Department of Chemical Engineering

Undergraduate Calendar

January 2022

Bangladesh University of Engineering and Technology (BUET)

Preamble

The Department of Chemical Engineering of Bangladesh University of Engineering and Technology (BUET) is one of the oldest Chemical Engineering departments in South-East Asia. Since its inception, the aim of the department has been to offer courses focusing on the modern concepts of chemical engineering education with due regard for the requirements of local and international industries, and on cutting edge research relevant to chemical engineering and allied disciplines. Upgrading the course curriculum is a continuous process. To support this process, the Undergraduate Course Curriculum Review Committee of BUET Chemical Engineering Department reviews Chemical Engineering course curricula of different renowned universities of USA, Canada, UK, Australia, Singapore and India. The course curriculum is designed with the aim to produce highly trained and competent Chemical Engineering graduates, who will be adept at serving industrial sectors and academia, locally and globally.

The current Chemical Engineering Undergraduate Course Curriculum was approved in the following BUET Academic Council Meetings: Academic Council Meeting Resolution 13-07-2021 (Agenda 2101002), and Academic Council Meeting Resolution 12-10-2021 (Agenda 211431).

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GENERAL INFORMATION

Historical Background

Bangladesh University of Engineering and Technology (BUET) is the highest seat of technical education in Bangladesh and now regarded as one of the best engineering education institutes in the world. Hundreds of meritorious students get themselves admitted in BUET. BUET has many highly qualified teachers with great academic and intellectual attainments. Students make the campus hum on working days with educational activities and live in amity with each other. Many BUET graduates find their niche in many places of the world and leave their footprint in the field of research. Yet many of the young generations may not know that BUET has come to this position after traversing a long way of about one hundred and fifty years of intellectual development or about them whose intensive efforts, tireless labor and pursuit have been as the propeller for the establishment of BUET.

When, Bangladesh was a part of British India as East Bengal, the area comprising present Bangladesh had no university for a long time during the British rule (1757-1947). In 1823, a general committee of public instruction was constituted in Calcutta for the development of education in this area. Afterward, education in this area was guided by the Christian missionaries with a new vision and they started setting up many new schools. This paved the way of English education in British India. In 1835, Lord Bentinck introduced English as the language of instruction in India. The colonials thus vouchsafed English medium education to the Indians as it is the language of business and globalization. In 1857, the establishment of Calcutta, Bombay and Madras University opened a new era for the development of higher education in British India. Thus, it appears that the first university adjacent to present Bangladesh was the University of Calcutta.

In about the middle of the colonial period, British engineers undertook the work of surveying and mapping, improvement of road and water transport and building of railroads in India. The history of engineering education in Bangladesh thus dates to 1876 when the Dacca Survey School was founded at Nalgola in a rented building near the west of the current Sir Salimullah Medical College Campus, in old Dhaka to train surveyors for the government of Bengal in British India. The nucleus of the present BUET was formed. BUET had thus a humble beginning as the survey school that was established with no great cause or mission in the minds of its founders except that the imperial rulers needed surveyors. Nawab of Dhaka Sir Khwaja Ahsanullah, a philanthropist endowed donations for developing the survey school. After his death in 1901, his son, the then Nawab of Dhaka, Sir Khwaja Salimullah released 112,000 rupees grant in 1902 for the upgrading, development, and expansion of this institution.

In 1902, Lord Curzon instituted the Indian University Commission to improve the condition of higher education in India. In 1905, during the period of Lord Curzon, Bengal was divided, and a province named East Bengal and Assam carved out with its capital in Dhaka. A country-wide agitation started, and the agitation was led by the privileged class in Calcutta against the partition. In 1906, the Survey School building was constructed at government initiative near the present Shahidullah Hall of Dhaka University. Even a few years ago a tall chimney that existed at this location used to bear the testimony to this institution. In 1908, the school started to offer diploma degrees. As an acknowledgment of Nawab's donation, the school was renamed to Ahsanullah School of Engineering. In 1911, the partition of Bengal was annulled. In 1912, the Ahsanullah Engineering School was moved to BUET's present premises. Initially, the school was affiliated with Dhaka College and later it was brought under the Director of Public Instruction. The annulment of Bengal partition left a deep mark of anger, sorrow, and frustration in the minds of the majority population of Eastern Bengal and Assam. In January 1912, the leading personalities of this section the Nawab of Dhaka Sir Salimullah, Syed Nawab Ali Chowdhury and Sher-e-Bangla A.K. Fazlul Huq made strong representations to the British Viceroy, Lord Hardinge, in favor of setting up a university at Dhaka. To assuage the feelings of the people of this part, the government issued a communiqué in February 1912 assuring them that it would be set up. In May 1912, the then government of Bengal set up a committee known as the Nathan Committee to recommend a scheme for the establishment of the university. In 1913, the government of India passed a resolution to establish some teaching and residential universities in British India including one in Dhaka. In 1917, the Calcutta University Commission was formed headed by Sir Michael Sadler. Finally, following the recommendations of the Commission, the University of Dhaka was established in the year 1921 which was the first university in present Bangladesh. In 1938, A.K. Fazlul Huq, the then Prime Minister of Bengal, appointed Hakim Ali as the principal of the Ahsanullah Engineering School. After World War II (1939-1945) the government took up large-scale plans for industrial development in Bengal, but there was an acute shortage of skilled manpower. A government appointed committee made recommendations for establishing an Engineering College at Dhaka with an enrolment capacity of 120 to offer a 4-year bachelor's degree program in mechanical, electrical, chemical and agricultural engineering.

The Indian subcontinent, when achieved independence from the British rule on August 14-15, 1947, was divided into two separate states in the name of India and Pakistan. Pakistan was divided into two wings i.e., West Pakistan and East Pakistan (presently Bangladesh). After the partition of India, Chief Minister of East Bengal Sir Khwaja Nazimuddin approved the Ahsanullah Engineering School to be upgraded to Ahsanullah Engineering College as a Faculty of Engineering under the University of Dhaka with a view to meeting the increasing demand for engineers in the country and expanding the facilities for the advancement of engineering education. Hakim Ali was appointed as the first Principal of the college. In 1948, the Government of East Pakistan gave recognition to the Engineering College and approved a degree program in civil, mechanical, electrical, chemical, agricultural and textile engineering and a three years long diploma program in civil, mechanical and electrical engineering. Later, metallurgical engineering was started instead of textile and agricultural engineering.

In 1951, TH Mathewman was appointed as the next principal. Dr. M. A. Rashid succeeded him in 1954 as the first Bengali principal of the college. In 1957, the enrolment capacity for the bachelor's degree was increased from 120 to 240 and the diploma course was withdrawn from 1958. As Manufacturing and process industries started to grow gradually in the 1950s and 1960s, the then government of Pakistan in 1958 set up an Education Commission known as Sharif Education Commission. Dr. Rashid was one of the members of this commission. In the middle of the year 1961, Dr. Rashid was appointed as the Director of newly established Directorate of Technical Education. The Sharif commission recommended establishing two technological universities: a university of engineering and technology by upgrading the Ahsanullah Engineering College into EPUET in Dhaka and an agricultural university by upgrading the East Pakistan College of Veterinary Science and Animal Husbandry into Mymensingh Agricultural University. After a few days, following the recommendation of the Commission a project committee was formed by the then East Pakistan Government to take actions for setting up an engineering university in this part. Its members were Education Secretary Mr. Ali Hasan, Technical Education Director Dr. Rashid, Education Advisor of Ahsanullah Engineering College Dr. Bergelin and the Technical Education Advisor of Government of Pakistan Dr. V. G DeSa. All the meetings of the project committee were held at the house of Dr. Bergelin. During the meeting, Dr. Bergelin, visiting professor from Texas A&M College, offered lunch and afternoon snacks with his own expenses. According to the recommendation of that project committee, the East Pakistan Engineering and Technological University (EPUET) Ordinance, 1961 was issued by the then East Pakistan Government in September 1961. Thus, in order to create facilities for postgraduate studies and research, the Ahsanullah Engineering College was upgraded to EPUET. And EPUET started its formal journey as a technical university on 1 June 1962. Dr. Rashid was appointed as the first Vice-Chancellor of the University. A partnership with the Agricultural and Mechanical College of Texas (renamed Texas A&M University) was formed, and professors from A&M came to teach and formulate the curriculum.

In 1962, when the Ahsanullah Engineering College was transformed into EPUET, then all the Classrooms, College Library, Laboratories, Principal's office, and Administrative offices were accommodated in the only yellow colored two-storied building of the College. The Building was called the "Press Building" as the Government Press office of the province, Eastern Bengal and Assam was situated (1905-1911) in the building. Workshops and other supporting offices of the college were located in some semi- building tin sheds. The present machine shop is standing as a witness of that time. In the college premises, there was the Principal's residence occupying a large area and two more Bungalows where senior teachers lived. There were also a few thatched barracks where some teachers, officers, and employees used to live. There were two College hostels – Main Hostel and Palashi Tin Shed Hostel. The University had started its journey with the allocation of only 18 lakh taka and teachers and employees of Ahsanullah Engineering College. Professor of Rajshahi Government College and renowned mathematician Muhammad Abdul Jabbar was appointed as the first registrar of the university. Professor M. Kabiruddin was appointed as the first director of student's welfare and Prof. Dr. V.G. DeSa was appointed as the director of DAERS. At that time, the post of controller of the examination was not created. University registrar did all the work related to the examination of the university. Professor

Momtazuddin took the charge of the first comptroller and Mr. M. Sahabuddin was appointed as the first librarian of the university. The construction works of the university started by building the present Civil Engineering Building. After that, Titumir Hall (then Quaid-e-Azam Hall), Sher-e-Bangla Hall, Suhrawardi Hall (then Liakot Hall), Shahid Smriti Hall, Female Students Hall (Chattri Hall) and Dr. M.A. Rashid Hall were constructed consecutively. Architecture and Planning Building, Gymnasium and Auditorium, EME Building etc were built. The residence of the teachers (building number 1, 2, 5, 6 and 7) was built by demolishing the residence of the Principal of the engineering college and later some more residential buildings were built on the land known as "Dhakeshwari area" when handed over to the university by the then Pakistan P. W. D. at the end of 1968. Earlier, the Vice-Chancellor Office and various administrative offices were shifted in the main hostel. At present, the urban campus occupies 91.37 acres (0.37km^2) of land. ECE Building of West Palashi campus is a landmark of BUET. The construction work of the university is still in progress. In the session, 1962-1963, the total number of enrolled students in EPUET was 1022; three of them were female in two faculties and 10 departments. There were 89 teachers.

After the independence of Bangladesh in 1971, East Pakistan University of Engineering and Technology (EPUET) was renamed as the Bangladesh University of Engineering and Technology (BUET). Out of six universities of the newly born Bangladesh, the four general universities began to operate under the New University Ordinance of 1973. They have a senate. In these universities, the teachers of the University also elect some of the members of the Senate, Syndicate, the Academic Council and the Deans of the Faculties. BUET did not come under the purview of the new 1973 ordinance as Bangabandhu thought that BUET should be run by the old 1961 ordinance. Bangabandhu, the Father of Nation, was a mastermind and a visionary who could see beyond the petty party squabbles and interest. He wanted the stakeholders of BUET to be preoccupied with learning, researching and teaching. He truly took a pragmatic initiative to stop the finishing of merit and creative faculty. BUET does not have the Senate, elected members of the Academic Council and the Syndicate. Deans of faculties are also not elected in BUET. In essence, there is no election in the university for different bodies and positions. BUET is perhaps one of our success stories of post-independent Bangladesh which we could be rightly proud about.

BUET has been trying over the years for being a center of excellence through research and scholastic achievements instead of remaining as a teaching university only. At present, BUET has eighteen teaching departments under five faculties and six institutes. About six hundred fifty teachers are teaching in these departments and institutes. The members of the faculty having envying strength of faculties are taking extensive programs for both teaching and research to emerge BUET as one of the most prestigious universities for higher education and innovative research in Bangladesh and be counted as a world top ranking university. Postgraduate research works are now among the primary functions of the university. BUET has a Technology Transfer Office (TTO) with a view to managing the intellectual properties created from our research and boosting up innovation culture in BUET. Every year the intake of undergraduate students is around 1200, while the intake of graduate students in Master’s and Ph.D. programs is around 1000. BUET is fully able and rendering its full support in the development programs of the country.

Our Alma Mater has grown slowly to the present position in the past few decades. We at the department are tirelessly working towards a common vision that BUET will reach the pinnacle of advancement in engineering education and research in the near future.

Academic Programs of BUET

The University has sixteen teaching departments under five faculties. All departments, except for the department of Humanities, offer degree programs; however, some of them offer postgraduate (PG) degrees only. Faculty wise list of the departments with the status of the degrees offered is given below:

Faculty of Civil Engineering
Department of Civil Engineering: UG and PG
Department of Water Resources Engineering: UG and PG

Faculty of Architecture and Planning
Department of Architecture: UG and PG
Department of Urban and Regional Planning: UG and PG
Department of Humanities: No degree offered

Faculty of Electrical and Electronic Engineering
Department of Electrical and Electronic Engineering: UG and PG
Department of Computer Engineering: UG and PG
Department of Biomedical Engineering (BME) UG and PG

Faculty of Engineering
Department of Chemical Engineering: UG and PG
Department of Material and Metallurgical Engineering: UG and PG
Department of Petroleum and Mineral Resources Engineering: PG
Department of Chemistry: PG
Department of Mathematics: PG
Department of Physics: PG
Department of Glass and Ceramic engineering: PG

Faculty of Mechanical Engineering
Department of Industrial and Production Engineering: UG and PG
Department of Mechanical Engineering: UG and PG
Department of Naval Architecture and Marine Engineering: UG and PG

Rules and Regulations for Undergraduate Program

1. Organizational Framework of the Bachelor's Degree Programs the Course System

The undergraduate curriculum at Bangladesh University of Engineering & Technology (BUET) is based on the course system. The salient features of the course system are:

(i) Reduction of the number of theoretical courses and examination papers to around five in each term,
(ii) The absence of a pass or a fail on an annual basis,
(iii) Continuous evaluation of student's performance,
(iv) Introduction of Letter Grades and Grade Points instead of numerical grades,
(v) Introduction of some additional optional courses and thus enable students to select courses according to his/her interest as far as possible,
(vi) Opportunity for students to choose fewer or more courses than the normal course load depending on his/her capabilities and needs,
(vii) The flexibility to allow the student to progress at his/her own pace depending on respective ability or convenience, subject to the regulations on credit and minimum Grade Point Average (GPA) requirements, and
(viii) Promotion of teacher-student contact.

In the curriculum for the undergraduate programs, besides the professional courses pertaining to each discipline, there is a strong emphasis on acquiring a thorough knowledge in the basic sciences of Mathematics, Physics and Chemistry. Due importance is also given for the study of several subjects in Humanities and Social Sciences which, it is expected will help the student to interact more positively with the society. Thus, the course contents of the undergraduate programs provide a harmonious blend of both basic sciences and their applications as well as their social relevance.

The first two terms of Bachelor's degree programs consist of courses in basic sciences, mathematics, humanities and social sciences, basic engineering and architecture subjects. The third and subsequent terms build directly on the knowledge of the basic subjects gained in the first two terms and go on to develop competence in specific disciplines.

