School of Chemistry
Faculty of Sciences
University of the Punjab, Lahore
Course Outline

Semester-VII

Programme	BS Chemistry	Course Code	Chem-461	Credit Hours	2
Course Title	Fuel Chemistry & Renewable Energy Resources	Course Type	Major (Elective)		

Course Introduction

The students will learn about the existing energy resources; their processing, refining and utilization.

Processing of crude oil:

Brief description of origin of petroleum, Petroleum processing like Desalting, Fractional distillation; refining, cracking; reforming, isomerization; alkylation and finishing processes (Doctor's Sweetening and Merox processes)

Coal chemicals & Renewable energy resources:

The destructive distillation of coal, coking of coal distillation of coal tar; Liquid Fuel and Hydrogenolysis, Solar Energy and Solar Cells, Wind and Water Energy

Geothermal Energy and Biofuels

Learning Outcomes

On the completion of the course:

- Students are expected to become familiarized with the concepts of Fuel chemistry
- This will enable them qualify for basic to moderate level jobs involving general knowledge of chemistry
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry.
- Students are able to understand the concept of GLP and GMP

Course Content		Assignments/Readings
Week 1	Brief description of origin of petroleum	Class Based learning/tests
Week 2	Desalting of petroleum	Class Based learning/tests
Week 3	Fractional Distillation of Petroleum	Class Based learning/tests
Week 4	Fractional Vacuum Distillation of Petroleum	Class Based learning/tests
Week 5	Cracking of Petroleum	Class Based learning/tests
Week 6	Reforming of Petroleum	Class Based learning/tests
Week 7	Isomerization of Petroleum	Written Assignment
Week 8	Alkylation of Petroleum	Class Based learning/tests
Week 9	Midterm Assessment	----
Week 10	Finishing Processes (Doctor's Sweetening and Merox processes)	Class Based learning/tests
Week 11	Destructive distillation of coal, coking of coal	Class Based learning/tests

Week 12	Distillation of Coal Tar	Class Based learning/tests
Week 13	Liquid Fuel and Hydrogenolysis	Class Based learning/tests
Week 14	Solar Energy and Solar Cells	Class Based learning/tests
Week 15	Wind and Water Energy	Quiz
Week 16	Geothermal Energy and Biofuels	Class Based learning/tests

Textbooks and Reading Material

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Water Supply and Sewerage, T.J.McGhee, McGraw Hill Book Co. New York.(1991)
3. Hand Book of Industrial Chemicals, By SIRI Board of Consultants and Engineers,
4. Shereve's Chemical Process Industries, 5th Ed.1975 by G.T.Austin McGraw Hill Book Co. New York.
5. Industrial chemistry, B. K. Sharma Krishna Prakashan Media (P) Ltd., Ed-15 (2006)
6. Environmental Chemistry by Stanely E. Manahann

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1.Written 7th week
2. Quiz 15th week

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-462**	**Credit Hour**	1
Course Title	**Applied Chemistry Lab-I**	**Course Type**		**Major (Elective)**	

Course Introduction

It will increase knowledge in the practical handling of fuels and their characterization. Also knowledge about the heavy metal load in industrial effluents will be acquired. Determination of Diesel index, Aniline point and pour point of petroleum products, Proximate analysis of Coal, Analysis of Industrial Effluents (Chromium, Iron, Chlorides etc.)

Learning Outcomes

On the completion of the course:

- Students are expected to become familiarized with the concepts of general chemistry
- This will enable them qualify for basic to moderate level jobs involving general knowledge of chemistry
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry
- Students are able to understand the concept of GLP and GMP

Course Content		**Assignments/Readings**
Week 1	Determination of Diesel Index of Diesel Oil	Lab work / Notebook
Week 2	Determination of Aniline Point of Diesel oil	Lab work / Notebook
Week 3	Determination of Cetane Number of Diesel oil	Lab work / Notebook
Week 4	Determination of Pour Point of Fresh Mobil Oil	Lab work / Notebook
Week 5	Determination of Pour point of Used Mobil Oil	Lab work / Notebook
Week 6	FTIR Assay of used and fresh Mobil Oil	Lab work / Notebook
Week 7	Determination of Smoke Point of Fresh Mobil Oil	Written Assignment
Week 8	Determination of Smoke Point of Used Mobil Oil	Lab work / Notebook
Week 9	Mid Term Examination	Lab work / Notebook
Week 10	Analysis of Industrial Effluents (Chromium)	Lab work / Notebook
Week 11	Analysis of Industrial Effluents (Chromium)	Lab work / Notebook
Week 12	Analysis of Industrial Effluents (Iron)	Lab work / Notebook
Week 13	Analysis of Industrial Effluents (Iron)	Lab work / Notebook
Week 14	Analysis of Industrial Effluents (Chlorides)	Lab work / Notebook
Week 15	Analysis of Industrial Effluents (Chlorides)	Quiz
Week 16	Review and Viva Voce	Lab work / Notebook

