

**Far Western University
Mahendranagar, Kanchanpur
Faculty of Science and Technology**



B. Sc. Fourth Semester Biology Group

FAR WESTERN UNIVERSITY

Faculty of Science and Technology

Course Title: Basic Chemistry IV
 Course No.: CHM241
 Nature of Course: Theory
 Level: B. Sc.
 Year: Second, Semester: Fourth

F.M.: 100
 P.M.: 45%
 Credit: 3
 Number of hours per week: 3
 Teaching Hours: 45

1. Course Description

The course intends to enable the students to be acquainted with some aspects of basic concepts of chemistry, in all three branches physical, organic and inorganic chemistry. Students will be familiarized with the fundamentals of electrochemistry, thermodynamics as well as chemistry of carbonyl group, carboxylic acid and *d*-block elements.

2. Course Objectives

The general objectives of the course are as follows:

- To acquaint the students with basic concept of electrochemistry.
- To enable the students to understand the fundamentals of chemical thermodynamics.
- To enable the students to understand basic chemistry of aldehydes, ketones and carboxylic acids.
- To acquaint the students with the fundamental chemistry of *d*-block elements.
- To enable the students to appreciate the importance of chemistry in day to day life and value the scientific method of chemical research and investigation.

3. Specific Objectives and Contents

Specific Objectives	Physical Chemistry Contents
<ul style="list-style-type: none"> ● Explain electrolytic conductance. ● State and explain Debye-Huckel Theory of activity coefficient. ● Describe about Debye-Huckel-Onsagar equation. ● Explain the effect of concentration, solvent, dielectric constant and temperature on conductance. ● Explain theory and applications of conductometric titrations. ● Explain the difference between Galvanic and Electrolytic Cells. ● Describe what EMF is and how to measure it. ● Show how calculation of Cell's EMF is done. ● Describe types, classification and description of electrodes. ● Explain theory and applications of potentiometric titration. ● Explain different types of commercial cells. 	<p>Unit I: Electrochemistry (7)</p> <p>Electrolytic conductance; Activities and activity coefficients of strong electrolytes; Debye-Huckel Theory of activity coefficient; Debye-Huckel-Onsagar equation; Effect of concentration, solvent, dielectric constant and temperature on conductance.</p> <p>Conductometric titrations involving neutralization and precipitation reactions; Advantages of conductometric titrations.</p> <p>Galvanic and Electrolytic Cells; Electromotive force and its measurement; Standard cells; Single electrode potentials; Cell reactions and EMF; Calculation of Cell's EMF from single electrode potentials; applications of EMF measurements; Types, classification and description of electrodes; Reference electrodes; Indicator electrodes; Determination of pH using hydrogen quinhydrone, glass and antimony electrodes; Potentiometric titrations; Commercial cells (The Leclanche or Dry cell, the Lead Storage cell, Nickel Cadmium Cell, Fuel Cell).</p>

<ul style="list-style-type: none"> • State and explain first law of Thermodynamics. • Describe The Thermodynamic system. • Explain the relation between Cp and Cv. • Describe The Joule- Thomson effect. • Describe the Carnot cycle. • Explain what entropy is. • State and explain second law of Thermodynamics. • Explain entropy change in ideal gases and entropy change in physical transformations. • Enable the students to solve the numerical problems related first and second laws of thermodynamics. • Explain the concept of the free energy, work function and their significance as well as criteria for spontaneity of the reactions. 	<p>Unit II: Thermodynamics(8) First law of Thermodynamics; The Thermodynamic system; Reversibility and maximum work; Enthalpy of a system; Heat capacity; Relation between Cp and Cv; Isothermal and adiabatic processes; Isothermal and adiabatic processes in ideal gases; The Joule- Thomson effect; The Carnot cycle; The Thermodynamic efficiency. Entropy; Entropy change in isolated system; The Second Law of Thermodynamics; Entropy change for a system; Dependence of entropy on variables of a system; Entropy change in ideal gases; Entropy change in physical transformations; Entropy change in chemical reactions; Spontaneous and non-spontaneous changes; Free energy, work function and their significance; Criteria for spontaneity of the reactions.</p>
<ul style="list-style-type: none"> • Explain the nomenclature and bonding of aldehydes and ketones. • Describe different ways of preparation of aldehydes and ketones. • Explain the major reactions shown by aldehydes and ketones with mechanism. • Discuss 1, 2-addition vs 1, 4-addition reactions and the factors that favour them. • Describe the reactions involving organolithium, Grignard reagents, Organocopper Organocadmium reagents. <ul style="list-style-type: none"> • Explain the nomenclature and bonding of carboxylic acids. • Describe different ways of preparation of carboxylic acids with mechanism. • Describe ways to prepare derivatives of carboxylic acids and their major reactions with mechanism. • Describe chemistry and applications of malonic ester and acetoacetic ester syntheses with mechanism. <ul style="list-style-type: none"> • Describe the characteristic features of <i>d</i>-block elements. • Discuss Werner's contribution in understanding the chemistry of coordination compounds. • Describe the geometry of coordination compounds. • Discuss bonding in transition metal complexes with reference to valence bond theory and Crystal field theory. • Define and explain the importance of chelates. • Describe some important catalytic reactions stressing on mechanism and applications. • Explain basic bioinorganic chemistry of Fe, Cr and Cu. 	<p>Unit III. Aldehydes and Ketones (8) Kinds of carbonyl compounds; Nature of carbonyl group; General reactions of carbonyl compounds. Names of aldehydes and ketones; Preparation of aldehydes and ketones; Oxidation of aldehydes and ketones; Nucleophilic addition reactions of aldehydes and ketones; The Hydration reaction; Cyanohydrin formation reaction; Nucleophilic addition of Grignard and Hydride reagents; Imine and enamine formation; The Wolff- Kishner reaction; Nucleophilic addition of alcohols: acetal formation; The Wittig reaction; The Cannizzaro reaction; 1,2-addition vs 1,4-addition reactions;1,2- addition by organolithium and Grignard reagents; Conjugate addition of Organocopper reagents, Organocadmium reagents.</p> <p>Unit IV. Carboxylic Acids (7) Introduction; Names of carboxylic acids; Structure and properties of carboxylic acids; Substituent effects on acidity; Preparation of carboxylic acids; Reactions of carboxylic acids; Formation of salt, acid chloride, anhydride, amide and ester and their major reactions; Chemistry and applications of Malonic ester and Acetoacetic ester syntheses</p> <p>Inorganic Chemistry content Unit V. The <i>d</i>-Block Elements (15) Electronic configuration; Metallic character; Variable oxidation states; Size of atoms and ions; Density; Melting and boiling points; Reactivity of metals; Ionization energies; Colors; Magnetic properties. Coordination compounds; Werner's contribution on coordination compounds; <i>d</i> orbital; Recent methods of studying complexes; Effective atomic number; Nomenclature; Coordination number and geometry; Effective atomic numbers; Bonding in transition metal complexes; Valence bond theory; Crystal field theory; Effect of Crystal field splitting; Jahn-Teller distortion; Square planar and tetrahedral arrangement; Chelates; Molecular orbital theory; Uses of coordination compounds. Catalytic properties of TiCl₄, TiO₂, V₂O₅, FeCl₃, PdCl₂, PtO₂, Ni, Ziegler-Natta catalyst); Bioinorganic chemistry of Fe, Cr and Cu.</p>