2. Student Admission

Students will be admitted in undergraduate curricula in the Departments of Architecture, Urban and Regional Planning, Chemical Engineering, Civil Engineering, Water Resources Engineering, Computer Science and Engineering, Electrical and Electronic Engineering, Biomedical Engineering Mechanical Engineering, Industrial & Production Engineering, Materials and Metallurgical Engineering and Naval Architecture and Marine Engineering as per existing rules of the University. The Registrar's Office will continue to serve as Admissions Office and will deal with course registration in addition to student admission.

3. Number of Terms in a Year

There will be two terms (Term I and Term II) in an academic year. The duration of each Term will be 18 weeks which will be used as follows:

Classes	14 weeks
Recess before Term Final Examination	2 weeks
Term Final Examination	2 weeks
Total	18 weeks

The duration of the Short Term will be around 8 weeks of which about 7 weeks will be spent for class lectures and one week for Term Final Examination.

4. Course Pattern and Credit Structure

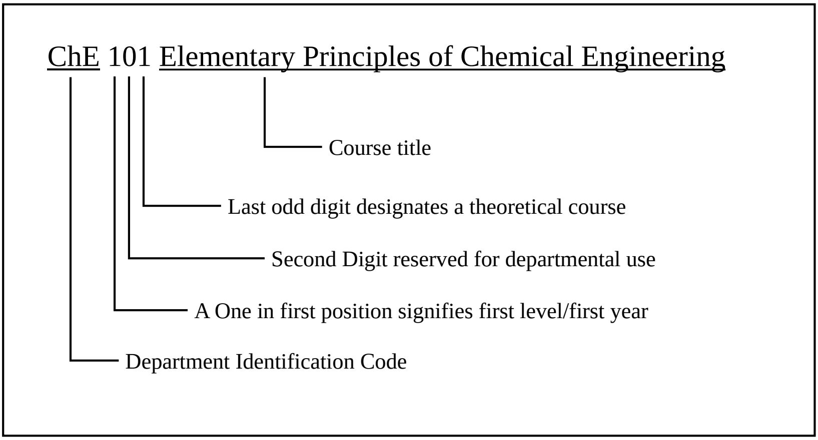
The entire undergraduate program is covered through a set of theoretical and laboratory/sessional/studio courses.

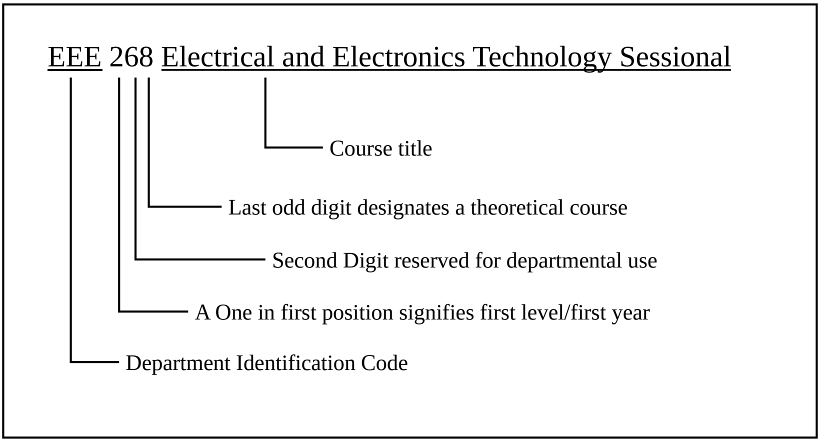
4.1 Course Designation and Numbering System

Each course is designated by a two to four letter word identifying the department and a three-digit number with the following criteria:

(a) The first digit will correspond to the year/level in which the course is normally taken by the students.
(b) The second digit will be reserved for departmental use for such things as to identify different areas within a department.
(c) The last digit will usually be odd for theoretical and even for laboratory or sessional courses.

The course designation system is illustrated by two examples.





4.2 Assignment of Credits

(i) Theoretical Courses

One lecture per week per term will be equivalent to one credit.

(ii) Laboratory/ Sessional/ Design

Credits for laboratory/sessional or design courses will be half of the class hours per week per term. Credits are also assigned to project and thesis work taken by students. The number of credits assigned to such work may vary from discipline to discipline.

The curriculum does not demand the same rate of academic progress from all students for obtaining the degree but only lays down the pace expected from a normal student. A student whose background or capacity for assimilation is lower will be permitted to complete the program at a slower pace by studying less number of courses during a given term (subject to a minimum course load). He may keep pace with his class by taking courses during the Short Term which he had dropped earlier during the Regular Terms, or by covering the entire degree program over an extended period without developing any feeling of inferiority complex.

5. Types of Courses

The courses included in undergraduate curricula are divided into several groups as follows:

5.1 Core Courses

In each discipline a number of courses will be identified as core courses which form the nucleus of the respective Bachelor's degree program. A student has to complete all of the designated core courses in his discipline.

5.2 Pre-requisite Courses

Some of the core courses are identified as pre-requisite courses. A pre-requisite course is one which is required to be completed before some other course(s) can be taken. Any such course, on which one or more subsequent courses build up, may be offered in each of the two Regular Terms.

5.3 Optional Courses

Apart from the core courses, students will have to complete a number of courses which are optional in nature. They will have the option to choose the required number of courses from a specified group/number of courses.

6. Course Offering and Instruction

The courses to be offered in a particular term will be announced and published in the Course Catalogue along with a tentative Term Schedule before the end of the previous term. Whether a course is to be offered in any term will be decided by the respective Board of Undergraduate Studies (BUGS). Respective departments may arrange to offer one or more pre-requisite or core courses in any term depending on the number of students who dropped or failed the course in the previous term.

Each course is conducted by a teacher. The course teacher is responsible for maintaining the expected standard of the course and for the assessment of a student's performance. Depending on the strength of registered students (i.e. the number of students) enrolled for the course, the teacher concerned might have course associates and teaching assistants (TA) to help him in teaching and assessment. For a course strength necessitating two or more parallel classes or sections, one of the course teachers or any other member of the teaching staff of the department be designated as course coordinator. He/she has the full responsibility for coordinating the work of the other members of the department involved in that course.

7. Departmental Monitoring Committee

Consistent with its resilient policy to keep pace with new developments in the field of science and technology, the university will update its course curriculum at frequent intervals (at least every three years). The updates not only aim to include the expanding frontiers of knowledge in the various fields but also to accommodate the changing social, industrial, and professional needs of the country. This can be done through deletion and modification of some of the courses and also through the introduction of new ones.

The Board of Undergraduate Studies (BUGS) of each department will constitute a Departmental Monitoring Committee with three teachers of the department. This committee will monitor and evaluate the performance of the Course System within the department. In addition to other teachers of the department, the committee may also propose from time to time to the BUGS any changes and modifications needed for upgrading the Undergraduate Curriculum and the Course System.

8. Teacher Student Contact

The proposed system encourages students to come in close contact with teachers. For promotion of teacher-student contact, each student is assigned to an Adviser and the student is free to discuss with his Adviser all academic matters, especially those related to courses taken and classes being attended by him. Students are also encouraged to meet with other teachers at any time for help on academic matters.

9. Student Adviser

One Adviser would normally be appointed for a batch of students by the Undergraduate Board of Studies of the concerned department(s) who will advise each student on the courses to be taken by the student. Adviser will discuss with the student his/her academic program and then decide the number and nature of courses for which he/she can register. However, it is the student's responsibility to keep contacts with his Adviser who will review and eventually approve the student's specific plan of study and check on subsequent progress. The Adviser should be in the rank of an Assistant Professor or above from the concerned department(s).

For a student of second and subsequent terms, the number and nature of courses for which he/she can register will be decided on the basis of his/her academic performance during the previous term. The advisor will advise the students to register for the courses during the next term within the framework of the guidelines in respect of minimum/maximum credit hours limits, etc. which are elaborated at appropriate places in this report. The Advisor is also authorized to permit the student to drop one or more courses based on his/her academic performance and the corresponding categorization (see Art. 16 for details). Special provisions exist for academically weak students with regard to make-up courses (see Art.19 for details).

10. Registration Requirements

Any student who makes use of classroom or laboratory facilities or faculty time is required to register formally. Being admitted to the University, each student is assigned to a student Adviser. The student can register for courses he intends to take during a given term only on the basis of the advice and consent of his/her Adviser.

10.1 Registration Procedure

Students must register for each class in which they will participate. Each student will fill up his/her Course Registration Form in consultation with and under the guidance of his/her adviser. The original copy of the Course Registration Form will be submitted to the Registrar's Office, and then the requisite number of photocopies will be made by the Registrar's Office for distribution. The date, time and venue will be announced in advance by the Registrar’s Office.

Alternatively, students must register for each class in which they want to participate in consultation with his/her Advisor. This can be done online within a specified deadline at http://biis.buet.ac.bd where a student can select courses in the online course registration form. The student is then required to meet his/her advisor to finalize and confirm the registration. Much counseling and advising is accomplished at the registration time. It is absolutely necessary that all students register at the specified time.

10.2 Limits on the Credit Hours to be Taken

A student must be enrolled in at least 15 credit hours. He may be allowed to enroll in up to a maximum of 24 credit hours if recommended by his/her Adviser. A student must enroll for the prescribed sessional/laboratory courses in the respective Term within the allowed credit-hour limits.

In special cases where a student cannot be allotted the minimum required 15 credit hours in a Term, the relevant BUGS may approve a lesser number of credit hours to suit individual requirements. Such cases shall only be applicable to students needing less than 15 credits for graduation.

10.3 Pre-condition for Registration

Some courses involve pre-requisite courses. A student will be allowed to register in those courses provided he has completed all of the pre-requisite courses. If a student fails in a pre-requisite course in any Term, the concerned BUGS may allow him/her to register for a course which builds on the pre-requisite course provided his/her attendance and grades in continuous assessment in the said pre-requisite course is found to be satisfactory.

Registration will be done at the beginning of each term. The registration program with dates and venue will be announced in advance. Late registration is, however, permitted within the first week after starting of the classes through payment of a late registration fee.

Students having outstanding dues to university, or a hall of residence shall not be permitted to register. Therefore, all students must clear their dues and get a clearance or no dues certificate, and only then, they will be given necessary permission to complete the course registration procedure. For the First-Year students, prior department-wise enrolment/admission is mandatory for registration.

10.4 Pre-registration

Pre-registration (currently not in practice) for courses to be offered by the students in a particular term will be done on a specified date before the end of the previous term. All students in consultation with their course Advisers are required to complete the pre-registration formalities. Failing to do so requires a fine of Tk. xx.xx (amount may be decided by the authority) to be paid before registration in the next term. Furthermore, a student who does not pre-register may not get the courses desired by him subsequently.

10.5 Registration Deadline

Student must register for the courses to be taken before the commencement of each term and no late registration will be accepted after one week of classes. Late registration after this date will not be accepted unless the student submits a written appeal to the Registrar through the concerned Head and can document extenuating circumstances such as medical problems (physically incapacitated and not able to be presented) from the Chief Medical Officer of the University or some other academic commitments which precluded enrolling prior to the last date of registration.

10.6 Penalty for Late Registration

Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. xx.xx (amount may be decided by the authority). This extra fee will not be waived whatever be the reason for late registration.

10.7 Course Adjustment Procedure

A student will have some limited options to add or delete courses from his/her registration list, within the first two weeks from the beginning of the term. However, minimum credit requirements mentioned in the Art.

10.2 need to be fulfilled after the adjustments. He/she may add courses only within the first two weeks of a regular Term and only the first week of Short Term. In case of dropping a course, a student will be allowed to do so within four weeks after the commencement of a regular Term and two weeks after commencement of a Short Term.

Adjustment of initially registered courses in any term can be done by duly completing the Course Adjustment Form. These forms will normally be available in the Registrar's Office. For freshman students, such forms may already be included in the registration packet at the time of orientation.

Any student willing to add or drop courses will have to fill up a Course Adjustment Form in consultation with and under the guidance of his/her Adviser. The original copy of the Course Adjustment Form will be submitted to the Registrar's Office, and then the requisite number of photocopies will be made by the Registrar's Office for distribution to the concerned Adviser, Head, Dean, Controller of Examination and the student.

All changes in courses must be approved by the Adviser and the Head of the department concerned. The completed Course Adjustment Form will have to be submitted to the Registrar's Office after it has been duly filled in and signed by the concerned persons. To add/drop a course, respective teacher's consent will be required.

Late Registration Fee is not necessary in these cases.

10.8 Withdrawal from a Term

If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the Term within a week after the end of the Term Final Examination. However, he/she may choose not to withdraw any laboratory / sessional / design course if the grade obtained in such a course is ‘D’ or better. The application must be supported by a medical certificate from the Chief Medical Officer of the University. The Academic Council will take the final decision about such an application.

11. The Grading System

The total performance of a student in a given course is based on a scheme of continuous assessment. For theory courses this continuous assessment is made through a set of quizzes/in class evaluation, class participation, homework assignments, and a term final examination. The assessment in laboratory/sessional courses is made through observation of the student at work in class, viva-voce during laboratory hours, and quizzes. For architecture students, assessments in design sessionals would be done through evaluation of a number of projects assigned throughout the term. As discussed earlier, each course has a certain number of credits which describe its weightage. A letter grade with a specified number of grade points is awarded in each course for which a student is registered. A student’s performance is measured by the number of credits that he/she has completed satisfactorily and the weighted average of the grade points that he/she has maintained. A minimum grade point average is required to be maintained for satisfactory progress. Also, a minimum number of earned credits should be acquired in order to qualify for the degree as prescribed under Art. 22.

Letter grades and corresponding grade-points will be awarded in accordance with provisions shown below.

Numerical Grade	Letter Grade	Grade Point
80% or above	A+ (A plus)	4.00
75% to less than 80%	A (A regular)	3.75
70% to less than 75%	A– (A minus)	3.50
65% to less than 70%	B+ (B plus)	3.25
60% to less than 65%	B (B regular)	3.00
55% to less than 60%	B– (B minus)	2.75
50% to less than 55%	C+ (C plus)	2.50
45% to less than 50%	C (C regular)	2.25
40% to less than 45%	D	2.00
less than 40%	F	0.00
Continuation (for project & thesis/ design courses)	X	-

11.1 Distribution of Marks

Thirty percent (30%) of marks shall be allotted for continuous assessment i.e., quizzes and homework assignments, in class evaluation and class participation. The remainder of the marks will be allotted to Term Final examination which will be conducted centrally by the University. There will be internal and external examiners for each course in the Term Final Examination. The duration of each term final examination will be 3 hours. The distribution of marks for a given course will be as follows:

Class participation	10%
Homework Assignment and Quizzes	20%
Final Examination (3 hours)	70%
Total	100%

Basis for awarding marks for class participation and attendance is generally as follows:

Attendance	Marks
90% and above	10
85% to less than 90%	9
80% to less than 85%	8
75% to less than 80%	7
70% to less than 75%	6
65% to less than 70%	5
60% to less than 65%	4
less than 60%	0

The number of quizzes of a course shall be at least n+1, where n is the number of credits of the course. Evaluation of the performance in quizzes will be on the basis of the best n quizzes. The scheme of continuous assessment that a teacher proposes to follow for a course will be announced on the first day of classes.

12. Earned Credits

The courses, in which a student has obtained 'D' or a higher grade, will be counted as credits earned by him/her. Any course in which a student has obtained 'F' grade will not be counted towards his/her earned credits.

A student who obtains an 'F' grade in any Core Course in any term, will have to repeat the course. If a student obtains an 'F' grade in an Optional Course, he/she may choose to repeat the course or take a substitute course if available.

'F' grades will not be counted for GPA calculation but will stay permanently on the Grade Sheet and Transcript. When a student will repeat a course in which he/she previously obtained an 'F' grade, he/she will not be eligible to get a grade better than 'B' in such a course. If a student obtains a grade other than 'F' in a course, he/she will not be allowed to repeat the course for the purpose of grade improvement.

