CHEMICAL ENGINEERING DEPARTMENT

Calendar
1993-94

Bangladesh University of Engineering & Technology (BET), Dhaka-1000
GENERAL INFORMATION

HISTORICAL BACKGROUND

Bangladesh University of Engineering and Technology, abbreviated as BUET, is the oldest institution for the study of Engineering and Architecture in Bangladesh. The history of the institution dates back to the days of Dhaka Survey School which was established at Nalgola in 1876 to train surveyors for the then Government of Bengal of British India. As the years passed, the Survey School became the Ahsanullah School of Engineering offering three-year diploma courses in Civil, Electrical and Mechanical Engineering. In 1948, the School was upgraded to Ahsanullah Engineering College (on its present premises) as a Faculty of Engineering under the University of Dhaka, offering four-year bachelor's courses in Civil, Electrical, Mechanical and Chemical Engineering with a view to meet the increasing demand for engineers in the country and to expand the facilities for quicker advancement of engineering education. In order to create facilities for post graduate studies and research, Ahsanullah Engineering College was upgraded to the status of a University under the name of East Pakistan University of Engineering and Technology in the year 1962. After independence of Bangladesh in 1971, it was renamed as the Bangladesh University of Engineering and Technology. Starting with two faculties, the university has now enlarged into five faculties.

The BUET campus is in the heart of the city of Dhaka. It has a compact campus with halls of residence within walking distances of the academic buildings. The physical expansion of the University over the last ten years has been impressive with construction of new academic buildings, auditorium complex, students hall of residence etc.

Undergraduate courses in the faculties of Engineering, Civil Engineering, Electrical and Electronic Engineering and Mechanical Engineering extend over four years and lead to B.Sc. Engineering in Civil, Electrical & Electronic, Mechanical, Chemical, Metallurgical, Computer and Naval Architecture & Marine Engineering. In the faculty of Architecture and Planning the degree of bachelor of Architecture is obtained in five years.
Postgraduate studies and research are now among the primary functions of the University. Most of the departments under the different faculties offer M.Sc.Engg. and M.Engg. degrees and some departments have started Ph.D. courses. Postgraduate degrees in Architecture (M. Arch) and in Urban and Regional Planning (MURP) are offered by the faculty of Architecture and Planning. In addition to its own research programmes, the University undertakes research programmes sponsored by outside organizations, viz. UN Organizations, Commonwealth, University Grants Commission (UGC) etc. The expertise of the University teachers and the laboratory facilities of the University are also utilised to solve problems of and to provide up-to-date engineering and technological knowledge to the various organisations of the country. The University is persistent in its effort to improve its research facilities, staff position and courses and curricula to meet the growing technological challenges confronting the nation.
FACULTIES AND TEACHING DEPARTMENTS

The University has sixteen teaching departments under five faculties. Not all of them are degree offering. Faculty-wise list of the departments with the status of the degrees offered is given below:

**Faculty of Civil Engineering**

<table>
<thead>
<tr>
<th>Department</th>
<th>Degree Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Civil Engineering</td>
<td>Both UG and PG</td>
</tr>
<tr>
<td>Department of Water Resources Engineering</td>
<td>PG only</td>
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**Faculty of Architecture and Planning**

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<tr>
<th>Department</th>
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<tbody>
<tr>
<td>Department of Architecture</td>
<td>Both UG and PG</td>
</tr>
<tr>
<td>Department of Urban &amp; Regional Planning</td>
<td>PG only</td>
</tr>
<tr>
<td>Department of Humanities</td>
<td>Non degree offering</td>
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**Faculty of Electrical and Electronic Engineering**

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<th>Department</th>
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<tbody>
<tr>
<td>Department of Electrical and Electronic Engineering</td>
<td>Both UG and PG</td>
</tr>
<tr>
<td>Department of Computer Science and Engineering</td>
<td>Both UG and PG</td>
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**Faculty of Engineering**

<table>
<thead>
<tr>
<th>Department</th>
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<tbody>
<tr>
<td>Department of Chemical Engineering</td>
<td>Both UG and PG</td>
</tr>
<tr>
<td>Department of Metallurgical Engineering</td>
<td>Both UG and PG</td>
</tr>
<tr>
<td>Department of Petroleum and Mineral Resources Engineering</td>
<td>PG only</td>
</tr>
<tr>
<td>Department of Chemistry</td>
<td>PG only</td>
</tr>
<tr>
<td>Department of Mathematics</td>
<td>PG only</td>
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<tr>
<td>Department of Physics</td>
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**Faculty of Mechanical Engineering**

<table>
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<th>Department</th>
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<tbody>
<tr>
<td>Department of Industrial and Production Engineering</td>
<td>PG only</td>
</tr>
<tr>
<td>Department of Mechanical Engineering</td>
<td>Both UG and PG</td>
</tr>
<tr>
<td>Department of Naval Architecture and Marine Engineering</td>
<td>Both UG and PG</td>
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</table>
CHEMICAL ENGINEERING DEPARTMENT.

Professor and Head
M. Sabder Ali, B.Sc.Engg(Chem), MSc Engg, Ph.D.

Professor Emeritus
M.A. Naser, BSc (Hon), MSc, M.S.E, Ph.D.