Note: The figures in the parentheses indicate the approximate periods for the respective units.

4. Evaluation System

Undergraduate Programs							
External Evaluation	Marks	Internal Evaluation	Weight age	Marks	Practical	Weight age	Mark
End semester examination	60	Assignments	20%	20	Practical Report copy	25%	20
(Details are given in the separate table at the end)		Quizzes	10%		Viva	25%	
		Attendance	20%		Practical Exam	50%	
		Internal Exams	50%				
Total External	60	Total Internal	100%	20		100%	20
Full Marks 60+20+20 = 100							

5. External evaluation

1. End semester examination:

It is a written examination at the end of the semester. The questions will be asked covering all the units of the course.

External Practical Evaluation:

After completing the end semester theoretical examination, practical examination will be held. External examiner will conduct the practical examination according to the above mentioned evaluation. There will be an internal examiner to assist the external examiner. Three hours time will be given for the practical examination. In this examination Students must demonstrate the knowledge of the subject matter.

Each student must secure at least 50% marks in internal evaluation in order to appear in the end semester examination. Failed student will not be eligible to appear in the end semester examinations.

6. Internal evaluation

Assignment: Each student must submit the assignment individually. The stipulated time for submission of the assignment will be seriously taken.

Quizzes: Unannounced and announced quizzes/tests will be taken by the respective subject teachers. Such quizzes/tests will be conducted twice per semester. The students will be evaluated accordingly.

Attendance in class: Students should regularly attend and participate in class discussion. Eighty percent class attendance is mandatory for the students to enable them to appear in the end semester examination. Below 80% attendance in the class will signify NOT QUALIFIED (NQ) to attend the end semester examination.

Presentation: Students will be divided into groups and each group will be provided with a topic for presentation. It will be evaluated individually as well as group-wise. Individual students have to make presentations on the given topics.

Mid-term examination: It is a written examination and the questions will be asked covering all the topics in the session of the course.

Discussion and participation: Students will be evaluated on the basis of their active participation in the classroom discussions.

Instructional Techniques: All topics are discussed with emphasis on real-world application. List of instructional techniques is as follows:

Lecture and Discussion

- Group work and Individual work
- Assignments
- Presentation by Students
- Quizzes
- Guest Lecture

Students are advised to attend all the classes and complete all the assignments within the specified time period. If a student does not attend the class(es), it is his/her sole responsibility to cover the topic(s) taught during that period.

7. Prescribed Texts

1. S. H. Maron, C. Prutton, **Principles of Physical Chemistry**, Oxford and IBH Publication and Co., 1992.
2. John McMurry, **Introduction to Organic Chemistry**, Brookes/Cole, 2007.
3. J.D. Lee, **Concise Inorganic Chemistry**, 5th Edition, John Wiley and sons. Inc., 2007.

8. Reference

4. F. Daniels, R. F. Alberty, **Physical Chemistry**, John Wiley & Sons, Latest Edition.
5. Gilbert. W. Castellan, **Physical Chemistry**, Narosa Publishing House, 1985.
6. R. T. Morrison, R. N. Boyd, **Organic Chemistry**, Prentice- Hall of India Pvt. Ltd., 2008.
7. J. S. H. Pine, **Organic Chemistry**, McGraw Hill International Edition Series, New York, USA, 1987.
8. F.A. Cotton, G. Wilkinson, C. Gaus, **Basic Inorganic Chemistry**, John Wiley & Sons (Asia) Pvt. Ltd., 2007.
9. D. F. Shriver, P. W. Atkins, **Inorganic Chemistry**, W. H. Freeman and Co., London, 1999.
10. B. R. Puri, L. R. Sharma , K. C. Kalia, **Principles of Inorganic Chemistry**, Shoban Lal Nagin Chand and Co., Delhi, India, 1996.

