Syllabus 1

1. Course Number & Title (Credit Hours, Required or Elective):
MATH 101 – Mathematics I (6.0, Required)

2. Catalog Description:
This subject covers techniques of differentiation, integration, exponential and logarithmic functions, Hyperbolic Function and Taylor's Series. This course has lectures, quizzes, assignments, and problem-based projects in class.

3. Prerequisite(s)
None

4. Textbook(s) and/or other required materials:
- Calculus and analytical geometry, George B. Thomas Jr.; Addison – Wesley publishing company, 14th edition, 2018.

5. Course Objectives:
At the end of this course students of Calculus I will be able to:

- Find limits and continuity of functions (graphically, numerically and algebraically)
- Determine derivatives by a variety of techniques including explicit differentiation, implicit differentiation, and related rates.
- Use basic techniques of integration to find particular or general antiderivatives.
- Apply the notions of differentiability to logarithmic and transcendental functions.
- Use differentiation and integration to solve real world problems such as rate of change, optimization, and area problems.
- Determine power series, including Tylor's and Binominal series.

6. Topics:
Students will learn:
- Precalculus and functions
- Limits and continuity
- Derivatives and their applications
- Integral and its applications
- Transcendental Functions
- Power series and their applications

7. Class/laboratory Schedule:
The Class schedule:

Week	**Material Covered**
Week 1	Limits and continuity
Week 2	Fundamentals of Differentiation
Week 3	Transcendental Functions
Week 4	Transcendental Functions, cont'd
Week 5	Methods of Integration, By parts

Week 6	Methods of Integration, Products of Powers of Trigonometric functions
Week 7	Methods of Integration, even powers of Sine and Cosine
Week 8	Trigonometric substitutions that replace a^2-u^2,a^2+u^2 and u^2-a^2
Week 9	Hyperbolic Function, Derivatives and Integrals of Hyperbolic Function
Week 10	Inverse of Hyperbolic Function
Week 11	Midterm exam
Week 12	Solved examples and problems
Week 13	Power Series, Taylor Polynomials
Week 14	Taylor's Series for Sine, Cosine and ex
Week 15	Binomial Theorem
Week 16	Solved examples and problems
Week 17	Final Exam

8. Design Project:

There is a problems-based project

9. Computer/software Use:

Students typically use calculators and MS office Words in writing their reports of assignments.

10. Evaluation Methods:

- Quizzes
- Assignments
- Onsite assignments
- Problem based projects
- Midterm exam

11. Contribution to Professional Component:

There are a significant contribution to professional component of the graduate, these include the obvious technical skills in mathematics itself as well as more generic skills, the awareness of a range of personal characteristics such as self-confidence and persistence, and the development of a professional identity. Also, it developed their ability to solve problems and think logically, although their interpretation of these terms was quite varied.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

- Limits and continuity (1)
- Fundamentals of Differentiation (1)
- Transcendental and hyperbolic Functions (1)
- Methods of Integration (1)
- Power Series (1)

Course Number & Title (Credit Hours, Required or Elective):
MATH –102 Mathematics II (6.0, Required)

2. Catalog Description:
This subject covers techniques of integration, differential equations, polar coordinates, vectors and double integrals. This course has in class lectures, quizzes, assignments, and problem-based projects.

3. Prerequisite(s)
MATH-101- Mathematics I

4. Textbook(s) and/or other required materials:
- Calculus and analytical geometry, George B. Thomas Jr.; Addison – Wesley publishing company, 14th edition, 2018.

5. Course Objectives:
At the end of this course students of this course will be able to:

- Apply the techniques of integration to solve wide range engineering problems.
- Convert polar coordinates to Cartesian coordinates, graphing in polar coordinates and finding areas and surface area in polar coordinates.
- Represent vectors analytically and geometrically, and compute dot and cross products for presentations of lines and planes, and analyze vector functions to find derivatives, tangent lines, integrals
- . Evaluate double and triple integrals for area and volume
- Analyze and solve first-order difference equations and first-order differential equations by the direct method, separating the variables, homogenous equations, and integral factor.

6. Topics:
Students will learn:
- Techniques of integration
- Polar Coordinates
- Vector Analysis
- Multiple Integral
- Partial Differentiation
- First Order Ordinary Differential Equations

7. Class/laboratory Schedule:
The Class schedule:

Week	**Material Covered**
Week 1	Techniques of integration
Week 2	Techniques of integration, cont'd
Week 3	Polar Coordinates
Week 4	Polar Coordinates, cont'd
Week 5	Area and Length of Polar Coordinates
Week 6	Vectors Dot Products
Week 7	Vectors Cross products
Week 8	Lines and Planes in Space

Week 9	Midterm exam
Week 10	Double Integral
Week 11	Area by double integral
Week 12	Double Integral in Polar
Week 13	Partial Differentiation
Week 14	Chain rules
Week 15	Ordinary Differential Equations: (1st & 2nd order Differential Equations)
Week 16	Solved examples and problems
Week 17	Final Exam

8. Design Project:

There is a problems-based project

9. Computer/software Use:

Students typically use calculators and MS office Words in writing their reports of assignments.

10. Evaluation Methods:

- Quizzes
- Assignments
- Onsite assignments
- Problem based projects
- Midterm exam

11. Contribution to Professional Component:

There is a significant contribution to professional component of the graduate, these include the obvious technical skills in mathematics itself as well as more generic skills, the awareness of a range of personal characteristics such as self-confidence and persistence, and the development of a professional identity. Also, it developed their ability to solve problems and think logically, although their interpretation of these terms was quite varied.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

- Techniques of integration (1)
- Polar Coordinates (1)
- Vector Analysis (1)
- Multiple Integral (1)
- Partial Differentiation (1)
- First Order Ordinary Differential Equations (1)

Course Number & Title (Credit Hours, Required or Elective):

CHEM_101– Organic chemistry (6.0, Required)

2. Catalog Description:

Is an introduction to organic chemistry, focusing primarily on the basic principles to understand the structure and reactivity of organic molecules. Emphasis is on substitution and elimination reactions and chemistry of the carbonyl group. The course also introduces the chemistry of aromatic compounds. Also, some techniques used to diagnose organic compounds

3. Prerequisite(s):

None

4. Textbook(s) and/or other required materials:

Finar, Organic Chemistry, Vol. I and II, ELBS

References:

1. Morrison & Boyd, Organic Chemistry, Prentice-Hall of India-
2. Bahl&Bahl, Advanced Organic Chemistry, S. Chand
3. Sony, P.L., Organic Chemistry, S. Chand

4. Course Objectives:

- Introduction and Review for hydrocarbons
- Structure and Properties of Organic Molecules
- Stereochemistry
- Stereochemistry, Cont'd
- The Study of Chemical Reactions
- Alkyl Halide, Nucleophilic Substitution and Elimination
- Structure, Synthesis and reactions of Alkenes
- Structure, Synthesis, and reactions of Alcohol
- Infrared Spectroscopy and Mass Spectrometry
- Nuclear magnetic resonance spectroscopy
- Ethers, epoxides, and sulfides
- Aromatic compounds and reactions
- Ketones and Aldehydes, reactions
- Carboxylic acid derivatives, reactions

6. Topics:

Students will learn:

At the end of this course, you (the student) will be able to:

1. Interpret 3D representations of molecular structures.
2. Understand the geometry resulting from atomic orbital hybridization.
3. Know how electronegativity and resonance causes charge distribution on molecules
4. Relate geometry and charge distribution to chemical and physical properties

5. Understand how kinetics, thermodynamics and statistical mechanics describe chemical reactions
6. Draw the structures of the products given specific reactants
7. Write the mechanisms of reactions
8. Understand how physical conditions influence rate and path of reactions
9. Use IR, NMR, UV, and MS to determine molecular structure

7. Class/laboratory Schedule:

Ten practical experiments, two hours for each practical experiment

8. Design Project:

In addition to two exams, there is quizzes, tasks, reports and seminars.

9. Computer/software Use:

Students typically use words in writing their reports of problem-based learning.

10. Evaluation Methods:

Exams (hour and half mid exam 10%, three hours final exam 50%)
Quizzes, assignments, seminars, reports 40%

11. Contribution to Professional Component:

The learning and teaching strategy is designed to: Carefully cover in lectures the necessary fundamental material and analytical techniques and demonstrate concepts with appropriate (and where possible practical) examples Allow students adequate time to practice the techniques using a large number of carefully selected tutorial problems.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

At the end of this course, you (the student) will be able to:

1. Interpret 3D representations of molecular structures.
2. Understand the geometry resulting from atomic orbital hybridization.
3. Know how electronegativity and resonance cause charge distribution on molecules
4. Relate geometry and charge distribution to chemical and physical properties
5. Understand how kinetics, thermodynamics and statistical mechanics describe chemical reactions
6. Draw the structures of the products given specific reactants
7. Write the mechanisms of reactions
8. Understand how physical conditions influence rate and path of reactions
9. Use IR, NMR, UV, and MS to determine molecular structure.

Course Number & Title (Credit Hours, Required or Elective):
ENG-102– Engineering Mechanics (5.0, Required)

2. Catalog Description:
Engineering Mechanics.
This course has 3 Quizzes,3 online assignments, 1 Project, 1 onsite assignment, and 1 seminar.

3. Prerequisite(s):
None

4. Textbook(s) and/or other required materials:
Engineering Mechanics-Statics, J.L.Meriam, L.G.Kraige, Wiley, 6th Edition, 2003, ISBN: 0-471-26607-8.

5. Course Objectives:
For Engineering Mechanics in Engineering students will learn:

- Understand and use the general idea of equilibrium of a particle and bodies.
- Analyze trusses, beams, frames, and machines.
- Calculate center of gravity, centroids, and moments of inertia.
- Apply friction forces and analyze their different applications.

6. Topics:
Students will learn:

- Force Vectors.
- Force System Resultants.
- Equilibrium of a Rigid Body.
- Friction.
- Center of Gravity and Centroid.
- Moments of Inertia and virtual work.
- Structure (trusses and Frames).

7. Class/laboratory Schedule:
No lab

8. Design Project:
None.

9. Computer/software Use:
Students typically use words in writing their reports of problem-based learning and Excel to draw the figures.

10. Evaluation Methods:
Exams (3 hours Quizzes 15%, Online Assignments 1 hours 15%, 1 hours 3% Seminars, onsite assignment hours 3%, Project 4%, and three hours final exam 50%)

11. Contribution to Professional Component:
For Engineering Mechanics, students will be able to Analise statics of particles, forces in plane, forces in space, equilibrium, moment of a force, moment of a couple, equivalent systems of forces on rigid bodies, equilibrium in two dimensions, equilibrium in three dimensions, distributed forces:

centroids and center of gravity, analysis of structures: trusses, frames and machines, internal forces in beams and cables, friction, moments of inertia of areas, and moments of inertia of masses.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

For Engineering Mechanics students will learn:

1. Understanding the equilibrium of particles frame, structures, and rigid bodies.
2. Determining the center of complicated shapes.
3. Analyzing the friction between different bodies.
4. Understanding the moment of inertia.

Syllabus

1. Course Number & Title (Credit Hours, Required or Elective):
ENG_107 – English Language (2.0, Required)

2. Catalog Description:
This course is designed to provide engineering students with the necessary oral and written skills required for effective communication in academic and workplace contexts, both with experts in their field and lay persons. It begins by introducing them to the principles of good academic practice, which are also presented as a model for ethical workplace practice, and thus help them to avoid issues such as plagiarism. The main part then leads on to developing research and summarizing skills that form the basis for the later activities. Students next learn to apply these skills to conducting technical presentations, as well as in group discussions that culminate in project planning activities.

3. Prerequisite(s):
None

4. Textbook(s) and/or other required materials:

- Beer, D. & McMurrey, D. 2004, A Guide to Writing as an Engineer (2nd ed), New York: Wiley

- Borowick, Jerome N., 2002, Technical Communication and its Applications (2nd ed), New Jersey: Prentice-Hall, Inc.