Professors
Iqbal Mahmud, BSc Engg(Chem), MSc Tech, Ph.D.
Nooruddin Ahmed, BSc Engg(Chem), M.Sc Engg, Ph.D.
A.K.M. Abdul Quader, BSc Engg(Chem), Ph.D.

Associate Professors
Dil Afroza Begum, M.Sc, Ph.D.
Dr. Ijaz Hossain, BSc. Engg(Chem), M.Sc.Engg, Ph.D.

Assistant Professors
M. Serajul Islam, B.Sc.Engg(Chem), Ph.D.
M. Hanif Siddiqui, B.Sc.Engg(Chem), M.Sc, Ph.D.

Lecturer
DEPARTMENT OF CHEMICAL ENGINEERING

Detailed Syllabus for B.Sc. Engineering

### SUMMARY OF CREDIT HOURS

<table>
<thead>
<tr>
<th>Term</th>
<th>Theory</th>
<th>Sessional</th>
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119 39
### TERM 1

#### Theory

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1. Phy 101</td>
<td>Physical Optics, Heat, Waves and Oscillations</td>
<td>3</td>
</tr>
<tr>
<td>2. Chem 111</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>3. Math 121</td>
<td>Differential Calculus and Co-ordinate Geometry</td>
<td>3</td>
</tr>
<tr>
<td>4. ME 141(N)</td>
<td>Engineering Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>5. EEE 155(N)</td>
<td>Electrical Engineering Fundamentals</td>
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#### Sessional

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1. Phy 102</td>
<td>Physics Sessional</td>
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</tr>
<tr>
<td>2. Chem 112</td>
<td>Inorganic Analysis Sessional</td>
<td>1.5</td>
</tr>
<tr>
<td>3. EEE 156(N)</td>
<td>Electrical Engineering Fundamentals Sessional</td>
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### TERM 2

#### Theory

<table>
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<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>1. ChE 111</td>
<td>Elements of Chemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>2. Phy 105</td>
<td>Structure of Matters, Electricity and Magnetism and Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>3. Chem 131</td>
<td>Physical Chemistry I</td>
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<tr>
<td>4. Math 123</td>
<td>Integral Calculus and Differential Equations</td>
<td>3</td>
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<tr>
<td>5. Hum 101</td>
<td>English</td>
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#### Sessional

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<tbody>
<tr>
<td>1. Chem 116</td>
<td>Inorganic Analysis II Sessional</td>
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</tr>
<tr>
<td>2. Shop 120</td>
<td>Workshop</td>
<td>1.5</td>
</tr>
<tr>
<td>3. ME 160(N)</td>
<td>Mechanical Engineering Drawing</td>
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## Chemical Engineering

### TERM 3

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<thead>
<tr>
<th>Theory</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1. ChE 201(N) Material and Energy Balance</td>
<td>3</td>
</tr>
<tr>
<td>2. ChE 203(N) Chemical Engineering</td>
<td></td>
</tr>
<tr>
<td>3. EEE 267(N) Electrical and Electronics Technology</td>
<td>3</td>
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<tr>
<td>4. Math 221(N) Vector Analysis, Matrices, and Laplace Transforms</td>
<td>4</td>
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<tr>
<td>5. Chem 235 Physical Chemistry II</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Sessional</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>1. ChE 208(N) Computer Programming and Applications</td>
<td>1.5</td>
</tr>
<tr>
<td>2. EEE 268(N) Electrical and Electronics Technology Sessional</td>
<td>1.5</td>
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<tr>
<td>3. Chem 236 Physical Chemistry Sessional</td>
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### TERM 4

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<tr>
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<tbody>
<tr>
<td>1. ChE 205(N) Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>2. ME 243(N) Mechanics of Solids</td>
<td>3</td>
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<tr>
<td>4. Chem 221 Organic Chemistry</td>
<td>3</td>
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<tr>
<td>5. Elective 1</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Sessional</th>
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<tbody>
<tr>
<td>2. ChE 206(N) Chemical Engineering Laboratory I</td>
<td>1.5</td>
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<tr>
<td>3. Chem 222 Organic Chemistry Sessional</td>
<td>1.5</td>
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## TERM 5

### Theory

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ChE 301(N)</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ChE 303(N)</td>
<td>Mass Transfer I</td>
<td>3</td>
</tr>
<tr>
<td>ChE 307(N)</td>
<td>Chemical Engineering Thermodynamics II</td>
<td>3</td>
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<tr>
<td>Elective II</td>
<td></td>
<td>3</td>
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<tr>
<td>Elective III</td>
<td></td>
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### Sessional

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ChE 302(N)</td>
<td>Chemical Engineering Laboratory II</td>
<td>1.5</td>
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<tr>
<td>ChE 308(N)</td>
<td>Chemical Process Analysis Sessional</td>
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<tr>
<td>Chem 352</td>
<td>Instrumental Methods of Analysis Sessional</td>
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## TERM 6

### Theory

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<tbody>
<tr>
<td>ChE 305(N)</td>
<td>Mass Transfer II</td>
<td>3</td>
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<tr>
<td>ChE 309(N)</td>
<td>Particle Technology</td>
<td>3</td>
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<tr>
<td>ChE 311(N)</td>
<td>Special Topics in Unit Operations</td>
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<tr>
<td>Elective IV</td>
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<tr>
<td>Elective V</td>
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### Sessional

