

#### 11.5.4 PRACTICAL INSTRUMENTAL ANALYSIS II

Program	BSc in Chemistry					
Module Name	Instrumental Analysis					
Module Number	05					
Module code	Chem-M2051					
Course Title	Practical Instrumental Analysis II					
Course Code	Chem2054					
Pre-requisite	Chem2053					
Module coordinator name and address	TBA					
Instructor(s) name and address	TBA					
Lecture days, Hours & room	TBA					
Cr.Hrs/ECTS	1/2					
Work load	Lecture	Tutorial	Lab.	Home study	Assessment	Total
	6	----	42	29	3	80
Target group	3 <sup>rd</sup> year chemistry students					
Semester	Semester II					
Mode of delivery	Semester based					
Status of the course	Core Compulsory					

#### Course Description

Experiments on spectroscopic techniques (absorption and emission techniques, molecular spectroscopic techniques).

#### Learning Outcomes

After completing this course students will be able to

- Describe the theory and application behind every technique;
- Estimate the correct choice of the instrument for a given analysis;
- Discuss the extent of accuracy in each method;
- Care about the precautions required in every method;
- Identify different parts of selected spectroscopic instruments and describe their respective functions;
- Operate and run different spectroscopic instruments and generate spectrum of a given substance;
- Elucidate structure of a compound using joint spectroscopic techniques. use selected instruments for qualitative, quantitative analysis and for structural elucidations
- operate and run different spectroscopic instruments and generate spectrum of a given substance
- Use appropriate spectroscopic method for qualitative and quantitative determination of sample components; and elucidate structure of a compound using joint spectroscopic techniques.

#### Course Outline and Schedule

Week	Contents	Mode of delivery	Student activity	Readings
1 <sup>st</sup> - 2 <sup>nd</sup>	Lab protocol orientation	Discussion Demonstration Rehearsal	<ul style="list-style-type: none"> <li>Attending</li> <li>Participation</li> <li>Manual collection</li> </ul>	Lab manual and texts
3 <sup>rd</sup>	<b>Refractive Index</b> <ul style="list-style-type: none"> <li>Constructing a calibration chart for the determination of sodium chloride or potassium chloride; determination of unknown concentration of potassium chloride.</li> </ul>	<ul style="list-style-type: none"> <li>Brief lecture,</li> <li>Group discussion,</li> <li>Individual works,</li> <li>Experimentation,</li> <li>Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Observation writing</li> <li>Listen and observing demonstration and lecture</li> <li>take notes on the lesson treated</li> <li>Ask questions on unclear idea</li> <li>Active participation in discussion</li> </ul>	G. Schwedt G. Svehla N. Retta Harris, D.C. J. Mendham
4 <sup>th</sup>	<ul style="list-style-type: none"> <li>Determination of percentage composition of the given mixture. Water and ethanol may be used.</li> <li>Studies on structural aspects.</li> <li>Determination of Specific and Molar refractivity of some solutions.</li> </ul>	<ul style="list-style-type: none"> <li>Brief lecture,</li> <li>Group discussion,</li> <li>Individual works,</li> <li>Experimentation,</li> <li>Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Observation writing</li> <li>Listen and observing demonstration and lecture</li> <li>take notes on the lesson treated</li> <li>Ask questions on unclear idea</li> <li>Active participation in discussion</li> </ul>	G. Schwedt G. Svehla N. Retta Harris, D.C. J. Mendham
5 <sup>th</sup> to 12 <sup>th</sup>	Studies on structural aspects: Selected experiments on spectroscopic techniques (absorption and emission techniques, molecular spectroscopic techniques Infra red spectroscopic techniques)	<ul style="list-style-type: none"> <li>Brief lecture,</li> <li>Group discussion,</li> <li>Individual works,</li> <li>Experimentation,</li> <li>Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Observation writing</li> <li>Listen and observing demonstration and lecture</li> <li>take notes on the lesson treated</li> <li>Ask questions on unclear idea</li> <li>Active participation in discussion</li> </ul>	Skoog/ Leary Skoog/ West, Gray D. Christian; R.M. Silverstein, G.C. Bassler and T.C. Morril
12 <sup>th</sup> - 15 <sup>th</sup>	<b>Project work on structural elucidation and presentations (20%)</b>			
16 <sup>th</sup>	<b>Final Examination (40%)</b>			

### Mode of Assessment

Type	Description	%	Assessment Date
Practical/Skills Evaluation	individual/group performance, and flow chart	10	Every Week
Individual Laboratory Performance	Practical examination	20	Week 10
Experiment Reports	Written report after each laboratory work	30	Every Week
Written Examinations	Exam at the end of the laboratory work	40	At the end of the Lab

## Course Policy

Beside the university's policy on course delivery and evaluation, students are expected to actively participate in learning process by obeying the following course policies:

- Keep all laboratory safety rules
- Keep good hygiene practices
- Submit laboratory report for every experiments on time
- Do not miss laboratory sessions unless you are forced due to health and other reasonable problems
- Be prepared to learn and actively participate in laboratory works
- Come with lab manual and flow chart
- Wear proper dress

## Reference

1. J. Hollas, Modern Spectroscopy, 3<sup>rd</sup> ed. John Willey and sons, 1996.
2. J.D. Ingle and S.R. Crouch, Spectrochemical analysis, Prentice Hall, 1988.
3. L.D. Field, S. Sternhell and S. Kalman, Organic structure from spectra, 2<sup>nd</sup> ed., John Willey and sons, 1995.
4. D.H. Williams and I. Fleming, Spectroscopic method in organic chemistry, 5<sup>th</sup> ed. McGraw Hill, 1995.
5. R. Davis and M. Freason, Mass spectrometry (analytical spectrometry by open learning), John Wiley and Sons, 1987.
6. H. Gunter, NMR Spectroscopy, 2<sup>nd</sup> ed., John Willey and sons, 1995.
7. J.R. Chapman, Organic Mass spectrometry, 2<sup>nd</sup> ed.; John Willey and sons, 1993.