FAR WESTERN UNIVERSITY

Faculty of Science and Technology

Course Title: Chemistry Lab 4
Course No.: CHM241
Nature of Course: Theory
Level: B. Sc.
Year: Second, Semester: Fourth

Credit: 1
Number of hours per week: 3
Teaching Hours: 45

1. Course Description

The course intends to enable the students to be skilful in the basic chemical laboratory techniques. Students will be introduced to scientific method of experimentation. Students will develop skill on performing an experiment, observing and recording results and judiciously interpreting the results.

2. Course Objectives

The general objectives of the course are as follows:

- To enable students to perform experiments on the conductometric and potentiometric titrations..
- To enable the students to develop basic skills on the identification of single organic compound.
- To enable the students to develop skill on the Gravimetric estimation.
- To enable students to develop skill on observation, recording and interpretation of an experiment.

3. Specific Objectives and Contents

Specific Objectives	Contents
<ul style="list-style-type: none">• Enable the students to undertake experiments on the conductometric titrations and interpret the results obtained.• Enable the students to undertake experiment on the potentiometric titration and interpret the results obtained.• Enable the students to use pH meter to determine pH of a solution.• Enable the students to perform experiment to identify the given organic compound.• Enable the students to perform experiments on Gravimetric analysis	<p>Physical Chemistry Content</p> <ol style="list-style-type: none">1. An experiment on conductometric titration of strong acid against strong base.2. An experiment on conductometric titration of weak acid against strong base.3. An experiment on potentiometric titration of strong acid against strong base.4. An experiment on calibration of pH meter and determination of pH using glass electrode. <p>Organic Chemistry content</p> <ol style="list-style-type: none">1. Experiments on determination of a single organic compound with preparation of at least one derivative (carbohydrate, carbonyl compound, carboxylic acid, phenol, amines, amide) <p>Inorganic Chemistry Content</p> <ol style="list-style-type: none">1. Experiments related to the following Gravimetric estimation are to be performed.<ul style="list-style-type: none">• Estimation of sulphate as barium sulphate.• Estimation of barium as barium chromate.• Estimation of copper as copper thiocyanate.• Estimation of copper in an alloy.

4. Instructional Techniques

Before the start of an experiment, the instructor presents a lecture on the details of the experiment including the safety considerations. Each student will perform independently all the experiments prescribed.

5. Evaluation

There will be continuous examination of the students. After the submission of the report of each experiment by the students, the instructor provides the grade. Besides this, the instructor takes quizzes and short examinations on the experiments done at frequent intervals amounting to 25 % of total grade. The final grade will be the accumulation of all individual grades. There will be no final examination

6. Attendance in Lab: Students should complete all the experiments prescribed.

7. Texts

1. David P. Shoemaker, Carl W. Garland, Joseph W. Nibler, **Experiments in Physical Chemistry**, 5th edition, McGraw-Hill Book Company, **1989**. (Latest Edition).
2. B. P. Levitt, ed. **Findlay's Practical Physical Chemistry**, Longman, London, **1973**. (Latest Edition)
3. J. N. Gurtu, R. Kapoor, **Advanced Experimental Chemistry** (Vol I – III), S. Chand and Co., New Delhi, India, **1989**. (Latest edition).
4. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchel, **Vogel's Text Book of Practical Organic Chemistry**, 5th Edition, Person Education, **2005**.
5. A. L. Vogel, **Qualitative Inorganic Analysis**, Prentice Hall, Latest Edition.
6. L. Shriner, R. C. Fuson, D. Y. Curtin, **The Systematic Identification of Organic Compounds, A Laboratory Manual**, John Wiley and Sons Inc, New York, USA , **1980**. (Latest Edition).
7. N. S. Gnanapragasam, G. Ramamurthy, **Organic Chemistry – Lab Manual**, S. Viswanathan Co., Pvt., India, **1998**.
8. **Vogel's Text Book of Inorganic Qualitative Analyses**, 4th Edition, ELBS, London, **1974**. (Latest Edition).
9. Moti Kaji Sthapit, R. R. Pradhananga, **Experimental Physical Chemistry**, Taleju Prakasan, Kathmandu, Nepal, **1998**.
10. K. N. Ghimire, M. R. Pokhrel K. P. Bohara, **University Experimental Inorganic Chemistry**, Quest Publication, Kirtipur, Kathmandu, Nepal, **2008**.
11. N. M. Khadka, S. D. Gautam, P. N. Yadav, **A Core Experimental Chemistry for B.Sc** , Kaea Book Centre, Kathmandu, Nepal, **2008**.
12. K. N. Ghimire, K. P. Bohara, **University Experimental Physical Chemistry**, Quest Publication, Kirtipur, Kathmandu, Nepal, **2008**.

**FAR WESTERN UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY**

Course Title	Environmental Pollution and Control Technologies	Credit	3
Course Code	ENV 241	Number of hours per week	3
Nature of the Course	Theory (Core Course)	Total hours	45
Year Level	Two B.Sc.	Semester: Fourth	

Course Objectives:

Upon completion of this course, Students will be able to

- Understand basic science about various type of environmental pollution,
- Understand the process behind these phenomenon
- Incept the knowledge and theory of pollution control technologies.
- Understand the discipline of ecotoxicology and fate of toxicants in environment.