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ChE 304(N)</td>
<td>Chemical Engineering Laboratory III</td>
<td>1.5</td>
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<tr>
<td>ChE 306(N)</td>
<td>Chemical Engineering Laboratory IV</td>
<td>1.5</td>
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<tr>
<td>ChE 310(N)</td>
<td>Computational Technique in Chemical Engineering</td>
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</table>
Chemical Engineering

**TERM 7**

**Theory**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ChE 401(N)</td>
<td>Reaction Engineering</td>
<td>3</td>
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<tr>
<td>ChE 403(N)</td>
<td>Process Control</td>
<td>3</td>
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<tr>
<td>ChE 405(N)</td>
<td>Process Design I</td>
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<tr>
<td>Elective VI</td>
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<td>3</td>
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<tr>
<td>Elective VII</td>
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**Sessional**

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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ChE 402(N)</td>
<td>Chemical Engineering Laboratory V</td>
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<tr>
<td>ChE 400(N)</td>
<td>Project/Thesis I</td>
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<tr>
<td>ChE 408(N)</td>
<td>Process Design Sessional I</td>
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**TERM 8**

**Theory**

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<tr>
<td>ChE 407(N)</td>
<td>Process Design II</td>
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<tr>
<td>ChE 409(N)</td>
<td>Corrosion Engineering</td>
<td>3</td>
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<tr>
<td>ChE 411(N)</td>
<td>Economics and Management of Chemical Process Industries</td>
<td>4</td>
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<tr>
<td>Elective VIII</td>
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**Sessional**

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<th>Credits</th>
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<tbody>
<tr>
<td>ChE 400(N)</td>
<td>Project/Thesis II</td>
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</tr>
<tr>
<td>ChE 408(N)</td>
<td>Process Design Sessional II</td>
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ELECTIVE COURSES

Elective I

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

Elective II

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

Electives III - VIII

With the consent of adviser the student will choose any approved* 3rd level or above course, subject to fulfillment of the following requirements:

1. A maximum of 12 credits in Humanities will be counted for graduation.
2. A student will choose any one of the chemical engineering specialization groups. From this group the student must collect 6 credits (2 courses).
3. Students who choose Chemical Technology as their specialization group, must collect at least 3 credits (1 course) from the Chemical Engineering Science group.
4. A student must have at least 3 credits (1 course) from the Chemical Technology group.

*A list of approved courses of other departments will be made available to the students.

Elective Subjects Other Than Chemical Engineering

Chem 323    Organic Synthesis (3 credits)
Math 321    Complex Variables, Bessel's Function and Legendre Polynomials (3 credits)
Math 323    Fourier Integral, Harmonic Functions and Partial Differential Equations (3 credits)
Phy 303     Electrical and Magnetic Properties of Solids (3 credits)
Chemical Engineering

ME 347  Mechanical Design of Process Equipment (3 credits)
Met 381  Fundamentals of Metallurgy (3 credits)

ELECTIVE COURSES IN CHEMICAL ENGINEERING

CHEMICAL TECHNOLOGY

ChE 431(N)  Food Preservation and Processing (3 credits)
ChE 433(N)  Polymers and Petrochemicals (3 credits)
ChE 435(N)  Glass, Ceramic and Cement Technology (3 credits)
ChE 437(N)  Refinery Engineering (3 credits)
ChE 439(N)  Polymer Processing (3 credits)
ChE 441(N)  Fertilizer, Pulp & Paper Technology (3 credits)
ChE 443(N)  Food and Sugar Technology (3 credits)

CHEMICAL ENGINEERING SCIENCE

ChE 451(N)  Fuels and Combustion Science (3 credits)
ChE 453(N)  Transport Phenomena (3 credits)
ChE 455(N)  Mathematical Models in Chemical Engineering (3 credits)
ChE 457(N)  Reactor Design (3 credits)
ChE 459(N)  Materials Science (3 credits)

BIOCHEMICAL ENGINEERING

ChE 471(N)  Biochemistry (3 credits)
ChE 473(N)  Biochemical Engineering I (3 credits)
ChE 475(N)  Biochemical Engineering II (3 credits)

ENVIRONMENTAL SCIENCE

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

PETROLEUM ENGINEERING

ChE 491(N)  Natural Gas Engineering (3 credits)
ChE 493(N)  Petroleum Reservoir Engineering (3 credits)
BUET Calendar

ChE 495(N) Gas & Oil Well Drilling & Logging (3 credits)
ChE 497(N) Transmission and Distribution of Natural Gas (3 credits)

DETAILED OUTLINE OF COURSES

ChE 111 Elements of Chemical Engineering
3.00 credits, 3 hours/week

ChE 201(N) Material and Energy Balance
3.00 credits, 3 hours/week

ChE 202(N) Material and Energy Balance Sessional
1.50 credits, 3 hours/week
Problem solving class based on Material an Energy Balance course.
Chemical Engineering