5. Course Objectives:
1. Identify various reading skills and apply them in reading, referencing and summarizing literature on engineering
2. Identify various skills of technical presentation and apply them in conducting short technical presentations based on information extracted from readings
3. Identify technical discussion skills and apply these in planning and conducting simulated technical discussions characteristic of those that go on in engineering contexts.
4. Identify and compare the structures and language characteristics of various types of written study and workplace reports characteristic of those produced by engineering students and practicing engineers (e.g., incident reports and progress reports) mainly, and applying this knowledge in writing one of the latter
5. Develop communication skills through active participation in class and group activities.

6. Topics:
Students will learn:
- Technical presentations
- Conducting technical discussions about engineering projects
- Writing technical documents
- Writing business correspondence

7. Class/laboratory Schedule:
No lab

8. Design Project:
In addition exams, there is a problems-based learning.

9. Computer/software Use:
Students typically use words in writing their reports of problem based learning.

10. Evaluation Methods:
Exams (two hours mid exam 10%, three hours final exam 50%)
Problem Based Learning project 10%

11. Contribution to Professional Component:

1. Cognitive goals
2. Developing the learning competence of getting a new language.
3. Setting the requirements and grammatical resemblance among languages.
4. The skills goals special to the program.
5. Writing and reading skills .
6. speaking and listening skills.

12. Relationship to Student Outcomes:
Course Learning Objectives (related Student Outcomes (4):

اللغة العربية (2 مطلوب).

1- وصف الكتالوج:

تبني هذه الدورة أساساً قوياً للتطوير العلمي لطلابها من خلال الفهم العميق للمفاهيم الأساسية لمبادئ اللغة العربية. تشمل المواضيع التي سيتم تناولها سور من القرآن الكريم
وقصائد لبعض الشعراء وكذلك بعض مواضيع قواعد اللغة العربية.

2- المتطلبات الأساسية:

لا يوجد

3- الكتب المدرسية أو المواد الأخرى المطلوبة:

التفسير الوسيط أ. د. وهبة الزحيلي.
المنهاج في القواعد والإعراب: محمد الأنطاكي

4- أهداف الدورة: في هذه الدورة يتعلم الطلاب:

- تطوير المهارات اللغوية وحفظ بعض السور القرآنية وتعزيز حب اللغة العربية لدى الطلبة.
- فهم كيفية تطبيق القواعد اللغوية في الحياة اليومية، ومعرفة المصطلحات اللغوية في مجالات الهندسة والعلوم.
- أهمية اللغة العربية في مجالات الحياة اليومية.
- استخدام القواعد اللغوية في كتابة التقارير والأبحاث العلمية بشكل صحيح.
- تعزيز التعلم الذاتي والاستقلالية في التعلم وتشجيع الطلاب على أخذ مبادرة في تعلم اللغة العربية.

5- المواضيع: سوف يتعلم الطلاب.

- قراءة وتفسير ومعرفة أسباب نزول بعض الآيات القرآنية.
- التعرف على بعض النصوص الشعرية.
- دراسة قواعد الإملاء وضبط علامات الترقيم.
- دراسة بعض مواضيع قواعد اللغة العربية.

7-جدول الفصل/ المختبر.

لا يوجد

8-مشروع التصميم.

لا يوجد

9-استخدام الكمبيوتر/ البرمجيات:

لا يوجد

10-طرق التقييم:

الامتحانات (ساعة منتصف الامتحان 10% ثلاث ساعات امتحان نهائي 50%).

الاختبارات القصيرة 10%، والواجبات المنزلية 15% والواجبات الميدانية 10% والندوات 5%

11- المساهمة في المكون المهني:

في هذا المقرر سيقوم الطلاب بمعرفة تفسير بعض سور القرآن الكريم والتعرف على أحكام التلاوة، والاطلاع على بعض قصائد شعراء المعلقات والشعراء المعاصرين، والتعرف وكيفية وضع علامات الترقيم، ودراسة بعض مفردات قواعد اللغة العربية.

12-العلاقة بمخرجات الطلاب:

الأهداف التعليمية للدورة (مخرجات الطلاب ذات الصلة 1-7).

في هذه الدورة سوف يتعلم الطلاب:

1- فهم القواعد اللغوية وعلامات الترقيم وحفظ السور القرآنية.

2-تطوير المحصلة اللغوية لدى الطلبة من خلال تعلم الشعر والقواعد اللغوية بشكل صحيح.

3-تغطية معظم المواضيع اللغوية التي يحتاجها المهندس في مسيرته العملية.

4-التدرب على الحفظ والنطق الصحيح لبعض السور القرآنية بالإضافة إلى التدرب على قراءة الشعر العربي وتعلم واستخدام قواعد اللغة العربية.

5- الممارسات المتكررة لشرح المادة النظرية واستخدام الآلات والوسائل الحديثة بشرح المادة مع ضمان ملائمة المادة النظرية للاحتياجات الواقعية.

ENG_104 – Computer Science I (3.0, Required),

7. Class/laboratory Schedule:

Week	Material Covered
Week 1	Lab 1: Computer Operating System (e.g. Microsoft Windows)
Week 2	Lab 2: Document Processing I (e.g. Microsoft Word)
Week 3	Lab 3: Document Processing II (e.g. Microsoft Word)
Week 4	Lab 4: Data Processing I (e.g. Microsoft Excel)
Week 5	Lab 5: Data Processing II (e.g. Microsoft Excel)
Week 6	Lab 6: Presentation Slides I (e.g. Microsoft PowerPoint)
Week 7	Lab 7: Presentation Slides II (e.g. Microsoft PowerPoint)

8. Design Project: None

9. Computer/software Use:

- Windows7
- Microsoft Word2010
- Microsoft PowerPoint2010
- Microsoft Excel2010

10. Evaluation Methods:

Exams (Two hours mid exam 10%, three hours final exam 50%)
Quizzes 10%, Home Assignments 18%, Seminars 12%

11. Contribution to Professional Component:

This course offers students a comprehensive exploration of the fundamental concepts and principles that underpin the field of computer science. By delving into various subjects including the historical development of computing, data representation, computer components, operating systems, applications, students will develop a well-rounded understanding of how deals with Microsoft Office2010 and be able to make presentation by using Microsoft PowerPoint2010. To understand how to this module equips students with the necessary foundation to pursue further studies or careers in computer science.

12. Relationship to Student Outcomes:

Course Learning Objectives :(related Student Outcomes 6):

Course Number & Title (Credit Hours, Required or Elective):

ENG_111 – Engineering Drawing (4.0, Required)

2. Catalog Description:

Engineering Drawing

This course has 3 exams, homework and classwork.

3. Prerequisite(s): for Engineering Drawing

None

4. Textbook(s) and/or other required materials:

- Engineering Drawing, Abdul-Rassul Abdul-Hussain, University of Technology, 1986.

5. Course Objectives:

For Engineering Drawing students will learn:

- Define and explain the uses of different drawing equipment.
- Identify the different drawing equipment.
- Layout drawing papers and prepare a title block.
- Practically distinguish the types of dimensioning.
- Carry out geometrical construction of different shapes.
- Carry out isometric and orthographic drawing of objects.

6. Topics:

Students will learn:

- Prepare and understand drawings.
- Identify various curves used in Engineering Drawing and their applications.
- Use the principles of orthographic projections.
- By studying about isometric projections students will be able to visualize three-dimensional objects and that will enable them to design new products.
- Design and fabricate surfaces of different shapes.
- Represent the objects in three dimensional appearances

7. Class/laboratory Schedule:

Drawing lab

8. Design Project:

In addition to two exams, there are 12 classwork and 28 homework drawings.

9. Computer/software Use:

Students typically uses of different drawing equipment in classwork and homework drawing.

10. Evaluation Methods:

- Exams (two hour and midterm exam 15%, three hours final exam 30%)

- Two Exams (two hour and half mid exam 15%)
- Classwork (12 problems) 10%
- Homework (16 problems) 10%

11. Contribution to Professional Component:

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

For Engineering Drawing students will learn how to use drawing rules to draw Engineering processes.

1. Course Number & Title (Credit Hours, Required or Elective):
CHEM_ENG 101 – Introduction to Chemical Eng (6.0, Required)

2. Catalog Description:
This course builds a strong foundation for the professional development of its students via deep understanding of the basic concepts of chemical engineering principles. Topics that will be covered include the definition of chemical engineering, dimensions, units, symbols and conversion factors of temperature, pressure, also, basis of calculation, principles and expressions of Ideal gas law..

3. Prerequisite(s):
None

4. Textbook(s) and/or other required materials:
- David m Himmelblau, Basic Principles and Calculations in Chemical Engineering, Seventh Edition

5. Course Objectives:
For this course, students will learn:
- Unit operations involved dimensions, units, symbols, and conversion factors
- Basis of calculation
- Principles and expressions of Density, specific gravity, Temperature, Pressure
- Ideal gas rule and equations of state for real gases
- Material balance

6. Topics:
Students will learn:
- Units
- Mole fraction and mass (weight) fraction formula
- Multicomponent solutions and mixtures
- Pressure
- Ideal gas mixtures and partial pressure
- Material balance without chemical reactions
- Material balances involving more than one unit

7. Class/laboratory Schedule:
No lab

8. Design Project:
No project.

9. Computer/software Use:
No software.

10. Evaluation Methods:

Exams (Two hours mid exam 10%, three hours final exam 50%)
Quizzes 10%, Home Assignments 15%, Onsite Assignments 6%, Seminars 4%, and Projects5%

11. Contribution to Professional Component:

For this course, students will identify and understand the unit operations involved dimensions, units, symbols, and conversion factors, basis of calculation, principles and expressions of density, specific gravity, temperature, pressure, Also, apply ideal gas rule and equations of state for real gases.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

For this course, students will learn:

1. Units, dimensions, and principles of density and specific gravity, specific gravity scales (1)
2. Mole concept and the concept of choosing basic (1)
3. Impact of temperature, pressure, and their scales (1)
4. Ideal gas law, Ideal gas mixtures, Real gas relationships, and Real gas mixtures (1)

CHEM_ENG 103 – Mass Balance (6.0, Required)

2. Catalog Description:

This subject builds a strong foundation for the professional development of its students via deep understanding the concepts of material balances. Topics that will be covered include the strategy for solving problems with and without chemical reactions. Identify the limiting and excess reactants in stoichiometric equations. Employ some concepts such as (Orsat analysis, dry basis, wet basis, theoretical air and excess air), in combustion problems. Understand in a general sense how material balances in industry process include recycling, bypass, and purge streams.

3. Prerequisite(s):

CHEa141 – Principles of Chem Eng. I

4. Textbook(s) and/or other required materials:

- David m Himmelblau, Basic Principles and Calculations in Chemical Engineering, Seventh Edition

5. Course Objectives:

For this course, students will learn:

- The concept of material balances with/without chemical reaction, and demonstrates their application in different types of processes
- The stoichiometric quantities of reactants and products in moles or mass given the chemical reaction
- The meanings of stack gas, flue gas, Orsat analysis, dry basis, wet basis, theoretical air (oxygen) and excess air (oxygen)
- The purpose and Calculations of a bypass and purge stream

6. Topics:

Students will learn:

- Stoichiometric quantities
- Extent of a reaction, excess and limiting reactant
- Material balances using species and element
- Material balances involving combustion
- Material balances for multiple units with reaction
- Recycle, bypass, purge and the industrial application of material balances

7. Class/laboratory Schedule:

No lab

8. Design Project:

No project.

9. Computer/software Use:

No software.