### 11.7.1 INDUSTRIAL CHEMISTRY II

Program	BSc in Chemistry
Module Name	Applied Chemistry
Module code	Chem-M3111
Module Number	11
Course Title	Industrial Chemistry II
Course Code	Chem3112

Pre-requisite	Chem3111					
Module coordinator name and addresses	TBA					
Instructor(s) name and addresses	TBA					
Lecture days, Hours & room	TBA					
Cr. Hrs/ECTS	3/5					
Work load	Lecture	Tutorial	Lab	Asses sment	Home study	Total
	48	16	----	5	66	135
Target group	3 <sup>rd</sup> year chemistry students					
Semester	Semester II					
Mode of delivery	Semester based					
Status of the course	Core Compulsory					

## Course Description

Basic organic industrial processes (coal petroleum, main petrochemicals, basic organic products, plastics, rubber and fibers; sugar; oils and fats, detergents, paper; foodstuff, pharmaceuticals, agrochemicals; dye stuff,; leather)

## Learning Outcomes

By the end of this course students should be able to:

- discuss the processing of coal and petroleum into value added products
- describe the industrial organic synthesis and manufacture and properties of plastics, rubber, fibers
- highlight the chemistry of oils, fats, soaps, detergents, pharmaceuticals, dyestuffs and insecticides Sucrose, Paper, Leather and Food processing Industries

## Course Outline and Schedule

Week	Contents	Teaching method	Acitivities	Reading/ assignmen ts
1	1. Coal and Petroleum Processing <ul style="list-style-type: none"> <li>• Origin of coal and its ranking               <ol style="list-style-type: none"> <li>1.1. Carbonisation of coal</li> <li>1.2. Gasification of coal</li> <li>1.3. Hydrogenation of coal</li> <li>1.4. Petroleum – origin, Classification</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reading Assignment</li> </ul>	<ul style="list-style-type: none"> <li>• Listen to a lecture and take notes on the</li> </ul>	B.K. Sharma

2	1.5. and mining 1.6. Distillation of petroleum 1.7. Rating of Petrol and Diesel 1.8. Cracking, Alkylation, Hydrotreating and Reforming	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reading Assignment</li> </ul>	<ul style="list-style-type: none"> <li>• Listen to a lecture and take notes on the</li> </ul>	B.K. Sharma
3	2. Main Petrochemicals 2.1. Introduction to petrochemicals 2.2. Chemical conversions for manufacture of petrochemicals 2.3. Petrochemicals from Methane, Ethylene, Propylene, Butylenes and BTX <ul style="list-style-type: none"> <li>• Manufacture of Acetylene, Ethylene oxide, Acrylonitrile, Dimethyl terephthalate</li> </ul>	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
Test 1 (10%)				
4	3. Basic Organic Products 3.1. Introduction to Industrial organic synthesis 3.2. Manufacture of Methanol and Isopropanol 3.3. Manufacture of Formaldehyde and Acetaldehyde 3.4. Manufacture of Acetic acid 3.5. Manufacture of Acetone 3.6. Manufacture of Phenol and Styrene	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
5	4. Plastics, Rubber and Fibers 4.1. Introduction to polymers 4.2. Nomenclature of polymers 4.3. Addition and condensation polymerization 4.4. Methods of Polymerisation 4.5. Effect of polymer structure on properties	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
6	4.6. Plastics-Properties and classification 4.7. Moulding constituents of plastics 4.8. Moulding of plastics into articles 4.9. Preparation, properties and uses of PE, PVC and Bakelite 4.10. Rubber – properties 4.11. Natural and synthetic rubber	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma

7	5. Sucrose Industry 5.1. Manufacture of cane sugar 5.2. Manufacture of sucrose from Beet Root 5.3. Testing of sugar	<ul style="list-style-type: none"><li>• Gapped Lecture</li><li>• Question and answer</li><li>• Small group discussion</li><li>• Reflection</li></ul>	<ul style="list-style-type: none"><li>• lesson treated,</li><li>• Ask questions on unclear ideas,</li><li>• Active participation in discussion</li></ul>	B.K. Sharma
	Assignment 1 (10%)			
8	6. Oils, Fats and Detergents 6.1. Introduction to oils and fats 6.2. Properties of oils and fats 6.3. Classification of oils 6.4. Manufacture of vegetable oils 6.5. Animal fats and oils	<ul style="list-style-type: none"><li>• Gapped Lecture</li><li>• Question and answer</li><li>• Small group discussion</li><li>• Reflection</li></ul>	<ul style="list-style-type: none"><li>• lesson treated,</li><li>• Ask questions on unclear ideas,</li><li>• Active participation in discussion</li></ul>	B.K. Sharma
9	6.6. Analysis of oils and fats 6.7. Hydrogenation of oils 6.8. Manufacture of soap <ul style="list-style-type: none"><li>• Introduction to detergents</li></ul>	<ul style="list-style-type: none"><li>• Gapped Lecture</li><li>• Question and answer</li><li>• Small group discussion</li><li>• Reflection</li></ul>	<ul style="list-style-type: none"><li>• lesson treated,</li><li>• Ask questions on unclear ideas,</li><li>• Active participation in discussion</li></ul>	B.K. Sharma
10	7. Paper Industry 7.1. Manufacture of pulp by mechanical and chemical process 7.2. Refining of pulp 7.3. . Manufacture of paper	<ul style="list-style-type: none"><li>• Gapped Lecture</li><li>• Question and answer</li><li>• Small group discussion</li><li>• Reflection</li></ul>	<ul style="list-style-type: none"><li>• lesson treated,</li><li>• Ask questions on unclear ideas,</li><li>• Active participation in discussion</li></ul>	B.K. Sharma
	Test 2 (10%)			
11	8. Chemical foodstuff processing 8.1. Introduction to fermentation 8.2. Alcohol Beverages 8.3. Manufacture of Beer, Spirit and wines.	<ul style="list-style-type: none"><li>• Gapped Lecture</li><li>• Question and answer</li><li>• Small group discussion</li><li>• Reflection</li></ul>	<ul style="list-style-type: none"><li>• lesson treated,</li><li>• Ask questions on unclear ideas,</li><li>• Active participation in discussion</li></ul>	B.K. Sharma