ChE 203(N) Chemical Engineering Thermodynamics
3.00 credits, 3 hours/week

Introduction: the scope of thermodynamics; fundamental quantities; secondary quantities. The first law and other basic concepts: Joule's experiments; internal energy; the first law of thermodynamics; the thermodynamic state and state functions; extensive and intensive properties; enthalpy; steady state flow process; phase rule; reversible and irreversible processes; heat capacity. Volumetric properties of pure fluids: P-V-T behaviour of pure substances; ideal and non-ideal gas and equations of state; applications of equations of state. Heat effects: heat capacities of gases as a function of temperature; heat capacities of solids and liquids; heat effects accompanying phase changes of pure substances; standard heat of reaction; effect of temperature on the standard heat of reaction. The second law of thermodynamics: alternative statements of the second law; heat engine; thermodynamic temperature scales; concept of entropy; entropy changes and irreversibility. The third law of thermodynamics. Thermodynamic properties of fluids: relationships among thermodynamic properties; single phase and two phase system; types of thermodynamic diagrams. Conversion of heat into work by power cycles: vapour cycles; steam power plant; analysis of the steam power plant (boiler, economiser, superheater, steam turbine); internal combustion engines (Otto engine, diesel engine, gas turbine, jet engines).

ChE 205(N) Fluid Mechanics
3.00 credits, 3 hours/week

Review of fluid statics and manometry. Concept of shear stress and classification of fluids. Flow of fluids in closed conduits: laminar and turbulent flow; friction factor; frictional losses in pipes and fittings; expansion contraction losses; pipeline with pump or turbine; series and parallel pipeline. Fluid flow measurements. Dimensional analysis. Microscopic balances: conservation of mass and momentum; stresses in a fluid; symmetry of stresses; deformation; Newtonian fluid and constitutive equation; Navier-Stokes equations in different co-ordinate systems; solutions of Navier-Stokes equation. Macroscopic balance and its applications. Introduction to turbulence, compressible flow and multi-phase flow.
ChE 206(N)  Chemical Engineering Laboratory I
1.50 credits, 3 hours/week

Laboratory work based on ChE 205(N)

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

An introductory course in FORTRAN programming and its applications to simple problems in Chemical Engineering.

ChE 301(N)  Heat Transfer
3.00 credits, 3 hours/week


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

Laboratory work based on ChE 301(N) and ChE 303(N)

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

Introduction to mass transfer processes. Phase equilibria. Equilibrium stage concept. Solvent Extraction: liquid-liquid extraction in single and multiple contact extractor with completely immiscible and partially miscible solvent; use of triangular diagram for stage calculations; batch and continuous leaching and washing of solids. Binary distillation: equilibrium flash and differential distillation; batch and continuous distillation with reflux; use of enthalpy concentration diagram
Chemical Engineering


ChE 304(N) Chemical Engineering Laboratory III
1.50 credits, 3 hours/week

Laboratory work based on ChE 301(N), ChE 303(N) and ChE 305(N).

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

Basic mass transfer theories: diffusion of gases and liquids; diffusion through stagnant layer and equimolar counter diffusion; mass transfer between gas and liquid phases; two film and other theories; HTU and NTU concepts. Mass transfer coefficients. Continuous contact mass transfer: packed and spray column; gas absorption in packed column; continuous liquid-liquid extraction in columns. Multicomponent distillation: bubble and dewpoint calculations for multicomponent systems; simplified methods for calculation of stages. Principles of simultaneous heat and mass transfer in humidification-dehumidification, drying, evaporation and crystallisation operations. Adsorption: principles; industrial application with special emphasis on ion-exchange and pressure swing adsorption.

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

Laboratory work based on ChE 309(N) and ChE 311(N)

ChE 307(N) Chemical Engineering Thermodynamics II
3.00 credits, 3 hours/week

Solution thermodynamics: relationships among the thermodynamic properties for systems of variable composition; partial molar properties; fugacity and fugacity coefficients; fugacities in ideal solutions; property changes of 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 for chemical reactions; equilibrium constant; effect of temperature on equilibrium constant; evaluation of equilibrium constants; phase rule and Duhem's theorem for reacting systems. Thermodynamics of flow processes: conservation of mass and energy; mechanical energy balance; maximum velocity in pipe flow; metering and throttling processes; nozzles; compressors; ejectors. Refrigeration and liquefaction: Carnot refrigeration cycle; air-refrigeration cycle; vapour-compression cycles; comparison of refrigeration cycles; absorption refrigeration—heat pump; liquefaction processes. Thermodynamic analysis of processes: ideal work; lost work; thermodynamic analysis of steady flow processes.

**ChE 308(N)  Chemical Process Analysis Sessional**

1.50 credits, 3 hours/week

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

**ChE 309(N)  Particle Technology**

3.00 credits, 3 hours/week

Properties of particulate solids: particle size and shape; mean diameters; screen analysis; analytical size distribution functions; size distribution of feed and products of crystallizers and size reduction equipment. Bulk properties of particulates: Mohr stress diagram; storage of solids; bin design. Fluid-solid momentum transport: flow past a sphere; drag coefficient; terminal settling velocity; pressure drop in packed beds; fluidization and sedimentation; slurry transport and pneumatic conveying. Fluid-solid separation based on momentum transport: classification, pretreatment of solid-liquid mixture, theory of coagulation, flocculation and flotation; gravity thickening. Filtration: filtration operations and basic equations for incompressible and compressible cakes; deep bed,
pressure, vacuum and centrifugal filtration; filter media; filter aids; cake washing and dewatering; optimum design of semi-continuous filtration equipment.