10. Evaluation Methods:

Exams (Two hours mid exam 10%, three hours final exam 50%)

Quizzes 15%, Home Assignments 6%, Onsite Assignments 9%, Seminars 5%, and Projects5%

11. Contribution to Professional Component:

For this course, students will identify and understand the material balance problems with and without reaction. The effective method of teaching this subject is rewarding professional careers by skillfully leveraging chemical engineering principles. To achieve these broad objectives, the curse provides the knowledge, skills and professional development concepts of lecturers, tutorials, and seminars.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

For mass balances, students will learn:

1. Apply Material balances with/without reaction (1)
2. Material balances for multiple units with reaction (1)
3. Calculations of recycle, bypass, and purge in the industrial application of material balances (1)

1. Course Number & Title (Credit Hours, Required or Elective):
CHE 132– -Strength of Materials (2.0, Required)

• *Credits and contact hours*

Credits: 3.0
Contact: 3.0

• *Instructor's or course coordinator's name*

Sabah M. Saleh

2. *Catalog Description:*

Analysis of the forces, moment and couples in the mechanisms (3D) .Also including displacement, velocity and acceleration

3. *Prerequisite(s):*

None

4. *Textbook(s) and/or other required materials:*

- Engineering Mechanics Statics, J. L. Meriam and L.G. Kraige, John Wiley & Sons, 2013.
- R. C. Hibbeler, "Engineering Mechanics: Statics & Dynamics", 14th ed. Pearson Prentice Hall.

5. *Course Objectives:*

In this course, students will learn:

- Fundamentals of Engineering Mechanics(3D)
- How to analyze the forces and moment in mechanisms(3D)
- Calculate the Resultant in three-dimensional force systems
- Introduction to dynamic

6. *Topics:*

In this course, for engineering mechanics students will learn:

- Three-dimensional force system, component forces for three dimensions
- Moment in three-dimensional force system, dot product, couple in three-dimensional force system, couple-force system in three-dimensional force system
- Resultant in three-dimensional force systems
- Equilibrium, free body diagram
- Types of friction, type's friction problems
- Introduction to dynamic
- Velocity, acceleration & motion laws

7. *Class/laboratory Schedule:*

15 weeks of 50 min. lectures, 1 time a week Laboratory 1 Hour / week

8. *Design Project:*

None

9. *Computer/software Use:*

None

10. *Evaluation Methods:*

Exams (hour and half mid exam 15%, one hour exam=10%, three hours final exam 60%) Homework = 5%

11. *Contribution to Professional Component:*

In this course, students learn how to apply the basic principles from physics and mechanics to analysis and solve the forces, moment and couples problems in three-dimensional (3D).

12. *Relationship to Student Outcomes:*

Course Learning Objectives (related Student Outcomes 1-7):

In this course, for Engineering Mechanics students will learn:

- Analysis the forces, moment and couples problems (3D). (outcome 1)
- Solve the forces, moment and couples problems (3D). (outcome 1)

CHE 123 Analytical Chemistry

2.Catalog Description:

This course aims to know and understand the principle of analytical chemistry and understand the procedures and applications of chemical reactions and analysis of substances through the use of automated analytical equipment prepared for this purpose. An in-depth study of analytical chemistry for a wide range of chemical reactions and their development through laboratory experiments, developing skills in titrimetry, volumetric and gravimetric analysis, and instrumental analysis.

3. Prerequisite(s): for energy efficiency

None

4. Textbook(s) and/or other required materials:

Douglas A. Skoog, Fundamentals of Analytical Chemistry (2004)**.**

5. Course Objectives:

In analytical chemistry, students will learn the following:

- Basic concepts of analytical chemistry.
- Types of chemical analysis
- Understanding chemical calculations and chemical equilibrium.
- Titration methods and chemical indicators.
- Know what the Acid is – Base equilibrium and what is the pH solution.
- Solubility, solubility product constant, precipitation reactions, and molecular precipitation.
- The nature of electromagnetic radiation and its effect on matter.
- The procedures and applications of analytical techniques.
- The principles of spectroscopic methods.

6. Topics:

Students will learn:

- Principles of gravimetric analysis.
- Principles of Volumetric analysis.
- Acid – Base Equilibria and pH of solutions.
- Titration curves and chemistry of indicators.
- Buffer solutions.

- Solubility Product.
- Electromagnetic radiation and its effect on matter.
- Principle of UV - Visible Spectroscopy.
- The principle of HPLC & GC.

7. Class/laboratory Schedule:

Ten practical experiments, two hours for each practical experiment

8. Design Project:

In addition to two exams, there is quizzes, tasks, and seminars.

9. Computer/software Use:

Students typically use words in writing their reports of problem based learning.

10. Evaluation Methods:

Quizzes (5, 15%), Homework Assignments (5, 5%), Onsite Assignments (5,10%), reports(2,10%) 40%

Exams (hour and half mid exam 10%, three hours final exam 50%).

11. Contribution to Professional Component:

For analytical chemistry, students will learn about basic concepts of analytical chemistry, types of chemical analysis, understanding chemical calculations and chemical equilibrium, titration methods and chemical indicators, know what is the Acid – Base equilibrium and what is the pH solution, enable students to know solubility, solubility product constant, precipitation reactions, and molecular precipitation, understanding the nature of electromagnetic radiation and its effect on matter. understanding the procedures and applications of analytical techniques, and understanding the principles of spectroscopic methods..

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

At the end of this course, students should be able to:

1-Understand the principle of analytical chemistry.

2-know chemical calculations and chemical equilibrium.

3- Know the Titration methods and chemical indicators.

4- Know solubility, solubility product constant, precipitation reactions, and molecular precipitation.

5- Understand the procedures and applications of the analytical techniques.

GE103a Workshops skills (4.0, Required)

2. Catalog Description:

This course have 2 **quizzes**, 5 **Assignments** (**Reports)** , 1 **Seminars** ,1 **Midterm Exam ,** 1 **Final exams**

3. Prerequisite(s): for energy efficiency

None

4. Textbook(s) and/or other required materials:

- **Metal manufacturing processes**, Abdul Khaleq Abdul Hassan, Mazen Abdul Sattar Al-Mufti, Foundation of Technical Education, Baghdad.
- **Principles of production processes,** Adel Mahmoud Hassan**,** Qahtan Khalaf Al-Khazraji , University of Baghdad ,Baghdad .

5. Course Objectives:

For the Engineering Workshop students will learn:
Theoretical and practical training in which the student is scientifically and technically established with the most necessary skills in the field of engineering technology.

6. Topics:

Students will learn:

- Industrial safety workshop (2 hours)
- Measurement &Marking workshop (3 hours)
- Carpentry workshop (10 hours)
- Welding workshop (10 hours)
- Casting workshop (10 hours)
- Machining workshop (10 hours)
- plumbing workshop (10 hours)
- Electrical workshop (10 hours)

7. Class/laboratory Schedule:

Class / laboratory Schedule	
	Material Covered
Week 1	Industrial safety workshop
Week 2	Measurement &Marking workshop
Week 3	Measurement &Marking workshop

Week 4	Carpentry workshop
Week 5	Carpentry workshop
Week 6	Carpentry workshop
Week 7	Welding workshop
Week 8	Welding workshop
Week 9	Welding workshop
Week 10	Machining workshop
Week 11	Machining workshop
Week 12	Machining workshop
Week 13	Casting workshop
Week 14	Casting workshop
Week 15	Casting workshop

8. Design Project:

None

9. Computer/software Use:

None

10. Evaluation Methods:

Exams (2 hours **Quizzes** (10%), 2 hours **Assignments (8%) and 4 Reports** (16%), 1hour **Seminars** (6%), **Midterm Exam** (1 10% (10)) , and three hours final exam 50%).

11. Contribution to Professional Component:

This package aims to provide the trainer with the necessary technical skills in the fields of industrial safety, measurement and determination, filing operations, carpentry, welding, plumbing, and mechanical operation.

12. Relationship to Student Outcomes:

On completion of this course students will be able to: Knowledge of technical skills in the field of industrial safety, measurement, filing, carpentry, welding, mechanical operation, sanitary engineering and the basics of electrical work

1. Course Number & Title (Credit Hours, Required or Elective):
Mathematics III(4.0, Required)

2. *Catalog Description:*
This course has 6 problems.

3. *Prerequisite(s): Mathematics II*

4. Textbook(s) and/or other required materials:

- Advanced Engineering Mathematics. K.A. Stroud,2003
- Advanced Engineering Mathematics, H.K. DASS. 2009

5. *Course Objectives:*

In this course, for advanced engineering mathematics students will learn

- Vectors
- Laplace Transforms
- Inverse Laplace Transforms
- Fourier Series
- Power Series

6. *Topics:*

In this course, for Advanced engineering mathematics students will learn:

- Application of Vectors
- Application of Laplace Transforms
- Application of Inverse Laplace Transforms
- Application of Fourier Series
- Application of Power Series.

7. *Class/laboratory Schedule:*

No lab

8. Design Project:

9. Computer/software Use:

10. Evaluation Methods:
Exams (hour and half mid exam 15%, three hours final exam
70%) Problem Based Learning projects (6 problems) 15%

11. *Contribution to Professional Component:*

In this course, students learn some details of advanced engineering mathematics, starting with Vectors, Laplace Transforms, Inverse Laplace Transforms, Fourier Series and Power Series.

12. *Relationship to Student Outcomes:*

Course Learning Objectives (related Student Outcomes 1):

In this course, for advanced engineering mathematics students will learn:

- Laplace Transforms (4)
- Inverse Laplace Transforms (4)
- Fourier Series (4)
- Power Series (1)
- Vectors (1)

. Course Number & Title (Credit Hours, Required or Elective):

CHEa 241 – Fluid Flow I (6.0 , Required)

2. Catalog Description:

The course begins with fluid flow applied to a range of problems in chemical engineering, including Fluid properties, Static fluid and its application, kinematic fluid, Dynamic fluid, flow pattern, flow in pipes, friction in multiple pipe connection, continuity equation, energy equation, pressure drop in pipes and its fitting, equivalent diameter, flow measurements,

Students will work to formulate the models necessary to study, analyses, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.

3. Prerequisite(s):

CHEb 141– Principles in Chemical Engineering II

4. Textbook(s) and/or other required materials:

- J, M. Coulson and J. F. Richardson "Chemical Eng. Vol. 1
- Fluid Mechanics / Frank M. White/ 7th edition
- McCabe W.L. & Smith J.C., Unit Operations of Chemical Eng, McGraw Hill
- Holland F. A. " fluid flow for Chem. Eng."

5. Course Objectives:

For this course, students will learn:

- To understand the basic concept of fluid flow, properties, viscosity, vapor pressure, cavitation and Newton law of viscosity
- To get acquainted the pressure due to fluid. Also, the measurement devices used to estimate this pressure such as, manometer, simple manometer, piezometer, u-tube manometer, differential manometer, mechanical gauge
- To understand mass and volume flow rate, continuity and energy equations.
- To develop problem solving Bernoulli's eq and its application. Velocity profile.
- To know how measure the flow by using venturi, orifice, pitot tube, rotameter, and nozzle
- To accommodate the flow pattern, velocity profile in laminar and turbulent flow
- To get acquainted the static, kinematic and dynamic fluids
- To understand energy losses and pressure drop in pipe and multiple pipe flow
- To fathom the fitting used in the pipes
- To distinguish between the major and minor losses due to friction in pipe

6. Topics:

Students will learn:

- basic concept of fluid flow, properties, viscosity, vapor pressure, cavitation and Newton law of viscosity
- static fluids, pressure and measurement devices used to estimate this pressure
- dynamic fluids, mass and volume flow rate, continuity and energy equations.
- Bernoulli's eq and its application.
- the flow pattern, velocity profile in laminar and turbulent flow
- energy losses and pressure drop in pipe and multiple pipe flow
- the fitting used in the pipes

7. Class/laboratory Schedule:

No lab

8. Design Project:

No project.

9. Computer/software Use:

- Students typically use words in writing their reports of problem-based learning.
- Students typically use Excel in solving some problems that need trial and error and also plotting curves.