Specific Objectives	Contents
<ul style="list-style-type: none"> • To make students able to understand the basic concept of Air pollution. • To provide scientific knowledge about process behind Air Pollution • To explain students about effect of Air pollution 	<p>Unit I: Basic Concept of Air pollution (5 hours) Basic concepts: Definition, Natural vs. Contaminated Air; Types of Air pollution: origin, chemical composition and State of Matter; Source of Air pollution; Mode of formation of criteria air pollutants (Ozone, COx, NOx, SOx, Particulate matters): Toxic Air Pollutants; Aerosols: Mode of formation, Types, Vertical variation of Aerosols; Effects of Air Pollution: Effects on human health: Effects on Vegetation: Effects on properties/materials: Effects on visibility: Effects on climate/Weather; Laws Governing Air Pollution: Gas Laws, Gaussian Plume dispersion Model, Plume Rise; Atmospheric Brown Cloud, Green House Effect, Ozone Depletion, Trans-boundary Air pollution; Indoor Air Pollution: Introduction and Effects</p>
<ul style="list-style-type: none"> • To provide knowledge about various type of air pollution control technologies • To explain the working principle of air pollution control measures 	<p>Unit II: Air pollution Control Technologies (7 hours) Introduction to Air Pollution Control; Approach to Air Pollution Control: Improve Dispersal (Atmospheric Cleansing Process), Preventive and Control Technologies, Equipment selection, Best Available Technology (BAT), Process Change and Use of Devices (Control Devices of Particulate Matter: Gravitational Settling Chambers, Centrifugal Collectors, Wet Collectors, Electrostatic Precipitators; Control of gaseous pollutants: Absorption, Adsorption and Combustion; Vehicular Emission Control); Air Pollution Control Strategies: Fundamental Approaches, Guiding Principles (Short term and Long Term); Indoor Air Pollution Control: ICS, Building Design; Legal and Regulatory Tools for Air Pollution Control: National Vehicular Emission Control</p>

<ul style="list-style-type: none"> • To make students able to understand the basic concept of Water pollution. • To provide scientific knowledge about process behind Water Pollution • To explain students about effect of Water pollution 	<p>Unit III: Basic concept of Water Pollution (5 hours) Properties of Water; Criteria of Safe Drinking water: Drinking Water quality parameters; Water pollution: Cause and Sources (Point and Non-Point sources); Water Pollutants: Types, sources, Mode of Formation; Surface water Pollution: Water pollution parameters: Bio-chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrification in Surface Water, Deoxygenation Oxygen Sag Curve, Eutrophication, Thermal Stratification, Acidification; Ground Water Pollution: Darcy's law, Flow Velocity, Cone of Depression, Groundwater Plumes and its Effect; Waste water: Types and Source; Characteristics of Municipal and Industrial Wastewater; Environmental Impacts of Water pollutants;</p>
<ul style="list-style-type: none"> • To provide knowledge about various type of water pollution control measures • To familiarize students about various type of water treatment system • To study the legal instruments related to water pollution 	<p>Unit IV: Water Pollution Control Technologies (5 hours) Water Treatment System: Municipal Water treatment and Waste Water Treatment; Drinking Water treatment System: Process; Household drinking water treatment methods; Waste water Treatment Methods: Types and General Approaches; Primary Treatment: Working Mechanism; Biological Treatment: Process and general Principal: Advance treatment: Introduction and Principal, Constructive Wetlands; Groundwater Pollution Control methods; Legal and Regulatory Tools for Water Pollution Control; Water Quality Criteria and Guidelines; Water Legislative Tools in Nepal</p>
<ul style="list-style-type: none"> • To make students able to understand the basic concept of Noise pollution. • To provide scientific knowledge about process behind Noise Pollution • To explain students about effect of Noise pollution • To provide knowledge about various type of Noise pollution control measures 	<p>Unit V: Noise Pollution (8 hours) Sound: Properties (Frequency, Wavelength, Pressure); Noise – How it differs from Sound; Human Sensitivity to Sound; Types of Sound/Pattern of Noise; Source of Noise; Sound Physics: Measurement of Sound Level, Sound Level vs Distance, Inverse Square Law; Environmental Impact of Noise; Noise Pollution Control: Source Control, Path Control and Receiver Control Technologies; Legal and Regulatory Tools for Noise Pollution Control; Noise Control Strategies and Guidelines;</p>
<ul style="list-style-type: none"> • To make students able to understand the basic concept of Soil pollution. • To provide scientific knowledge about process behind Soil Pollution • To explain students about source and effect of Soil pollution • To accustom students about waste and Waste management system 	<p>Unit VI: Soil Pollution (8 hours) Properties of Soil; Role of Soil in Environment; Soil Pollution: Changes in Soil Characteristics, Sources; Environmental Impact of Soil Pollution: Soil Quality Index and Salinity Hazard; Concept of Soil Health; Residual Toxicity; Soil Pollution Control Technologies: Sustainable Soil Management Techniques, Farmer to Farmer Diffusion Model, Soil Conservation and Watershed Management Modules; Legal and Regulatory Tools for Soil Pollution Control; Waste: Definitions and Concept; Types of waste; source of waste; Municipal Solid waste; hazardous Waste; E-waste; Environmental impact of waste; Waste management Issue;</p>

• To make students capable of **Unit VII: Environmental Toxicology (7 hours)**

<p>understand the discipline of ecotoxicology and fate of toxicants in environment.</p> <ul style="list-style-type: none"> To accustom students about effect of toxicants in environment 	<p>Introduction to Toxicology and eco-toxicology; Types of Eco-toxicants: Toxic Elements and elemental form, Toxic Inorganic compounds, Toxic organic compounds, Radio-nuclides: Sources, Radioactive decay; Distribution and fate of Toxic substances: Types of Toxicity-Acute and chronic Toxicity, Persistence, Chemical interaction, Relative Toxicity, Xenobiotic and Endogenous substances, Toxicological chemistry: Phase I and Phase II Reactions, Phases of Toxicants movements; Dose response relationships; Toxic Effects: Independents, Additive, Synergetic, Antagonism, Teratogenesis, Mutagenesis, Carcinogenesis, Estrogenesis; Factors that influence Toxicity, Routes of Exposure; Environmental effects of toxicants: Terrestrial and Aquatic Environments, Effects on Human health; Eco-toxicological Tests; Ecological Risk Assessments: Hazard Identification, Exposure Assessment, Dose response assessment, Risk Characterization; Environmental Toxicity management: Technical Approach, Environmental Regulation</p>
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Text Books:

1. De, A. K., 2008. Environmental Chemistry. New Age International Publishers, NewDelhi.
2. Manahan S. E., 2000. Environmental Chemistry (7th edition). CRC Press, LLC BocaRaton. ISBN 1-56670-492-8 U.S.
3. Masters, G.M., 2008. Introduction to Environmental Engineering and Science 4th Edition. Prentice Hall, New Delhi

Reference Books:

1. APHA, 1998. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington, DC.
2. Asthana and Asthana 2010. Environment: Problems and solutions, S. Chand and Company Ltd.
3. Banerji, S. k., 2003. Environmental Chemistry, Prentice Hall of India Private Limited
4. Goel, P.K., 2001. Water pollution: Causes, Effects and Control, New age International publishers
5. Mark, Z.J., 2002. Atmospheric Pollution: History, Science and Regulation. Cambridge University Press, Cambridge.
6. Miller, Jr. G.T., 2010. Environmental Science. Thirteen Edition. Brooks/Coles Cengage Learning, USA
7. Sharma, P.D., 1998. Environmental Biology and Toxicology. Rastogi Publications, New Delhi.
8. Sapkota, B., 2004 Fundamental of Noise pollution, Department of Physics, Pulchowk campus

FAR WESTERN UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY

Course Title **Environmental Pollution and Control Technologies PR** Credit **1**
 Course Code **ENV 241** Number of hours per week **3**
 Nature of the Course: **Practical (Core Course)** Total hours **45**
 Year: **Two** Semester **Fourth** Level: **B.Sc.**

Thematic Areas	Practical	Hours
Sampling Techniques	Practical No. 1: Sampling and Preservation techniques for: a. Drinking water quality assessment. b. River water quality assessment c. Lentic water bodies for water quality assessment. d. Ambient air quality e. Soil quality f. Solid waste assessment	2 hours
Air Pollution	Practical No. 2: Examination of air pollution in urban area/rural area using Natural Indicators Practical No. 3: Study of particulate matter (TSP, PM_{2.5} and PM₁₀) presence in ambient air. Practical No. 4: Study of presence of SO_x, NO_x, CO_x in ambient air.	9 hours
Water Pollution	Practical No. 5: Examination of water quality: To determine the Iron concentration in drinking water of given sample water. OR Practical No. 6: Examination of drinking water quality: To determine the Arsenic concentration in drinking water of given sample water. Practical No. 7: Examination of drinking water quality: To determine the Coliform bacteria presence in drinking water of given water sample. Practical No. 8: Examination of water pollution in surface water bodies (River/Rivulets/Lake/Ponds): To determine the Biological Oxygen Demand (BOD) of given Samplewater. Practical No. 9: Examination of water pollution in surface water bodies (River/Rivulets/Lake/Ponds): To determine the Chemical Oxygen Demand (COD) in River Water and Lake Water.	15 hours
Soil Quality Analysis	Practical No. 10: Soil Analysis: To determine the Organic Carbon content of soil of given sample. Practical No. 11: Soil Analysis: To determine the Total	10 hours

	available Nitrogen content of given sample of soil. Practical No. 12: Soil Analysis: To determine the Phosphorous content of given sample of soil. Practical No. 13: Soil Analysis: To determine the Potassium content of given sample of soil. Practical No. 14: Soil Analysis: To determine the C: N ratio of given sample of soil.	
Noise Assessment	Practical No. 15: To measure and compare Noise level (equivalent and percentile) in public, residential and business area.	3 hours
Study of Solid Waste	Practical No. 16: Waste Analysis: Study the Composition of Municipal Solid waste and classify them into various category of waste. Practical No. 17: Waste Analysis: To determine the Mass, Volume and Density of municipal waste. Practical No. 18: Waste Analysis: To determine the Moisture content in municipal solid waste.	6 hours

Some major points related to aforementioned practical:

1. Practical number 1 is fully demonstration class where sampling techniques will be demonstrated by instructor.
2. Students have to carry out *field visit* to nearby urban/rural area for supporting practical number **2, 3, 4, 15, 16, 17 and 18**. The field work is for complete academic purpose. For this purpose University will have to support students for necessary transportation cost.
3. Students have to prepare a field report of the field visit and submit during practical examination.
4. One day field visit will be conducted in nearby urban/rural area with following objectives:
 - a. To identify point and non-point sources of water pollution.
 - b. To identify sources of air pollution.
 - c. To study the various pollution control technologies/measures adopted by local authorities.
 - d. To collect the samples for waste characterization.
5. Students have to submit a field note book of each field visits, during practical examination.

FAR WESTERN UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY

Course Title: **Solid Waste Management**

Credit: **3**

Course Code: **WMN 221**

Number of hours per week: **3**

Nature of the Course: **Theory (Interdisciplinary)** Total hours: **45**

Year: **Two**

Semester: **Fourth**

Level: **B.Sc.**

Course Objectives

Upon completion of the course, the students should be able to:

1. Understand the types of solid waste, characterize the municipal solid waste and outline the processes of generation and in collection of solid waste.
2. Describe main features of the management of Solid Waste and of the technologies involved in the various treatment processes.
3. Identify the stakeholders involved in Solid Waste Management planning and execution in Nepal.
4. Assess the benefits that can be generated from Solid Waste through the various management approaches.