ChE 310(N)  Computational Technique 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.

ChE 311(N)  Special Topics in Unit Operations
4.00 credits, 4 hours/week

(The emphasis of the course is on equipment design and industrial practice) Mechanical separation: gravity settlers; impingement separators; centrifugal separators and scrubbers.

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(N)  Reaction Engineering
3.00 credits, 3 hours/week

Kinetics of homogeneous reactions: variables affecting rate; elementary and non-elementary reactions. Thermodynamics of chemical reactions: temperature and pressure effects. Basic concepts in chemical kinetics: determination of the reaction rate expression; molecular interpretations of kinetic phenomena; multiple reactions; auto-catalytic reactions. Basic concepts in reactor design: types of reactors; ideal reactors; recycle reactor; auto-catalytic reactors; isothermal operation; treatment of multiple reactions; temperature and energy effects in chemical reactors; optimum temperature progression. Kinetics of heterogeneous reactions: mechanism of catalysis; types of catalysts; operation and properties of catalysts.

ChE 402(N)  Chemical Engineering Laboratory V
1.50 credits, 3 hours/week

Laboratory work on fuel testing and based on ChE 401(N) and ChE 403(N).

ChE 403(N)  Process Control
3.00 credits, 3 hours/week

Basic concepts of chemical process control: incentives for process control; design aspects; hardware elements. Modelling for control purposes: development of mathematical models; linearization of nonlinear systems; input-output model; transfer functions. Dynamic and static behavior of chemical processes: first, second and higher order processes; transportation lag; systems in series. Analysis and design of feedback control systems: concept of feedback control; feedback controllers and final control elements; block diagrams; closed loop responses; concept of stability; stability testing. Frequency response analysis: Bode diagrams; Nyquist plots; Bode and Nyquist stability criteria; control system design by frequency response analysis.

Analysis and design of advanced control systems: control of system with large dead time or inverse response; multiple-loop control systems; feedforward and ratio control; adaptive and inferential control. Design of control systems for multivariable
processes: synthesis of alternative control configurations for multiple-input and multiple-output processes; interaction and decoupling of control loops. Design of control systems for complete plants.

ChE 405(N) Process Design I
3.00 credits, 3 hours/week


ChE 407(N) Process Design II
2.00 credits, 2 hours/week


ChE 408(N) 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(N) Corrosion Engineering
3.00 credits, 3 hours/week

Different materials: Non-metals, metals and alloys. Corrosion and its mechanisms: different forms of corrosion; their mechanisms and remedial measures. Methods of corrosion prevention. Steels, stainless steels and some of the common alloys used in process industries.
ChE 411(N) Economics and Management of Chemical Process Industries
4.00 credits, 4 hours/week

ELECTIVES COURSES IN CHEMICAL ENGINEERING

CHEMICAL TECHNOLOGY

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


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

Introduction. Prospect of polymer and petrochemical industries in Bangladesh. Raw materials of polymers and petrochemicals. Petrochemicals: reaction mechanism, kinetics, manufacturing technologies and uses of ammonia, methanol, oxochemicals, acetylene, vinylchloride, 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 rubbers (butadiene, isoprene, styrene).
ChE  435(N)  Glass, Ceramics and Cement Technology
3.00 credits, 3 hours/week


ChE  437(N)  Refinery Engineering
3.00 credits, 3 hours/week


ChE  439(N)  Polymer Processing
3.00 credits, 3 hours/week

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


Food and Sugar Technology
3.00 credits, 3 hours/week


Application of shell balances and equations of change for momentum, energy and mass transfers. Laminar and turbulent flows. Multi-component systems. Analogy equations relating momentum, energy and mass transfer.


Chemical Engineering

ChE 459(N)  Materials Science
3.00 credits, 3 hours/week


BIOCHEMICAL ENGINEERING

ChE 471(N)  Biochemistry
3.00 credits, 3 hours/week


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

Introduction to biochemical engineering and concept of biological catalysts, nature of microorganisms, their requirements and classification, industrially important microorganisms. Kinetics of enzyme catalyzed reactions, Michaelis-Menten equation, immobilized-enzyme technology, immobilized enzyme kinetics. Metabolic stoichiometry and energetics. Molecular genetics and control systems. Batch fermentation: yield coefficients for biomass and product formation, rates of reaction, growth, limiting substrate concentrations, Monod's equation.
Biochemical Engineering II
3.00 credits, 3 hours/week


Environmental Science I
3.00 credits, 3 hours/week

Introduction to environmental engineering: environmental systems; environmental legislations and regulations; environmental ethics; material balance approach. Hydrology fundamentals: rainfall analysis; runoff analysis; groundwater and wells. Air pollution: origin and fate of air pollutants, atmospheric dispersion; stationary and mobile sources; source control. Noise pollution: noise effects; community noise sources and criteria; noise control.