10. Evaluation Methods:

Exams (Two hours mid exam 10%, three hours final exam 50%)
Quizzes 10%, Home Assignments 18%, Seminars 12%

11. Contribution to Professional Component:

For this course, students will identify and understand the fluid mechanics, properties, viscosity Newton law of viscosity. Static fluid and its application, dynamic fluids, continuity and energy equation, Bernoulli's equation and its application, flow measurement in closed and open channels, major and minor loss in pipes, pressure drop calculation, flow pattern, velocity profile in laminar and turbulent flow, flow pattern

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-6):

For this course, students will learn:

- Fluid definition, properties, Newton law of viscosity (1 to 3)
- Static and dynamic fluids (4 to 6)
- Flow measurements (5)
- Continuity, energy, Bernoulli's equation (7 and 8)

1. Course Number & Title (Credit Hours, Required or Elective):
CHEb 241 – Fluid Flow II (6.0 , Required)

2. Catalog Description:
The course begins with fluid flow applied to a range of problems in chemical engineering, including dimensional analysis, pumps, pump types, calculation of the energy required to pumping the liquid through the pipes, compressible fluids, compressor, mixing and their ranges of application, concept of vorticity, flow in the presence solid particle

Students will work to formulate the models necessary to study, analyses, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.

3. Prerequisite(s): for energy efficiency
CHEa 241 Fluid Flow II

4. Textbook(s) and/or other required materials:
- J, M. Coulson and J. F. Richardson "Chemical Eng. Vol. 1
- Fluid Mechanics / Frank M. White/ 7th edition
- McCabe W.L. & Smith J.C., Unit Operations of Chemical Eng, McGraw Hill
- Holland F. A." fluid flow for Chem. Eng."

5. Course Objectives:
For this course, students will learn:
- To understand pumping in liquids, types of pumps
- To understand the calculation of energy needed to pump liquid in the pipe system
- To knowledge about dimensional analysis
- Simplify the Dimensional analysis and the dimensionless group
- To get acquainted with the basic concept of the boundary layer
- To get acquainted the compressible fluid, isothermal and adiabatic flow
- To understand the compressor and the energy required to compress the fluids
- To explain the mixing of liquids
- To understand the vortex and its types
- To comprehend the flow in presence of solid particles

6. Topics:
Students will learn:
- Pumping of liquid, types of pumps and energy needed to pump liquids in pipe system
- Dimensional analysis and dimensionless group
- Concept of boundary layer
- Compressible fluids, isothermal and adiabatic flow, compressor
- Mixing of liquid

- concept of vorticity, vortex and its types
- Flow in presence of solid particle

7. Class/laboratory Schedule:

15 weeks of 120 min, lectures, 1 times a week

8. Design Project:

No project.

9. Computer/software Use:

- Students typically use words in writing their reports of problem based learning.
- Students typically use Excel in solving some problem that needs trial and error and also plotting curves

10. Evaluation Methods:

Exams (Two hours mid exam 10%, three hours final exam 50%)
Quizzes 10%, Home Assignments 10%, lab 10%, Seminars 10%

11. Contribution to Professional Component:

For this course, students will identify and understand the types of pumps and pumping of liquids, energy required to pumps the liquids, dimensional analysis and dimensional group, compressible fluid, mixing of liquids, concept of vorticity and the flow in the presence of solid particles

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-9):

For this course, students will learn:

- Pumping of liquids, types of pumps and energy required to pumps liquid (1 to 2)
- concept of vorticity (3and 5)
- compressible fluids and compressors (4)
- boundary layer and dimensional analysis (6)
- terminal settling velocity, including their forces (7, 8 and 9)

13. Prepared by:

Burhan S. Abdulrazzaq, 2023

1. Course Number & Title (Credit Hours, Required or Elective):

Physical chemistry I (6.0, Required)

2. Course Description:

The course begins with chemical kinetic applied to a range of problems in chemical kinetics. The physical chemistry course covered the energetic introduction to these concepts, and to develop the problem-solving skills essential to good engineering practice of physical chemistry in practical applications. And how to calculate the order of any simple reaction also included rate of reaction method for measuring order of reaction for similar and complex reaction, also to know the theory of reaction

3. Prerequisites)

Engineering Analysis (CHEM_ENG201), Mass Balance (CHEM_ENG103), Thermodynamics II(CHEM_ENG306), Heat Transfer II (CHEM_ENG307)

4. Textbook(s) and/or other required materials:

Elements of Chemical Reaction Engineering 6th Edition by H. Scott Fogler. 2020 Publisher: Pearson ISBN: 9780135486252

5. Course Learning Outcomes

On successful completion of this course students will be able to:

1. Ability the application law of kinetics that can be used for any order of reactions
2. To be enabled to solve problems in different cases of processes in chemical kinetic by using the law s of kinetics
3. Interpret experimental and test results and present these in an appropriate engineering report format
4. Collaborate with others in a team project environment to conduct engineering investigations and produce engineering reports

6. Topics:

Students will learn:

Phase equilibrium

Real and ideal solutions

Order of reaction

Zero order reaction

First order reactions

Second order reaction

Third order reaction

Complex reaction

Methods for measuring order of reaction

Electro chemistry

7. Class/laboratory Schedule:

No lab

8. Design Project:

None

9. Computer/software Use:

Students typically use Matlab, Polymath and Excel to solve the online assignment, they will also use Microsoft Word in writing their online assignment.

10. Evaluation Methods:

Exams (mid exams 25%, Quizzes 5%, Online assignment (Homework) 10%, and final exam 60%)

Note: Problem Based Learning approach will be used in one of the midterm exams (15%)

11. Contribution to Professional Component:

For Reactor Design and Prof. Ethics I, it will provide students with an opportunity to develop the graduate attributes such as deep discipline knowledge, career and leadership readiness and ability to solve chemical reactors trouble shooting. It also provides them with professional skills to order catalysts and parts of fabrication of chemical reactors.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

1. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.

5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

CHEa 244 Principles of Chem Eng. III

2. Catalog Description:
Basic Principles and Calculations in Chemical Engineering 2/1
This course has 2 tests that will be solved based on learning method.

3. Prerequisite(s):
- CHE141b: Basic Principles and Calculations in Chemical Engineering II

4. Textbook(s) and/or other required materials:
- David M Himmelblau, Basic principles and calculations in chemical engineering, Prentice Hall.
- Richard M Felder & Ronald W. Rousseau Elementary Principles of Chemical Processes, Wiley India.

5. Course Objective:
By teaching energy balance in chemical engineering, students acquire the knowledge and skills to analyze and optimize energy use in chemical processes, which is essential for a sustainable and efficient operation in the field of chemical engineering.

6. Topics:
- Understanding the multi-phase equilibrium.
- Fundamentals of Energy Balance.
- Estimation of enthalpy of vaporization, latent heat.
- Energy Balance for non-reactive systems.
- Energy Balance for reactive systems.
- Integrated Material and energy balance.
- Case study.

.
7. Class/laboratory Schedule:
No lab

8. Design Project:
In addition to two exams, there are two learning based problems and one seminar.

9. Computer/software Use:
Students typically use Microsoft words and PowerPoint in writing their reports of problem-based learning and seminar.

10. Evaluation Methods:
Quizzes: 5 Marks
Assignments: 20 Marks
Seminars: 5 Marks
Midterm Exam: 10 Marks
Final Exam: 60 Marks

11. Contribution to Professional Component:

This course introduces students to the fundamental principles and applications of energy balance in chemical engineering. It focuses on the analysis and quantification of energy flows within chemical processes and the optimization of energy usage for improved efficiency and sustainability. Through lectures, problem-solving exercises. Also, they will learn how to write and present a seminar using Microsoft PowerPoint. Students will learn how to deal with real industrial problems by solving Learning Based Problems.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

Student will learn:

1. Understanding the multi-phase equilibrium to define heat, work, energy, enthalpy, etc, then apply the engineering design process to produce solutions that meet specified needs with consideration for public safety, environmental, and economic factors (2, 3, 6).
2. An ability to make estimations of heat capacity and to calculate enthalpy changes for systems without and with phase changes (1, 2).
3. An ability to solve energy balances for closed and open systems (with and without chemical reaction) at steady and unsteady modes (1, 4, 6, 7).
4. Work in cooperation in teamwork to solve simple combined material and energy balances (systems without and with chemical reaction) (1, 4, 6, 7).

1. Course Number & Title (Credit Hours, Required or Elective):
CHEa 243 Environmental pollution (3.0, Required)

2. *Catalog Description:*

The course treats the combustion & air pollution. Various sources such as combustion in piston engine, gas turbine combustion, sources of air pollution from all types are explained. An analysis of different alternative sources for combustion and air pollution will be performed and key scientific, economic and social roadblocks for large scale implementation will be investigated.

3. Prerequisite(s):
None

4. *Textbook(s) and/or other required materials:*

- Hand book of air pollution from internal combustion engines pollutant formation and control by ERAN SHER, 1998.
- Internal combustion engines, applied thermo science, 2nd edition by colin R. Ferguson, 2001.
- Fundamentals and Tech of com combustion by F. EL-Mahallawy2002.
- Engineering fundamentals of the internal combustion By Willard W. Pulkrabek.

5. *Course Objectives:*

Aims of the course:

- To develop student's practical skills and knowledge required to critically evaluate alternative combustion process for different types of system sources, and provide applied solutions to the combustion problems.
- To explain concept of various forms combustion process &air pollution problem
- To outline division aspects and utilization new process of combustion and improve of different type of fuel and energy sources for different uses such as domestics and industrial applications.
- To analysis and understand the process of combustion and improve the system of reducing emission.

6. *Topics:*

- Fuel and its chemical composition
- Thermo-chemistry of fuel-air mixture
- Combustion in spark ignition engine
- Combustion in diesel engines
- Combustion in furnaces and other open systems
- Air pollution and emission.

7. *Class/laboratory Schedule:*

15 weeks of 1 hours lecture, and 1 hour tutorials and 1 hour practical.

8. *Design Project:*

None

9. *Computer/software Use:*

Students typically use scientific calculator's software to complete the homework.

10. Evaluation

Methods: First
semester exam 10%
Second semester
exam 10%
Homework 10%
Practical 10%
Final exams 60%

11. *Contribution to Professional Component:*

In this course, students learn some details of basic kinds of fuels (solid, liquid and gas). Students use to apply the basic principles of chemical equations to solve different problem in combustion and air pollutions. Students will also learn the types of engines and the emissions that product from this engine in the team project laboratory.

12. *Relationship to Student Outcomes:*

Course Learning Objectives (related Student Outcomes 1-7):

In this course, for energy efficiency students will learn:

- Various forms of combustion process (1)

1. **Course Number & Title (Credit Hours, Required or Elective):**
   CHEb 243 Industrial safety (3.0, Required)

2. *Catalog Description:*

A course of the technical fundamentals of chemical process safety: includes impact of chemical plant accidents and concepts of societal and individual risk; hazards associated with chemicals and other agents used in chemical plants, including toxic, flammable and reactive hazards: concepts of inherently safer design; control and mitigation of hazards to prevent accidents, including plant procedures and designs; major regulations that impact safety of chemical plants; consequences of chemical plant incidents due to acute and chronic chemical release and exposures; hazard identification procedures; introduction to risk assessment.

3. **Prerequisite(s):**
   None

4. *Textbook(s) and/or other required materials:*

- Daniel A. Crowl and J. F. Louvar, Chemical Process Safety, Fundamentals with Applications, 3rd ed., Prentice Hall, 2011. 723 pages. ISBN-13: 978-0-13-138226-8
- Lees F.P. Lee's Loss Prevention in Process industries: Hazard Identification, Assessment and control

5. ***Course Objectives:***

Aims of the course:

1. define major components of process safety and Process Safety Management (PSM)
2. use online e-learning tools and obtain a SACHE certificate while recognizing the need for life-long learning in chemical process safety
3. explain and apply OSHA PSM and it 14 elements when applicable
4. identify the components of PSI and explain how it is obtained and utilized
5. describe safety and differentiate inherently safe and safe

6. *Topics:*

- Recognize Hazards
- Assess and minimize risk
- Prepare for Emergencies

7. *Class/laboratory Schedule:*

   15 weeks of 1 hours lecture, and 1 hour tutorials and 1 hour practical.