Textbooks and Reading Material

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Petroleum Refining Technology, Ram Parsad (2002).
3. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
4. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1.Written 7th week
2.Quiz 15th week

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-463**	**Credit Hours**	**2**
Course Title	**Steel Industry and Metal Finishing**	**Course Title**		**Major (Elective)**	

Course Introduction

The students will learn about the metallurgical operation regarding steel industry as well as classical and advance technologies to save iron from corrosion.

Steel industry:

Steel – Mechanical properties of materials and change with respect to temperature, phase diagram of Fe-C system, manufacturing of steel, classification of steel, heat treatment of steel, important alloys of iron and their applications. Types of Corrosion and passivation techniques

Metal finishing technology:

Introduction, need for surface treatment, different surface finishing processes, basics of electrodeposition, electroplating principles, electrochemistry applied to electroplating, mechanical preparation of surfaces - pickling, cleaning, rinsing, composition and conditions of plating bath, electroplating of metals-chromium, nickel, electroplating of plastics, electroplating waste treatment and metal recovery.

Learning Outcomes

On the completion of the course:

- Students are expected to become familiarized with the concepts of Steel Metallurgy and Electroplating
- This will enable them qualify for basic to moderate level jobs involving general knowledge of chemistry
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry
- Students are able to understand the concept of GLP and GMP

	Course Content	Assignments/Readings
Week 1	Mechanical properties of materials and change with respect to temperature	Class Based learning/tests
Week 2	Mechanical properties of materials and change with respect to temperature, phase diagram of Fe-C system	Class Based learning/tests
Week 3	Manufacturing of Steel	Class Based learning/tests
Week 4	Manufacturing of Steel	Class Based learning/tests
Week 5	Important alloys of iron and their applications	Class Based learning/tests
Week 6	Types of Corrosion and passivation techniques	Class Based learning/tests
Week 7	Types of Corrosion and passivation techniques	Written Assignment
Week 8	Heat Treatments of Steel	Class Based learning/tests
Week 9	Mid-term Assessment	----
Week 10	Introduction of Metal Finishing Technology	Class Based learning/tests
Week 11	Need of Surface treatment	Class Based learning/tests
Week 12	Different surface finishing processes	Class Based learning/tests

Week 13	Basics of electrodeposition, electroplating principles	Class Based learning/tests
Week 14	Electrochemistry applied to electroplating, mechanical preparation of surfaces - pickling, cleaning, rinsing, composition	Class Based learning/tests
Week 15	Conditions of plating bath, electroplating of metals-chromium, nickel	Quiz
Week 16	Electroplating of plastics, electroplating waste treatment and metal recovery	Class Based learning/tests

Textbooks and Reading Material

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Chemistry of iron and Steel Manufacture, C. Bodsworth, Longman Press, London, 1963.
3. Graham's Electroplating Engineering Hand Book, Ed. L.J. Durney, CBS Publishers and Distributors, New Delhi. (1997).
4. Nickel and Chromium plating, J.K. Dennis & T.E. Such, Newness Butterworth, London (1972).

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1.Written 7th week
2. Quiz 15th week

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-464**	**Credit Hours**	**1**
Course Title	**Applied Chemistry Lab-II**	**Course Title**		**Major (Elective)**	

Course Introduction

Students will learn how to apply basic and instrumental techniques to determine metal ions in metallurgical samples.
Analysis Iron in steel by titrimetry, Analysis of Nickel in steel by Gravimetry and Solvent Extraction, Analysis of Chromium in steel by Spectrophotometry, Heavy metal analysis of steel by AAS, Analysis of dolomite, chromite and bauxite Ore by titration method.