Environmental Science II
3.00 credits, 3 hours/week


Industrial Pollution Control
3.00 credits, 3 hours/week

Scope and purpose. Source and nature of pollutants in air and water. Air pollution: measuring and estimating emission from

**PETROLEUM ENGINEERING**

**ChE 491(N) Natural Gas Engineering**

3.00 credits, 3 hours/week

Introduction to the natural gas industry in Bangladesh. Phase behaviour of natural gas. Water-hydrocarbon systems. Gas well deliverability and tests of natural gas wells. Field processing of natural gas: dehydration and sweetening techniques; liquid hydrocarbon recovery; selection of processing plant and equipment.

**ChE 493(N) Petroleum Reservoir Engineering**

3.00 credits, 3 hours/week


**ChE 495(N) 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. Cementing and well completion. Well logging; types of logging techniques; interpretation of logging data.
ChE 497(N) Transmission and Distribution of Natural Gas
3.00 credits, 3 hours/week


SYLLABUS OF PHYSICS FOR THE DEPARTMENT OF CHEMICAL ENGINEERING

Phy 101 Physical Optics, Heat, Waves & Oscillation
3.00 credits, 3 hours/week


Phy 105  Structure of matter, Electricity & magnetism and Modern Physics
3.00 credits, 3 hours/week


Phy 303  Electrical and Magnetic Properties
3.00 credits, 3 hours/week


Semiconductors: Intrinsic and impurity semiconductors. Transport property of semiconductors. Frequency dependent conductivity. Contact phenomena, p-n junction. p-n-p and n-pn type semiconductor junctions and their characteristic properties.


HUMANITIES COURSES FOR CHEMICAL ENGINEERING DEPARTMENT

**Hum 101(N) English**

3.00 credits, 3 hours/week


**Hum 103(N) Economics**

3.00 credits, 3 hours/week

Definition of Economics. Economics and Engineering.

Principles of Economics.


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. Youths and Drugs: Youths in Bangladesh; sources of frustration among youths; drugs as a menace to society and to individuals.

**Hum 201(N) Sociology**

3/00 credits, 3 hours/week

**Scope of Sociology:** Micro and Macro Sociology. Some fundamental concepts.

**Society:** From savagery to civilization (Table).

**Social evolution and Techniques of production:** Social structure of Bangladesh. Oriental and Occidental Societies. Feudalism.

**Industrial Revolution:** the growth of capitalism, features, social consequences. Socialism. Fascism.

**Social Control:** Need, means, future of social control.

**Leadership:** Types, functions, techniques and social power.


**Social Pathology:** Crime, juvenile delinquency. Slum.


Urban Ecology: City, pre-industrial and industrial; growth and nature of cities in Bangladesh.

Rural Sociology: Features of village community in Bangladesh, Social Mobility. Urban Rural contrast. Social structure of the tribal people of Bangladesh.

Hum  203(N)  Government
3.00 credits, 3 hours per week

Scope: Some fundamental concepts of government and politics.


Citizenship: Rights, duties, hindrances to good citizenship.

Forms of Government: Aristotle's Classification. Modern Classification: democracy, dictatorship, cabinet, presidential, unitary and federal.


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.


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

Accounting elements: the accounting equation, accounts, transactions, the double entry mechanism. Accounting procedure: the financial statements.


Relevant costing: analysing profitability within the firm. Guidelines for decision making: short-run decisions.


**SYLLABUS OF MATHEMATICS FOR THE DEPARTMENT OF CHEMICAL ENGINEERING**

**Math 121 Differential Calculus and Coordinate Geometry**
3.00 credits, 3 hours/week

**Differential Calculus:**

**Co-ordinate Geometry:**
Changes of axes: Transformation of co-ordinates, simplification of equation of curves. Conic section (pair of straight line, system of circle, parabola, Ellipse, Hyperbola).

**Math 123 Integral Calculus and Differential Equation**
3.00 credits, 3 hours/week

**Integral Calculus:**
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 volumes of surface of revolution.

**Differential Equation:** Solutions of first order differential
equations by various method. Solutions of general linear
equations of second and higher orders with constant co-
efficients. Solution of homogeneous linear equations.
Applications.

Solution of differential equations of the higher order when the
dependent and independent variables are absent. Solution of
differential equation by the method based on the factorization
of the operators.

**Math 221(N) Vector Analysis, Matrices, and**
**Laplace Transform**
4.00 credits, 4 hours/week

**Vector Analysis:** Scalars and vectors, equality of vectors.
Addition and subtraction of vectors. Multiplication of vectors by
scalars. Position vector of a point. Resolution of vectors. Scalar
and vector product of two vectors and their geometrical
interpretation. Triple products and multiple products.
Application to geometry and mechanics. Linear dependence and
independence of vectors. Differentiation and integration of
vectors together with elementary applications. Definition of
line, surface and volume integrals. Gradient, divergence and curl
of point functions. Various formulae. Gauss's theorem. Stoke's
theorem, Green's theorem and their applications.

**Matrices:** Definition of matrix. Different types of Matrices.
Algebra of matrices. Adjoint and inverse of a matrix. Rank and
elementary transformations of matrices. Normal and canonical
forms. Solution of linear equations. Quadratic forms. Matrix
polynomials. Caley-Hamilton theorem. Eigenvalues and
eigenvectors.