8. *Design Project:*

   None

9. *Computer/software Use:*

Students typically use scientific calculator's software to complete the homework.

10. Evaluation

Methods: First
semester exam 10%
Second semester
exam 10%
Homework 10%
Practical 10%
Final exams 60%

11. *Contribution to Professional Component:*

The standard is designed to minimize or prevent incidents and accidents from the release of toxic, flammable, reactive or explosive chemicals. The goal of process safety management is to minimize and prevent incidents resulting from the release of hazardous chemicals. It also focus on ethical behavior of the graduates.

12. *Relationship to Student Outcomes:*

Course Learning Objectives (related Student Outcomes 1-7):

In this course, students will learn:

- How to incorporate safety in design of equipment (2)

1. Course Number & Title (Credit Hours, Required or Elective):
CHEa331 Engineering analysis I (4.0, Required)

2. *Catalog Description:*
This an advanced engineering mathematics course. This course has 6 problems.

3. *Prerequisite(s): G221 Engineering Mathematics*

4. Textbook(s) and/or other required materials:

- Advanced Engineering Mathematics. K.A. Stroud,2003
- Advanced Engineering Mathematics, H.K. DASS. 2009

5. *Course Objectives:*
In this course, for advanced engineering mathematics students will learn

- Vectors
- Laplace Transforms
- Inverse Laplace Transforms
- Fourier Series
- Power Series
- Modeling
- Simulation

6. *Topics:*
In this course, for Advanced engineering mathematics students will learn:

- Application of Vectors
- Application of Laplace Transforms
- Application of Inverse Laplace Transforms
- Application of Fourier Series
- Application of Power Series.

7. *Class/laboratory Schedule:*
No lab

8. Design Project:

9. Computer/software Use:

10. Evaluation Methods:
Exams (hour and half mid exam 15%, three hours final exam
70%) Problem Based Learning projects (6 problems) 15%

11. *Contribution to Professional Component:*

In this course, students learn some details of advanced engineering mathematics, starting with Vectors, Laplace Transforms, Inverse Laplace Transforms, Fourier Series and Power Series.

12. *Relationship to Student Outcomes:*

Course Learning Objectives (related Student Outcomes 1):

In this course, for advanced engineering mathematics students will learn:

- Laplace Transforms (4)
- Inverse Laplace Transforms (4)
- Fourier Series (4)
- Power Series (1)
- Vectors (1)

1- Course Number & Title (Credit Hours, Required or Elective):
CHEb331– Engineering Analysis II (4.0, Required)

2- *Catalog Description:*

This Course Specification provides the main features of the theory of engineering analysis for the students of 3rd year in Electromechanical Engineering Department. Learning outcomes which gained by this program will help a typical student to achieve and demonstrate the learning opportunities that are provided during the course study and to comply with the program's specification as Chemical Engineering.

3- *Prerequisite(s):*

Mathematic I
Mathematics II
Engineering Mathematics
Engineering analysis I

4- *Textbook(s) and/or other required materials:*

- Stroud, Kenneth Arthur, and Dexter J. Booth., "Advanced engineering mathematics," *Palgrave Macmillan*, 2011.

5- *Course Objectives:*

- Aims of the course are to graduates qualified engineers who they have theoretical experience in advanced engineering in electromechanical field.
- This unit of study aims to provide theoretical knowledge and principles of advanced numerical and the ability to analysis and solve the engineering problems.
- Illustration and discussion the main the application of engineering methods for the solution of ordinary differential equation(power series), differentiation of complex function that occur in most engineering of electromechanical field.
- The student may also go beyond the subject and perform grid sensitivity, parametric study and stability analysis.

6- *Topics:*

- Complex analysis
- Complex mapping:
- Differentiation of complex function:
- Harmonic functions
- Power series solution of ordinary differential equation
- Power series solutions:

7- *Class/laboratory Schedule:*

15 weeks of 120- min. lectures, 2 times a week.

8- *Design Project:*

In addition to regular homework assignments and two exams, there is a team project in which student learn how to understanding the MATLAB coding program to implement the

engineering analysis methods. Students can discuss the ideas in solving the problem for each team of students (3-4) and submit the project report.

9- *Computer/software Use:*

Students typically use the following pieces of software to complete the homework and project in the course: MS Word and MATLAB program.

10- *Evaluation Methods:*

First Exams (one hour and half) = 15%
Second Exam one hour and half) = 15%
Final Exam (Two hour) = 60%
Design project = 10%

11- *Contribution to Professional Component:*

Students learn how to apply the basic principles from with engineering analysis through solving the differential equations, partial equations, Harmonic functions, Z – Transformation.

12- *Relationship to Student Outcomes:*

A. Course Learning Objectives (related Student Outcomes 1-7):

1. Aims of the course are to graduates a qualified engineers who they have theoretical experience in advanced numerical and engineering analysis in electromechanical field (1)
2. This unit of study aims to provide theoretical knowledge and principles of advanced numerical and engineering analysis and the ability to analysis and solve the engineering problems (1)
3. Illustration and discussion the Main the application of engineering methods for the solution of differential equations (ordinary and partial) that occur in most engineering of electromechanical field(1)
4. The student may also go beyond the subject and perform grid sensitivity, parametric study, stability analysis (1)

1. Course Number & Title (Credit Hours, Required or Elective):

CHEa343 -Heat Transfer I (3.0, Required)

2. Catalog Description:

Students will learn analysis and demonstration of heat transfer principles including conduction, convection, and radiation modes. Analysis of Heat exchanger as an application for heat transfer principles.

3. Prerequisite(s):

CHEb 241 Fluid flow II,

GE221 Engineering mathematics

4. Textbook(s) and/or other required materials:

Heat Transfer, Tenth Edition, J. P. Holman, 2002

5. Course Objectives:

The goal of this course is to build up the students' interest in fundamental heat transfer problems and develop the skills of applying knowledge in solving the problems.

6. Topics:

- Conduction heat transfer (1D)
- Heat transfer through fins
- Two dimensional steady state heat conduction
- One and Two dimensional unsteady state heat conduction
- Convective heat transfer
- Forced convection
- Natural convection
- Thermal radiation
- Heat exchangers

8. *Course Learning Objectives (related Student Outcomes 1-7):*

- Defining the heat transfer modes concepts to the second year students.
- Defining the theoretical basics of the conduction heat transfer coincided with a laboratory experiment.
- Defining the theoretical basics of the forced and free convective heat transfer coincided with a laboratory experiment.
- Defining the theoretical basics of the radiation heat transfer.
- Defining the theoretical basics of the heat exchangers coincided with a laboratory experiment
- Defining the theoretical basics of the mixed modes of heat transfer

9. Class/laboratory Schedule:

15 weeks of 60 min. lectures and 1hrs Practice, 1 times a week.

10. Computer/ Software Use:

Students typically use word in writing their reports of problem based learning.

11. Evaluation Methods:

Exams (Two hour mid exam 30%, Laboratory Experiments 10%, three hours final exam 60%)

12. Contribution to Professional Component:

In this course, students learn some details of heat transfer modes and their application as in heat exchanger types. Students apply the basic principles of thermodynamics, fluid mechanics, physics and mathematics to solve different problem in heat transfer. This course serves as final applicable in the program (energy and renewable energies).

13. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

- Conduction mode
- Convection mode
- Radiation mode
- Heat exchanger

1. Course Number & Title (Credit Hours, Required or Elective):
CHE351 – Mass Transfer I (3.0, Required)

2. Catalog Description:
Mass Transfer 1
This course have 3 problems that will be solved by problem based learning method.

3. Prerequisite(s):
- CHE141: Principles of Chem. Eng. I
- CHE142: Principles of Chem. Eng. II
- CHE244: Principles of Chem. Eng. III
- CHE245: Principles of Chem. Eng. IV

4. Textbook(s) and/or other required materials:
- Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 1, six edition, ELBS, Pergamon Press. 2002.
- Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 2, fifth edition, ELBS, Pergamon Press. 2002.

5. Course Objectives:
For Mass Transfer 1 students will learn:
- How to calculate diffusion fluxes in various systems.
- Demonstrate a broad and integrated knowledge for gas-liquid absorption process.
- Explain the physical phenomena, theoretical concepts, and design aspects of stripping process.

6. Topics:
Students will learn:
- Stagnant diffusion, equimolecular counter diffusion, diffusion with reaction, diffusion coefficient in gases and in liquids.
- Unsteady-state Diffusion, diffusion through variable cross-sectional area, mass transfer coefficient.
- Mass transfer theories, overall gas-phase and overall liquid-phase mass transfer coefficients.
- Introduction to absorption process, solubility of gases in liquids, selection of solvent for absorption, packed tower absorption.
- Determine packed absorption height, minimum liquid flow rate.
- Plate absorption tower, calculating trays number and height, absorption column efficiency.
- Determine the height of stripping column and the number of trays.

7. Class/laboratory Schedule:
No lab

8. Design Project:
In addition to two exams, there are three learning-based problems and one seminar.

9. Computer/software Use:

Students typically use Microsoft words and PowerPoint in writing their reports of problem-based learning and seminar.

10. Evaluation Methods:

- Exams (hour and half midterm exam 13%, three hours final exam 60%)
- Learning Based Problem (3 problems) 15%
- Seminar 8%
- Quizzes 4%

11. Contribution to Professional Component:

Students will gain knowledge on diffusion of gases and liquids in different systems. Also, they will learn how to write and present a seminar using Microsoft PowerPoint. Students will learn how to deal with real industrial problems by solving Learning Based Problems.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

For Mass Transfer 1 students will learn:

1. Understanding the mass transfer in different system (1).
2. Packed and plated absorption processes (1)
3. Stripping column calculations (1)

1. Course Number & Title (Credit Hours, Required or Elective):

CHEb342 – Mass Transfer II (3.0, Required)

2. Catalog Description:

Mass Transfer II

This course has 3 problems that will solve by problem-based learning method.

3. Prerequisite(s):

- CHE141: Principles of Chem. Eng. I
- CHE142: Principles of Chem. Eng. II
- CHE244: Principles of Chem. Eng. III
- CHE245: Principles of Chem. Eng. IV
- CHEa342 : Mass Transfer I

4. Textbook(s) and/or other required materials:

- Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 1, six edition, ELBS, Pergamon Press. 2002.
- Coulson J.M. & Richardson J.F., Chemical Engineering, Volume 2, fifth edition, ELBS, Pergamon Press. 2002.

5. Course Objectives:

For Mass Transfer II students will learn:

- How to calculate the number of plates required in distillation column.
- Demonstrate a broad and integrated knowledge in binary and multicomponent distillation process.
- Explain the physical phenomena, theoretical concepts, and design aspects of liquid – liquid extraction.

6. Topics:

Students will learn:

- Introduction to distillation, vapor–liquid equilibrium.
- Batch distillation, Flash distillation.
- Fractional distillation, the top and bottom operating line, the q line and energy balances,
- McCabe-Thiele graphical method, distillation operations economics.
- Column and plate efficiency, Lewis- Soral method.
- Multi-component distillation.
- Multi feeds and side streams distillation.
- Introduction to liquid – liquid extraction, Simple multi-stage contactors.
- Counter-current contactors.

7. Class/laboratory Schedule:

No lab

8. Design Project:

In addition to two exams, there are three learning-based problems and one seminar.

9. Computer/software Use:

Students typically use Microsoft words and PowerPoint in writing their reports of problem based learning and seminar.