If a student obtains a grade lower than 'B' in a course, he/she will be allowed to repeat the course only once for the purpose of grade improvement by forgoing his/her earlier grade, but he/she will not be eligible to get a grade better than 'B' in such a course. A student will be permitted to repeat for grade improvement purposes a maximum of four courses in B.Sc. Engg. and B.URP programs and a maximum of five courses in B. Arch. program.

If a student obtains 'B' or a better grade in any course, he/she will not be allowed to repeat the course for the purpose of grade improvement.

13. Honors

Candidates for Bachelor's degree in engineering and architecture will be awarded the degree with honors if their overall GPA is 3.75 or better.

13.1 Dean's List

As a recognition of excellent performance, the names of students obtaining an average GPA of 3.75 or above in two regular Terms in each academic year may be published in the Dean's List in each faculty. Students who have received 'F' grade in any course during any of the two regular terms will not be considered for the Dean's List in that year.

14. Calculation of GPA

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses passed/completed by a student. For example, if a student passes/completes five courses in a semester having credits of C1, C2, C3, C4, and C5 and his grade points in these courses are G1, G2, G3, G4, and G5, respectively then

$$GPA = \frac{\sum C_i G_i}{\sum C_i}$$

14.1 A Numerical Example

Suppose a student has completed five courses in a Term and obtained the following grades:

Course	Credits	Grade	Grade Points
EEE 203	3	A+	4.00
EEE 205	3	B	3.00
EEE 207	3	A	3.75
Math 205	2	B+	3.25
Hum 203	1	A-	3.50

Then his/her GPA for the term will be computed as follows:

$$GPA = \frac{3(4.0) + 3(3.0) + 3(3.75) + 2(3.25) + 1(3.5)}{(3 + 3 + 3 + 2 + 1)} = 3.52$$

15. Student Classification

For a number of reasons, it is necessary to have a definite system by which to classify students as First Year/Freshman, Second Year/Sophomore, Third Year/Junior, and Fourth Year/Senior. At BUET, regular students are classified according to the number of credit hours earned towards a degree. The following classification applies to the students.

Year/Level	Earned credit Hours	
	Engineering /URP	Architecture
First Year (Freshman) / Level I	0 to 36	0 to 34
Second Year (Sophomore) / Level II	>36 to 72	>34 to 72
Third Year (Junior) / Level III	>72 to 108	>72 to 110
Fourth Year (Senior) / Level IV	> 108	> 110 to 147
Fifth Year / Level V		> 147

16. Registration for the Second and Subsequent Terms

A student is normally required to earn at least 15 credits in a term. At the end of each term, the students will be classified into the following three categories:

Category 1
Consisting of students who have passed all the courses prescribed for the previous term and have no backlog of courses. A student belonging to Category 1 will be eligible to register for all courses prescribed for the next term.

Category 2
Consisting of students who have earned at least 15 credits in the term but do not belong to Category 1. A student belonging to Category 2 is advised to take at least one course less in the next term subject to the condition that he has to register for such backlog courses as may be prescribed by the Adviser.

Category 3
Consisting of students who have failed to earn 15 credits in the previous term. A student belonging to Category 3 is advised to take at least two courses less subject to registration for a minimum of 15 credits. However, he/she will be required to register for such backlog courses as may be prescribed by the Adviser.

17. Performance Evaluation

The performance of a student will be evaluated in terms of two indices, viz. term grade point average, and cumulative grade point average, which is the grade average for all the terms. The term grade point average is computed dividing the total grade points earned in a term by the number of term hours taken in that term. The overall or cumulative grade point average (CGPA) is computed by dividing the total grade points accumulated up to date by the total credit hours earned. Thus, a student who has earned 275 grade points in attempting 100 credit hours of courses would have an overall grade point average of 2.75.

Students will be considered to be making normal progress toward a degree if their cumulative or overall GPA for all work attempted is 2.20 or more. Students who regularly maintain Term GPA of 2.20 or better are making good progress toward their degrees and are in good standing with the University. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when one or more of the following conditions exist:

(i) Term GPA falls below 2.20
(ii) Cumulative GPA falls below 2.20
(iii) Earned credits fall below 15 times the Number of Terms attended/ studied

All such students can make up deficiencies in GPA and credit requirements by completing courses in next term(s) and backlog courses, if there are any, with better grades. When GPA and credit requirements are achieved, the student is returned to good standing.

18. Academic Progress, Probation and Suspension

<u>Academic Progress:</u> Undergraduate students will be considered to be making normal progress toward a degree if their cumulative or overall GPA for all work attempted is not less than 2.20.

<u>Probation and Suspension:</u> Undergraduate students who regularly maintain Term GPA of 2.20 or better are making good progress toward their degrees and are in good standing with the University. Students who fail to maintain this minimum rate of progress may be placed on academic probation.

The status of academic probation is a reminder/warning to the student that satisfactory progress towards graduation is not being made. A student may be placed on academic probation when either of the following conditions exist:

(i) The Term GPA falls below 2.20 or
(ii) The cumulative GPA falls below 2.20

Students on probation are subject to such restrictions with respect to courses and extracurricular activities as may be imposed by the respective Dean of faculty.

The minimum period of probation is one Term, but the usual period is for one academic year. This allows the student an opportunity to improve the GPA through the completion of additional course work during the period that the student is on probation. The probation is extended for additional terms until the student achieves an overall GPA of 2.20 or better. When that condition is achieved, the student is returned to good standing.

Academic probation is not to be taken lightly - it is a profoundly serious matter. A student on academic probation who fails to maintain a GPA of at least 2.20 during two consecutive academic years may be suspended from this University. A student who has been suspended may submit a petition to the Dean of faculty, but this petition will not be considered until the student has been suspended for at least one full Term.

Petitions for reinstatement must set forth clearly the reasons for the previous unsatisfactory academic record and it must delineate the new conditions that have been created to prevent the recurrence of such work. Each of such petitions is considered individually on its own merits. After consideration of the petition, and perhaps after consultation with the student, the Dean in some cases, reinstate the student, if this is the first suspension. However, a second suspension will be regarded as final and absolute.

19. Measures for Helping Academically Weak Students

The following provisions will be made as far as possible to help academically weak students to enable them to complete their studies within the maximum period of seven years in engineering and eight years in architecture students, respectively:

a) All such students whose cumulative grade point average (CGPA) is less than 2.20 at the end of a term may be given a load of not exceeding four courses, in the next term.
b) For other academic deficiencies, some basic and core courses may be offered during the Short Term in order to enable the student to partially make-up for the reduced load during Regular Terms.

Following criteria will be followed for determining academically weak students:
a) CGPA falling below 2.20.
b) Term grade point average (TGPA) falling below 2.20 points below that of the previous term.
c) Earned credit falling below 15 times the number of terms attended.

20. Special Courses

a) These courses, which include self-study courses, will be from amongst the regular theory courses listed in the course catalog, a special course can be run only in exceptional cases.
b) Whether a course is to be floated as a special course will be decided by the Head of the concerned department in consultation with the teacher/course co-coordinator concerned. Decisions to float a course as a special course shall be reported to the Academic Council.
c) The special course may be offered to any student in his/her last term if it helps him/her to graduate in that term. It will be offered only if the course is not running in that term as a regular course.
d) Normally no lecture will be delivered for the special course, but laboratory/design classes may be held if they form a part of the course. The course coordinator/course teacher will also assign homeworks,

administer quizzes and final examinations for giving his or her assessments at the end of the term.

e) A student will be allowed to register for a maximum of two courses on self-study basis.

f) A Special Course shall not be utilized for grade improvement purposes.

21. Rules for Courses offered in a Short Term

a) The courses to be run during the Short Term shall be decided on the recommendations of Departments on the basis of essential deficiencies to be made up by a group of students. Once floated, other students could be allowed to register in those courses subject to the capacity constraints and satisfaction of prerequisites.

b) Students will be allowed to register in a maximum of two courses during the Short Term.

c) A course may be given a weightage up to 6 credits in any Short-Term following a graduating/final Term if he/she is short by a maximum of 6 earned credits only, on a self-study basis with no formal instruction. In a self-study course, there will be a Final Examination, beside the continuous assessment.

d) A fee of Tk. xx.xx (amount may be decided by the authority) for each credit hour to be registered to be borne by the students who enroll during Short Term.

22. Minimum Earned Credit and GPA Requirements for Obtaining Graduation

Minimum credit hour requirements for the award of Bachelor's degree in engineering and architecture will be decided by the respective BUGS. However, at least 157 credit hours for engineering and 190 credit hours for architecture must be earned to be eligible for graduation, and this must include the specified core courses. The minimum GPA requirement for obtaining a bachelor's degree in engineering, URP or architecture is 2.20.

Completion of full time Studentship:
Students who have completed the minimum credit requirement for graduation for a Bachelor's degree shall not be considered and registered as full-time students.

A student may take additional courses with the consent of his/her Adviser in order to raise GPA, but he/she may take a maximum of 15 such additional credits in engineering and URP and 18 such additional credits in architecture beyond respective credit-hour requirements for bachelor's degree during his/her entire period of study.

22.1 Application for Graduation and Award of Degree

A student who has fulfilled all the academic requirements for the Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional degree will be awarded on completion of credit and GPA requirements. Such provisional degrees will be confirmed by the Academic Council.

23. Industrial/Professional Training Requirements

Depending on each department's own requirement a student may have to complete a prescribed number of days of industrial/professional training in addition to minimum credit and other requirements, to the satisfaction of the concerned department.

24. Time Limits for Completion of Bachelor's Degree

A student must complete his studies within a maximum period of seven years for engineering and URP and eight years for architecture.

25. Inclusion of Repeaters from Annual System in Course System

Repeater students including Private students of the Annual system will be included in the Course System of curricula as and when such a situation will arise.

25.1 Equivalence of Courses and Grades

Equivalence of courses passed previously by any repeater student including Private students shall be determined by the respective BUGS for the purpose of:

a) Allowing course exemption, and
b) Conversion of numerical grades into letter grades in exempted courses.

25.2 Exemption of Courses

Repeater students including private students may be granted exemption in theoretical course(s) in which he/she secured 45% or more marks and in sessional/laboratory course(s) in which he/she secured 41% or more marks.

25.3 Time Limit for Completion of Bachelor's Degree

Time allowed for a student included in the Course System from Annual System to complete studies leading to a Bachelor's degree will be proportional to the remaining credits to be completed by him/her. A student in engineering, for example, having earned 40 credit hours through equivalence and exemption (of previously completed courses) out of a total requirement of 160 credits for Bachelor's degree will get (7 yrs× 120/160 = 5.25) = 5.5 years (rounded to next higher half-a year) or 11 (eleven) Regular Terms to fulfill all requirements for Bachelor's degree. For a student in architecture, time allowed will be calculated in a similar way.

25.4 Relaxation of Course Registration for Students Transferred to Course System from Annual System

The requirement of registration of a minimum 15 credit hours in a term shall be waived for only the terms of the level where he/she has been transferred in the course system provided that he/she has been granted exemption in some of the courses offered in those terms.

26. Supplementary Examination

26.1 Students of Graduating Term

Students of graduating term, having One (01) or Two (02) Theory Courses left for graduation, can register for supplementary examination if they meet the following criteria:

a) Only one (01) or two (02) theory courses that are left for graduation which were previously incomplete due to "Term withdrawal" or completed by obtaining an "F" grade.
b) Students have to register these courses in the graduating term for attending supplementary examinations.
c) All Sessional/ Industrial Training/ Practical Survey courses have already been completed by the previous terms.
d) Supplementary examination cannot be used for grade improvement of any theory courses and the highest grade any student can obtain from this examination is "B".

26.2 Students of Non-Graduating Term

Students of non-graduating term can register for supplementary examination as per the following criteria:

a) Students of Engineering and URP departments who have completed 108 credits and students of Department of Architecture who have completed 147 credits can register for a maximum of two (02) theory courses (extra from the courses and credits of the regular term) from the previous terms which was completed by obtaining an “F” grade. All other students can register for only one (01) theory course (extra from the courses and credits of the regular term) from the previous terms which was completed by obtaining an “F” grade.

b) The Departments will decide the courses that will be offered for supplementary examination.

c) Students have to pay a registration fee (to be decided by the University) for attending the supplementary examination.

d) Supplementary examination cannot be used for grade improvement of any theory courses and the highest grade any student can obtain from this examination is “B”.

27. Attendance, Conduct, Discipline etc.

27.1 Attendance

All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly, and one is required to attend at least 60% of all classes held in every course.

27.2 Conduct and Discipline

A student shall conform to a high standard of discipline, and shall conduct himself, within and outside the precincts of the university in a manner befitting the students at a university of national importance. He shall show due courtesy and consideration to the employees of the university and Halls of Residence, good neighborliness to his fellow students and the teachers at the university and pay due attention and courtesy to visitors.

To safeguard its ideals of scholarship, character and personal behavior, the university reserves the right to require the withdrawal of any student at any time for any reason deemed sufficient.

28. Absence during Term

A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks which count towards the final grade. Absence in Term Final Examination will result in ‘F’ grades. A student who has been absent for short periods, up to a maximum of three weeks due to illness should approach the course teacher(s) or the course -coordinator(s) for make-up quizzes or assignments immediately on returning to the classes. Such request should be supported by a medical certificate from a university Medical Officer. The medical certificate issued by a registered medical practitioner (with the Registration Number shown explicitly on the certificates) will also be acceptable only in those cases where the student has valid reasons for his absence from the university.

DEPARTMENT OF CHEMICAL ENGINEERING

Introduction

The Department of Chemical Engineering of Bangladesh University of Engineering and Technology (previously known as the Ahsanullah Engineering College) is one of the Oldest Chemical Engineering departments in South Asia. The first batch of five chemical engineering students graduated in 1952. Today, the Chemical Engineering department at BUET (Bangladesh University of Engineering and Technology) is known worldwide for its strong academic program and qualified faculty members. The department now offers B.Sc., M.Sc., and Ph.D. degrees in chemical engineering. The enrollments of students in the undergraduate and graduate programs are sixty and fifteen per year, respectively. The courses offered in this department are designed based on the modern concepts of chemical engineering education with due emphasis on the industrial requirements in the country.

FIRST BATCH OF CHEMICAL ENGINEERS

Sitting (L to R)—Prof. A. Quadir Chowdhury, Prof. M. Haque, Prof. M.A. Naser, Principal T.H. Matthewman, Mr. Yunus, Dr. M. Ibrahim.

Standing (L to R)—Mr. A. Ghafoor, Mr. Rezaul Karim, Mr. Emdadul Haque, Mr. Mushfiqur Rahman Chowdhury, Mr. Abdul Malek.

Since its inception, the department's aim has been to offer courses focusing on the modern concepts of chemical engineering education with due regard for the requirements of local and international industries, and on innovative research relevant to chemical engineering and allied disciplines. The courses offered in this department are designed based on the modern concepts of chemical engineering education with due emphasis on the industrial requirements in the country.

In addition to learning the core principles of chemical engineering, students become well-versed in specialized sub-domains of this dynamic field. Environmental Science and Industrial Pollution Control, Industrial Safety, Biochemical Engineering, Energy Engineering, Sustainable Process Engineering and Process Control, Petroleum Engineering - students have the freedom to explore a variety of related avenues, through courses and intensive research. Our undergraduate and graduate students regularly publish papers in international journals, which is a testament to the thriving research activities of the department’s faculty members.