12	<b>9. Pharmaceuticals</b> 9.1. Sulfonamide drugs 9.2. Antimalarial, antibacterial and antiviral agents Antibiotics	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
13	<b>10. Chemicals for agriculture</b> 10.1. Introduction to Insecticides 10.2. DDT, BHC and Parathion 10.3. Fungicides – Baygon and 2,4,6-Trichloro Phenol 10.4. Herbicides–2,4-D and 2,4,5-T 10.5. Pesticides pollution	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
14	<b>11. Dyestuff</b> 11.1. Introduction to dyes 11.2. Colour and constitution 11.3. Methods of dyeing 11.4. Classification of dyes	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
Quiz (10%)				
15	<b>12. Leather Industry</b> 12.1. Animals skin 12.2. Preparation of skin for tanning 12.3. Vegetable tanning 12.4. Chrome tanning 12.5. Leather finishing	<ul style="list-style-type: none"> <li>• Gapped Lecture</li> <li>• Question and answer</li> <li>• Small group discussion</li> <li>• Reflection</li> </ul>	<ul style="list-style-type: none"> <li>• lesson treated,</li> <li>• Ask questions on unclear ideas,</li> <li>• Active participation in discussion</li> </ul>	B.K. Sharma
Report submission on industry visit (10%) and presentation (10%)				
16	Final exam (50%)			

### Mode of Assessment

Assessment Breakdown	%
continuous assessment (not more than 10% for each)	<b>50</b>
End of Semester Examination	<b>50</b>

### Course policy



Beside the university's policy on course delivery and evaluation, students are expected to actively participate in learning process by obeying the following course policies:

- Coming class on time (punctuality)
- Attend all class sessions
- Be prepared to learn and actively participate during class discussion
- Do all assignments, group works, project works, and presentations on time
- All students are expected to complete their own work to the best of their ability and cheating is strictly forbidden
- Do not miss quizzes, assignments, and exams unless you are forced due to health and other reasonable problems
- Cite all sources consulted to any extent (including material from the internet), whether or not assigned and whether or not quoted directly. It is strictly forbidden to take others work and present as own.
- Make-up class shall be conducted if classes are missed due to national holidays and/or when unpredicted conditions result in class dismissal

#### Reference

1. P.C. Jain and M. Jain, Engineering Chemistry by; Dhanpatrai & sons, 11<sup>th</sup> ed, 1996.
2. B.K. Sharma, Industrial Chemistry, Goel publishing house; 11<sup>th</sup> ed, 2004.
3. J.N. Delgado and W.A. Remers, Text book of organic medicinal and pharmaceutical chemistry

#### 11.7.2 ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY

Program	BSc in Chemistry						
Module Name	Applied Chemistry						
Module Number	11						
Module code	Chem-M3111						
Course Title	Environmental Chemistry and Toxicology						
Course Code	Chem3114						
Prerequisite	Chem1022						
Module coordinator's name and address	TBA						
Instructor(s) name and address	TBA						
Lecture days, Hours & room	TBA						
Cr. Hrs/ EtCTS	3/5						
Work load (per week)	Lecture	Tutorial	Lab.	Home	Assessment	Total	

				study		
	48	16	-----	66	5	135
Target group	3 <sup>rd</sup> year chemistry students					
Mode of delivery	Semester based					
Semester	Semester II					
Status of the course	Core Compulsory					

## Course Description

Major chemical cycles and effects of environmental pollution in these systems; basics of atmospheric chemistry; aquatic chemistry; soil chemistry; pollution of air, water and soil; chemical toxicology: toxicants and their metabolism; energy production and its impact on the environment; analytical methods in environmental studies; Introduction to green chemistry.