Specific Objectives	Contents
<ul style="list-style-type: none"> • Acquaint with the types of waste • Understand the concept of integrated solid waste management (ISWM) 	<p>Unit I: Introduction (4 Hrs) Definition of waste, types of waste; Global scenario of waste, global and local issues on solid waste management; Waste management hierarchy; Integrated solid waste management (ISWM)</p>
<ul style="list-style-type: none"> • Understand the various properties (Physical, Chemical and Biological) of municipal solid waste • Develop idea on composition of solid waste and method of its determination 	<p>Unit II: Characterization of Solid Waste (4 Hrs) Definition of municipal solid waste (MSW); Physical, Chemical and Biological properties of municipal solid waste; Sources of municipal waste; Types of municipal waste; Composition of municipal solid waste and its determination</p>
<ul style="list-style-type: none"> • Assess solid waste generation and characterize • Understand strategies for reduction of solid waste at source • Familiarize with different waste collection systems 	<p>Unit III: Generation and Collection of Solid Waste (4 Hrs) Assessment of solid waste generation and characteristics; Factors affecting solid waste generation rate; Source reduction; strategies for source reduction; Logistics of solid waste collection; Types of waste collection systems, equipment and personnel requirements</p>
<ul style="list-style-type: none"> • Understand the process of 	<p>Unit IV: Solid Waste Management (10 Hrs)</p>

<p>municipal solid waste management</p> <ul style="list-style-type: none"> • Develop idea on 3R principle of solid waste management • Acquaint with energy and material recoveries from solid waste • Understand solid waste management scenario in Nepal and UNEP guideline for management of solid waste 	<p>Hrs)</p> <p>Process of municipal solid waste management; Solid waste management techniques: 3R principle (Reuse, Reduce, Recycle), composting, vermi-composting and disposal; Social, environmental and economic aspects of MSW management; Energy recovery from solid wastes; Types of materials recovered from MSW; Waste management scenario in the context of Nepal; UNEP guidelines and legal framework for solid waste management; case study</p>
<ul style="list-style-type: none"> • Understand transfer and landfilling process including design consideration • Acquaint with formation, composition and management of leachate from landfill • Study of environmental quality at landfills and apply IEE/EIA 	<p>Unit V: Disposal of Municipal Solid Waste (10 Hrs)</p> <p>Transfer station; Landfill: classification, planning and landfill processes; Landfill design considerations; Generation and composition of landfill gases; Formation, composition and management of leachate; Landfill operation; Environmental quality monitoring at landfills; Landfill closure, post-closure care and remediation; IEE/EIA related SWM projects; case study</p>
<ul style="list-style-type: none"> • Define hazardous waste and understand sources, impacts and characteristics of hazardous waste • Understand hazardous management techniques • Understand special waste, e-waste and disaster waste and their management techniques 	<p>Unit VI: Hazardous and Special Wastes (8 Hrs)</p> <p>Definition, identification and classification of hazardous solid waste; Sources, impacts and characteristics of hazardous solid waste; Bio-medical waste, its sources, generation, storage, transportation, treatment and disposal; Hazardous waste management techniques; Special wastes and e-wastes and their management; Disaster waste and its management; case study</p>
<ul style="list-style-type: none"> • Map institutions and stakeholders involved in solid waste at national and local level • Understand policies, laws, regulations and strategies related to solid waste management in Nepal 	<p>Unit VII: Institutions and Regulatory Framework (5 Hrs)</p> <p>National level organization structure, human resource management, community mobilization, financial management on SWM; Types of private sector participation and its benefits; Policy, law and regulations, strategy related to SWM in Nepal</p>

References

1. Tchobanoglous, G. and Kreith, F. (2002). Handbook of Solid Waste

Management Second Edition; McGraw-Hill Publication, New York Chicago San Francisco.

2. ADB. (2013). Solid Waste Management in Nepal: Current Status and Policy Recommendations. Asian Development Bank, Philippines.
3. PAN and EU. (2008). Best Practices on Solid Waste Management in Nepalese Cities. Practical Action Nepal, Kathmandu.
4. UN-HABITAT. (2010). Solid Waste Management in the World's Cities. United Nations Human Settlements Programme. Earthscan Publications, London.

Course Title: Microbial Biotechnology

Course No: MIB241 (Major/ Minor)

Nature of the Course: Practical

Semester: IV

Full Marks: 1credit

Pass Marks:

Year: II

Techniques for biochemical analysis

paper chromatography, thin layer chromatography (TLC), Column chromatography, SDS PAGE, Gel Electrophoresis, Protein estimation

Screening of Wine Yeast and wine production

Production of Alcohol

Isolation, characterization, screening of industrially important bacterial cultures

Production of Kinema

Extraction, purification and estimation of amylase and protease enzymes of bacteria

Plant tissue culture

Isolation and characterization of Rhizobium, Azotobacter and Mycorrhiza

Course Title: Microbial Biotechnology

Course No: MIB241 (Major/ Minor)

Full Marks: 3 credit

Pass Marks:

Year : II

Semester: IV

Nature of the Course: Theory

Course Objectives

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

- Principle and applications of microbial biotechnology
- Basic concept of bioinformatics