Because we have a strong partnership with industry, we ensure our students are exposed to industrial processes in real-life as well, which would cement their understanding of chemical engineering. In addition, our students are extensively involved in co-curricular and extra-curricular activities, winning prestigious awards conferred, for example, by the American Institute of Chemical Engineers (AIChE).

The faculty members are highly qualified and well regarded because of their research and other professional endeavors. Two of the faculty members were awarded Ekushey Padak (Dr M. A. Naser, 1987 and Dr. Iqbal Mahmud, 2005), one of the highest civilian awards in Bangladesh, for their outstanding contributions in Education. But what sets the faculty members apart is their emphasis on mentorship. The department collectively believes in fostering friendly and supportive student-teacher connections, which continue well after students have graduated.

Laboratories and Research Facilities

During the early days, a well-equipped Unit Operations Laboratory served the laboratory requirement of the department. Over the years, new laboratories were setup to keep the teaching in line with the modern development. Currently, the department owns several additional laboratories including Corrosion Laboratory, Kinetics Laboratory, Fuel and Petroleum Processing Laboratory, Mass Transfer Laboratory, Particle Technology Laboratory, Fluid Mechanics Laboratory, etc. The department also possesses facilities for research in areas of Reaction Engineering and Oil and Gas Processing. Recently procured equipment and modern facilities for Process Control and Environmental Engineering Laboratories have enabled the department to develop expertise in computer aided process control and air pollution monitoring. The department also has computer facilities equipped with specialized chemical engineering software for the use of undergraduate and post-graduate students. The department has other specialized laboratories solely for research purposes, which include the Applied Bioengineering Research Incubator and the Textile Analytical Laboratory. Each laboratory is equipped with state-of-the-art facilities to expand the department's research capabilities.

ChE Library

The departmental library has a respectable number of recent publications, books and journals in Chemical Engineering and related disciplines, and it is one of the finest departmental libraries in the country. The department regularly publishes Chemical Engineering Research Bulletin for highlighting departmental, national, and international research activities in different fields of chemical engineering.

List of Faculty Members

Dr. Md. Mominur Rahman
Professor and Head
Ph.D., BUET
Energy and Environment

Dr. Iqbal Mahmud
Professor Emeritus and Ex-Vice Chancellor, BUET
Ph.D., University of Manchester Institute of Science and Technology
Corrosion Engineering

Dr. Syeda Sultana Razia
Professor
Ph.D., University of Alberta
Process safety, Chemical safety and security, Distillation and separation processes, Effluent treatment

Dr. Md. Ali Ahammad Shoukat Choudhury
Professor
Ph.D., University of Alberta
Process Control, Chemical Engineering Modeling and Identification

Dr. Md. Shahinoor Islam
Professor
Ph.D., University of Alberta
Adsorption, Advanced oxidation, Nanocomposite synthesis and applications, Effluent Treatment, Microbial Fuel Cells

Dr. Shoeb Ahmed
Professor
Ph.D., North Carolina State University
Bioengineering & Biotechnology, Biological and Medical Image Analysis, Quantitative Biology, Air Pollution Modeling

Dr. Kazi Bayzid Kabir
Professor
Ph.D., Monash University
Solid Fuels, Gasification, Coal/Biomass-to-Liquid, Heterogeneous Catalysis

Dr. Md. Ruhul Amin
Associate Professor
Ph.D., King Fahd University of Petroleum and Minerals
Polymers and Petrochemicals

Dr. Md. Tanvir Sowgath
Associate Professor
Ph.D., University of Bradford
Process Modelling, Simulation and Optimization

Dr. Nahid Sanzida
Associate Professor
Ph.D., Loughborough University
Process Control, Electrochemical Engineering, Environmental Engineering

Dr. Md. Iqbal Hossain
Associate Professor
Ph.D., Nanyang Technological University
Energy Management in Industries, Separation Techniques, Fuel Chemistry and Technology, Gas Processing

Dr. Md. Easir Arafat Khan
Associate Professor
Ph.D., Nanyang Technological University
Chemical Process Safety, Fire Safety and Risk Management, Gas Liquid Separation, Advance porous materials

Dr. Nafisa Islam
Associate Professor
Ph.D., North Carolina State University
Biocompatible materials, Biosensing, Environmental Chemistry, Biomaterials

Dr. Kawnish Kirtania
Associate Professor
Ph.D., Monash University
H_2 energy, Bioenergy/biofuels, CO_2 Utilization, Low carbon technology, Waste valorization, Techno-economic Analysis

Dr. Iftekher Ahmed Khan
Assistant Professor
Ph.D., University of South Carolina
Environmental Engineering, Nanotechnology, Environmental Technology, Technology Management

Kaniz Fatema
Assistant Professor
M.Sc., BUET
Energy & Environment Engineering

Ahaduzzaman Nahid
Assistant Professor
M.Sc., BUET
Process Systems Engineering

Swarit Ahmed Shadman
Lecturer
B.Sc., BUET
Biochemical Engineering

Nishat Tabassum
Lecturer
B.Sc., BUET
Biomaterials, Microbial Electrochemical Systems

DETAILS OF COURSE CURRICULUM

Vision Statement

The vision of the department is to become one of the top-tier chemical engineering departments in Asia through academic excellence, research and innovation.

Mission Statement

We provide world class education in chemical engineering along with contemporary topics so that the graduates are prepared to take up various positions in a wide range of industries, academia and research organizations. Our research is focused on the emerging needs of the country in the fields of process control and safety, energy and environmental engineering, and biochemical engineering. We aspire to develop teaching and research in sustainable and environmentally benign processing of fuels and chemicals through good engineering practices.

Program Outcomes

Graduates from the department of Chemical Engineering, will be able to:

(a) **Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

(b) **Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

(c) **Design/development of solutions**: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

(d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

(e) **Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.

(f) **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.

(g) **Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts.

(h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

(i) **Individual work and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

(j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(k) **Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

(l) **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Summary of Credit Hours

Term/Semester	Theory	Sessional
Level 1 Term I	15	4.5
Level 1 Term II	14	6.0
Level 2 Term I	15	4.5
Level 2 Term II	16	4.5
Level 3 Term I	15	4.5
Level 3 Term II	15	4.5
Level 4 Term I	15	6.0
Level 4 Term II	13	6.0
	118	**40.5**

Courses (i.e., Credits) offered to complete B.Sc. in Chemical Engineering at BUET	
Total Credits	**158.5**
Chem Eng Departmental Courses	***92.5 Credits***
Non Chem Eng Courses	***66 Credits***

Other Departmental courses offered to the Department of Chemical Engineering	
Physics	7.5 Credits
Chemistry	19.5 Credits
Mathematics	16 Credits
HUM	9.5 Credits
ME	4.5 Credits
EEE	9 Credits
Total	**66 Credits**

Distribution of Courses

Level 1, Term I

Theory			Credits
1.	ChE 101	Elementary Principles of Chemical Engineering	3
2.	Phy 127	Physical Optics, Waves & Oscillations and Modern Physics	3
3.	Chem 111	Inorganic Chemistry	3
4.	Math 125	Calculus	3
5.	EEE 155	Electrical Engineering Fundamentals	3

Sessional			Credits
1.	Phy 102	Physics Sessional	1.5
2.	Chem 112	Inorganic Analysis Sessional	1.5
3.	EEE 156	Electrical Engineering Fundamentals Sessional	1.5

Level 1, Term II

Theory			Credits
1.	ChE 103	Engineering Thermodynamics	3
2.	Phy 171	Structure of Matter, Electricity & Magnetism and Nanophysics	3
3.	Chem 131	Physical Chemistry I	3
4.	Math 127	Linear Algebra and Vector Calculus	3
5.	Hum 125	English	2

Sessional			Credits
1.	Chem 116	Inorganic Analysis II Sessional	1.5
2.	Shop 120	Workshop	1.5
3.	ME 174	Mechanical Engineering Drawing and CAD	1.5
4.	Hum 272	English Sessional	1.5

Level 2, Term I

Theory			Credits
1.	ChE 201	Material and Energy Balance	3
2.	EEE 267	Electrical and Electronics Technology	3
3.	Math 225	Differential Equations and Laplace Transforms	3
4.	Chem 235	Physical Chemistry II	3
5.	Elective I		3
Sessional			**Credits**
1.	ChE 208	Computer Programming and Applications	1.5
2.	EEE 268	Electrical and Electronics Technology Sessional	1.5
3.	Chem 236	Physical Chemistry Sessional	1.5

Level 2, Term II

Theory			Credits
1.	ChE 205	Fluid Mechanics	3
2.	ME 251	Mechanics of Rigid and Deformable Solids	3
3.	Math 227	Engineering statistics and data analysis	4
4.	Chem 221	Organic Chemistry	3
5.	Elective II		3
Sessional			**Credits**
1.	ChE 202	Material and Energy Balance Sessional	1.5
2.	ChE 206	Chemical Engineering Laboratory I	1.5
3.	Chem 222	Organic Chemistry Sessional	1.5

Level 3, Term I

Theory			Credits
1.	ChE 301	Heat Transfer	3
2.	ChE 303	Mass Transfer I	3
3.	ChE 313	Solution Thermodynamics	3
4.	ChE 311	Special Topics in Unit Operations	3
5.	Elective III		3

Sessional			Credits
1.	ChE 302	Chemical Engineering Laboratory II	1.5
2.	ChE 308	Chemical Process Analysis Sessional	1.5
3.	Chem 352	Instrumental Methods of Analysis Sessional	1.5

Level 3, Term II

Theory			Credits
1.	ChE 305	Mass Transfer II	3
2.	ChE 309	Particle Technology	3
3.	ChE 401	Reaction Engineering	3
4.	Elective IV		3
5.	Elective V		3

Sessional			Credits
1.	ChE 304	Chemical Engineering Laboratory III	1.5
2.	ChE 306	Chemical Engineering Laboratory IV	1.5
3.	ChE 310	Computational Technique in Chemical Engineering	1.5

Level 4, Term I

Theory			Credits
1.	ChE 403	Process Control	3
2.	ChE 413	Process Design	3
3.	ChE 417	Fundamentals of Process Safety	3
4.	ChE 453	Transport Phenomena	3
5.	Elective VI		3
Sessional			Credits
1.	ChE 402	Chemical Engineering Laboratory V	1.5
2.	ChE 400	Project/Thesis I	3
3.	ChE 408	Process Design Sessional I	1.5

Level 4, Term II

Theory			Credits
1.	ChE 415	Process Engineering and Professional Ethics	3
2.	ChE 409	Corrosion Engineering	3
3.	ChE 411	Economics and Management of Chemical Process Industries	4
4.	Elective VII		3
Sessional			Credits
1.	ChE 400	Project/Thesis II	3
2.	ChE 408	Process Design Sessional II	3

Equivalence Table

For retake, the following old courses will be considered equivalent to new courses:

Old Courses	Equivalent New Courses
Phy 111 (Physical Optics, Heat, Waves & Oscillation) (3 Credit)	Phy 127 (Physical Optics, Waves & Oscillations and Modern Physics) (3 Credit)
Phy 155 (Structure of matter, Electricity & magnetism and Modern Physics) (3 Credit)	Phy 171 (Structure of matter, Electricity & magnetism and Nanophysics) (3 Credit)
ChE 111 (Elements of Chemical Engineering) (3 Credit)	ChE 101 (Elementary Principles of Chemical Engineering) (3 Credit)
ChE 203 (Chemical Engineering Thermodynamics) (3 Credit)	ChE 103 (Engineering Thermodynamics) (3 Credit)
ChE 307 (Chemical Engineering Thermodynamics II) (3 Credit)	ChE 313 (Solution Thermodynamics) (3 Credit)
ChE 405 (Process Design I) (3 Credit)	ChE 413 (Process Design) (3 Credit)
ChE 455 (Mathematical Models in Chemical Engineering) (3 Credit)	ChE 461 (Chemical Process Modelling and Optimization) (3 Credit)
ChE 451 (Fuels and Combustion Science) (3 Credit)	ChE 421 (Fuel Science) (3 Credit)

The following old courses will be available for retake only:

Phy 303	(Electrical and Magnetic Properties) (3 Credit)
Math 121	(Differential Calculus and Coordinate Geometry) (3 Credit)
Math 123	(Integral Calculus and Differential Equation) (3 Credit)
Math 221	(Vector Analysis, Matrices, and Laplace Transform) (4 Credit)
Math 223	(Numerical Analysis and Statics) (3 Credit)

Math 321	(Complex Variable, Bessel's Function and Legendre Polynomials) (3 Credit)
Math 323	(Fourier Analysis, Harmonic Functions and Partial Differential Equation) (3 Credit)
ME 141	(Engineering Mechanics) (3 Credit)
ME 160	(Mechanical Engineering Drawing-I (3 Credit)
ME 243	(Mechanics of Solids) (3 Credit)
ChE 407	(Process Design II) (2 Credit)

Chemical Engineering Compulsory Courses

Level-1 Term-1
ChE 101 Elements of Chemical Engineering (3 credits)

Level-1 Term-2
ChE 103 Engineering Thermodynamics (3 credits)

Level -2 Term-1
ChE 201 Material and Energy Balance (3 credits)
ChE 208 Computer Programming and Applications (1.5 credits)

Level -2 Term-2
ChE 205 Fluid Mechanics (3.0 credits)
ChE 202 Material and Energy Balance Sessional (1.5 credits)
ChE 206 Chemical Engineering Laboratory I (1.5 credits)

Level -3 Term-1
ChE 301 Heat Transfer (3.0 credits)
ChE 303 Mass Transfer I (3.0 credits)
ChE 313 Solution Thermodynamics (3.0 credits)
ChE 311 Special Topics in Unit Operations (3.0 credits)
ChE 302 Chemical Engineering Laboratory II (1.5 credits)
ChE 308 Chemical Process Analysis Sessional (1.5 credits)

Level -3 Term-2
ChE 305 Mass Transfer II (3.0 credits)
ChE 309 Particle Technology (3.0 credits)
ChE 304 Chemical Engineering Laboratory III (1.5 credits)
ChE 306 Chemical Engineering Laboratory IV (1.5 credits)
ChE 310 Computational Technique in Chemical Engineering (1.5 credits)
ChE 401 Reaction Engineering (3.0 credits)

Level -4 Term-1
ChE 403 Process Control (3.0 credits)
ChE 413 Process Design (3.0 credits)
ChE 417 Fundamentals of Process Safety (3.0 credits)
ChE 453 Transport Phenomena (3.0 credits))
ChE 402 Chemical Engineering Laboratory V (1.5 credits)
ChE 400 Project/Thesis I (3.0 credits)
ChE 408 Process Design Sessional I (1.5 credits)

Level -4 Term-2

ChE 415 Project Engineering and Professional Ethics (3.0 credits)
ChE 409 Corrosion Engineering (3.0 credits)
ChE 411 Economics and Management of Chemical Process Industries (3.0 credits)
ChE 400 Project/Thesis II (3.0 credits)
ChE 408 Process Design Sessional II (3.0 credits)

Elective Courses

1. The list of elective courses offered for each term will be made available for the students.
2. A maximum of 12.5 credits in Humanities will be counted for graduation.