## Learning Outcomes

By the end of this course students should be able to:

- Familiarize with the concept of environmental chemistry
- Identify the common causes of environmental pollution
- Describe about aquatic chemistry and water pollution
- Explain about atmospheric chemistry and air pollution;
- Familiarize with the concept of green chemistry;
- Study some toxic organic chemicals and their effects; and
- Devise methods to decrease pollution

## Course Outline and Schedule

Week	Contents	Methodology	Activities	Readings
1 <sup>st</sup> & 2 <sup>nd</sup>	<b>1. Introduction to Environmental Chemistry</b> <ul style="list-style-type: none"> <li>• Basic concepts in Environmental chemistry</li> <li>• Properties of chemicals in the environment</li> <li>• Environmental transformation and degradation <ul style="list-style-type: none"> <li>➤ Abiotic transformation and degradation</li> <li>➤ Biotransformation and degradation</li> </ul> </li> <li>• Matter and cycles of matter</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Oral questions</li> <li>• Asking questions</li> </ul>	<ul style="list-style-type: none"> <li>• Listen</li> <li>• Question &amp; answering</li> <li>• Home/class works</li> <li>• Taking short note</li> </ul>	Manahan pp 15-21 , 62 M. H Yu pp 235 - 255
<b>Assignment 1 (10 %)</b>				

3 <sup>rd</sup> , 4 <sup>th</sup> & 5 <sup>th</sup>	<b>2. Aquatic chemistry and Water pollution</b> <ul style="list-style-type: none"> <li>• Introduction to the Fundamentals of aquatic chemistry</li> <li>• The Properties of water, a unique substance</li> <li>• Water Quality</li> <li>• Water quality requirements</li> <li>• Nature and types of Water pollutants</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Oral questions</li> <li>• Asking questions</li> </ul>	<ul style="list-style-type: none"> <li>• Listen</li> <li>• Question &amp; answering</li> <li>• Home/class works</li> <li>• Taking short note</li> </ul>	Manahan Pp 71 – 92; 200 - 236
	<b>Test 1 (10 %)</b>			
6 <sup>th</sup> , 7 <sup>th</sup> & 8 <sup>th</sup>	<b>3. Atmospheric chemistry and Air pollution</b> <ul style="list-style-type: none"> <li>• Importance and physical characteristics of the atmosphere</li> <li>• Atmospheric chemical reactions</li> <li>• Air quality</li> <li>• Nature and classification of air pollutants               <ul style="list-style-type: none"> <li>➤ Gaseous inorganic air pollutants</li> <li>➤ Organic air pollutants</li> <li>➤ Photochemical smog</li> <li>➤ Chlorofluro compounds and ozone layer depletion</li> <li>➤ Green House Gases and Global warming</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Oral questions</li> <li>• Asking questions</li> <li>• Field Study</li> </ul>	<ul style="list-style-type: none"> <li>• Listen</li> <li>• Question &amp; answering</li> <li>• Home/class works</li> <li>• Taking short note</li> </ul>	Manahan pp 278 – 314; 341 – 361; 365 – 387; 391 – 412; 416 - 438 M. H Yu pp 183-202
	<b>Assignment 2 (10 %)</b>			
9 <sup>th</sup> & 10 <sup>th</sup>	<b>4. Soil Chemistry</b> <ul style="list-style-type: none"> <li>• Soil and agriculture</li> <li>• Nature and composition of soil</li> <li>• Nutrients in soil</li> <li>• Reactions in soil               <ul style="list-style-type: none"> <li>➤ Wastes and pollutants in soil</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Oral questions</li> <li>• Asking questions</li> </ul>	<ul style="list-style-type: none"> <li>• Listen</li> <li>• Question &amp; answering</li> <li>• Home/class works</li> <li>• Taking short note</li> </ul>	Manahan pp 484 – 497; 505 - 507
	<b>Test 2 (10 %)</b>			

11 <sup>th</sup> & 12 <sup>th</sup>	<b>5. Environmental Toxicity and toxicology</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Organic and inorganic pollutants</li> <li>• Agricultural and pharmaceutical contaminants</li> <li>• Pesticides</li> <li>• PCB's (polychlorinated biphenyls)</li> <li>• Nitrogen and phosphorous compounds</li> <li>• Toxic heavy metals and organo-metallic compounds <ul style="list-style-type: none"> <li>➤ mercury</li> <li>➤ lead</li> <li>➤ arsenic</li> <li>➤ Chromium</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Oral questions</li> <li>• Asking questions</li> <li>• Field study</li> </ul>	<ul style="list-style-type: none"> <li>• Listen</li> <li>• Question &amp; answering</li> <li>• Home/class works</li> <li>• Taking short note</li> </ul>	Manahan pp 727 – 753; 727 – 753; 221 – 232; 727 – 753, 203 – 205; 203 – 205 M. H Yu 219- 230
<b>Presentation (5 %)</b>				
13 <sup>th</sup> & 14 <sup>th</sup>	<b>6. Green chemistry</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• The concept of Atom Economy</li> <li>• Design and application of surfactants for carbon dioxide</li> <li>• Designing an environmentally safe marine synthetic antifoulant</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Oral questions</li> <li>• Asking questions</li> <li>• Field study</li> </ul>	<ul style="list-style-type: none"> <li>• Listen</li> <li>• Question &amp; answering</li> <li>• Home/class works</li> <li>• Taking short note</li> </ul>	Clark & Macquarr ie Pp 12; 482 - 500
15 <sup>th</sup>	Field study, report and defense	<ul style="list-style-type: none"> <li>✓ Forming group</li> <li>✓ Giving Guidance</li> </ul>	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Reporting</li> <li>• Presenting</li> </ul>	
<b>Field trip report (5 %)</b>				
16 <sup>th</sup>	<b>Final written examination (50 %)</b>			

### Mode of Assessment

Assessment Breakdown	%
continuous assessment and field tripe report	<b>50</b>
End of Semester Examination	<b>50</b>