Learning Outcomes

On the completion of the course:

- Students are expected to get familiarized with the concepts of general chemistry
- This will enable them qualify for basic to moderate level jobs involving general knowledge of chemistry
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry
- Students are able to understand the concept of GLP and GMP

	Course Content	Assignments/Readings
Week 1	Analysis of Iron in steel by titrimetry	Lab work / Notebook
Week 2	Analysis of Iron in steel by titrimetry	Lab work / Notebook
Week 3	Analysis of Nickel in steel by Gravimetry	Lab work / Notebook
Week 4	Analysis of Nickel in steel by Solvent Extraction	Lab work / Notebook
Week 5	Analysis of Nickel in steel by Solvent Extraction	Lab work / Notebook
Week 6	Analysis of Chromium in steel by spectrophotometry	Lab work / Notebook
Week 7	Analysis of Chromium in steel by spectrophotometry	Written Assignment
Week 8	Heavy metals analysis of steel by AAS	Lab work / Notebook
Week 9	Mid Term Examination	Lab work / Notebook
Week 10	Heavy metals analysis of steel by AAS	Lab work / Notebook
Week 11	Heavy metals analysis of steel by AAS	Lab work / Notebook
Week 12	Analysis of Dolomite Ore	Lab work / Notebook
Week 13	Analysis of Chromite Ore	Lab work / Notebook
Week 14	Analysis of Chromite Ore	Lab work / Notebook
Week 15	Analysis of Bauxite Ore	Quiz
Week 16	Review and Viva Voce	Lab work / Notebook

Textbooks and Reading Material

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Chemistry of iron and Steel Manufacture, C. Bodsworth, Longman Press, London, 1963.
3. Graham's Electroplating Engineering Hand Book, Ed. L.J. Durney, CBS Publishers and Distributors, New Delhi. (1997).
4. Nickel and Chromium plating, J.K. Dennis & T.E. Such, Newness Butterworth, London (1972).
5. Applied Chemistry by Vermani

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1.Written 7th week
2.Quiz 15th week

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-465**	**Credit Hours**	**2**
Course Title	**Separation and Spectral Techniques**	**Course Title**		**Major (Elective)**	

Course Introduction

Students will learn about the principle, theory and working of basic analytical techniques.
Chromatography
Thin Layer Chromatography – Basic principle, theory and mechanism, stationary and mobile phase selection, locating reagents, applications, introduction to HPTLC
High Performance Liquid Chromatography (HPLC) – Basic principle, types, theory and mechanism, stationary and mobile phase selection and types, basic parts of HPLC including pump, column, injector, detector, thermostat etc. Explanation of typical chromatogram highlighting retention time, peak height and width, tailing factor, resolution, theoretical plates, Isocratic and gradient elution and its significance, HPLC detectors such as Refractive Index, UV/Vis, photodiode array and fluorescence detector, Applications of HPLC
Gas Chromatography Mass Spectrometry (GCMS) – Basic principle, theory and mechanism, stationary and mobile phase selection and types, basic parts of typical gas chromatography including sample injection port, gas reservoir, column and detectors. Nature of samples to be analyzed by GCMS, temperature selection, packed and capillary columns, Mass analyzers, quaderpole mass analyzers, Time of flight analyzer Applications of GCMS
Spectroscopy
Introduction, Basic Principle, Theory and Applications of Flame emission spectroscopy (FES), Flame atomic absorption spectroscopy (FAAS), continuous and line sources, construction of hollow cathode lamp, types of flames and their appropriate use, sensitivity and detection limits, Optical, Chemical, Physical and Ionization interferences and their possible solutions,
Introduction, Basic Principle, Theory and Applications of UV/Vis spectroscopy and Thermal Analysis Techniques.

Learning Outcomes

On the completion of the course:

- Students are expected to become familiarized with the concepts of basic Analytical Techniques
- This will enable them qualify for basic to moderate level jobs involving general knowledge of Chemistry
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry
- Students are able to understand the concept of GLP and GMP

	Course Content	**Assignments/Readings**
Week 1	Thin Layer Chromatography – Basic principle, theory and mechanism, stationary and mobile phase selection, locating reagents, applications, introduction to HPTLC	Class Based learning/tests
Week 2	Thin Layer Chromatography – Basic principle, theory and mechanism, stationary and mobile phase selection, locating reagents, applications, introduction to HPTLC	Class Based learning/tests