Elective I

Hum 103 Economics (3 credits)
Hum 109 Social Psychology (3 credits)

Elective II

Hum 203 Government (3 credits)
Hum 201 Sociology (3 credits)
Hum 303 Principles of Accounting (3 credits)

Elective Courses in Chemical Engineering

ELECTIVE COURSES IN CHEMICAL ENGINEERING – GENERAL (ELECTIVE III, V)

ChE 429 Sustainable Process Engineering (3 credits)
ChE 431 Food Preservation and Processing (3 credits)
ChE 433 Polymers and Petrochemicals (3 credits)
ChE 439 Polymer Processing (3 credits)
ChE 441 Fertilizer, Pulp and Paper Technology (3 credits)
ChE 443 Food and Sugar Technology (3 credits)
ChE 445 Textile Engineering and Technology (3 credits)
ChE 461 Chemical Process Modelling and Optimization (3 credits)
ChE 457 Reactor design (3 credits)
ChE 459 Materials Science (3 credits)
ChE 471 Biochemistry (3 credits)

ELECTIVE COURSES IN MATHEMATICS (ELECTIVE III)

Math 325 Fourier Analysis and Special Functions

Math 327 Multivariable Statistical Analysis and Complex Analysis

ELECTIVE COURSES IN CHEMICAL ENGINEERING – SPECIALIZATION (ELECTIVE IV, VI, VII)

Biochemical Engineering

ChE 473 Biochemical Engineering I (3 credits)
ChE 475 Biochemical Engineering II (3 credits)
ChE 477 Biomolecular Engineering (3 credits)
ChE 479 Bioprocess Engineering (3 credits)

Environmental Engineering

ChE 481 Environmental Science I (3 credits)
ChE 483 Environmental Science II (3 credits)
ChE 485 Industrial Pollution Control (3 credits)

Process Control

ChE 321 Process Data Analytics (3 credits)
ChE 323 Process Dynamics, Modeling and Simulation (3 credits)
ChE 447 Digital Process Control (3 credits)
ChE 449 Optimization in Chemical Engineering (3 credits)

Process Safety Engineering

ChE 463 Risk Analysis in Safety Engineering (3 credits)
ChE 465 Industrial Safety Engineering (3 credits)
ChE 467 Occupational Safety and Health (3 credits)
ChE 469 Fire Safety in Process Industries (3 credits)

Energy Engineering

ChE 421 Fuel Science (3 credits)
ChE 423 Solid Fuel Systems (3 credits)
ChE 425 Energy Management (3 credits)

ELECTIVE COURSES IN PETROLEUM ENGINEERING – SPECIALIZATION

PMRE 401 Introduction to Petroleum Engineering
PMRE 403 Natural Gas Production and Transportation
PMRE 411 Petroleum Reservoir Engineering
PMRE 413 Natural Gas Engineering
PMRE 415 Gas and Oil Well Drilling and Logging
PMRE 417 Transmission and Distribution of Natural Gas

Detailed Outline of Courses

Physics Courses for the Department of Chemical Engineering

Phy 127
Physical Optics, Waves & Oscillations and Modern Physics
3.00 credits, 3 hours/week

Physical Optics: Theories of light; Interference of light; Young's double-slit experiment; Displacement of fringes and its uses; Fresnel bi-prism; Interference at wedge shaped films; Newton's rings; Interferometers; Diffraction of light; Fresnel and Fraunhofer diffraction; Diffraction through single slits; Diffraction from a circular aperture; Resolving power of optical instruments; Diffraction at double slit and N-slits-diffraction grating; Polarization; Production and analysis of polarized light; Brewster's Law; Malus' Law; Polarization by double refraction; Retardation plates; Nicol prism; Optical activity; Polarimeters; Polaroids.

Waves and Oscillations: Differential equation of a simple harmonic oscillator; Total energy and average energy; Combination of simple harmonic oscillations; Lissajous figures; Spring-mass systems; Calculation of the time period of a torsional pendulum; Damped oscillations; Determination of damping coefficient; Forced oscillations; Resonance; Two-body oscillations; Reduced mass; Differential equation of a progressive wave; Power and intensity of wave motion; Stationary waves; Group velocity and phase velocity; Architectural acoustics; Reverberation and Sabine's formula.

Modern Physics: Michelson-Morley's experiment; Galilean transformation; Special theory of relativity and its consequences; Quantum theory of radiation; Photo- electric effect; Compton effect; Wave-particle duality; Interpretation of Bohr's postulates; Radioactive disintegration; Properties of nucleus; Nuclear reactions; Fission; Fusion; Chain reaction; Nuclear reactors.

Phy 102
Physics Sessional
1.50 credits, 3 hours/week

Phy 171
Structure of matter, Electricity & Magnetism and Nanophysics
3.00 credits, 3 hours/week

Structure of Matter: Crystalline and non-crystalline solids; Single crystal and polycrystal solids; unit cell; crystal systems; coordination number; crystal planes

and directions; NaCl and CsCl structure; Packing factor; Miller indices; Relation between interplanar spacing and Miller indices; Bragg's Law; Methods of determination of interplanar spacing from diffraction patterns; Defects in solids: Point defects and line defects; Bonds in solids; Interatomic distances; Calculation of cohesive and bonding energy; Introduction to band theory: Distinction between metals,

semiconductors and insulators.
Electricity and magnetism: Coulomb's Law; Electric field (E); Gauss's Law and its application; Electric potential (V); Capacitors and capacitance; Capacitors with dielectrics; Dielectrics an atomic view; Charging and discharging a capacitor; Ohm's Law; Kirchhoff's Laws; Magnetic fields: Magnetic induction; Magnetic force on a current- carrying conductor; Torque on a current-carrying loop; Hall effect; Faraday's law of electromagnetic induction; Lenz's law; Self induction; Mutual induction; Magnetic properties of matter; Hysteresis curves; Electromagnetic oscillation: L-C oscillations and its analogy to simple harmonic motion.
Nanophysics: Postulates of quantum mechanics; Schrödinger's equation; Uncertainty principle; Expectation value; Particle in a zero potential; Calculation of energy; Concepts of nanomaterials; Synthesis and characterization of nanomaterials; Applications of nanostructured materials; Production, characterization and applications of thin films; Defects in thin films; Electron transport in thin films; Optical properties of thin films.

Phy 305
Solid-State of Physics
3.00 credits, 3 hours/week

Free electron theory: Free electron theory of metals; Density of states; Fermienergy; Explanation of electrical and thermal conductivity; specific heat; transport phenomena. Band theory of solids: Crystal periodicity and Bloch functions; Nearly free electron approximation; Tight-binding approximation; E-K curves for band gaps; Distinction of metal, insulators and semi-conductors.
Semiconductors: Intrinsic and Extrinsic semiconductors; Transport property of semiconductors; Frequency-dependent conductivity; Contact phenomena; p-n junction; p-n-p and n-p-n type semiconductor junctions and their characteristic properties.
Superconductivity: Meissner effect; London's theory; Type-I and Type-II superconductors; Thermodynamics of superconducting transitions; Cooper pairs; BCS theory; High Tc superconductors.
Magnetism: Different types of magnetic materials; Para-, ferro-, ferri- and antiferromagnetic materials; Weiss theory of ferromagnetism; Exchange energy; Néel's theory of antiferromagnetism; Domains and magnetic anisotropy of domain walls; Magnetostriction.

Chemistry Courses for the Department of Chemical Engineering

Chem 111
Inorganic Chemistry
3.00 credits, 3 hours/week

Modern concept of atomic structure and the periodic table of elements: Molecular structure and advanced theories of chemical bonding; Modern theories of acids and bases; Donor-acceptor chemistry.
Coordination chemistry: Theories of coordination compounds; Application of stabilities of complex compounds.

Introduction to organometallic and bioinorganic chemistry. Diffraction methods and microscopy in inorganic chemistry.

Chem 112
Inorganic Analysis Sessional
1.50 credits, 3 hours/week

Volumetric analysis: Acid-base titration; Oxidation-reduction titration and iodometric titration; Precipitation titration.
Gravimetric analysis: Estimation of sulfate and zinc; Separation and estimation of iron and calcium, copper and zinc from their mixtures.

Chem 131
Physical Chemistry I
3.00 credits, 3 hours/week

Solutions: Properties of solutions; Raoult's law and measures of composition; Solubility and solubility diagrams; Distribution law and its applications; Dilute solution and colligative properties. Introduction to nano chemistry.
Thermodynamics: Enthalpy; Activity; Entropy; Free Energy; Spontaneity of chemical reactions; Thermodynamic treatment of equilibrium constant; Thermochemistry; Adsorption; Catalysis; Colloids.

Chem 116
Inorganic Analysis II Sessional
1.50 credits, 3 hours/week

Complexometric titration. Analysis of water and some industrial products.

Chem 221
Organic Chemistry
3.00 credits, 3 hours/week

The hybridization of carbon atom and covalent bonding. A comprehensive study of aliphatic hydrocarbons with special reference to nomenclatures; Methods of preparation; Properties; Conformational analysis and important uses; Types of reactions and applications in industrial and biological processes of aliphatic hydrocarbons and their homologues. Aromatic compounds and aromaticity: Preparation, properties, reactions and industrial applications of benzene and its derivatives in industrial and biological processes. Heterocyclic compounds and their applications in industrial and biological processes.

Chem 222
Organic Analysis Sessional
1.50 credits, 3 hours/week

Detection of elements in organic compounds. Identification of functional groups. Preparation of different organic compounds. Separation, purification and characterization of organic compounds.

Chem 235
Physical Chemistry II
3.00 credits, 3 hours/week

Chemical kinetics, spectroscopy, rotational, vibrational, electronic and nuclear magnetic resonance spectra of molecules; Photochemistry; Photochemical vs. thermal reactions.

Phase equilibria, phase rule and its applications. Electrolytic conduction and electrical properties of solutions. Inter-ionic attraction theory.

Electrochemical cells: Thermodynamics of electrochemical cells and concentration cells; Applications of emf measurements; Ionic equilibria.

Chem 236
Physical Chemistry Sessional
1.50 credits, 3 hours/week

Partition coefficients. Equilibrium constant by distribution method. Heat of reaction by calorimetry. Heat of solution by solubility measurements. Viscosity measurement. Determination of specific rate constant. Measurement of equivalent conductance and solubility of sparingly soluble salt.

Chem 352
Instrumental Methods of Analysis
1.50 credits, 3 hours/week

Spectrophotometry. Potentiometric titration. pH-titration. Conductometric titration. Thin-layer chromatography.

Mathematics Courses for the Department of Chemical Engineering

Math 125
Calculus
3.00 credits, 3 hours/week

Differential calculus: Continuity and differentiability of a function; Successive differentiation of various types of function; Leibnitz’s theorem; Rolle’s theorem; Mean value theorem and expansion of functions; Partial differentiation; tangent and normal in the cases of Cartesian and polar co-ordinates; Maximum and minimum; Indeterminate forms.

Integral calculus: Integration by methods of substitution; Integration by the method of successive reduction; Definite integrals with properties; Improper integrals; Beta and gamma function; Area under a plane curve in Cartesian and polar co-ordinates; Area of the region enclosed by the two curves in Cartesian and polar co-ordinates; Arc lengths of curves in Cartesian and polar co-ordinates; Area and volume of a surface of revolution.

Math 127
Linear Algebra and Vector Calculus
3.00 credits, 3 hours/week

Linear algebra: Introduction to systems of linear equations; Gaussian elimination; Matrix polynomials; Euclidean n-space; Linear transformations from $\Re^n$ to $\Re^{m;}$ Properties of linear transformations from $\Re^n$ to $\Re^m$. Real vector spaces and subspaces; Basis and dimension; Rank and nullity; Inner product spaces; Gram-Schmidt process; Eigenvalues and eigenvectors; Diagonalization; Linear transformation; Kernel and range; Application of linear algebra to chemical engineering.
Vector calculus: Differentiation and integration of vectors together with elementary applications; Definition of line, surface and volume integrals; Gradient, divergence and curl of point functions; Gauss's theorem, Stoke's theorem and Green's theorem, and their applications.

Math 225
Differential Equations and Laplace Transform
3.00 credits, 3 hours/week

Ordinary differential equations: Solutions of first order differential equations by various methods; Solutions of general linear equations of second and higher orders with constant coefficients; Solution of homogeneous linear equations and applications; Solutions of differential equations of the higher order when the dependent and independent variables are absent.
Partial Differential Equations: Introduction; Equations of linear and non-linear first order partial differential equations; Standard forms; Linear equations of higher order; Equations of the second order with variable coefficients.
Laplace transform: Definition; Laplace transforms of some elementary functions; Sufficient conditions for existence of Laplace transforms; Inverse Laplace transforms; Laplace transforms of derivatives; The unit step function; Periodic functions; Some special theorems on Laplace transforms; Partial fraction; Solutions of differential equations by Laplace transforms; Evaluation of improper integrals.

Math 227
Engineering statistics and data analysis
4.00 credits, 4 hours/week

(3.00 credits: Course Work, 1 credit: Sessional)
Concept of sample and population; Measures of location: mean, median, mode, percentiles and quartiles; Measures of variability: range, interquartile range, variance, standard deviation, coefficient of variations and box plots, moments, skewness and kurtosis; Random variable and its probability distribution; Probability; Conditional probability; Addition and multiplication rules of probability; Bayes' theorem;

Distributions: normal, exponential, gamma, weibull; Test of hypotheses: z-test , t-test, chi-squared test, F-test; Concept of p-value; Interval estimation; Central limit theorem; Simple linear regression and its properties including test of fitness, correlation and preliminary data reconciliation. Sessional: Data and Data file; Data entry program; Range check, logical (consistency check), etc.; Operations with data variables; Data management and presentation. Data manipulation and transformation: Inserting variables and cases; Merging and splitting files; Recoding; Selection of a random sample; Numerical description of data using central tendency, dispersion, skewness and kurtosis; Parameter estimation for regression line; Sampling distribution; Calculation of p-value; Analysis of variance (ANOVA).
Software: SPSS/ Minitab, etc.

Math 325
Fourier Analysis and Special Functions
3.00 credits, 3 hours/week

Fourier Analysis: Real and complex form; Finite transform; Fourier integral; Fourier transforms and their uses in solving boundary value problems including 2D heat equation. Bessel Functions and Legendre Polynomials: solution of differential equations in series by the Frobenious method; Bessel's functions; Legendre's polynomials and their properties.

Math 327
Multivariable Statistical Analysis and Complex Analysis
3.00 credits, 3 hours/week

Multivariable statistical analysis: Aspects of multivariable analysis; Multivariate normal distribution; Inferences about mean and variances (MANOVA); Multivariate linear regression; Principal component analysis
Complex variable: Complex number system; General functions of a complex variable; Limits and continuity of a function of complex variable and related theorems; Complex differentiation and the Cauchy-Riemann equations; Mapping by elementary functions; Line integral of a complex function; Cauchy's integral theorem; Cauchy's integral formula; Residue; Cauchy's residue theorem; Evaluation of residues; Contour integration; Conformal mapping.

HUM Courses for the Department of Chemical Engineering

Hum 125
English
2.00 credits, 2 hours/week

General discussion: Grammatical problems; English phonetics. Reading skill. Vocabulary; writing skill: Principles of effective writing; Organization in writing; Planning and development; Composition; Précis writing.
General Strategies for the writing process: Generating ideas; Identifying audiences and

purposes; Constructive arguments; Stating problems; Drafting and finalizing.
Approaches to communication: Tenders and quotations; Resume and job letters; Journal articles; Technical and scientific presentation.

Hum 272
Developing English Skills (Sessional)
1.50 credits, 3 hours/week

Grammar; Vocabulary building; Developing reading skills; Developing writing Skills; Listening skills and note-taking; Developing speaking skills.