10. Evaluation Methods:

- Exams (hour and half midterm exam 13%, three hours final exam 60%)
- Learning Based Problem (3 problems) 15%
- Homework 8%
- Quizzes 4%

11. Contribution to Professional Component:

Students will gain knowledge on distillation process in details and in liquid-liquid extraction process. Also, they will learn how to write and present a seminar using Microsoft PowerPoint. Students will learn how to deal with real industrial problems by solving Learning Based Problems.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

For Mass Transfer II students will learn:

1. Understanding the separation of liquid mixtures by distillation process (1).
2. Multicomponent and multi feed streams distillation calculations (1)
3. Liquid – liquid extraction theory and calculations (1)

13. Prepared by:

Suhaib S. Salih, 2023

1. Course number and name

CHEa341 Thermodynamics I (3.0, Required)

2. Credits and contact hours

Credits: 3.0
Contact: 3.0

3. Instructor's or course coordinator's name

Duraid F.Ahmed

4. Textbook, title, author, and year

Thermodynamic an Engineering Approach, Yunus A. Cengel, Michael A. Boles, 5th edition 2004

5. Specific course information

a. brief description of the content of the course (catalog description) Students will learn:

• Analysis and demonstration of thermodynamic principles including parameters, units, and definitions
• Analysis of the 1st, 2nd, 3rd, and zero laws of the thermodynamic and their application on the idea gas processes, cycles, steam, enthalpy, and entropy.

b. Thermodynamic Prerequisites:
GEb 121
Mathematics II

c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
•Required

6.Specific goals for the course

The goal of this course is to build up the students' interest in fundamental of the Thermodynamic problems and develop the skills of applying knowledge in solving the problems.

7.Brief list of topics to be covered

- properties of system (P, V, and T)
- Thermodynamic laws (1st, 2nd, 3rd, zero)
- Energy balance
- Open and close system
- Ideal gas
- Ideal gas processes
- Heat engine and heat pump
- Gas cycles (Carnot cycle for gas)
- Steam plant (Carnot and Rankine)
- Ideal gas cycles (Diesel, Otto, Daul)

8. Course Learning Objectives (related Student Outcomes 1-7):
    - Defining the Thermodynamic concepts to the second-year students.
    - Defining the theoretical basics of the close and open systems coincided with a laboratory experiment.
    - Defining the theoretical basics of the thermodynamic laws coincided with a laboratory experiment.
    - Defining the theoretical basics of the idea gas processes.
    - Defining the theoretical basics of the steam table coincided with a laboratory experiment

9. Class/laboratory Schedule:

    30 weeks of 120 min. lectures and 1hrs Practice, 1 times a week.

10. Computer/ Software Use:

Students typically use word in writing their reports of problem based learning.

11. Evaluation Methods:

    Exams (Two hour mid exam 30%, Laboratory Experiments 10%, three hours final exam 60%)

12. Contribution to Professional Component:

    In this course, students learn some details of the thermodynamic laws and their application as in close and open systems and ideal gas cycles. Students use to apply the basic principles of physics and mathematics to solve different problem in thermodynamic.

13. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7): Outcome 1

- properties of system (P, V, and T)
- Thermodynamic laws (1^{st}, 2^{nd}, 3^{rd}, zero)
- Energy balance
- Open and close system energy balance
- Ideal gas processes and cycles

1. Course Number & Title (Credit Hours, Required or Elective):

CHEb341 Thermodynamics II (2.0, Required)

2. Catalog Description:

Analysis of fluid machinery, including analysis of hydro-electrical power plants, hydraulic turbines, pumps and compressors. The course includes brief introduction to hydro-electrical power plants design by employing problem-based learning method.

3. Prerequisite(s):

CHEa341
Thermodynamics

4. Textbook(s) and/or other required materials:

Hydraulic machines including fluidics, Dr. Jag – sh. Lal, 1979 Fluid mechanics and hydraulic machines, R. K. Rajput, 2007

5. Course Objectives:

In this course, students will learn how to analyze the flow within the fluid machinery in order to calculate force and power developed or consumed in additional to their efficiency. Topics include analysis and working principle for each machine. There is also a brief introduction to hydro-electrical power plants design.

6. Topics:

- Dynamic action of fluid
- Hydro-electrical power plants
- Pelton turbine or impulse turbine
- Reaction turbine (Francis and Kaplan)
- Pumps
- Unit and specific quantities
- Compressors

7. Class/laboratory Schedule:

15 weeks of 120- min. lectures,
1 times a week. 15 weeks of
120-min. lab, 2 times a month.

8. Design Project:

In addition to regular homework assignments and two exams, there is a team project in which student learn how to clarify design of hydro-electrical power plant. Students can discuss the ideas in solving the problem but each team of students (5-6) is expected to produce an independent project report.

9. Computer/software Use:

Students typically use word in writing their reports of problem based learning.

10. Evaluation Methods:

First semester exam 15%

Second semester exam	10%
Lab	10%
Design project	5%
Final exam	60%

11. *Contribution to Professional Component:*

Students learn how to apply the basic principles from fluid mechanics to calculate the force and power developed or consumed in the fluid machinery. Students will also learn how to handle an open-ended design problem in the team project.

12. *Relationship to Student Outcomes:*

A. Course Learning Objectives (related Student Outcomes 1-7):

- Outcome 1

1. Course Number & Title (Credit Hours, Required or Elective):

CHEa333 Engineering statistics (4.0, Required)

2. Catalog Description:

This course introduces probability and statistics with applications, provides a practical ability to choose, generate, and properly interpret appropriate descriptive and inferential methods.

3. Prerequisite(s):

GEb 121Mathematics II

4. Textbook(s) and/or other required materials:

1- Kim, Bong Sun, Sang Gyu Park, Young Kwan You, and Soo Il Jung. "Probability & statistics for engineers & scientists." (2011).
2- Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John wiley & sons, 2010.

5. Course Objectives:

The course teaches students the basic concepts of statistics and the logic of statistical reasoning.

6. Topics:

1. Introduction to probability
2. Random experiment, Sample Spaces, Events, Probability
3. Random variables and probability distributions
4. Mathematical expectation and variance
5. Engineering Statistic
6. Skewness & Kurtosis Measures

7. Class Schedule:

12 weeks of 150min. lectures, one time a week.

8. Computer/software Use:

Students typically use words and numbers in writing their reports of problem based learning.

9. Evaluation Methods:

Mid-semester exam 20%
Student activities 10%
Final exam 70%

10. Contribution to Professional Component:

1. Introduction to Probability theory.
2. Students learn to calculate the sample spaces, and events.

3. Students learn to calculate the Random variables.
4. Students learn to calculate the probability distributions, mathematical expectation and variance
5. Students learn to calculate the Engineering Statistic

12. Relationship to Student Outcomes:

A. Course Learning Objectives (related Student Outcomes 1-7):

1. Calculation of sample spaces, events, Random variables, probability distributions, mathematical expectation, variance and. Engineering Statistic (outcome 1).

1- Course Number & Title (Credit Hours, Required or Elective):

CHEa321 Numerical methods (4.0, Required)

2- Catalog Description:

This Course Specification provides the main features of the theory of numerical analysis for the students of 3rd year in Electromechanical Engineering Department. Learning outcomes which gained by this program will help a typical student to achieve and demonstrate the learning opportunities that are provided during the course study and to comply with the program's specification as Energy and Renewable Energies Engineering.

3- Prerequisite(s):

EME105 – Mathematic I EME106 – Mathematics II
EME203 -Advanced Mathematics I
EME204 –Advanced Mathematics II
EME205- Computer Science

4- Textbook(s) and/or other required materials:

- Chapra, Steven C., and Raymond P. Canale., "Numerical methods for engineers," Vol. 2, New York: McGraw-Hill, 2012.

5- Course Objectives:

- Aims of the course are to graduates qualified engineers who they have theoretical experience in advanced numerical in electromechanical field.
- This unit of study aims to provide theoretical knowledge and principles of advanced numerical and the ability to analysis and solve the numerical problems.
- Illustration and discussion the main the application of numerical methods for the solution of equation(s) - linear, non-linear (algebraic) that occur in most numerical of electromechanical field.
- The student may also go beyond the subject and perform grid sensitivity, parametric study and stability analysis.

6- Topics:

Solution of non –linear equations by numerical methods:

- Simple Iteration Method
- Bisection method
- Newton – Raphson iterative

Curve fitting

&Interpolation

a) Curve fitting :

- Least square method

b) Interpolation :

- Newton Interpolation Polynomial
- Lagrange Interpolation

Polynomial Numerical Solution
of linear equations systems:

- Direct method
- Indirect method

Numerical integration

- Trapezoidal rule
- Simpson's rule

Solution of differential equations by numerical methods:

- Modified Euler's method
- Runge-Kutta method

7- *Class/laboratory Schedule:*

15 eeks of 120- min. lectures, 2 times a week.

8- *Design Project:*

In addition to regular homework assignments and two exams, there is a team project in which student learn how to understanding the MATLAB coding program to implement the numerical analysis methods. Students can discuss the ideas in solving the problem for each team of students (3-4) and submit the project report.

9- *Computer/software Use:*

Students typically use the following pieces of software to complete the homework and project in the course: MS Word and MATLAB program.

10- *Evaluation Methods:*

First Exams (one hour and half) = 15% Second Exam one hour and half) = 15%
Final Exam (Two hour) = 60%
Design project = 10%

11- *Contribution to Professional Component:*

Students learn how to apply the basic principles from numerical analysis through solving linear and nonlinear equations in additional to solve the differential equations, curve fitting, interpolation, numerical differential and integration.

12- *Relationship to Student Outcomes:*

Course Learning Objectives (related Student Outcomes 1-7):

1. Aims of the course are to graduates a qualified engineers who they have theoretical experience in advanced numerical analysis in electromechanical field (1)
2. This unit of study aims to provide theoretical knowledge and principles of advanced numerical and engineering analysis and the ability to analysis and solve the engineering problems (1)

Course Number & Title (Credit Hours, Required or Elective):

CHEb321 Optimization methods (4.0, Required)

Catalog Description:

This course provides the main features of optimization methods for 3rd-year students in the Electromechanical Engineering Department. Learning outcomes achieved by this program will help students demonstrate the learning opportunities provided during the course study and comply with the program's specification in Energy and Renewable Energies Engineering.

Prerequisite(s): CHEa321 Numerical methods
Textbook(s) and/or other required materials:

- Rao, Singiresu S. "Engineering Optimization: Theory and Practice." John Wiley & Sons, 2019.
- Bazaraa, Mokhtar S., Hanif D. Sherali, and C. M. Shetty. "Nonlinear Programming: Theory and Algorithms." John Wiley & Sons, 2013.

Course Objectives:

- Graduate qualified engineers with theoretical and practical experience in optimization methods relevant to the electromechanical field.
- Provide theoretical knowledge and principles of optimization methods and the ability to analyze and solve optimization problems.
- Illustrate and discuss the main applications of optimization methods in various engineering contexts.
- Enable students to perform sensitivity analysis, parametric studies, and optimization-based decision-making.

Topics:

- **Introduction to Optimization:**
  - Definition and Classification of Optimization Problems
  - Applications of Optimization in Engineering
- **Linear Programming:**
  - Formulation of Linear Programming Problems
  - Simplex Method
  - Duality and Sensitivity Analysis
- **Nonlinear Programming:**
  - Unconstrained Optimization Techniques
  - Constrained Optimization Techniques
  - Karush-Kuhn-Tucker (KKT) Conditions
- **Integer Programming:**
  - Formulation and Solution Techniques
  - Branch and Bound Method
  - Cutting Plane Method
- **Dynamic Programming:**
  - Principle of Optimality
  - Recursive Relationships

    - Applications in Engineering
- **Multi-Objective Optimization:**
    - Pareto Optimality
    - Techniques for Multi-Objective Optimization
    - Case Studies
- **Heuristic and Metaheuristic Methods:**
    - Genetic Algorithms
    - Simulated Annealing
    - Particle Swarm Optimization

Class/Laboratory Schedule:

15 weeks of 120-minute lectures, 2 times a week.

Design Project:

In addition to regular homework assignments and two exams, there is a team project where students learn to use MATLAB to implement optimization methods. Students can discuss ideas for solving problems in teams of 3-4 and submit a project report.

Computer/Software Use:

Students typically use the following software to complete homework and projects in the course: MS Word and MATLAB.