**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
function. Some special theorems on Laplace transforms. Partial
fraction. Solutions of differential equations by Laplace
transforms. Evaluation of improper integrals.
Math 223(N)  Numerical Analysis and Statistics
3.00 credits, 3 hours/week


Math 321(N)  Complex Variable, Bessel's Function and Legendre Polynomials
3.00 credits, 3 hours/week

Chemical Engineering


Math 323(N)        Fourier Analysis, Harmonic Functions and Partial Differential Equation
                    3.00 credits, 3 hours/week


SYLLABUS OF ELECTRICAL ENGINEERING FOR THE DEPARTMENT OF CHEMICAL ENGINEERING

EEE  155(N)        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(N)        Electrical Engineering Fundamentals
                    Sessional
                    1.50 credits, 3 hours/week

Laboratory experiments based on EEE 155(N).
EEE 267  Electrical and Electronic Technology
3.00 credits, 3 hours/week


Semiconductor diode, transistors, operational amplifiers (OPAMs), silicon controlled rectifiers (SCR's): principles of operation and applications. Oscilloscope, Transducers: temperature, pressure, flow-rate, speed and torque measurements.

EEE 268(N)  Electrical and Electronic Technology Sessional
3.00 credits, 3 hours/week

Laboratory experiments based on EEE 267(N).

SYLLABUS OF MECHANICAL ENGINEERING FOR THE DEPARTMENT OF CHEMICAL ENGINEERING

ME 141(N)  Engineering Mechanics
3.00 credits, 3 hours/week


ME 160(N)  Mechanical Engineering Drawing-I
1.50 credits, 3 hours/week

ME 243(N)  Mechanics of Solids
3.00 credits, 3 hours/week

Stress analysis: statically indeterminate axially loaded member, axially loaded member, thermal and centrifugal stresses. Stresses in thin and thick walled cylinders and spheres.


Introduction to experimental stress analysis techniques. Strain energy. Failure theories.

ME 347  Mechanical Design of Process Equipment
3.00 credits, 3 hours/week

Vessels: classification, fundamental principles and design equations, codes and standards: Design of thin-walled cylinders and spherical shells under internal pressure: Design of thin-walled cylindrical vessels under external pressures:

Design of vessels subject to combined loading: Vessel heads and supports: Bolted flanged joints: High pressure vessels: Performance tests.

Shell and tube heat exchangers: general considerations and thickness of various components. Pipeline: wall thickness and schedule number.

SYLLABUS OF CHEMISTRY FOR THE DEPARTMENT OF CHEMICAL ENGINEERING

Chem 111  Inorganic Chemistry
3.00 credits, 3 hours/week

Modern concept of atomic structure; periodic table and its application; isotopes and application of radioactive isotopes.
brief discussion on noble gas; different types of chemical bonds, wave nature of electron, advanced concept of chemical bonds, hybridization, molecular structure; theories of coordination compounds, application of stability of complex compounds. General treatment of the elements of different groups. Modern theories of acids and bases.

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


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


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

Complexometric titration. Analysis of water and some industrial products.

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


Chemical Engineering

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


Chem 221  Organic Chemistry
3.00 credits, 3 hours/week


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


Chem 323  Organic Synthesis
3.00 credits, 3 hours/week

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

Spectrophotometry. Potentiometric titration; pH-titration.
Conductometric titration. Thin layer chromatography.
POSTGRADUATE COURSES

TRANSPORT PROCESS AND REACTION ENGINEERING

ChE 6101  Transport Phenomena


ChE 6102  Advanced Thermodynamics


ChE 6103  Fluid Mechanics


ChE 6104  Heat Transfer


ChE 6105  Mass Transfer

Diffusivity and mechanisms of mass transport. The equations of change for multicomponent system. Steady and unsteady state
diffusion in stagnant medium. Convective mass transfer in laminar and turbulent flows. Interphase transport and mass transfer at higher mass flux.

**ChE 6106 Kinetics and Catalysis**


**ChE 6107 Advanced Chemical Reactor Design**

Study of the factors involved in the design and operation of Chemical reactors for both homogeneous and heterogeneous systems, batch reactors, continuous flow stirred tank reactors, tubular reactors, multibed adiabatic reactors and cold shot converters. Determination of optimal temperature gradients and yields, catalysts effectiveness factors, optimal control with decaying catalysts, reactor optimization problems in local industries.

**ChE 6108 Equilibrium Stage Processes**

Chemical Engineering 41

ChE 6109 Non-Newtonian Fluid Flow and Heat Transfer


PROCESS ENGINEERING AND TECHNOLOGY

ChE 6201 Advanced Plant Design


ChE 6202 Polymer Science for Chemical Engineers


ChE 6203 Nuclear Chemical Engineering


ChE 6204 Electrochemical Engineering

Introduction to the electrochemical systems. Equilibrium potential, theory of overvoltages, irreversible electrode kinetics, ionic transfer, mass transfer at electrode surfaces. Application in the areas of corrosion, batteries, fuel cells, chemical synthesis, molten electrolyte, electrowinning, and electro refining processes. Electrochemical reactor design.
ChE 6205 Corrosion Science and Engineering


ChE 6206 Corrosion Protection systems

Principles of protection, passivation and inhibition. Various protection systems, material selection, alteration of environment, design, coating inhibitors and passivators. Electrochemical systems, cathodic and anodic protection, design and applications. Economics of protection, multiple systems. Corrosion testing and practical applications.