Hum 103
Economics
3.00 credits, 3 hours/week

Definition of Economics. Economics and Engineering. Principles of Economics. Microeconomics: The theory of demand and supply and their elasticities; Price determination; Nature of an economic theory and applicability of economic theories to the problems of developing countries; Indifference curve technique; Marginal analysis; Production, production function and types of productivity; Rational region of production of an engineering firm; Concepts of market and market structure; Cost analysis and cost function; Small scale production and large- scale production; Optimization; Theory of distribution.
Macroeconomics: Savings, investment and employment; National income analysis; Inflation; Monetary policy, fiscal policy and trade policy in the context of Bangladesh. Economics of development and planning.

Hum 109
Social Psychology
3.00 credits, 3 hours/week

Introduction to social psychology. The nature of social psychology.

Social factors in perceptual-cognitive processes: Social perception; person perception; social attitudes; The nature of attitude; The formation of attitude; The change of attitude.
Socialization: Process of social learning; Factors in conscience formation; Socialization and family structure. Status and communication. Emerging norms and conformity. Leadership. Public opinion, propaganda and advertisement. Youth and Drugs: Youth in Bangladesh; sources of frustration among the youth; drugs as a menace to society and individuals.

Hum 201 Sociology
3.00 credits, 3 hours/week

Scope of Sociology: Micro- and macrosociology; Fundamental concepts in sociology; Society from savagery to civilization.

Social evolution and techniques of production: Social structure of Bangladesh. Oriental and Occidental Societies: Feudalism.
Industrial Revolution: The growth of capitalism, its features and social consequences. Socialism and fascism.
Social Control: The need, means and future of social control.
Leadership: Types, functions, techniques and social power.
Society and Population: Social determinants of fertility and mortality; Human migration; Demographic transition; Population density and the standard of living; Population pyramid; Population and world resources; Malthusian, optimum and socialistic population theories; The population problem of Bangladesh.
Social Pathology: Crime; Juvenile delinquency; Slums.
Nature of Social Change: Biological, physical, economic, cultural and technological factors of social change; Change in production technology; Means of communication and transportation; Social effects deriving from the convergence of material inventions; Effects of technology on major social institutions; Social inventions; Urbanization and industrialization in Bangladesh.
Sociology of Development: Processes of development; Social Planning; Planning as a factor of social change; Social change in Bangladesh; Nature and trend of social change.
Urban Ecology: Pre-industrial and industrial cities; Growth and nature of cities in Bangladesh.
Rural Sociology: Features of village community in Bangladesh; Social mobility; Urban-rural contrast; Social structure of Bangladesh's tribal communities.

Hum 203
Government
3.00 credits, 3 hours/week

Scope: Some fundamental concepts of government and politics.
Origin of the State: Stages of development of the modern state; Nation, nationalism, internationalism and sovereignty; De jure and de facto sovereignty. Functions of State: Individualism, socialism, welfare state and fascism.
Citizenship: Rights and duties of citizens; Hindrances to good citizenship.
Forms of Government: Aristotle's Classification; Modern classification based on democracy, dictatorship, cabinet, presidential, unitary and federal.
Organs of government and separation of power: Legislature, executive, judiciary and bureaucracy. The Electorate: Party system and public opinion. Local self- government. Socio-political and economic background of the movement for Bangladesh. Government and politics in Bangladesh. Some major administrative systems. International Political Organization: The UN and its specialized agencies.

Hum 303
Principles of Accounting
3.00 credits, 3 hours/week

Accounting elements: The accounting equation; Accounts and transactions; The double

entry mechanism. Accounting procedure: The financial statements.
Costs in general: Objectives and classification of costs; Allocation and apportionment of overhead costs.
Product costing: Cost sheet under job costing; Operating costing and process costing. Costing of byproducts and joint products.
Marginal costing: Tools and techniques; Cost-volume-profit analysis. Designing the optimal product mix.
Relevant costing: Analysis of profitability within the firm. Guidelines for decision making: Short-run decisions. Long-run planning and control: Capital budgeting; The master budget; Flexible budget and standard cost; Variance analysis.

ME Courses for the Department of Chemical Engineering

ME 174
Mechanical Engineering Drawing and CAD
1.50 credits, 3 hours/week

ME 251
Mechanics of Rigid and Deformable Solids
3.00 credits, 3 hours/week

Basic concepts of mechanics; Statics of particles and rigid bodies; Coulomb friction; Centroids of lines; Areas and volumes; Moments of inertia of area and mass.
Stress analysis: Axially loaded members; Statically indeterminate problems; Stresses in thin walled cylinders and spheres.
Beams: Shear force and bending moment diagrams; Flexure formula; Stresses in beams; Beam deflection using integration method.
Torsion of circular shafts and columns: Euler's formula.
Combined stresses.

EEE Courses for the Department of Chemical Engineering

EEE 155
Electrical Engineering Fundamentals
3.00 credits, 3 hours/week

Electrical units and standards; Electrical networks and circuits theorems; Introduction to measuring instruments; Alternating current, RLC series, Parallel circuits, Magnetic concepts and magnetic circuits.

EEE 156
Electrical Engineering Fundamentals
1.50 credits, 3 hours/week

Laboratory experiments based on EEE 155

EEE 267
Electrical and Electronic Technology
3.00 credits, 3 hours/week

Balanced three-phase circuits; Introduction to single-phase and three-phase transformers; Principles of construction, operation and applications of DC generators, DC motors, synchronous generators, synchronous motors and induction motors; Principles of operation and applications of semiconductor diodes, transistors, operational amplifiers (OPAMs), silicon-controlled rectifiers (SCRs); Oscilloscopes; Temperature, pressure, flow-rate, speed and torque measurements using transducers.

EEE 268
Electrical and Electronic Technology Sessional
1.50 credits, 3 hours/week

Laboratory experiments based on EEE 267

Chemical Engineering Core Courses

ChE 101
Elementary Principles of Chemical Engineering
3.00 credits, 3 hours/week

Scope of Chemical Engineering: Global and local context.

Principles of chemical engineering calculation: System of units; Dimensional analysis; Process variables; Significant numbers.

Introduction to common unit operations in chemical engineering.

Material balances: Types of processes; Balances for non-reactive and reactive systems; Balances involving recycle and purge streams; Combustion processes.

Energy balances: Forms of energy; First law of thermodynamics; Mechanical energy balance; Heat capacities; Steam tables; Energy balance on simple non-reactive systems; Energy balance for simple reactive systems.

ChE 201
Material and Energy Balance
3.0 credits, 3 hours/week

Review of material balances involving recycle and purging operations.

Single phase systems: Liquid and solid densities; Equations of state for ideal and non-ideal gases. Multiphase systems: Phase equilibrium; The Gibbs phase rule; Vapour pressure; Gas-liquid equilibrium for single and multi-component systems; Operations involving condensation, vaporization, drying and humidification; Solutions of solids in liquids.

Energy balances on non-reactive systems: Heat capacities; Energy balance involving change of temperature, pressure and phases; Phase change operations; Psychrometric chart for air-water system; Enthalpy-composition diagrams; Heats of solutions and mixing.

Energy balances on reactive systems: Heats of formation and reaction; Hess's Law; Energy balances on reactive systems; Combined material and energy balance; Fuels and combustion; Adiabatic flame temperature.

Computer aided balance calculations. Balances on transient processes.

ChE 202
Material and Energy Balance Sessional
1.50 credits, 3 hours/week

Problem solving class based on Material and Energy balance course.

ChE 103
Engineering Thermodynamics
3.00 credits, 3 hours/week

General: The scope of thermodynamics; Fundamental and secondary quantities. The first law and other basic concepts.

Volumetric properties of pure fluids: P-V-T behaviour of pure substances; Ideal and non-ideal gas; Equations of state and its applications.
Heat effects: Heat capacities; Phase changes of pure substances; Standard heat of reaction and effect of temperature.
The second law of thermodynamics: Alternative statements; Heat engine; Entropy changes and irreversibility. The third law of thermodynamics.
Thermodynamics properties: Single phase and two-phase systems; Thermodynamic diagrams. Conversion of heat into work by power cycles: Vapor cycles; Steam power plant; Internal combustion engines and gas turbines; Combined gas-vapor cycle.

ChE 205
Fluid Mechanics
3.00 credits, 3 hours/week

General: Properties and classification of fluids; Rheological properties; Fluid statics; Kinematics of fluid flow.
Energy considerations in steady flow: Energy forms and head; General energy equation; Energy equations for incompressible and compressible fluids; Bernoulli's theorem; Energy lines. Laminar and turbulent flow: Flow development; Velocity and stress distributions; Friction factors; Frictional energy loss; Minor energy losses; Pipelines in series and parallel. Similarity and dimensional analysis.
Fluid and flow measurements: Measurements of density, viscosity, pressure, velocity and discharge.
Application of equations of motion (Navier-Stokes equation) and continuity in common multidirectional flows. Basic concept of CFD. Basics of steady compressible flow and multi-phase flow. Fluid moving machinery: Pumps, compressors, and blowers.

ChE 206
Chemical Engineering Laboratory I
1.50 credits, 3 hours/week

Laboratory work based on ChE 205.

ChE 208
Computer Programming and Applications
1.50 credits, 3 hours/week

An introductory course in Computer Programming and its applications to problems in Chemical Engineering. Computer aided data analysis.

ChE 301
Heat Transfer
3.00 credits, 3 hours/week

Concepts and mechanisms of heat transfer.
Conduction: Mechanism of thermal conduction in solids, liquids and gases; Other

thermal properties; Steady state heat conduction in one dimension; Transient heat conduction.
Convective heat transfer: Approximate solutions of convective heat transfer; Dimensionless correlations for forced and free convection.
Heat transfer with phase changes: Boiling and condensation.
Thermal radiation: Black body radiation; Heat exchange between infinite and finite surfaces in different orientations/combinations in enclosures.
Heat exchangers: Mean temperature difference in different flow arrangements; Thermal and mechanical design; Heat transfer across extended surfaces. Types of heat transfer equipment.

ChE 302
Chemical Engineering Laboratory II
1.50 credits, 3 hours/week

Laboratory work based on ChE 301 and ChE 303.

ChE 303
Mass Transfer I
3.00 credits, 3 hours/week

Concept of equilibrium: Phase equilibria; Equilibrium stage concept and its link to separation processes.
Binary Distillation: Flash distillation; Column distillation; Simplified methods for stage calculations; Batch distillation; Tray hydraulics and design considerations; Tray efficiency; Column design.
Gas-liquid absorption: Scrubbers and strippers; Analytical and graphical methods for stage calculations. Solvent Extraction: Liquid-liquid extraction in single and multiple contact extractors with completely immiscible and partially miscible solvents; Use of triangular diagrams for stage calculations; Batch and continuous leaching; Washing.

CHE 304
Chemical Engineering Laboratory III
1.50 credits, 3 hours/week

Laboratory work based on ChE 301, ChE 303 and ChE 305.

ChE 305
Mass Transfer II
3.00 credits, 3 hours/week

Mathematical description of mass transfer: Fick’s law for diffusion; Diffusion in gases, liquids and solids; Mass transfer between gas and liquid phases; Theories of mass transfer and mass transfer coefficients.
Continuous contact mass transfer: Distillation and gas absorption in packed column; HETP method of Packing Height calculation; HTU and NTU concepts; Simultaneous

heat and mass transfer; Cooling tower design.
Adsorption: Adsorbents and adsorption isotherms; Breakthrough curves; Mass transfer effects; Ion exchange and pressure swing adsorption.
Membrane separation: Types of membrane and membrane modules; Gas separation; Reverse osmosis; Ultrafiltration; Dialysis; Pervaporation.
Multicomponent distillation: Bubble and dew point calculations for multicomponent systems; Simplified methods for calculation of stages.

ChE 306
Chemical Engineering Laboratory IV
1.50 credits, 3 hours/week

Laboratory work based on ChE 309 and ChE 311

ChE 313
Solution Thermodynamics
3.00 credits, 3 hours/week

Thermodynamic properties: Relationships among the thermodynamic properties for systems of variable composition; Partial molar properties; Fugacity and fugacity coefficients; Fugacities in ideal solutions; Property changes upon mixing; Activity and activity coefficients; Heat effects of mixing processes. Phase equilibria: Nature and criteria of equilibrium; Phase rule and Duhem's theorem; Vapour-liquid equilibrium calculations for miscible systems; Gibbs- Duhem equation.
Chemical reaction equilibria: The reaction coordinate; Criteria of equilibrium; Equilibrium constant and effect of temperature; Phase rule and Duhem's theorem. Thermodynamics of flow processes: Conservation of mass and energy; Mechanical energy balances; Maximum velocity in pipe flow; Metering and throttling processes; Nozzles, compressors and ejectors.
Refrigeration and liquefaction: Carnot, air, and vapour-compression refrigeration cycles and their comparison; Absorption refrigeration; Heat pump; Liquefaction processes.
Thermodynamic analysis of processes: Ideal work; Lost work; Thermodynamic analysis of steady flow processes.

ChE 308
Chemical Process Analysis Sessional
1.50 credits, 3 hours/week

Process description and calculations of the following industries: Gaseous liquid, solid & secondary fuels. sulfur compounds (sulfuric acid), nitrogen compounds (ammonia, urea), lime & cement, chloro-alkali industries, air-conditioning & refrigeration (humidification-dehumidification), ceramic industry, phosphorus industry (phosphate fertilizer), soap & detergent, sugar industry, pulp & paper industry, fermentation industry, petroleum & petrochemicals.

ChE 309

Particle Technology
3.00 credits, 3 hours/week

Properties and characterisation of particulate solids: Particle size and shape; Bulk density and porosity; Screen analysis; Mean diameters; Analytical distribution function. Particle size reduction and enlargement: Law of crystal growth; Fundamental relationship of crystallizers; Size distribution of feed and product of crushers, grinders and crystallizers.

Bulk properties of particulates: Mohr stress diagram; Pressure in masses of particles; Bin design. Fluid-solid momentum transport: Flow past a sphere; Drag coefficient; Terminal setting velocity; Pressure drop in packed beds; Fluidization and sedimentation; Slurry transport and pneumatic conveying.

Fluid-solid separation based on momentum transport: Classification and classifiers; Centrifugal classification; Cyclones and centrifuges. Separation based on pre-treatment of solid-liquid interface: Coagulation, flocculation and flotation; Gravity thickening.

Separation based on porous mediums: Application of packed bed equation to deep bed and pressure filtration; Filtration equipment and operations; Optimum design; Continuous rotary filtration; Filter media and aids. Environmental hazards of fine particles.

ChE 310
Computational Techniques in Chemical Engineering
1.50 credits, 3 hours/week

Computational techniques in numerical methods of solution of algebraic and transcendental equations, integration and differential equations. Application to chemical engineering design and optimization problems. Simulation using computational software. Preliminary data reconciliation.

ChE 311
Special Topics in Unit Operations
3.00 credits, 3 hours/week

[The course is designed to advance students' knowledge on chemical process equipment selection, detailed equipment design and current industrial practices]
Mechanical separation: Gravity settlers; Impingement and centrifugal separators; Scrubbers.

Size Reduction: Principles and methods of crushing and grinding; Laws for energy requirements; Selection criteria for crushers and grinders; Size reduction equipment.

Solid handling machinery: Selection criteria and applications of mechanical conveyors.

Ejectors and other vacuum systems: Types of ejector load; Performance factor of ejectors; Operating ranges of different vacuum systems.

Pressure relieving devices: Principles; Relief device location; Relief devices and applications; Relief sizing.

Mixing and agitation: Theory of mixing; Types of impeller; Flow patterns; Power requirements of agitated vessels; Range of operation; Inline static mixer; Jet mixer.