### Course Policy

Beside the university's policy on course delivery and evaluation, students are expected to actively participate in learning process by obeying the following course policies:

- Coming class on time (punctuality)
- Attend all class sessions
- Be prepared to learn and actively participate during class discussion
- Do all assignments, group works, project works, and presentations on time
- All students are expected to complete their own work to the best of their ability and cheating is strictly forbidden
- Do not miss quizzes, assignments, and exams unless you are forced due to health and other reasonable problems
- Cite all sources consulted to any extent (including material from the internet), whether or not assigned and whether or not quoted directly. It is strictly forbidden to take others work and present as own.
- Make-up class shall be conducted if classes are missed due to national holidays and/or when unpredicted conditions result in class dismissal

## References

1. Manahan, Environmental Chemistry, 7<sup>th</sup> edition, ©2000 by CRC Press, Lewis Publishers
2. S.C. BHATIA, Environmental Chemistry ©2007, Satish Kumar Jain for CBS Publishers and Distributors
3. P.S.SINDHU, Environmental Chemistry ©2002, New Age International Publishers
4. Ming-Ho Yu (2005), Environmental Toxicology, Second edition, CRC Press
5. A.K.DE, Environmental Chemistry, 6<sup>th</sup> edition, ©2002, New Age International Publishers
6. Reeve, Environmental Analysis, ©1994, Wiley and Sons Publishers
7. Renep.Schwarzenbach, Philip M. Gschwend& Dieter M.Imboden, Environmental Organic Chemistry 2<sup>nd</sup> edition ,©2003, Wiley and Sons, Inc., Hoboken, New Jersey Publishers
8. Clark J, Macquarrie D, Handbook of Green Chemistry and Technology.Blackwell Science Ltd, 2002

### 11.7.3 BIOCHEMISTRY

Program	BSc in Chemistry
Module Name	Applied Chemistry
Module Number	11
Module code	Chem-M3111
Course Title	Biochemistry
Course Code	Chem3116
Prerequisite	Chem3091
Module coordinator's name and address	TBA

Instructor(s) name and address	TBA					
Lecture days, Hours & room	TBA					
Cr. Hrs/ EtCTS	3/5					
Work load (per week)	Lecture	Tutorial	Lab.	Home study	Assessment	Total
	48	16	-----	66	5	135
Target group	3 <sup>rd</sup> year chemistry students					
Mode of delivery	Semester based					
Semester	Semester II					
Status of the course	Core Compulsory					

## Course Description

Unique properties of Water as applied to Life, Structure and chemistry of biomolecules (proteins, carbohydrates, lipids, nucleic acids, Minerals and Hormones); enzymology; intermediary metabolism and generation and storage of metabolic energy; oxidative-reductive processes; selected metabolic pathways of carbohydrates and fats; integration of metabolism, Structure and chemistry of biomolecules (proteins, carbohydrates, lipids, nucleic acids); enzymology; Hormones and their roles in metabolic regulations; intermediary metabolism and generation and storage of metabolic energy; oxidative-reductive processes; selected metabolic pathways of carbohydrates and fats; integration of metabolism.

## Learning Outcomes

By the end of this course students should be able to:

- Write the structures and chemistry of biological molecules namely: proteins, carbohydrates, lipids and nucleic acids;
- Discuss about the different metabolic reactions that take place in our body;
- Describe enzymology and enzymatic reactions
- Describe the applications of chemistry in life and write the different metabolic reactions and pathways in different kinds of living things.

## Course Outline and Schedule

Week	Contents	Methodology	Activities	Readings
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1 & 2	<b>1. Introduction to biochemistry</b> <ul style="list-style-type: none"> <li>• Definition and scope of biochemistry</li> <li>• Chemical and biochemical reactions</li> <li>• Chemistry of organelles (hierarchical organization of organelles in living cells, composition, properties, and function of organelles)</li> </ul> <b>2. Water, pH, and buffer</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Unusual properties of water to be used as a biological solvent</li> <li>• Role of water in biological system</li> <li>• Intermolecular forces</li> <li>• Colligative properties</li> <li>• Hydronium ion and pH</li> <li>• Physiological Buffers and buffering agent</li> <li>• Buffers used by cells</li> <li>• Some common Buffers used in biochemical reactions</li> </ul>	✓ Lecture ✓ Group discussion ✓ Oral questions ✓ Asking questions	➤ Listen ➤ Question & answering ➤ Home/class works ➤ Taking short note	➤ A.L. Lehninger Principles of Biochemistry, 4 <sup>th</sup> edition, 2005: <b>pp 1-28; 47-74</b>
	<b>Assignment 1 (10 %)</b>			