ChE 6207 Ion Exchange

Structure and properties of ion exchangers. Preparation of ion exchangers, ion exchange capacity, equilibria of ion exchange and thermodynamic models of equilibria. Ion exchange in concentrated solutions. Ion exchange column calculation. Water treatment by ion exchange. Ion exchange membranes.

ChE 6208 Adsorption and Diffusion in Porous Media


ChE 6209 Fluidization and its Applications

Chemical Engineering

**ChE 6210  Industrial Safety**


**COMPUTER APPLICATION AND PROCESS CONTROL**

**ChE 6301  Advanced Numerical Methods in Chemical Engineering**

Review of numerical techniques. Application of the methods of weighted residuals, orthogonal collocation and finite element methods to solution of problems in transport process and reaction engineering.

**ChE 6302  Process Dynamics**

A study of the dynamic behaviour of lumped and distributed system, dynamic model building and analysis. Interpretation of frequency and time response of linear systems. State-space methods, approximations to models and responses, stability analysis, and the behaviour of nonlinear systems. Applications to heat exchangers, tubular reactors and fixed bed sorption processes.

**ChE 6303  Process Control**

A survey of selected advanced topics of control as applied to chemical processes, mathematical modeling, parameter estimation and process identification, multivariable control, optimal and adaptive control, Real time, digital control.

**ChE 6304  Computer Aided Process Design**

Use of computer to solve large scale problems in chemical process plant design and simulation. Review of existing computer aided process design packages (CAD). Comparative advantages and disadvantages of sequential and equation based flowsheet simulation. Introduction to process structure and
organization. Selected topics in recycle convergence acceleration, ordering of computations, tearing techniques and optimization as applied to process design. Simulation and optimization of some realistic chemical engineering systems using a CAD package.

**Che 6305 Optimization Techniques in Chemical Engineering**


**ENERGY AND ENVIRONMENTAL ENGINEERING**

**Che 6401 Fuels and Combustion Science**


**Che 6402 Combustion Engineering and Technology**

Chemical Engineering

ChE 6403  Energy Management and Modeling


ChE 6404  Industrial Furnaces

Physical, chemical and thermal properties of refractories and other high temperature insulating materials. Design principles of industrial furnaces, petroleum heaters, different types of reformers, converters and regenerators. Analysis of industrial furnaces and fired heaters used in chemical process plants. Specification of fuels for furnaces. Instrumentation and control of furnaces.

ChE 6405  Water Pollution and Control


ChE 6406  Air Pollution and Control

FOOD AND BIOCHEMICAL ENGINEERING

ChE 6501 Chemistry and Microbiology of Food

ChE 6502 Food Processing and Preservation
Food preservation principles. Unit operations and unit processes in food processing. Effects of processing on food products. Evaluation of different processing techniques. Design of food processing equipment and plants. Plant effluent treatment and waste management.

ChE 6503 Food Technology
An in depth study of different food processing industries with special reference to processing of cereal, vegetable, fruit, milk, fish, edible oils and production of fermented food products and sugar technology.

ChE 6504 Fermentation Technology

ChE 6505 Biochemical Engineering
The application of chemical engineering principles of mass, momentum and energy transport as well as reaction kinetics to biochemical reaction systems. Design of biochemical systems based on transport process and chemical reaction principles. Study of different phases of some common biochemical systems.
Chemical Engineering

ChE 6506  Quality Control in Food and Biochemical Industries


PETROLEUM AND NATURAL GAS ENGINEERING

ChE 6601  Introduction to Petroleum Engineering


ChE 6602  Petroleum Reservoir Fluids

Composition and nature of petroleum reservoir fluids. Phase reservoir behavior of multicomponent hydrocarbons and hydrocarbon-nonhydrocarbon systems. Production of equilibrium ratios. Rock and fluid property correlations.

ChE 6603  Oil Well Drilling and Completion


ChE 6604  Petroleum Production Technology

An overview of well completion. Theory of reservoir fluid flow, flow measurement and control. Primary and secondary recovery, Fluid separation and treatment. Design and operation of gathering lines and production facilities. Well testing and recompletion. Oil and gas regulations.
Well Logging and Formation Evaluation

Background of well logging and its purposes. Different types of well logging, their principles and applications. Physical properties of the porous media, fluid saturations and chemical composition of the saturating fluids. Interpretation and use of the information of logging in reservoir engineering.

Reservoir Engineering


Natural Gas Engineering

A review of the physical and chemical properties of natural gas, phase behavior, vapor-liquid equilibrium data and computation, water-hydrocarbon systems, flow of gas-liquid mixtures, engineering principles used in the production of natural gas and its associated liquids. A detailed review of design and operations criteria encountered in the production, well head treatment of natural gas, producing and testing of gas wells, dew point control, LPG recovery, sulfur recovery, environmental control problems in natural gas processing, gas sweetening.

Transmission and Distribution of Natural Gas