Crystallization: Theory; Design of crystallizers; Crystallization equipment.
Drying: Mechanism; Drying curve; Design; Types of dryers and applications.
Evaporation: Basic concepts; Performance; Maintenance; Design; Types of evaporator; Auxiliary equipment.

ChE 400
Project/Thesis
6.00 credits, 6 hours/week for two terms

With the assistance of a teacher, the student will select a problem in any field of chemical engineering. The problem must require experimental work and not be merely a paper thesis and must be sufficiently limited in scope so that the student can expect to attain a satisfactory solution in one year of work. The purpose of this course is to make the student responsible for planning and carrying out an engineering project and presenting his work as an acceptable engineering report. (A student will work for 6 hours per week in term 7 and 6 hours per week in term 8 for this course. Credits will be given at the end of term 7 and term 8).

ChE 401
Reaction Engineering
3.00 credits, 3 hours/week

Review of relevant thermodynamic concepts: Equilibrium constant; Effect of temperature and pressure; Determination of equilibrium composition.
Chemical kinetics: Mathematical characterization; Interpretation of batch reactor data; Reaction mechanisms and molecular theories of chemical kinetics.
Reversible, parallel, series, and complex multiple reactions systems. Heterogeneous catalysis: Adsorption isotherms; Preparation and characterization; Poisoning and deactivation; Kinetics of heterogeneous reactions.
Ideal reactors for homogeneous reactions: Ideal reactor models; Design for single reactions; Recycle reactors; Design for multiple reactions; Temperature and pressure effects on reactor sizing; Choosing the reactor type.
Ideal reactors for heterogeneous reactions: Diffusion in heterogeneous reactions; Packed and fluidized bed reactors; Trickle bed and slurry reactors; Deactivation of catalysts.

ChE 403
Process Control
3.00 credits, 3 hours/week

Basic concepts of process control: Incentives; Design aspects; Hardware elements. Modelling for control purpose: Development of mathematical models; Review of Laplace transform; Input-output, Transfer function, and State space models; Linearization of nonlinear models; Empirical models from process data.
Dynamic behavior of chemical processes: First, second and higher order processes; Time Delay; Interactive and non-interactive systems in series. Feedback control

systems: Concept; Feedback controllers and final control elements; Closed loop responses; Concept of stability; Routh Stability criteria; Root locus diagrams.
Frequency response analysis: Bode diagrams; Nyquist plots; Bode and Nyquist stability criteria; Control system design.
Enhanced control systems: Cascade, selective, feedforward, ratio, and inferential controls. Preliminaries of distributed control system (DCS) and programmable logic controller (PLC).

ChE 413
Process Design
3.00 credits, 3 hours/week

Design considerations: Design basis; Calculations and solution strategy for mass and energy balances; Process flow Diagram (PFD); Piping and instrumentation diagram (P&ID). Equipment selection, specification and design: Fluid transport in pipelines; Pumps & compressors, heat transfer equipment, separation columns, reactors, pressure vessels and solid handling equipment.

Selection of materials of construction for equipment and services.
Economic evaluation: Estimation of investment, capital and operating costs. Estimation of product cost.
Optimization in design: Optimum design and economic design criteria; Heat integration and pinch analysis; Energy efficient design.

ChE 415
Project Engineering and Professional Ethics
3.00 credits, 3 hours/week

Project Engineering
Engineering project management processes: Time and cost management; Project quality issues; Risk management.
Chemical engineering project: Project definition, technical specifications, design basis, process licensing, and engineering studies; Basic & detailed engineering, and codes & standards; Procurement; Engineering document preparation; Contract negotiation; Vendors, inspection and performance tests.
Professional ethics
General: Professional codes of ethics and responsibilities of engineers; Ethical analyses; Ethical leadership in engineering & society; Conflicts of interests. Ethics in the workplace: Fairness, reliability, risk & safety, work experience report, resource allocations, and ethics in digital age; Privacy and confidentiality issue; Ethics in research and innovation.
Intellectual property and technology transfer. Sustainable engineering. Global and cultural considerations.

ChE 408
Process Design Sessional

4.50 credits; 3 hours/week in First term and 6 hours/week in Second term

Integrated design of a chemical plant considering related design considerations and cost estimation.
(A student will work for 3 hours per week in term 7 and 6 hours per week in term 8 for this course. Credits will be given at the end of term 7 and term 8).

ChE 409
Corrosion Engineering
3.00 credits, 3 hours/week

Corrosion engineering principles: Corrosion mechanisms; Thermodynamics of corrosion; Polarization; Passivity; Engineering materials.
Corrosion in specific environments: Corrosion of iron and steel; Atmospheric corrosion; Soil corrosion; Microbiologically influenced corrosion; Stray-current corrosion; Influence of mechanical factors and stress corrosion; Oxidation and high temperature corrosion.
Corrosion prevention and protection: Design considerations for corrosion prevention; Cathodic and anodic protection; Coating; Corrosion reduction by environmental modifications; Alloying for better corrosion resistance; Case studies of material selection.
Corrosion Monitoring: Testing; Monitoring; Failure analysis.

ChE 411
Economics and Management of Chemical Process Industries
4.00 credits, 4 hours/week

Engineering economics and chemical process industries.
Investment cost and interest calculation: Types of interest; Present worth and discount; Annuities, perpetuities and capitalized costs; Concept of equivalence.
Applications of money-time relationships: Determining MARR; PW, FW, AW, IRR, ERR and Payout Period for investment projects. Comparing alternatives: The study period; Alternatives having useful lives equal and different to the study period; Capitalized worth method; Mutually exclusive combinations of projects.
Dealing with risk and uncertainty: Sources of uncertainty; Breakeven analysis; Sensitivity graphs; Estimating O-M-P; Risk adjusted MARR and reduction of useful life. Evaluating projects with B/C ratio method: Differences between private and public projects; Self-liquidating and multipurpose projects; Difficulties in evaluating public sector projects; Interest rate for public projects; Evaluating independent projects and mutually exclusive alternatives by B/C ratios. Value chain concept. Elements of input-output analysis. Cost of Capital. Taxes and Insurance.

History of origin and development of management.
Functions of management in CPI: Decision making, planning, organizing, directing, communicating and controlling.
Strategic management: Strategy statement; Strategic management process; SWOT

analysis.
Operations Management: Definition; Time and Motion Study, Total Quality Management. Quantitative techniques in decision making: Gantt Chart; Network analysis – PERT, CPM. Information management. Technology management.

ChE 417
Fundamentals of Process Safety
3.00 credits, 3 hours/week

Safety in chemical process industries: Loss prevention; Hazard, risk and inherent safety; Toxicology.
Industrial hygiene: Government regulations; Safety Data Sheet; Evaluation and control. Consequence analysis: Source models; Flow of liquid and vapor through holes and pipes; Realistic vs. worst-case scenario; Toxic release and dispersion models.
Design to prevent fire and explosions.
Hazard analysis: Process hazards checklist and HAZOP studies.
Risk assessment: Probability theory; Event Trees and Fault Tree Analysis; Quantitative Risk Assessment – QRA; Accident investigations with case studies.

ChE 453
Transport Phenomena
3.00 credits, 3 hours/week

Unified approach to the study of fluid dynamics, heat transfer and mass transfer.
Momentum transport: Viscosity and momentum flux; Shell momentum balances; Velocity distribution in laminar & turbulent flows and with more than one independent variable; Equations of change for isothermal systems.
Heat transport: Thermal conductivity and heat flux; Shell energy balances; Temperature distributions in solids, in laminar flow and with more than one independent variable; Equations of change for non-isothermal systems.
Mass transport: Diffusivity and mass flux; Shell mass balances; Concentration distributions for multi-component systems in solids and laminar flow; Equations of continuity for multi-component systems.
Analogy equations relating momentum, energy and mass transfer.

Electives Courses in Chemical Engineering - General

ChE 429
Sustainable Process Engineering
3.00 credits, 3 hours/week

Sustainability concepts: Cleaner production; Industrial ecology; Circular economy. Strategies for Sustainability: Process synthesis by hierarchical approach; Waste minimization in reactors and separation processes; Energy conservation; Materials recycling; Waste minimization; Case studies.

Evaluation: Life cycle assessment; Case studies; Assessment of cost and societal impacts; Sustainability assessment through integration of economic, environmental, and social performances; Case studies.
Implementation: Planning for sustainable process industries; Design and development; Operations management of process plants.

ChE 431
Food Preservation and Processing
3.00 credits, 3 hours/week

Food properties: Classification of foods; Composition and nutritive value of protein, carbohydrate, vitamins, minerals, lipids and pectic substances; Flavour, aroma and natural pigment; Food additives.
Food spoilage: Physical, microbial, and chemical spoilages; Food poisoning. Fundamentals of microbiology: Microbes in food and fermentation industries; Morphology, physiology and genetics of microbes; Enzymes; Growth and destruction of microorganisms; Growth curve.
Food preservation and processing: General principles; Physical biological and chemical processing; Effect of cooking and processing on the nutritive value.
Microorganism in natural products: Control; Source and prevention.
Energy metabolism of aerobic and anaerobic microbes. Nitrogen fixation. Basic principles of food plant sanitation.

ChE 433
Polymers and Petrochemicals
3.00 credits, 3 hours/week

Prospect of polymer and petrochemical industries in Bangladesh.
Raw materials of polymers and petrochemicals.
Petrochemicals: Kinetics and reaction mechanism; Manufacturing technologies and uses of ammonia, methanol, oxo-chemicals, acetylene, vinyl chloride, synthetic detergents, olefins, dienes, waxes, and aromatics.
Polymers: Classification of polymeric materials and their chemical structure; Nomenclature for polymers; Molecular weight and its measurement; Polymerization mechanisms and methods; Reactor types; Manufacture and technological properties of PE, PP, PVC, PVA, PTFE, nylons, polyesters, and synthetic rubbers (butadiene, isoprene, styrene).

ChE 439
Polymer Processing
3.00 credits, 3 hours/week

Processing principles: Mechanical, electrical, thermal and optical properties of polymeric materials with special reference to time-temperature and environmental effects and testing standards.
Formulation and compounding: Principles and practices; Degradation and stabilization of polymers; Rheological properties of polymeric melt-solutions & suspensions and

their measurements; Flow in channels of simple cross-section; Analysis of the principles of extrusion, injection molding, film blowing, calendaring, mixing, etc. for sizing equipment, power requirements and understanding of process performance.
Safety in polymer processing: Processes and operations; Planning of processing facilities; Layout and maintenance; Process safety measures; Health and safety measures.

ChE 441
Fertilizer, Pulp and Paper Technology
3.00 credits, 3 hours/week

The world fertilizer market. Fertilizer industries in Bangladesh.
Nitrogen fertilizers (ammonia, urea): Raw materials, reaction kinetics, manufacturing processes, design considerations, status of production and comparative economics of different nitrogenous fertilizers.
Phosphate fertilizers (SSP, TSP): Raw materials, reaction kinetics, manufacturing processes, design considerations and comparative economics of different phosphate fertilizers; Manufacturing process of different potash fertilizers and their uses. Complex and compound fertilizers.
The world pulp and paper market. Pulp and paper industries in Bangladesh.

Pulping of wood: Types of raw materials and chemical compositions of wood; Preparation of raw material for pulping; Chemical pulping processes.
Kraft process: Chemistry, digestion and chemical recovery; Recovery boiler;
Advanced uses of black liquor.

Papermaking: Bleaching, beating, and sizing; Paper machine.

Waste disposal methods from fertilizer and pulp & paper industries.

ChE 443
Food and Sugar Technology
3.00 credits, 3 hours/week

Principles of preservation methods: Chemical, thermal, low temperature & freezing, and irradiation.
Unit operations in food processing and preservation: Fluid flow, heat transfer, concentration by evaporation, drying, separation methods, mixing, size reduction and sterilization; Calculations in food engineering.
Technology for processing and preservation in specific industries: Cereals, fruits & vegetables, fish, milk & dairy products, and oils & fats; Packaging in food industry. Sugar technology: Composition of cane and juice; Extraction and purification of juices; Treatment of mud water and clarified juice.
Cane sugar refining: Clarification, decolourization, crystallization and finishing. Microbiology in sugar manufacture and refining. Economics of sugar industry.

ChE 445
Textile Engineering and Technology

3.00 credits, 3 hours/week

Textile raw materials: Selection of fibrous materials; Yarn manufacturing technology; Types, characteristics and selection of dyes; Pigments and their classifications; Color and its different theories.
Fabric structure, design and manufacturing technology.
Textile wet processing: Pre-dyeing, dyeing & post-dyeing stages, washing, and printing. Textile testing and quality control.
Environmental management: Pollution Control in Textile Industry; Caustic recovery; Cleaner production options.

ChE 461
Chemical Process Modelling and Optimization
3.00 credits, 3 hours/week

Model analysis and solution strategies for steady state processes: Direct and iterative methods for linear models; Solution strategies for nonlinear models using linearization.
Model analysis and solution strategies for dynamic processes: Numerical tools for initial value ODE problems of CSTR and other reactor models; Stability; Stiffness; Scaling; Interpolation, extrapolation and quadrature; Integration. Application to problems in staged operations related to fluid mechanics, mass transfer and heat transfer using finite difference method: Modeling multiple stages; Solution using finite difference method for mass transfer and heat transfer problems.
Fundamental features of optimization: Concepts of continuity, convexity and concavity of functions.
Numerical solution methods: Newton and quasi-Newton; Finite difference approximations; Polynomial approximation; Termination criteria.
Linear programming: Geometry of linear programs; Simplex algorithm; Barrier method; Sensitivity analysis. Nonlinear and mixed integer programming, and other methods. Selected advanced optimization methods.

ChE 457
Reactor design
3.00 credits, 3 hours/week

Prerequisite: ChE 401
Review of homogeneous and heterogeneous reaction systems.
Stirred tank and plug flow isothermal unsteady-state reactors.
Non-isothermal reactor design: Adiabatic plug flow reactors; Flow reactors with heat exchangers; Unsteady-state non-isothermal reactors.
Reactor design for adiabatic and other non-isothermal conditions. Heat and mass transport processes.
Non-ideal reactors: Residence time distribution; Models for non-ideal reactors. Design of industrial reactors: Reactor design at meso, micro and nano scales; Scaling up/down; Case studies.

ChE 459

Materials Science
3.00 credits, 3 hours/week

Review of atomic bonding and crystal structure. Phase diagrams. Microstructures. Imperfection of crystals including dislocations. Phases and interfaces in material systems. Transport in materials. Phase transformations.

Heat treatment processes. Deformation of materials. Electrical, magnetic and optical behaviour of materials.

Fracture. Deterioration of materials. Electronic structure and physical properties.

ChE 471
Biochemistry
3.00 credits, 3 hours/week

General: Molecular logic of living systems; Biomolecules and cells; Water, acids and buffer.

Proteins: Amino acid sequences; Primary, secondary, tertiary and quaternary structures; Classification of proteins.

Enzymes: Mechanism; Kinetics; Inhibition.

Nucleic acids: Nucleotides; DNA and RNA composition and simple structure; DNA replication, transcription and translation; Genetic code and genetic engineering.

Biomacromolecules' structure and function: Sugars, polysaccharides, lipids, triglycerides and phospholipids; Biological membranes; Vitamins and coenzymes; Digestion of polysaccharides, lipids and proteins.

Metabolism and energy transfer: Glycolysis and oxidative phosphorylation; Biological high-energy compounds; Oxidation of fatty acids and oxidative degradation of amino acids; Photosynthetic phosphorylation; Interrelationship and control metabolism; Some inborn errors of metabolism.