Week 3	High Performance Liquid Chromatography (HPLC) – Basic principle, types, theory and mechanism, stationary and mobile phase selection and types,	Class Based learning/tests
Week 4	Basic parts of HPLC including pump, column, injector, detector, thermostat.	Class Based learning/tests
Week 5	Explanation of typical chromatogram highlighting retention time, peak height and width, tailing factor, resolution, theoretical plates, Isocratic and gradient elution and its significance.	Class Based learning/tests
Week 6	Explanation of typical chromatogram highlighting retention time, peak height and width, tailing factor, resolution, theoretical plates, Isocratic and gradient elution and its significance	Class Based learning/tests
Week 7	HPLC detectors such as Refractive Index, UV/Vis, photodiode array and fluorescence detector, Applications of HPLC	Written Assignment
Week 8	Gas Chromatography Mass Spectrometry (GCMS) – Basic principle, theory and mechanism, stationary and mobile phase selection and types,	Class Based learning/tests
Week 9	Midterm Assessment	----
Week 10	Basic parts of typical gas chromatography including sample injection port, gas reservoir, column and detectors.	Class Based learning/tests
Week 11	Nature of samples to be analyzed by GCMS, temperature selection,	Class Based learning/tests
Week 12	Packed and capillary columns, Mass analyzers, quadrupole mass analyzers, Time of flight analyzer, Applications of GCMS	Class Based learning/tests
Week 13	Introduction, Basic Principle, Theory and Applications of Flame Emission Spectroscopy (FES),	Class Based learning/tests
Week 14	Flame atomic absorption spectroscopy (FAAS), continuous and line sources, construction of hollow cathode lamp, types of flames and their appropriate use, sensitivity and detection limits. Optical, Chemical, Physical and Ionization interferences and their possible solutions.	Class Based learning/tests
Week 15	Flame atomic absorption spectroscopy (FAAS), continuous and line sources, construction of hollow cathode lamp, types of flames and their appropriate use, sensitivity and detection limits, Optical, Chemical, Physical and Ionization interferences and their possible solutions,	Quiz
Week 16	Introduction, Basic Principle, Theory and Applications of UV/Vis spectroscopy and Thermal Analysis Techniques.	Class Based learning/tests

Textbooks and Reading Material
1. T. B. of Quantitative Inorganic Analysis, Vogal's Ed-4th, Longman Group Limited (1978). 2. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan. 3. Instrumental Analysis, Gary D. Christain, 1978, Introduction to Instrumental Analysis by Braun, McGraw-Hill Book company, 1987. 4. Instrumental Analysis by B.K. Sharma
Teaching Learning Strategies
1. Lectures 2. Group Discussion 3. Laboratory work 4. Seminar/ Workshop
Assignments: Types and Number with Calendar
1.Written 7th week 2. Quiz 15th week
Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-466**	**Credit Hours**	**1**
Course Title	**Applied Chemistry Lab-III**	**Course Title**		**Major (Elective)**	

Course Introduction

Student will apply the analytical techniques for characterization of Industrial samples. Spectrophotometric analysis of iron in pharmaceutical tablets, Chlorides in water, phosphates in fertilizers, Chromium in Tannery wastewater, Recovery of chromium from tannery waste water, Application of AAS on analysis of heavy metals of various industrial effluents.

Learning Outcomes

On the completion of the course:

- Students are expected to become familiarized with the concepts of general chemistry
- This will enable them qualify for basic to moderate level jobs involving general knowledge of Chemistry
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry
- Students are able to understand the concept of GLP and GMP

Course Content		Assignments/Readings
Week 1	Spectrophotometric analysis of iron in pharmaceutical tablets	Lab work / Notebook
Week 2	Spectrophotometric analysis of iron in pharmaceutical tablets	Lab work / Notebook
Week 3	Determination of Chlorides in water by spectrophotometry	Lab work / Notebook
Week 4	Determination of Chlorides in water by spectrophotometry	Lab work / Notebook
Week 5	Determination of phosphates in Fertilizers	Lab work / Notebook
Week 6	Determination of phosphates in Fertilizers	Lab work / Notebook
Week 7	Analysis of Chromium in Tannery wastes	Written Assignment
Week 8	Analysis of Chromium in Tannery wastes	Lab work / Notebook
Week 9	Mid Term Examination	Lab work / Notebook
Week 10	Recovery of Chromium from Tannery wastes	Lab work / Notebook
Week 11	Application of AAS on analysis of heavy metals of various industrial effluents.	Lab work / Notebook
Week 12	Application of AAS on analysis of heavy metals of various industrial effluents.	Lab work / Notebook
Week 13	Application of AAS on analysis of heavy metals of various industrial effluents.	Lab work / Notebook
Week 14	Application of AAS on analysis of heavy metals of various industrial effluents.	Lab work / Notebook

