Far Western University
Mahendranagar, Kanchanpur
Faculty of Science and Technology

B. Sc. Sixth Semester Biology Group

FAR WESTERN UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY

Course Title: **Energy and Environment** Credit: **3**

Course Code: **ENV 362** Number of hours per week: **3**

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

Year: **Third** Semester: **Six**

Level: **B.Sc.**

Course Objectives

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

- Understand the basics of linkages between energy and environment
- Acquire knowledge on various types of renewable energy and technologies to harness the respective energies
- Acquire knowledge on various types of non-renewable energy and environmental impacts of non-renewable energy consumption
- Understand approaches to use energy sustainably and efficiently
- Understand contemporary issues in energy policy
- Take insights on organizations/institutions in energy sector

Objectives	**Units, Contents and Lecture Hours**
• Understand the basics of linkages between energy and environment	**Unit I: Introduction (6 Hrs)** Concept of energy and energy units; Renewable and non-renewable energy sources; Energy consumption and environmental impacts; Environmental concerns in energy development; Status and issues of energy resources in Nepalese context
• Acquire knowledge on classification, production and consumption of energy	**Unit II: Classification, production and consumption of energy (5 Hrs)** Energy classification: Renewable and non-renewable; Traditional, commercial and alternative energy resources; Production and consumption of energy: Global, regional and national scenario;
• Acquire knowledge on various types of renewable energy and technologies to harness the respective energies	**Unit III: Renewable Energy and Technologies (12 Hrs)** Renewable energy technologies, share of renewable energy in energy use; Hydropower energy: hydroelectricity in Nepal, environmental impacts; Solar energy: solar thermal energy, solar photo voltaic, solar energy in Nepal; Bio-energy:

	biogas production and use in Nepal, charcoal, bio-briquettes; Energy from waste (Waste to energy, W2E); Ocean energy (OTEC, wave energy, tidal wave); Wind energy; Hydrogen energy and fuel cells; Geothermal energy;
• Acquire knowledge on various types of non-renewable energy and environmental impacts of non-renewable energy consumption	**Unit IV: Non-renewable Energy (7 Hrs)** Non-renewable energy: conventional fossil fuels (coal, petroleum, natural gas) and non-conventional fossil fuels (oil shale, natural gas hydrates in marine sediments) ; Nuclear energy; Environmental impacts of non-renewable energy consumption
• Understand approaches to use energy sustainably and efficiently	**Unit V: Conservation of Energy Resources (5 Hrs)** Introduction to sustainable energy; Sustainability challenge: energy, climate and environment; Energy efficiency: industry, transportation, commercial and residential buildings;
• Understand contemporary issues in energy policy • Take insights on organizations/institutions in energy sector	**Unit VI: Energy Economics and Policy (10 Hrs)** Prospects of green technology and financing; Energy markets and strategy Contemporary issues in energy policy; Energy and Society: energy issues in developing countries; Climate change and the quest for green energy; Decarbonizing energy sector: challenges and opportunities Organizations/institutions working on energy development, Policy directives**,** Scope and challenges of renewable energy applications in Nepal

References:

1. Boyle, G. (2008). (Ed.). Renewable energy: power for sustainable future. Oxford University Press, New York.
2. Hinrich, R.A. (1996). Energy: its use and the environment. Sanders College Publishing, Philadelphia.
3. Kothari, D.P., Singal, K.C., and Ranjan, R. (2009). Renewable energy sources and energy technology. PHI Learning Pvt. Ltd., New Delhi.

4. Masters, G.M. (1974). Introduction to environmental science and technology. Wiley, New York.
5. Miller, Jr. G. T. and Spoolman, S.E. (2009). Living in the Environment: Concepts, Connections, and Solutions, 16th Edition. Brooks/Cole, Cengage Learning.
6. Nalini, K.S. (1993). Environmental Resources and Management. Anmol Publishers.
7. Ristinin, R.A. and Kraushaar, J.J. (2006). Energy and Environment. John Wiley and Sons, Inc., New York.
8. Ristinin, R.A. and Kraushaar, J.J. (2006). Energy and environment. John Wiley and Sons Inc., New York.
9. UNDP/NPC. (1995). Prospective energy plan for Nepal. Perspective Energy Plan Project United Nations Development Programme and National planning Commission, Kathmandu.
10. WECS, 2010. Energy Synposis Report, Water and Energy Commission Secretariat, GoN, Kathmandu.
11. WECS. (1995). Alternative energy technology- overview and assessment. Water and Energy Commission Secretariat, GoN, Kathmandu.
12. WECS. (2006). Energy synopsis report. Water and Energy Commission Secretariat, GoN, Kathmandu.