3 & 4	<b>3. Protein Structure and Function</b> <ul style="list-style-type: none"> <li>Structure and function of Amino Acids <ul style="list-style-type: none"> <li>➤ Introduction to Amino acids (essential and non-essential amino acids)</li> <li>➤ Structure of Amino Acids</li> <li>➤ Amino Acids as Buffers</li> <li>➤ Peptide Bond Formation (Peptide linkage)</li> </ul> </li> <li>Structure and function of Proteins <ul style="list-style-type: none"> <li>➤ Primary Structure of Proteins</li> <li>➤ Secondary Structure of Proteins</li> <li>➤ Tertiary Structure of Proteins</li> <li>➤ Quaternary Structure of Proteins</li> <li>➤ Denaturation of Proteins</li> <li>➤ Uses of proteins</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>✓ Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listen</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	➤ A.L. Lehninger Principles of Biochemistry, 4 <sup>th</sup> edition, 2005: <b>pp 75-156</b> Garret and Grisham Biochemistry: <b>PP 120-126</b>
	<b>Quiz 1 (5 %)</b>			
5 & 6	<b>4. Enzymes</b> <ul style="list-style-type: none"> <li>Definition of Enzymes</li> <li>Properties of Enzymes</li> <li>Major Classes of Enzymes</li> <li>Enzyme Kinetics</li> <li>Enzyme Mechanism (mechanism of catalysis)</li> <li>Regulation of Enzyme activity (Activation/Inhibition)</li> </ul>	<ul style="list-style-type: none"> <li>✓ Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listen</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	A.L. Lehninger Principles of Biochemistry, 4 <sup>th</sup> edition, 2005: <b>pp 190-237</b>
	<b>Test 1 (10 %)</b>			
7 & 8	<b>5. Lipids</b> <ul style="list-style-type: none"> <li>Definition of lipids</li> <li>Discussion on different classes of lipids (Free fatty acids, Triacylglycerols, waxes, , phospholipids, sphingolipids, eicasanoids, isoprenoids, Steroids and other lipids)</li> <li>Biological membranes</li> <li>Membrane transports</li> </ul>	<ul style="list-style-type: none"> <li>✓ Gapped Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> <li>✓ Reading assignme nt</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listening</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	A.L. Lehninger Principles of Biochemistry, 4 <sup>th</sup> edition, 2005: <b>pp 343-368</b>



	<b>Presentation (10 %)</b>			
9	<b>6. Carbohydrates</b> <ul style="list-style-type: none"> <li>• Definition and Classification,</li> <li>• Monosaccharides</li> <li>• Disaccharides</li> <li>• Polysaccharides</li> </ul>	<ul style="list-style-type: none"> <li>✓ Gapped Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> <li>✓ Reading assignment</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listening</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	<ul style="list-style-type: none"> <li>➤ A.L. Lehninger Principles of Biochemistry, 4<sup>th</sup> edition, 2005: <b>pp 238-246</b></li> <li>➤ John McMurry, Organic Chemistry, 7<sup>th</sup> edition, 2007: <b>Pp 973-997</b></li> <li>➤ A.L. Lehninger Principles of Biochemistry, 4<sup>th</sup> edition, 2005: <b>pp 247-255</b></li> <li>➤ John McMurry, Organic Chemistry, 7<sup>th</sup> edition, 2007: <b>Pp 977-1005</b></li> </ul>

9 & 10	<b>7. Introduction to Metabolism</b> <ul style="list-style-type: none"> <li>• Metabolic Pathways</li> <li>• Bioenergetics</li> <li>• Regulations</li> </ul> <b>8. Carbohydrate Metabolism</b> <ul style="list-style-type: none"> <li>• Structure of Carbohydrate <ul style="list-style-type: none"> <li>➤ Overview</li> <li>➤ Digestion of Carbohydrate</li> </ul> </li> <li>• Glycogen Metabolism/Starch <ul style="list-style-type: none"> <li>➤ Overview</li> <li>➤ Degradation of Glycogen</li> </ul> </li> <li>• Metabolism of Monosaccharides and Disaccharides (Overview)</li> <li>• Glycolysis <ul style="list-style-type: none"> <li>➤ Fates of Pyruvate</li> <li>➤ Energy yield of Glycolysis</li> </ul> </li> <li>• Citric Acid Cycle</li> <li>• Electron Transport Chain and Oxidative Phosphorylation</li> <li>• Hexose Monophosphate Pathway (Pentose Phosphate pathway) <ul style="list-style-type: none"> <li>➤ Overview</li> <li>➤ NADPH/Pentose</li> </ul> </li> <li>• Gluconeogenesis <ul style="list-style-type: none"> <li>➤ Overview</li> <li>➤ Reactions Unique to Gluconeogenesis</li> <li>➤ Substrates for Gluconeogenesis</li> <li>➤ Regulations of Gluconeogenesis</li> </ul> </li> </ul>	✓ Gapped Lecture ✓ Group discussion ✓ Oral questions ✓ Asking questions	➤ Listening ➤ Question & answering ➤ Home/class works ➤ Taking short note	A.L. Lehninger Principles of Biochemistry, 4 <sup>th</sup> edition, 2005: <b>pp 489-520; 521-630</b>
	<b>Presentation (5 %)</b>			

11 <sup>th</sup> & 12 <sup>th</sup>	<b>9. Lipid Metabolism</b> <ul style="list-style-type: none"> <li>• Introduction <ul style="list-style-type: none"> <li>➤ Metabolism of Dietary Lipids <ul style="list-style-type: none"> <li>▪ Overview</li> <li>▪ Digestion, Absorption, Secretion, and Use of Dietary Lipids</li> </ul> </li> <li>➤ Fatty Acid and Triacylglycerol Metabolism</li> <li>➤ Mobilization of Stored Fats and Oxidation of Fatty Acids</li> </ul> </li> <li>• Phospholipid Metabolism</li> </ul>	<ul style="list-style-type: none"> <li>✓ Gapped Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> <li>✓ Reading assignment</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listen</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	<ul style="list-style-type: none"> <li>➤ A.L. Lehninger Principles of Biochemistry, 4<sup>th</sup> edition, 2005: <b>pp 631-655</b></li> </ul>
	<b>Test 2 (10 %)</b>			