Biochemical characterization. Synthetic Biology.

Elective Courses offered for Specialization Topics

Specialization Topic: Biochemical Engineering
(Courses offered by ChE Dept)

ChE 473
Biochemical Engineering I
3.00 credits, 3 hours/week

The concept of biological catalysis.

Microorganisms: Nature of microorganisms, their importance and classification; Industrially important microorganisms.

Biomolecules: Amino acids and proteins; Metabolic stoichiometry and energetics; Molecular genetics and control systems.
Kinetics of enzyme catalyzed reactions: Michaelis-Menten equation; Immobilized-enzyme technology; Enzyme-linked Immunosorbent Assay; Immobilized enzyme kinetics. Batch fermentation: Biomass yield and product formation; Rates of reaction; Growth; Limiting substrate concentrations; Monod's equation.
Introduction to food microbiology and environmental biotechnology.

ChE 475
Biochemical Engineering II
3.00 credits, 3 hours/week

Biological reactors: Design and analysis; Ideal reactors; Reactor dynamics; Reactors with nonideal mixing; Sterilization reactors; Multiphase bioreactors.
Transport phenomena in bioprocess systems: Gas liquid mass transfer in cellular systems; Determination of oxygen transfer rates; Forced convection.
Microbial culture for bioproduct development: Separation of cells and recovery of useful products; Analysis of multiple interacting microbial populations; Mixed microbial population in applications and natural systems.
Biosensors: Classes and components; Transducing mechanisms; Sensitivity and Selectivity; Nanobiosensors.
Cell signaling and quantification of the cellular responses. Basic cloning techniques.

ChE 477
Biomolecular Engineering
3.00 credits, 3 hours/week

Fundamental principles of biomolecular engineering and its applications in pharmaceutical, agricultural, chemical and food industries. Molecular bioengineering: Structures, dynamics, and functions of biomolecules; Kinetics in small systems and biochemical processes; Receptor-mediated adhesion; Dynamics of ion-channels; Ligand binding; Biochemical transport.
Basics of molecular tools in biotechnology: Gene discovery; Rational design; Recombinant DNA technology; Directed evolution; Pathway engineering; Functional genomics and proteomics.

ChE 479
Bioprocess Engineering
3.00 credits, 3 hours/week

The biology of organisms of biotechnological importance.
Expression of a gene in a heterologous host: Metabolic pathways; Regulation in gene expression and metabolism; Microbial growth.
Enzymes and applications: Bioreactors for enzymatic and microbial processes; Stoichiometry in bioprocesses.
Upstream and downstream processing: Use of genetically engineered organisms in

bioprocesses; Mammalian cell culture and bioreactors; Basic principles of bioseparations; Regulatory issues in biopharmaceutical industry.

Specialization Topic: Environmental Engineering (Courses offered by ChE Dept)

ChE 481
Environmental Science I
3.00 credits, 3 hours/week

General: Introduction to environmental systems; Environmental laws, regulations and quality standards; Environmental ethics.
Water pollution: Sources and characteristics; Effects of contaminants; Wastewater microbiology; Primary, secondary, and tertiary wastewater treatment; Nitrogen and phosphorous removal; Sludge treatment and disposal.
Air pollution: Origin and fate of air pollutants; Effects on humans and environment; Air pollution meteorology; Atmospheric dispersion and modeling; Stationary and mobile sources; Source control.
Noise pollution: Noise effects; Community noise sources and criteria; Noise control.

ChE 483
Environmental Science II
3.00 credits, 3 hours/week

Solid waste management: Physical and chemical characterization of solid waste; Resource conservation and recovery; Treatment and disposal methods including pyrolysis & incineration, sanitary landfill and composting.

Radioactive and hazardous waste management.

Environmental impact and economic assessment: Legal and administrative framework of EIA; EIA process; Underlying principles and scope of the EIA study; Study limitations and alternatives in EIA; EIA approach and methodology; Future of EIA – legislative and regulatory changes; Environmental and social impacts; Evaluation of hazards and risks; Mitigation of impacts; Economic assessment of EIA; Environmental monitoring plan.

ChE 485
Industrial Pollution Control
3.00 credits; 3 hours/week

Industrial pollutants: Sources and nature of pollutants in air and water; Standards; Pollutant measurement technologies.
Source controlling of pollutants: Control and management technologies of air and water pollution.

Pollution control of specific industries (but not limited to): Tannery and leather; Pulp and paper; Textile and garments; Petroleum and refinery; Fertilizer; Brick and ceramic; Iron and steel; Electrochemical; Cement; Food and allied; Inorganic chemical; Pharmaceutical.
Pollution control of thermal power plants: Particulates; NOx; Flue gas desulphurization; Clean coal technologies.

Specialization Topic: Process Control
(Courses offered by ChE Dept)

ChE 321
Process Data Analytics
3.00 credits; 3 hours/week

Basic data analysis: Motivation; Data collection – sampling and measurement; Data visualization; Data quality; Outliers – detection and replacement; Frequency distribution; Measures of central tendency and dispersion; Auto-covariance and covariance; Cross-correlation; Simple linear regression.
Basic machine learning for chemical engineering: Classifiers; Decision trees; Principal Component Analysis (PCA), Partial Least Squares (PLS), Linear Discriminant Analysis (LDA); Clustering; Big data; Pattern recognition.
Process monitoring: Traditional monitoring techniques; Data reconciliation; Quality control charts; Statistical process control – Process capability indices and Six sigma approach; Bivariate charts; Multivariate charts – Hotelling's T2.

ChE 323
Process Dynamics, Modeling and Simulation
3.00 credits; 3 hours/week

Process modeling: Motivation; Types; Balance equations; Lumped and distributed parameter models of simple processes.
Dynamic models: Laplace transforms; Transfer function models; Nonlinear models; Linearization; State-space models; Relation between transfer function and state- space models.
Solution of ODE models: Solution of 1st, 2nd and nth order linear homogeneous and non-homogeneous ODEs; Solution of nonlinear ODEs.
Dynamic response: Dynamic behavior of first, second and higher order processes; Series, parallel, and feedback & recycle systems; Inverse response; Dead-time.
Nonlinear system analysis: Phase-plane; Equilibrium and limit cycle; Chaotic behavior and bi-furcation analysis.

ChE 447
Digital Process Control
3.00 credits; 3 hours/week

Basic concepts of Digital control; Sampling theory; Aliasing; Zero-order hold; z- Transform and difference equations.

Analysis of sampled data systems: Transfer function; state-space representations; Stability; Sensitivity and robustness; Controllability and observability; Pole-zero cancellation; Filter design.

Design of digital controller: PID, internal model, and minimum variance controllers; Pole placement design.

Model predictive controller: Concept, design and application.

Multi-loop and multivariable control: Loop pairing; Relative gain array; Interaction; Decoupler design.

Industrial controllers: Data acquisition; Programmable logic controllers (PLC) – simple ladder logic programming; Programmable automation controllers (PAC); Distributed control system.

ChE 449
Optimization in Chemical Engineering
3.00 credits; 3 hours/week

Basic concepts of optimization: Statement and classification of optimization problems; Models for optimization; Review of linear algebra; Continuity of functions; Unimodal and multimodal functions; Optimality criteria for unconstrained single variable and multivariable functions; Equality constrained problems; Lagrange multipliers; Kuhn Tucker conditions.

Optimization problems in chemical engineering.

Unconstrained single variable optimization: Newton-Raphson, Bisection, and Secant methods and their applications.

Unconstrained multivariable optimization: Direct search methods – Simplex, Hooke-Jeeves pattern search, and Powell's conjugate direction); Gradient based methods – Cauchy's, Newton's and Marquardt.

Linear Programming: Formulation of linear programming models; Graphical solution; The Simplex method.

Constrained nonlinear programming: Penalty function and Lagrange multiplier methods.

Applications: Optimization of various chemical and biochemical processes; Software tools for optimization.

Specialization Topic: Process Safety Engineering (Following are courses offered by ChE Dept)

ChE 463
Risk Analysis in Safety Engineering
3.00 credits; 3 hours/week

Risk assessment: Concept of hazards, risk, risk analysis, probability and reliability; Risks and their control; Risk assessment methods; Fault trees, event trees and

consequence analysis; Models used in dispersion modeling software; Layer of Protection Analysis (LOPA).
Qualitative risk analysis (QRA): Risk contributors; Risk metrics, ranking and values; Risk acceptance criteria; Risk reduction process; Safety critical measures/elements. Risk management principles. Risk communication and safety culture. Risk perception.
Examples and exercises on risk-informed and cost-effective engineering practices.

ChE 465
Industrial Safety Engineering
3.00 credits; 3 hours/week

Safety in industry: Health, security and environment; Performance measurement and regulatory requirements; Management system; Ergonomics; Industrial hygiene.
Safe work practice: Storage, handling and transportation of hazardous, i.e., toxic/flammable /explosive/corrosive materials; Personal protective equipment; Electrical hazards; Fire protection; Emergency response; Accident investigations and root cause analysis; Design aspects to reduce hazards and resolve noise and ventilation issues; Human error analysis.
Safety audit: Evaluation, recommendations and documentation

ChE 467
Occupational Safety and Health
3.00 credits; 3 hours/week

Occupational hazard control: Theory and history; Effects of hazards and failures on organizational control and productivity; Safety and health legislation; Accident causation.
Safety and health programs: Organization and administration; Aspects of recognizing, evaluating and understanding control of safety & health hazards; Acquiring hazard data.

Safety and health management: Communication techniques; Hazard communications and analytical tools.
The content of specific safety and health programs and the role of interfacing management systems in hazard control.

ChE 469
Fire Safety in Process Industries
3.00 credits; 3 hours/week

Fire basics: Fire triangle; Flammability of liquids and vapors; Ignition energy; Inerting; Fire dynamics, behavior, causes and spread; Pool fire.
Fire protection design for chemical, petrochemical and hydrocarbon storage and processing facilities.
Special fire hazards: Detonation and deflagration; Confined and dust explosions; Vapor Cloud Explosion (VCE); Boiling Liquid Expanding Vapor Explosion (BLEVE); Blast damage resulting from overpressure.
Fire risk management: Fire and explosion hazard analysis; Fire risk assessment;

Emergency response; Fire and explosion incident investigations.

Specialization Topic: Energy Engineering

(Following are courses offered by ChE Dept

ChE 421
Fuel Science
3.00 credits; 3 hours/week

Global energy scenario: Energy statistics and energy balance; Energy resources of Bangladesh. Fuel properties: Classification and analysis; Combustion properties.
Fuel conversion fundamentals: Stoichiometry, thermodynamics, heat transfer, and kinetics. Primary energy conversion: Power generation cycles and theoretical efficiencies; IGCC; Polygeneration; Efficiency of real systems. Advanced technologies in fuel conversion. Flue gas cleaning: Sampling and analysis of flue gases; Removal of particulates; Flue gas desulphurization.

ChE 423
Solid Fuel Systems
3.00 credits; 3 hours/week

Overview of solid fuel utilization: World and Bangladesh scenarios.
Solid fuel properties and characterization: Origin of solid fuels; Proximate and ultimate analyses; Ash characterization.
Conversion technologies: Anaerobic digestion; Pyrolysis; Gasification; Combustion; Hydrothermal treatment.
Combustion and gasification systems: Pulverized and fluidized bed combustors; Fluidized bed and entrained flow gasifiers.
Miscellaneous applications: Co-firing; Improved biomass cookstoves; Charcoal production; Incineration of solid wastes. Post-conversion management: Utilization of combustion residues; Environmental impacts and control.

ChE 425
Energy Management
3.00 credits; 3 hours/week

Fundamentals of energy management: ISO 50001; Benefits; Planning, operation, performance evaluation and monitoring.
Thermal systems: Boilers; Steam distribution systems; Furnaces; Insulation and refractories; Cogeneration and tri-generation; Waste heat recovery.
Electro-mechanical systems: Motors; Pumps, fans, and blowers; HVAC and refrigeration; Lighting.
Energy performance assessment: Energy audit; Indicators; Greenhouse gas emission

management; Techno-economic evaluation; Life cycle costing.

Specialization Topic: Petroleum and Mineral Resources Engineering
(Courses offered by PMRE Dept)

PMRE 401
Introduction to Petroleum Engineering
3.00 credits; 3 hours/week

Review of petroleum geology; Origin, migration and accumulation of hydrocarbon, classification of traps, clastic and non-clastic reservoirs. Geological and geophysical methods for hydrocarbon exploration. Reservoir rock and fluid properties. Introduction to Darcy's law. Drilling of oil and gas wells: vertical and directional drilling, rig components and auxiliaries, properties of drilling fluids. Well completion and stimulation techniques. Introduction to well logging and its interpretation. Overview of the production system, productivity index, IPR. Introduction to reservoir engineering: reserve estimation, drive mechanism, recovery stages and recovery factors. An overview of hydrocarbon reserves in Bangladesh.

PMRE 403
Natural Gas Production and Transportation
3.00 credits; 3 hours/week

Overview of natural gas properties. Qualitative phase behavior of hydrocarbons. Gas production systems and components. Deliverability tests of gas wells. Analysis of water-hydrocarbon systems. Field processing of natural gas: gas-liquid separation, dehydration, desulphurization, LPG and liquid hydrocarbon recovery techniques, selection of processing plant and equipment. Review of natural gas transmission and distribution methods. Pipeline design, construction, operation, inspection and maintenance practices. Gas gathering systems. Safety and environmental aspects. Review of fluid flow theories and flow calculations. Gas compression. Review of gas metering techniques. Network analysis of distribution systems.

PMRE 411
Petroleum Reservoir Engineering
3.00 credits; 3 hours/week

Review of petroleum geology: origin, migration and accumulation of hydrocarbon, classification of traps. Reservoir rock and fluid properties, laboratory techniques. Darcy's law for different coordinate systems. Transient, steady and pseudo-steady states in flows through porous media. Diffusivity equations in Cartesian- and cylindrical-coordinate systems. Introduction to absolute, effective and relative permeability in multiphase flows. Volumetric and material-balance methods for reserve estimation. Drive mechanisms, recovery stages and recovery factors. Introduction to decline-curve analysis.

PMRE 413
Natural Gas Engineering
3.00 credits; 3 hours/week

Overview of natural gas properties. Qualitative phase behavior of hydrocarbons. Gas production systems and components. Deliverability tests of gas wells. Analysis of water-hydrocarbon systems. Field processing of natural gas: gas-liquid separation, dehydration, desulfurization, LPG and liquid hydrocarbon recovery techniques, selection of processing plant and equipment. Introduction to the natural gas industry in Bangladesh.

PMRE 415
Gas and Oil Well Drilling and Logging
3.00 credits; 3 hours/week

Gas and oil well drilling methods and equipment. Drilling fluids and their properties. Load and power calculation for hoisting and circulation systems. Well completion: casing design, cementing, perforation. Blow out prevention, well control, well killing, plugging and abandonment. Directional drilling and deviation control. Wellbore damage and stimulation. Introduction to Well logging and formation evaluation: types and application of logging tools, determination of porosity and fluid saturations.

PMRE 417
Transmission and Distribution of Natural Gas
3.00 credits; 3 hours/week

Review of natural gas transmission and distribution methods. Pipeline design, construction, operation, inspection and maintenance practices. Gas gathering systems. Safety and environmental aspects. Review of fluid flow theories and flow calculations. Review of gas metering techniques. Gas compression. Network analysis of distribution systems. Economics of transmission and distribution systems.