Concept of biotechnology and Microbial Biotechnology

5 hrs

Scope and applications, Risk and hazards of biotechnology

Screening and Improvement of Industrial Microorganisms

5 hrs

General principles of culture maintenance & preparation, Bacterial cultures, yeast cultures, Molds cultures; Bacteria: Lactobacillus, Acetobacter, Acetic acid bacteria, Yeast- Saccharomyces cerevisiae (in Murcha), Molds: Aspergillus oryzae, Aspergillus niger, Rhizopus, Lipolytic and proteolytic, sachharolytic, pectinolytic microorganisms

Food biotechnology & Fermented Foods

10hrs

Principles of fermentation, Fermentative pathways, Fermentation process, production of cultures for food fermentation, Application of food biotechnology, GMOs, microbial synthesis of food; Food and Enzymes from Microorganisms, Microorganisms as food-single cell protein (SCP), Concept of enzyme production and application of key products improvement of traditional fermented foods; coffee, cocoa, yeast extracts, mizo, chhurpi, soyabean products- soyasauce, tempe, Tofu, Kinaema, natto, beer and traditional foods.

Concept Agricultural microbial biotechnology:

5hrs

Plant tissue culture, Mushroom culture, Types and potentials of microorganisms as biofertilizers- Azotobacter, Rhizobium and Mycorrhiza

Fermentation Technology:

5 hrs

Types of Fermentation - Solid state Fermentation, Submerged state fermentation, Fermenter designs, Fermentation process of beer, ethanol, and acetic acid

Dairy Technology:

5 hrs

Processing of Milk – Pasteurization, Production of Cheese, yogurt and icecream

Enzyme Technology:

5 hrs

Production and purification of proteases, amylases, chitinase, pectinase

Methods in genetic engineering & Introductory Bioinformatics:

5 hrs

Concept of genetic engineering, Scope and applications, Technique of gene manipulation, Outline of gene cloning

Scope and applications of bioinformatics in Microbiology, Concept of database: submission, analysis, retrieval

Reference Books:

1. Crugger, W. and Crugger, A. (2000). **Biotechnology: A Text Book of Industrial Microbiology**, Prentice Hall India
2. Smith, J. E. (2004). **Biotechnology**. 4th Edition, (Series: Studies in Biology), Cambridge University Press
3. Plummer, D. T. (1988). **An Introduction to Practical Biochemistry**. 3rd Edition. Tata McGraw Hill, New Delhi
4. Krane, D.E. and Raymer, M. L. (2003) **Fundamental concept on bioinformatics**, Pearson Education Ltd.

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Semester IV

Course Title: Animal Physiology and Endocrinology

Credit 3

Nature of the Course: Theory

Number of hours per week: 3

Course No: ZOO241

Instruction hours: 45

Year: Second

Semester IV

Course Objectives:

At the end of course students will be able to understand the following general objectives:

- Know the physiological processes of different systems in animals.
- Understand the concept of endocrine glands and hormones.
- To describe how organisms interact with their environments and how environmental conditions modulate these interactions through adaptive mechanisms.

. Course Description:

A. Animal Physiology:

Specific Objectives	Units & Course Contents
Describe the digestive and absorptive mechanism of food in animals by the use of gastro-intestinal secretions and understand the metabolism.	<p>1. Digestion (3 hrs):</p> <p>Digestion and absorption of carbohydrates, fats and proteins. Gastro-intestinal secretions and its regulations. Metabolism and metabolic pathways.</p>
Understand the respiratory mechanism, regulation of respiration, structure and function of haemoglobin and its relation to the transport of O ₂ and CO ₂ in mammals.	<p>2. Respiration (3 hrs):</p> <p>Respiratory mechanism, Respiratory pigments and Regulation of Respiration. Structure & function of haemoglobin, transport of O₂ and CO₂ in mammals, Bohr and Haldane effect, and Chloride shift.</p>

<p>Know the composition and function of blood, the coagulation mechanism as well as the origin and control of heart beat.</p>	<p>3. Circulation (3 hrs):</p> <p>Composition of blood and their functions, blood coagulation (process, factors and significance). Origin and conduction system of heart. Cardiac output and its control. Regulation of heart beat.</p>
<p>Describe the process of excretion in animals with the mechanism of urine formation and maintenance of electrolyte and pH by kidney.</p>	<p>4. Excretion (3 hrs):</p> <p>Excretion and its types, and excretory products in animals. Mechanism of urine formation and role of kidney in the maintenance of electrolyte and pH.</p>
<p>Understand the organization of nervous system and recognize how the nervous system operates and how nerve impulse and synaptic transmission take place.</p>	<p>5. Nervous System (3 hrs):</p> <p>Organization of nervous systems. Physiology of Neurons, Transmission of nerve impulse, Mechanism of synaptic transmission, Reflex action. Neuro-muscular junction and autonomic nervous system.</p>
<p>Understand the basic mechanism and theory related to skeletal muscle contraction.</p>	<p>6. Muscle Contraction (1 hrs):</p> <p>Physiology of muscle contraction (physical changes during muscle contraction and “Sliding Filament Theory” of muscle contraction.</p>
<p>Understand how organisms interact with their environments and how environmental conditions modulate these interactions through adaptive mechanisms.</p>	<p>7. Thermal Physiology (3 hrs):</p> <p>Ectotherms and Endotherms. Structures and mechanisms involved in thermoregulation Homeostssis and acclimatization. Adaptation for extreme climates: adaptive hreterothermy, thermogenesis and freeze-tolerance.</p>
<p>Understand the General principles of sensory physiology in human and other organisms</p>	<p>8. Sensory Physiology (3 hrs):</p> <p>Physiology of vision in Human. Compound eyes and image formation in insects. Physiology of hearing and balance Physiology of taste, smell and touch</p>