13 & 14	<p><b>10. Amino Acids/Nitrogen Metabolism</b></p> <ul style="list-style-type: none"> <li>Nitrogen Fixation and Synthesis of Amino Acids <ul style="list-style-type: none"> <li>Digestion of Dietary Proteins</li> <li>Removal of Nitrogen from Amino Acids</li> <li>Urea Cycle: The Major Pathway of Disposal of Nitrogen</li> </ul> </li> <li>Amino Acids: Metabolism of Carbon Atoms <ul style="list-style-type: none"> <li>Catabolism of the Carbon Skeletons of Amino Acids</li> <li>Biosynthesis of Nonessential Amino Acids</li> </ul> </li> <li>Conversion of Amino Acids to Specialized Products: An overview</li> </ul> <p><b>11. Integration of Metabolism</b></p> <ul style="list-style-type: none"> <li>Metabolic Effects of Insulin and Glucagon <ul style="list-style-type: none"> <li>Overview</li> <li>Insulin</li> <li>Glucagon</li> </ul> </li> <li>Starvation and fasting; similarity and differences</li> <li>Nutrition</li> <li>Vitamins</li> </ul>	<ul style="list-style-type: none"> <li>✓ Gapped Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> <li>✓ Reading assignment</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listen</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	<ul style="list-style-type: none"> <li>➤ A.L. Lehninger Principles of Biochemistry, 4<sup>th</sup> edition, 2005: <b>pp 671-750; 881-920</b></li> <li>➤ Garret and Grisham Biochemistry: <b>PP 584-607</b></li> <li>➤ Harpers Illustrated Biochemistry, 26<sup>th</sup> edition, 2003: <b>Pp 231-236</b></li> </ul>
15	<p><b>12. Nucleic Acid Structure and Function</b></p> <ul style="list-style-type: none"> <li>Structure of DNA and RNA</li> <li>DNA Synthesis (Overview) (Replication)</li> <li>RNA Synthesis <ul style="list-style-type: none"> <li>➤ Overview</li> <li>➤ Transcription</li> </ul> </li> <li>Protein Synthesis <ul style="list-style-type: none"> <li>➤ The Genetic Code</li> <li>➤ Translation</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>✓ Gapped Lecture</li> <li>✓ Group discussion</li> <li>✓ Oral questions</li> <li>✓ Asking questions</li> <li>✓ Reading assignment</li> </ul>	<ul style="list-style-type: none"> <li>➤ Listen</li> <li>➤ Question &amp; answering</li> <li>➤ Home/class works</li> <li>➤ Taking short note</li> </ul>	<ul style="list-style-type: none"> <li>➤ A.L. Lehninger Principles of Biochemistry, 4<sup>th</sup> edition, 2005: <b>pp 921-1080</b></li> </ul>

16	Final written exam (50 %)
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### Mode of Assessment

Assessment Breakdown	%
continuous assessment (not more than 10% for each)	50
End of Semester Examination	50

### Course Policy

Beside the university's policy on course delivery and evaluation, students are expected to actively participate in learning process by obeying the following course policies:

- Coming class on time (punctuality)
- Attend all class sessions
- Be prepared to learn and actively participate during class discussion
- Do all assignments, group works, project works, and presentations on time
- All students are expected to complete their own work to the best of their ability and cheating is strictly forbidden
- Do not miss quizzes, assignments, and exams unless you are forced due to health and other reasonable problems
- Cite all sources consulted to any extent (including material from the internet), whether or not assigned and whether or not quoted directly. It is strictly forbidden to take others work and present as own.
- Make-up class shall be conducted if classes are missed due to national holidays and/or when unpredicted conditions result in class dismissal

### References

1. D.L. Nelson and M.M. Cox, A.L. Lehninger Biochemistry, Worth Publishers, Inc. New York. 2005
2. E.E Cohn and P.K Stumpf. Outlines of Biochemistry John will & sons, Inc.
3. Elliott, WH & Elliott, DC 2001. Biochemistry and Molecular Biology, 2<sup>nd</sup> edn, Oxford University Press, Oxford.
4. J.M. Berg, J.L. Tymoczko and L. Stryer, Biochemistry, 5<sup>th</sup> Ed., 2005: and Student's Companion to Stryer's Book.
5. L. Smith, et al, Principles of Biochemistry, General aspects, McGraw-hill Book Co, 1982.
6. Mathews, CK, Van Holde, KE & Ahern, K.G, Biochemistry, 3rd edn, Benjamin/Cummings Publishing Company, 2000 (Pearson Educ)
7. P.C. Champe; R.A. Harvey, Biochemistry, 4th Ed., Lippincott, s Illustrated Reviews, 2007.

8. Voet, D, Voet, J G & Pratt, C. W Fundamentals of Biochemistry, John Wiley & Sons, New York. 1998.
9. Zubay, Parson and Vance, Principles of Biochemistry, 1995.

#### 11.7.4 ANALYSIS OF REAL SAMPLE

Program	BSc in chemistry					
Module Name	Applied Chemistry					
Module Number	11					
Module code	Chem-M3111					
Course Title	Analysis of Real Sample					
Course Code	Chem3118					
Prerequisite	Chem2053 & Chem2054					
Module coordinator's name and address	TBA					
Instructor(s) name and address	TBA					
Lecture days, Hours & room	TBA					
Cr. Hrs/ ECTS	2/3					
Work load (per week)	Lecture	Tutorial	Lab.	Home study	Assessment	Total
	9	----	84	24	3	120
Target group	3 <sup>rd</sup> year chemistry students					
Semester	Semester II					
Mode of delivery	Semester based					
Status of the course	Core Compulsory					

### Course Description

Systematic analysis of real samples: sampling, preservation and preparation of samples for the determination of the major, trace elements, inorganic compounds (speciation) and organic compounds; biological samples; food and beverages; water and waste water samples; soils and related samples.

