solutions of the appropriate partial differential equations<br>3. Develop and solve the model describing the combined effect of heat, mass and momentum transport in a typical chemical engineering equipment (heat exchanger, catalyst bed, chemical reactor, etc.). |

| **Course Code and Title** | **CHME 455 Heterogeneous Reactor Engineering** |
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| *Course Descriptor* | The main objective of this course is to complete the knowledge of undergraduate students on the design of chemical reactors by introducing the subject of heterogeneous reaction systems. After completing the course, the students must be able to develop kinetic expressions for surface catalytic reactions; understand catalyst properties and characterization techniques; identify and deal with external and internal heat and mass transfer phenomena for catalytic reactors; design heterogeneous reactors. The modern catalytic reactors such as membrane and honeycomb monolith reactors are also discussed. Emphasis is given on algorithm development and problem solving. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Interpret kinetic data and expressions for catalytic reactions.<br>2. Identify important catalyst properties and relevant characterization techniques.<br>3. Evaluate external and internal heat and mass transfer resistances.<br>4. Design heterogeneous reactors.<br>5. Articulate a chemical reaction engineering project in front of an audience. |

| **Course Code and Title** | **CHME 458 Corrosion Protection in Oil and Gas Industry** |
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| *Course Descriptor* | This course is designed for undergraduate engineering students and engineers, and will cover aspects of corrosion theory and practice, including theories of electrochemical and non-electrochemical corrosion, underground and practical application of various corrosion protection techniques specific for oil & gas industry. Basic aspects of design and engineering for corrosion prevention will be discussed. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Describe the concepts and theory of corrosion<br>2. Apply the theory of corrosion for practical problems. |

| **Course Code and Title** | **CHME 456 Colloids and Surface Science** |
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| *Course Descriptor* | The theoretical knowledge of colloids and surface sciences has advanced significantly during the last two decades and is now practically applied at a wide level in industries related to paints, polymers, nanomaterials, biotechnology, catalysis, waste treatment, etc. This course covers the |

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| | fundamentals of the colloids and forces governing colloidal stability, in addition to the other related phenomena such as surface tension effects and biological applications of colloids. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Apply the knowledge of thermodynamics to surfaces and colloid particles.<br>2. Describe the effectiveness of surfactants based on its structure.<br>3. Analyze the stability of colloidal particles based on DLVO theory and its applications in biological, chemical and environmental industries.<br>4. Perform calculations on diffusion and sedimentation of nanoparticles. |

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| **Course Code and Title** | **CHME 459 Biomechanics** |
| *Course Descriptor* | This course is designed to cover the basics and applications of biomechanics principals (i.e. kinematic, dynamic, static). The topics in this course will include skeletal muscle system, biomechanics of lower and upper extremity bones, spine biomechanics as well as cell biomechanics. More specifically, the students are expected to learn about biomechanics of bone, articular cartilage, tendons and ligaments, peripheral nerves and spinal nerve roots, skeletal muscle, knee, hip, foot and ankle, lumbar spine, cervical spine, shoulder, elbow, wrist and hand, fracture fixation, arthroplasty, and gait. Recent advances and major problems relevant to cell/tissue/organ biomechanics will also be presented and discussed. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Define the basics of mechanic concepts<br>2. Describe the function, structure and composition of body components in relation to biomechanical properties<br>3. Describe the forces applied to body parts during locomotion, exercise or under load and calculate their limits to stay uninjured<br>4. Design and develop devices related to orthopedic applications<br>5. Perform literature survey on relevant topics and present their results in front of audience |

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| **Course Code and Title** | **CHME 421 Tissue Engineering** |
| *Course Descriptor* | This course is designed to cover the basics and applications of tissue engineering as an emerging therapeutic approach to treat degenerated or damaged tissues/organs. The topics in this course will include tissue engineering strategies such as the design, fabrication and utilization of biomaterials; cellular engineering including cell therapy, drug delivery; as well as cell-biomaterial interactions. Recent advances and major problems relevant to tissue engineering will also be presented and discussed. |
| *Course LOs* | By the end of the course the student will be expected to be able to:<br>1. Describe the structure, function and composition of human body components.<br>2. Define basic concepts (biomaterials, cells, biomolecules) associated with tissue engineering.<br>3. design scaffolds for various tissues and investigate the interaction between biomaterials and cells<br>4. characterize engineered tissues and compare them with native tissues<br>5. write and present scientific reports related to tissue engineering |

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| **Course Code and Title** | **CHME 460 Polymer Processing and Rheology** |
| *Course Descriptor* | The objective of the course is to give Engineering students a working understanding of the salient features of polymeric materials, including structure, synthesis, rheological properties and processing. This course will cover the application and the analysis of key processing operations for polymeric materials, namely extrusion, injection molding and calendaring. Prior to this, the structure of polymeric materials and their rheological |

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| | behavior and characterization will be reviewed, as they relate to processing. As part of the course, the students undertake an individual research project of computational (simulation and analysis of some polymer processing operation, possibly outside those covered in the class) or experimental (measurement of an important property of a polymer system, such as viscosity or glass transition temperature) nature. The final grade is the result of a final exam, a project and eight homework assignments. The course is open to Engineering students outside CHE, with demonstrated competence in Fluid Mechanics or Computational Methods. Such students might undertake a project related to polymer processing from the point of view of their particular discipline. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Explain glass transition in polymers and the techniques by which it is measured.<br>2. Explain the main methods used for polymer synthesis.<br>3. Interpret the results of rheological measurements and use the underlying theory.<br>4. Describe the processes involved in polymer processing operations.<br>5. Carry out literature survey on relevant topics and present their results. |

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| **Course Code and Title** | **CHME 461 Powder Technology** |
| *Course Descriptor* | Overview of industrial applications of powder processing. Characterization of powders: size distribution, shape, flowability. Unit operations for processing particulate materials: size enlargement and size reduction, solid-liquid and solid-gas separation, mixing, storage, pneumatic conveying, fluidization. Nanoparticle technology: production, properties and behavior. Fire and explosion hazards of powders, industrial dust control and health risks. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Characterize quantitatively the size distribution, shape and flowability of powders.<br>2. Identify the basic mechanisms and equipment for unit operations in processing of particulate materials.<br>3. Design the production process of high value particles using knowledge of powder technology.<br>4. Assess fire, explosion and health hazards of powders. |

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| **Course Code and Title** | **CHME 457 Advanced Process Safety and Risk Modeling** |
| *Course Descriptor* | Since Risk Analysis is becoming ever more widely used with growing sophistication, the course aims to provide a detailed understanding of advanced safety concepts, risk concept, risk modeling and simulation, and more recent advancement in the field of risk and reliability engineering. Another important aim of the course is to provide a good understanding of uncertainty in the Risk and reliability modeling. This course will also provide a good understanding of human reliability assessment, which is one of the import contributors to the safety issues and often get ignored by engineers. |
| *Course LOs* | By the end of this course students will be able to:<br>1. Perform dynamic accident and risk assessment modeling<br>2. Conduct human reliability assessment modeling<br>3. Carry out process safety data analysis |