Evaluation Methods:

- First Exam (one hour and a half) = 15%
- Second Exam (one hour and a half) = 15%
- Final Exam (two hours) = 60%
- Design Project = 10%

Contribution to Professional Component:

Students learn to apply basic principles from optimization methods to solve linear, nonlinear, and multi-objective optimization problems, as well as to use heuristic and metaheuristic methods.

Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

1. Graduate qualified engineers with theoretical and practical experience in optimization methods relevant to the chemical engineering field (1).
2. Provide theoretical knowledge and principles of optimization and engineering analysis, and the ability to analyze and solve engineering problems (1).

CHE344 – Chemical Industries (3.0, Elective)

Catalog Description:

This course provides an overview of the chemical industries, including their history, processes, products, and environmental impact. Students will gain an understanding of the

major chemical industries, their importance in the global economy, and the challenges they face.

Prerequisite(s):

CHE201 – Chemical Engineering Thermodynamics CHE202 – Fluid Mechanics CHE301 – Heat Transfer CHE302 – Mass Transfer CHE303 – Chemical Reaction Engineering

Textbook(s) and/or other required materials:

- Shreve, R. Norris, and J. A. Brink. "Chemical Process Industries." McGraw-Hill Education, 2017.
- Towler, Gavin, and R. Sinnott. "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design." Elsevier, 2012.

Course Objectives:

- To introduce students to the major chemical industries and their processes.
- To provide an understanding of the principles behind the design and operation of chemical plants.
- To familiarize students with the environmental and safety issues related to chemical industries.

Topics:

- **Introduction to Chemical Industries:**
  - Overview of Chemical Industry Sectors
  - Importance of Chemical Industries in the Economy
- **Chemical Process Technology:**
  - Overview of Chemical Processes
  - Chemical Reaction Engineering in Industry
- **Unit Operations in Chemical Industries:**
  - Distillation
  - Extraction
  - Absorption
  - Adsorption
  - Filtration
- **Chemical Plant Design and Economics:**
  - Principles of Plant Design
  - Economic Considerations in Plant Design
- **Environmental and Safety Issues in Chemical Industries:**
  - Environmental Impact Assessment
  - Safety Management Systems
  - Hazard Identification and Risk Assessment

Class Schedule:

15 weeks of 120-minute lectures, 2 times a week.

Design Project:

None

Computer/Software Use:

None

Evaluation Methods:

- Midterm Exam = 20%
- Final Exam = 30%
- HWs = 30%
- Class Participation = 20%

Contribution to Professional Component:

This course contributes to the professional development of students by providing them with knowledge and skills relevant to the chemical industry, including process design, safety management, and environmental impact assessment.

CHE342 – Petrochemical Industries (4.0, Required)

Catalog Description:

This course provides an in-depth study of the petrochemical industry, focusing on the processes involved in the production of petrochemicals, their derivatives, and their industrial applications. Students will gain theoretical knowledge and practical skills related to petrochemical processes and their significance in various industries.

Prerequisite(s):

CHE344 Chemical industries

Textbook(s) and/or Other Required Materials:

"Chemical Process Industries" by Shreve and Brink Jr.

Course Objectives:

- To provide theoretical knowledge and principles of petrochemical processes in the chemical engineering field.
- To understand the significance of petrochemicals and their derivatives in various industries.
- To analyze and solve problems related to petrochemical industries.
- To explore emerging trends and innovations in petrochemical processes.

Topics:

1. Introduction to Petrochemicals
2. Petrochemical Feedstocks
3. Petrochemical Refining Processes
4. Petrochemical Derivatives and Applications
5. Overview of the Petrochemical Industry
6. Petrochemical Process Technologies
7. Environmental and Economic Impacts of Petrochemicals
8. Case Studies and Industry Insights
9. Safety and Regulatory Considerations in Petrochemical Industries
10. Future Trends and Innovations in Petrochemicals

Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week.

Design Project:

- In addition to regular homework assignments and two exams, there is a team project in which students learn how to analyze and solve problems related to petrochemical industries. Students can discuss ideas in solving problems in teams of 3-4 and submit a project report.

Computer/Software Use:

- Students will use MS Word and MATLAB for completing homework and the project.

Evaluation Methods:

- First Exam (1.5 hours) = 15%
- Second Exam (1.5 hours) = 15%
- Final Exam (2 hours) = 60%
- Design Project = 10%

Contribution to Professional Component:

- Students will apply basic principles from petrochemical industries to analyze and solve problems, contributing to their engineering skills.

Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing theoretical and practical skills in petrochemical industries.

Course Number & Title:

CHEb441 – Unit Operation II (4.0, Required)

Catalog Description:

This course builds on the principles and practices learned in Unit Operation I, focusing on more advanced topics in chemical engineering unit operations. Topics include distillation, absorption, extraction, and reaction engineering.

Prerequisite(s):

- CHE441: Unit Operation I

Textbook(s) and/or Other Required Materials:

- McCabe, W., Smith, J., & Harriott, P. (2001). Unit Operations of Chemical Engineering (7th ed.). McGraw-Hill.

Course Objectives:

- To deepen theoretical knowledge and principles of unit operations in chemical engineering.
- To understand advanced principles behind distillation, absorption, extraction, and reaction engineering.
- To analyze and solve complex problems related to unit operations in chemical engineering.

Topics:

1. Distillation
2. Absorption
3. Extraction
4. Reaction Engineering

Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week.

Design Project:

- None

Computer/Software Use: None

Evaluation Methods:

- First Exam (1.5 hours) = 20%
- Second Exam (1.5 hours) = 20%
- Final Exam (2 hours) = 60%

Contribution to Professional Component:

- Students will apply advanced principles from unit operations in chemical engineering to analyze and solve complex problems, contributing to their engineering skills.

Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing advanced theoretical and practical skills in unit operations in chemical engineering.

Syllabus

1. Course Number & Title (Credit Hours, Required or Elective):
CHEa 445– Reactor Design and Prof. Ethics I (6.0, Required)

2. Course Description:

Reactor Design and Prof. Ethics I provide fundamental knowledge of chemical Reactor Design and Prof. Ethics. Interpretation of chemical rate data in homogeneous and heterogeneous reaction systems. Development and application of the theory of chemical kinetics, including collision approach. Theory and analysis of reactions in homogeneous phases. Reactor Design and Prof. Ethics with applications to and extension of ideal reactor models: plug flow and mixed flow.
This course have projects that will solve by problem based learning method.

3. Prerequisites)
Engineering Analysis (CHEM_ENG201), Mass Balance (CHEM_ENG103), Thermodynamics II(CHEM_ENG306), Heat Transfer II (CHEM_ENG307)

4. Textbook(s) and/or other required materials:
Elements of Chemical Reaction Engineering 6th Edition by H. Scott Fogler. 2020 Publisher: Pearson ISBN: 9780135486252

5. Course Learning Outcomes
On successful completion of this course students will be able to:

a) Handle chemical reaction problems and the effect of reaction temperature;
b) Interpret and analyse chemical reaction kinetics data and application of reaction kinetics in chemical reaction engineering using analytical methods and a software;
c) Specify and size the most common industrial chemical reactors to achieve production goals for processes involving homogeneous reaction systems with safety and economics considerations;
d) Judge chemical reactors engineering problems based on ethical, professional, and engineering considerations taking economics, environmental and social contexts into consideration.

6. Topics:
Students will learn:

- Fundamentals of chemical kinetics and effect of reaction temperature
- Interpretation of chemical reaction kinetics, data analyses and development of reaction rate law
- Isothermal Reactor Design and Prof. Ethics/Batch, CSTR, and PFR and combination of reactors
- Ethics and professional values of chemical engineers and consideration in Reactor Design and Prof. Ethics.

7. Class/laboratory Schedule:
No lab

8. Design Project:
None

9. Computer/software Use:
Students typically use Matlab, Polymath and Excel to solve the online assignment, they will also use Microsoft Word in writing their online assignment.

10. Evaluation Methods:

Exams (PBL project 15%, Quizzes 15%, Online assignment (Homework) 10%, and final exam 60%)

11. Contribution to Professional Component:

For Reactor Design and Prof. Ethics I, it will provide students with an opportunity to develop the graduate attributes such as deep discipline knowledge, career and leadership readiness and ability to solve chemical reactors trouble shooting. It also provides them with professional skills to order catalysts and parts of fabrication of chemical reactors.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

2.An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.

5.An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

For Reactor Design and Prof. Ethics I students will learn how to:

- **a)** Handle chemical reaction problems and the effect of reaction temperature (1);
- **b)** Interpret and analyze chemical reaction kinetics data and application of reaction kinetics in chemical reaction engineering using analytical methods and a software (1, 2);
- **c)** Specify and size the most common industrial chemical reactors to achieve production goals for processes involving homogeneous reaction systems with safety and economics considerations (2);
- **d)** Judge chemical reactors engineering problems based on ethical, professional and engineering considerations taking economics, environmental and social contexts into consideration(5).

1. Course Number & Title (Credit Hours, Required or Elective):
CHEb445– Reactor Design and Prof. Ethics II (6.0, Required)

2. Course Description:

This course introduces the basic concepts of heterogeneous reactions and packed bed Reactor Design and Prof. Ethics. It also covered multiple reactions, and non-isothermal operation of reactors. I have 5 main course objectives:

1- Perform mass and energy balances on various reactors (plug flow reactors, CSTRS, packed bed reactors, membrane reactors) at non-isothermal conditions.

2- Manipulate variables in the design equations to design reactors that achieve specific conversions and/or volumes under constraints for multiple reactions.

3- Use computational software to solve reactor problems. Investigate complex reaction systems using PolyMath and MatLab or other softwares. Analyze and comprehend the results for accuracy and rationality toward engineering judgments.

4- Recognize the general applicability of chemical engineering design to ensure safe operation and preparedness for emergency.

5- Effectively perform in teams. Work effectively in teams and develop problem solving skills.

3. Prerequisites)
CHEa 445 Reactor Design and Prof. Ethics I.

4. Textbook(s) and/or other required materials:
Elements of Chemical Reaction Engineering 6th Edition by H. Scott Fogler. 2020 Publisher: Pearson ISBN: 9780135486252

5. Course Learning Outcomes
On successful completion of this course students will be able to:

e) Handle chemical reaction problems and the effect of reaction temperature and pressure drop;
f) Interpret and analyse multiple reaction systems using analytical methods and a software;
g) Specify and size the most common industrial chemical reactors to achieve production goals for processes involving hetrogeneous reaction systems with safety and economics considerations;
h) Judge chemical reactors engineering problems based on ethical, professional, and engineering considerations taking economics, environmental and social contexts into consideration.

6. Topics:
Students will learn:
- Packed bed reactor

- Non-isothermal operation, CSTR, PFR, PBR
- Multiple reactions
- Ethics and professional values of chemical engineers and consideration in reactor packed bed and complex reactions design.

7. Class/laboratory Schedule:

No lab

8. Design Project:

None

9. Computer/software Use:

Students typically use Matlab, Polymath and Excel to solve the online assignment, they will also use Microsoft Word in writing their online assignment.

10. Evaluation Methods:

Exams (mid exams 20%, Quizzes 10%, PBL project 10%, and final exam 60%)

11. Contribution to Professional Component:

For Reactor Design and Prof. Ethics II, it will provide students with an opportunity to develop the graduate attributes such as deep discipline knowledge, career and leadership readiness and ability to solve chemical reactors trouble shooting at non isothermal operation. It also provide them with professional skills to order catalysts and parts of fabrication of chemical reactors and run reactors with pressure drop and how to avoid incidents and accidents in reactor operation.

12. Relationship to Student Outcomes:

Course Learning Objectives (related Student Outcomes 1-7):

2. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.

5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

CHEa447 – Process Control I (4.0, Required)

1. Catalog Description:

This course introduces the principles and techniques of process control in chemical engineering. Topics include feedback control systems, stability analysis, controller design, and tuning methods.