### Learning Outcomes

By the end of this course students should be able to:

- Select appropriate sampling and preservation of a particular real sample
- Identify preparation methods for analysis of metals by different methods
- Perform experiments on water, soil and air

- Familiarize the students with the techniques of sampling, storage, and analysis of real samples.

### Course Outline and Schedule

Week	Contents	Method of teaching	Student activity	Readings
1 <sup>st</sup> & 2 <sup>nd</sup>	Systematic analysis of real samples	<ul style="list-style-type: none"> <li>• Practical laboratory experiments,</li> <li>• Questioning</li> <li>• Presentation</li> <li>• Discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Collecting real samples</li> <li>• Sample preparations</li> <li>• Observation writing</li> <li>• Listening and observing demonstration</li> <li>• Doing practical work</li> <li>• Analysis of observations</li> <li>• Ask questions on unclear idea</li> <li>• Active participation in discussion</li> </ul>	To be designated at commencement of the course.
3 <sup>rd</sup> - 5 <sup>th</sup>	Sampling, preservation and preparation of samples for the determination of the major, trace elements, inorganic compounds (speciation) and organic compounds	<ul style="list-style-type: none"> <li>• Practical laboratory experiments,</li> <li>• Questioning</li> <li>• Presentation</li> <li>• Discussions</li> <li>• Presentation</li> </ul>	<ul style="list-style-type: none"> <li>• Collecting real samples</li> <li>• Sample preparations</li> <li>• Observation writing</li> <li>• Listening and observing demonstration</li> <li>• Doing practical work</li> <li>• Analysis of observations</li> <li>• Ask questions on unclear idea</li> <li>• Active participation in discussion</li> </ul>	To be designated at commencement of the course.
6 <sup>th</sup> & 7 <sup>th</sup>	Biological samples	<ul style="list-style-type: none"> <li>• Practical laboratory experiments,</li> <li>• Laboratory data analysis</li> <li>• Presentations</li> <li>• Questioning</li> <li>• Discussions</li> </ul>	<ul style="list-style-type: none"> <li>• Collecting real samples</li> <li>• Preservations of samples</li> <li>• Sample preparations</li> <li>• Observation writing</li> <li>• Listening and observing demonstration</li> <li>• Doing practical work</li> <li>• Analysis of observations</li> <li>• Ask questions on unclear idea</li> <li>• Active participation in discussion</li> </ul>	To be designated at commencement of the course.

8 <sup>th</sup> & 9 <sup>th</sup>	Food and beverages samples	<ul style="list-style-type: none"> <li>• Practical laboratory experiments,</li> <li>• Questioning, Report writing</li> </ul>	<ul style="list-style-type: none"> <li>• Collecting real samples</li> <li>• Preservations of samples</li> <li>• Sample preparations</li> <li>• Observation writing</li> <li>• Listening and observing demonstration</li> <li>• Doing practical work</li> <li>• Analysis of observations</li> <li>• Ask questions on unclear idea</li> <li>• Active participation in discussion</li> </ul>	To be designated at commencement of the course.
10 <sup>th</sup> & 11 <sup>th</sup>	Water and waste water samples	<ul style="list-style-type: none"> <li>• Practical laboratory experiments,</li> <li>• Questioning, Report writing</li> </ul>	<ul style="list-style-type: none"> <li>• Collecting real samples</li> <li>• Preservations of samples</li> <li>• Sample preparations</li> <li>• Observation writing</li> <li>• Listening and observing demonstration</li> <li>• Doing practical work</li> <li>• Analysis of observations</li> <li>• Ask questions on unclear idea</li> <li>• Active participation in discussion</li> </ul>	To be designated at commencement of the course.
12 <sup>th</sup> & 13 <sup>th</sup>	Soils and related samples	<ul style="list-style-type: none"> <li>• Practical laboratory experiments,</li> <li>• Questioning, Report writing</li> </ul>	<ul style="list-style-type: none"> <li>• Collecting real samples</li> <li>• Preservations of samples</li> <li>• Sample preparations</li> <li>• Observation writing</li> <li>• Listening and observing demonstration</li> <li>• Doing practical work</li> <li>• Analysis of observations</li> <li>• Ask questions on unclear idea</li> <li>• Active participation in discussion</li> </ul>	To be designated at commencement of the course.
14 <sup>th</sup> and 15 <sup>th</sup>	<b>Project work (20%)</b>			

### Mode of Assessment

Type	Description	%	Assessment Date
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Practical/Skills Evaluation	individual/group performance, and flow chart	10	Every Week
Individual Laboratory Performance	Practical examination	20	Week 10
Experiment Reports	Written report after each laboratory work	30	Every Week
Written Examinations	Exam at the end of the laboratory work	40	At the end of the Lab

### Course Policy

Beside the university's policy on course delivery and evaluation, students are expected to actively participate in learning process by obeying the following course policies:

- Keep all laboratory safety rules
- Keep good hygiene practices
- Submit laboratory report for every experiments on time
- Do not miss laboratory sessions unless you are forced due to health and other reasonable problems
- Be prepared to learn and actively participate in laboratory works
- Come with lab manual and flow chart
- Wear proper dress