Understand the physiology of reproduction in human and other organisms	<p>9. Reproduction (3 hrs):</p> <p>Physiology of the mammalian oestrous cycle (follicular and luteal phases). Physiology of gametogenesis, pregnancy (maternal physiological changes in pregnancy), placentation, gestation, parturition, puerperium period and lactation.</p>
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B. Endocrinology:

Specific Objectives	Units & Course Contents
Understand endocrinology and endocrine glands found in various animals.	<p>1. Endocrinology (2 hrs):</p> <p>Definition of endocrinology. Concept of endocrine glands. Endocrine glands in insects, crustaceans, certain mollusks and vertebrates.</p>
Describe types of endocrine glands, their location, structures, and hormones with their biological functions.	<p>2. Endocrine Glands (7 hrs):</p> <p>Structure, location and functions of following endocrine glands with their respective hormones and their biological functions: Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads and Thymus.</p>
Understand the basics of hormones, their classification, hormone receptors and signal transduction mechanism in animals.	<p>3. Hormones, Hormone receptors and Signal transduction (5 hrs):</p> <p>Concept and classification of hormones. Nature of hormones. Hormones and homeostasis. Mechanism of action of hormones. Hormone receptors and their signaltransduction pathways utilized by steroidal and nonsteroidal hormones. Endocrine, paracrine, and autocrine modesof hormone delivery. Feedback mechanisms.</p>
Recognize specific function of endocrine glands in insect and the concept of pheromone.	<p>4. Endocrine Glands in Insect (3hrs):</p> <p>Pars intercerebralis, Corpus cardiacum, Corpus allatum complex. Prothoracic gland. Pheromones as means of communication in external environment.</p>

Describe the neuroendocrine control of metamorphosis and molting in insects and amphibians and know the chromatophones and melanogenesis in animals.	<p>5. Neuroendocrine Control (3 hrs):</p> <p>Neuroendocrine control of metamorphosis and molting in insects and amphibians. Chromatophones, melanogenesis and regulation of functions among animals.</p>
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Text Books

- Boral, A.K. Mammalian Endocrinology. Published by New Central Book Agency (P) Ltd, India
- Jordan, E.L. and Verma, P.S. Chordate Zoology & Animal Physiology. Latest ed., S. Chand, New Delhi.
- Kotpal, R.L. Modern Textbook of Zoology: Vertebrates. Latest ed., Rostogi Pub., Meerut India.
- Rastogi, S.C. Text Book of Physiology. Willey Eastern Ltd.
- Verma, P.S. and Agarwal, V.K. 2012. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. Published by S.Chand & Company LTD, New Delhi India.

References:

- Bijlani, R.L. (Ed.) Understanding Medical Physiology, Jaypee Brothers, Medical Publishers (P.) LTD. India.
- Eckert, R. and Randall, D. Animal Physiology, CBS Publishers and Distributers, India.
- Goel, K.A. and Sastri, K.V. 1998. A Text Book of Animal Physiology. Rastogi Pub., Meerut.
- Guyton, A.C. & Hall, J.E. 2006. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
- Hoar, William S. General and Comparative Physiology. Prentice Hall.
- Juneja, Kavija. 2002 Animal physiology, 1st ED. Pub.: Anmol Publications
- Knut Schmidt- Nielson. Animal Physiology. Cambridge Univ. Press.
- Knut Schmidt-Nielsen. 1973. Animal Physiology. Foundations of Modern Biology Series. Prentice Hall. Scientific Publishers Ltd, 9 Newtec Place, Magdalen Road, Oxford OX4 IRE, UK.
- Sherwood, Lauralee., Klandorf, Hillar., Yancey, Paul H. 2013. Animal physiology: from genes to organisms; 2nd ed., International ed; Brooks/Cole ;Cengage Learning
- Sperelakis, Nicholas & O.Babck, Robert 2002. Essentials of Physiology, 2nd ED.
- Yapp, W.B. 1970. An Introduction to Animal Physiology. Oxford at the Clarendon Press.
- Tortora, G.J. & Grabowski, S. 2006. Principles of Anatomy & Physiology. XI Edition. John Wiley & sons, Inc.

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Semester IV

Course Title: Animal Physiology and Endocrinology

Credit 1

Nature of the Course: Practical

Number of hours per week: 3

Course No: ZOO241

Instruction hours: 45

Year: Second. Semester IV

Course Objectives:

- To impart practical knowledge on animal physiology and endocrinology.
- **Course Contents:**

1. Demonstrate activity of salivary amylase and effect of acid and heat on its activity.
2. Determination of haemoglobin percentage in the blood.
3. Determination of blood clotting time.
4. Blood grouping.
5. Determination of the total number of human RBCs, WBCs.
6. Detection of carbohydrates.
7. Detection of proteins.
8. Detection of lipids.
9. Detection of sugar and urea in urine.
10. Study of estrus cycle in rat – vaginal smear method.
11. Demonstration of the knee jerk reflex.
12. Measurement of the rate of contraction and relaxation of muscles using kymograph.
13. Study of internal ear, eye muscles and gills in fish.
14. Determine the pregnancy in the mammal by means of a urinary hormone assay.
15. Dissection of mammal for localization of endocrine glands.
16. Study of histological slides of the following endocrine glands: pituitary, thyroid, parathyroid, adrenal, pancreas, testis and ovary.

References:

- American Physiological Society. Hand Book of Physiology, Oxford University Press, Section 7: Multiple volumes set.
- Swarup, H., Pathak, C.S. and Arora, S. Laboratory Techniques in Modern Biology. Himalayan Publishers.
- Verma, P.S. (2016). A manual of Practical Zoology: Chordates, 11th edition. S. Chand Publishing, New Delhi.