Week 15	Application of AAS on analysis of heavy metals of various industrial effluents.	Quiz
Week 16	Review and Viva Voce	Lab work / Notebook

Textbooks and Reading Material

1. T. B. of Quantitative Inorganic Analysis, Vogal's Ed-4th, Longman Group Limited (1978).
2. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
3. Instrumental Analysis, Gary D. Christain, 1978, Introduction to Instrumental Analysis by Braun, McGraw-Hill Book company, 1987.
4. Instrumental Analysis by B.K. Sharma

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1.Written 7th week
2.Quiz 15th week

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Semester VII					
Programme	**BS Chemistry**	**Course Code**	**Chem-467**	**Credit Hours**	**3**
Course Title	**Processing Industries**	**Course Title**		**Major (Elective)**	

Course Introduction

Students will understand and learn about the operation and processes involved in Paper, Leather and Oils/Fats industries starting from the raw material(s) to the end product.
Paper & leather industry
Paper – History, Survey of Raw materials, Production of Pulp by Soda process, Sulphite process, Kraft (Sulphate) process, Recovery of cooking liquor, manufacturing of paper, Environmental aspects of paper Industry.
Leather – Introduction, Types of Skin, Theory of Tanning, Beamhouse Operations, Vegetable and Chrome tanning, Finishing processes, Waste Disposal and Pollution Aspects.
Oils and fats
Classification of oils and fats, vegetable oils, essential oils, various methods of extraction of oils, refining and hydrogenation of oils, Industrial applications of oils in resins, surfactants, lubricants and paints.

Learning Outcomes

On the completion of the course, the students will:

- Students are expected to get familiarized with the concepts of basic Analytical Techniques
- This will enable them qualify for basic to moderate level jobs involving general knowledge of Chemistry.
- The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to chemistry.

Course Content		Assignments/Readings
Week 1	Paper – History, Survey of Raw materials	Class Based learning/tests
Week 2	Production of Pulp by Soda process	Class Based learning/tests
Week 3	Production of Pulp by Sulphite process	Class Based learning/tests
Week 4	Production of Pulp by Kraft (Sulphate) process	Class Based learning/tests
Week 5	Recovery of cooking liquor	Class Based learning/tests
Week 6	Manufacturing of paper	Class Based learning/tests
Week 7	Environmental aspects of the Paper Industry	Written Assignment
Week 8	Leather – Introduction, Types of Skin, Theory of Tanning	Class Based learning/tests
Week 9	Midterm Assessment	----
Week 10	Beamhouse Operations	Class Based learning/tests
Week 11	Vegetable and Chrome tanning	Class Based learning/tests
Week 12	Finishing processes, Waste Disposal and Pollution Aspects.	Class Based learning/tests

Week 13	Classification of oils and fats, vegetable oils, essential oils	Class Based learning/tests
Week 14	Various methods of extraction of oils	Class Based learning/tests
Week 15	Refining and hydrogenation of oils	Quiz
Week 16	Industrial applications of oils in resins, surfactants, lubricants and paints	Class Based learning/tests

Textbooks and Reading Material

1. Applied Chemistry, Haq Nawaz Bhatti and Muhammad Salman, 2017, Caravan Book Publisher, Pakistan.
2. Pulp and Paper Technology, Testing and Applications, K.P. Rao (2003), CBS Publishers.
3. Chemistry of Pulp and Paper making, Edwin Sutermeister, Ed-3rd (1946)
4. Fertilizers and Soil Fertility, U.S.Jones, Reston Publishing Co. Virginia, 1979.
5. Industrial chemistry, B. K. Sharma, Krishna Prakashan Media (P) Ltd., Ed-15 (2006).
6. Shereve's Chemical Process Industries, 5th Ed.1975, by G.T.Austin, McGraw Hill Book Co. New York.

Teaching Learning Strategies

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

Assignments: Types and Number with Calendar

1.Written 7th week
2. Quiz 15th week

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.