2. Prerequisite(s):

CHE241: Chemical Engineering Thermodynamics

CHE342: Petrochemical Industries

3. Textbook(s) and/or Other Required Materials:

Seborg, D. E., Edgar, T. F., Doyle III, F. J., & Mellichamp, D. A. (2010). Process Dynamics and Control (3rd ed.). John Wiley & Sons.

4. Course Objectives:

To provide theoretical knowledge and principles of process control in chemical engineering.

To understand the fundamentals of feedback control systems and stability analysis.

To learn controller design and tuning methods for chemical processes.

5. Topics:

Introduction to Process Control

Mathematical Modeling of Processes

Feedback Control Systems

Stability Analysis

Controller Design

Tuning Methods

Class/Laboratory Schedule:

15 weeks of 120-minute lectures, 2 times a week.

6. Design Project:

None

7. Computer/Software Use:

Students will use MS Word and MATLAB for completing homework and the project.

8. Evaluation Methods:

First Exam (1.5 hours) = 20%

Second Exam (1.5 hours) = 20%

Final Exam (2 hours) = 60%

9. Contribution to Professional Component:

Students will apply principles from process control in chemical engineering to analyze and solve control problems, contributing to their engineering skills.

10. Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing theoretical and practical skills in process control in chemical engineering.

CHEb447 – Process Control II (4.0, Required)

1.Catalog Description:

This course builds upon the principles learned in Process Control I, focusing on more advanced topics in process control. Topics include advanced control strategies, multivariable control, and process optimization.

2.Prerequisite(s):

- CHEa447: Process Control I

3.Textbook(s) and/or Other Required Materials:

- Seborg, D. E., Edgar, T. F., Doyle III, F. J., & Mellichamp, D. A. (2010). Process Dynamics and Control (3rd ed.). John Wiley & Sons.

4.Course Objectives:

- To deepen theoretical knowledge and principles of process control in chemical engineering.
- To understand advanced control strategies, multivariable control, and process optimization.
- To analyze and solve complex control problems in chemical processes.

5.Topics:

1. Advanced Control Strategies
2. Multivariable Control
3. Process Optimization
4. Advanced Process Control Applications

6.Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week. Also, a laboratory with several experiments

7.Design Project:

- In addition to regular homework assignments and two exams, there is a team project in which students learn how to apply advanced process control principles to analyze and solve complex control problems in chemical processes. Students can discuss ideas in solving problems in teams of 3-4 and submit a project report.

8.Computer/Software Use:

- Students will use MS Word and MATLAB for completing homework and the project.

9.Evaluation Methods:

- First Exam (1.5 hours) = 15%
- Second Exam (1.5 hours) = 15%
- Final Exam (2 hours) = 60%
- Design Project = 10%

10.Contribution to Professional Component:

- Students will apply advanced principles from process control in chemical engineering to analyze and solve complex control problems, contributing to their engineering skills.

11.Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing advanced theoretical and practical skills in process control in chemical engineering.

CHEa443 – Petroleum Refining I (4.0, Required)

1.Catalog Description:

This course provides an introduction to the principles and practices of petroleum refining. Topics include crude oil properties, refining processes, and product specifications.

2.Prerequisite(s):

- CHE241: Chemical Engineering Thermodynamics

3.Textbook(s) and/or Other Required Materials:

- Gary, J. H., Handwerk, G. E., & Kaiser, M. J. (2007). Petroleum Refining: Technology and Economics (5th ed.). CRC Press.

4.Course Objectives:

- To provide theoretical knowledge and principles of petroleum refining in chemical engineering.
- To understand the processes involved in crude oil refining and their economic significance.
- To analyze and solve problems related to petroleum refining processes.

5.Topics:

1. Introduction to Petroleum Refining
2. Properties of Crude Oil
3. Refinery Feedstocks and Products
4. Refinery Processes: Distillation
5. Refinery Processes: Conversion
6. Refinery Processes: Treatment

6.Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week. Several experiments throughout the course.

7.Design Project: None

8.Computer/Software Use: None

9. Evaluation Methods:

- First Exam (1.5 hours) = 15%
- Second Exam (1.5 hours) = 15%
- Final Exam (2 hours) = 60%
- Laboratory = 10%

10.Contribution to Professional Component:

- Students will apply principles from petroleum refining in chemical engineering to analyze and solve problems, contributing to their engineering skills.

11.Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing theoretical and practical skills in petroleum refining in chemical engineering.

CHEb443 – Petroleum Refining II (4.0, Required)

2. Catalog Description:

This course builds upon the principles learned in Petroleum Refining I, focusing on more advanced topics in petroleum refining. Topics include advanced refining processes, refinery economics, and environmental aspects of refining.

3. Prerequisite(s):

CHEa443: Petroleum Refining I

4. Textbook(s) and/or Other Required Materials:

- Gary, J. H., Handwerk, G. E., & Kaiser, M. J. (2007). Petroleum Refining: Technology and Economics (5th ed.). CRC Press.

5. Course Objectives:

1. To deepen theoretical knowledge and principles of petroleum refining in chemical engineering.
2. To understand advanced refining processes and their economic and environmental implications.
3. To analyze and solve complex problems related to advanced petroleum refining processes.

6. Topics:

1. Advanced Refining Processes:
    - 1.1 Catalytic Cracking
    - 1.2 Hydroprocessing
2. Refinery Economics:
    - 2.1 Cost Estimation and Profitability Analysis
    - 2.2 Energy Optimization
3. Environmental Aspects of Refining:
    - 3.1 Pollution Control and Waste Management
    - 3.2 Sustainable Practices

7. Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week.

8. Design Project:

- In addition to regular homework assignments and two exams, there is a team project in which students learn how to apply advanced principles of petroleum refining to

analyze and solve complex problems. Students can discuss ideas in solving problems in teams of 3-4 and submit a project report.

9. Computer/Software Use: None

10. Evaluation Methods:

- First Exam (1.5 hours) = 15%
- Second Exam (1.5 hours) = 15%
- Final Exam (2 hours) = 60%
- Design Project = 10%

11. Contribution to Professional Component:

- Students will apply advanced principles from petroleum refining in chemical engineering to analyze and solve complex problems, contributing to their engineering skills.

12. Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing advanced theoretical and practical skills in petroleum refining in chemical engineering.

1. Course Number & Title:

CHEa444 – Equipment Design I (4.0, Required)

2. Catalog Description:

This course introduces students to the principles and methods of chemical engineering equipment design. Topics include design criteria, material selection, and design of pressure vessels and piping systems.

3. Prerequisite(s):

CHE441: Unit Operation I

4. Textbook(s) and/or Other Required Materials:

- Towler, G., & Sinnott, R. (2012). Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design. Elsevier.

5. Course Objectives:

1. To provide theoretical knowledge and principles of chemical engineering equipment design.
2. To understand the design criteria and material selection for chemical engineering equipment.
3. To learn and apply methods for the design of pressure vessels and piping systems.

6. Topics:

1. Introduction to Equipment Design
2. Design Criteria and Standards
3. Material Selection for Equipment
4. Pressure Vessel Design
5. Piping System Design

7. Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week.

8. Design Project:

- None

9. Computer/Software Use:

- None

10. Evaluation Methods:

- First Exam (1.5 hours) = 20%
- Second Exam (1.5 hours) = 20%
- Final Exam (2 hours) = 60%

11. Contribution to Professional Component:

- Students will apply principles from equipment design in chemical engineering to analyze and solve design problems, contributing to their engineering skills.

12. Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing theoretical and practical skills in equipment design in chemical engineering.

1. Course Number & Title:

CHEb444 – Equipment Design II (4.0, Required)

2. Catalog Description:

This course builds upon the principles learned in Equipment Design I, focusing on more advanced topics in chemical engineering equipment design. Topics include heat exchangers, reactors, and process safety.

3. Prerequisite(s):

- CHEa444: Equipment Design I

4. Textbook(s) and/or Other Required Materials:

- Ludwig, E. E. (2011). Applied Process Design for Chemical and Petrochemical Plants (Vol. 3). Gulf Professional Publishing.

5. Course Objectives:

- To deepen theoretical knowledge and principles of chemical engineering equipment design.
- To understand the design criteria and methodologies for heat exchangers and reactors.
- To learn about process safety considerations in equipment design.

6. Topics:

1. Heat Exchanger Design
2. Reactor Design and Prof. Ethics
3. Process Safety in Equipment Design

7. Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week.

8. Design Project:

- In addition to regular homework assignments and two exams, there is a team project in which students learn how to apply advanced principles of equipment design to solve real-world design problems. Students can discuss ideas in teams of 3-4 and submit a project report.

9. Computer/Software Use:

- None

10. Evaluation Methods:

- First Exam (1.5 hours) = 15%
- Second Exam (1.5 hours) = 15%
- Final Exam (2 hours) = 60%
- Design Project = 10%

11. Contribution to Professional Component:

- Students will apply advanced principles from equipment design in chemical engineering to analyze and solve complex design problems, contributing to their engineering skills.

12. Relationship to Student Outcomes:

- Course objectives relate to Student Outcomes 1 and 2, focusing on developing advanced theoretical and practical skills in equipment design in chemical engineering.

1. Course Number & Title:

GED111 – English Language (3.0, Required)

2. Catalog Description:

This course aims to develop students' proficiency in English language skills, including reading, writing, listening, and speaking. The course focuses on improving grammar, vocabulary, and communication skills.

3. Prerequisite(s):

None

4. Textbook(s) and/or Other Required Materials:

- TBD by instructor

5. Course Objectives:

- To improve students' English language proficiency in reading, writing, listening, and speaking.
- To enhance students' vocabulary and grammar skills.
- To develop students' ability to communicate effectively in English.

6. Topics:

1. Reading Comprehension
2. Writing Skills
3. Listening Comprehension
4. Speaking and Pronunciation

7. Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week.

8. Assignments and Assessments:

- Regular reading and writing assignments
- Listening comprehension exercises
- Speaking and pronunciation practice
- Quizzes and exams

9. Computer/Software Use:

- Limited use of computers for language learning software and online resources.

10. Evaluation Methods:

- Class participation = 10%
- Assignments and quizzes = 40%
- Midterm Exam = 20%
- Final Exam = 30%

11. Contribution to Professional Component:

- The course contributes to the development of students' communication skills, which are essential in various professional settings.

12. Relationship to Student Outcomes:

- Course objectives align with Student Outcomes 1 and 2, focusing on improving English language proficiency and communication skills.

1. Course Number & Title:

CHE448 – Applications of Computer in Chemical Engineering (2.0, Required)

2. Catalog Description:

This course introduces students to the application of computer software in chemical engineering. Topics include process simulation, data analysis, and optimization using Aspen HYSYS software.

3. Prerequisite(s):

- CHE341: Chemical Engineering Kinetics and Reactor Design and Prof. Ethics
- CHE342: Petrochemical Industries
- CHE441: Unit Operation I

4. Textbook(s) and/or Other Required Materials:

- No specific textbook required. Materials will be provided by the instructor.

5. Course Objectives:

- To familiarize students with the use of Aspen HYSYS software for process simulation.
- To teach students how to analyze process data using computer software.
- To introduce students to optimization techniques in chemical engineering using computer tools.

6. Topics:

1. Introduction to Aspen HYSYS
2. Process Simulation
3. Data Analysis
4. Optimization Techniques

7. Class/Laboratory Schedule:

- 15 weeks of 120-minute lectures, 2 times a week. Also, several laboratory applications.

8. Assignments and Assessments:

- Regular assignments on Aspen HYSYS simulation
- Data analysis projects
- Optimization case studies
- Quizzes and exams

9. Computer/Software Use:

- Students will use Aspen HYSYS software for simulation, data analysis, and optimization exercises.

10. Evaluation Methods:

- Class participation = 10%
- Assignments and projects = 40%
- Midterm Exam = 20%
- Final Exam = 30%

11. Contribution to Professional Component:

- The course contributes to the development of students' technical skills in using computer software for chemical engineering applications.

12. Relationship to Student Outcomes:

- Course objectives align with Student Outcomes 1 and 2, focusing on developing practical skills in using computer tools for chemical engineering analysis and design.