FAR WESTERN UNIVERSITY
FACULTY OF SCIENCE AND TECHNOLOGY

Course Title: **Environmental Engineering** | Credit: **3**

Course Code: **ENV 361** | Number of hours per week: **3**

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

Year: **Third** | Semester: **Sixth**

Objectives

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

- Understand the fundamentals of environmental engineering
- Acquaint with air and water pollution, pollutants and their classification, sources and effects
- Understand air, noise, water and solid waste pollution control technology
- Understand the fundamentals of water pollution, characteristics of wastewater and treatment of wastewater
- Understand the basics of landfill sites (design and operation)

Specific Objectives	**Contents**
• Understand the fundamentals of environmental engineering	**Unit I: Introduction to Environmental Engineering (5 Hrs*)*** Definitions: environment, engineering and environmental engineering; Scope and areas of application of environmental engineering; Units of measurement: base SI units, derived SI units, units outside SI system; Measurement of environmental pollution: air/water pollutant concentration measurement units, conversion of measurement units
• Acquaint with air pollution, air pollutants and their classification, sources and effects • Understand air pollution control technology • Know basics of noise	**Unit II: Air and Noise Pollution Control (10 Hrs)** Sources and types of air pollutants: definition of air pollution, classification of air pollutants, sources of air pollutants; Effects of air pollutants; Environmental standards for air quality: Air Quality Standards (AQS), emission standards; Transport and diffusion of air pollutants: source characteristics, downwind distance,

pollution and control options	wind speed and direction, atmospheric stability; Introduction of air pollution control technology: control of gaseous pollutants, control of particulate pollutants, control of mobile source/automobile emissions; Positive Crankcase Ventilation (PCV) system; Adsoprtion Canisters; Catalytic converters Noise Pollution Control: Sound vis-a-vis Noise; Typical sources of noise; Quantification of sound in terms of SPL and PWL; Typical noise levels at different places and effects of noise; Noise control options
• Get fundamentals of water quality analysis • Understand raw water treatment technology and monitoring of water quality	**Unit III: Water Supply and Treatments (10 Hrs)** Sources of Water Supply; Impurities in water: states of solution impurities; Water quality analysis: types of sampling (grab, composite), types of quantitative analysis (gravimetric analysis, volumetric analysis, colorimetry, physical methods/nephelometry); Engineered systems for water purification; Raw water treatment technology: surface water treatment technology, groundwater treatment technology; Monitoring of water quality: water quality parameters and standards (in-stream standards, potable water standards)
• Understand the fundamentals of water pollution and characteristics of wastewater • Understand the basics of wastewater treatment technology	**Unit IV: Water Pollution Control and Wastewater Treatment (10 Hrs)** Sources of Wastewater: Point sources and Non-point Sources, Water pollutants and their sources; Environmental pollution caused by untreated wastewater; Characteristics of wastewater: characteristics of domestic/municipal WW, characteristics of industrial WW; Characteristics of WW sewerage system: Types of wastewater sewerage system; Wastewater Treatment Technology: Primary treatment, Secondary (Biological) treatment, Advanced treatment; Effluent Standards: Definition, Types; Design and criteria of constructed wetlands
• Acquaint with resource recovery from solid waste	**Unit V: Solid Waste Management (10 Hrs)**

(material, energy) • Understand the basics of landfill sites (design and operation)	Concept of Integrated SW Management (ISWM): hierarchy of waste management; Collection, transfer, disposal of SW: types of collection system, inter-route transfer, final disposal and sanitary landfill, site selection, site preparation; Introduction to resource recovery: material recovery, recovery of biological conversion products, recovery of thermal conversion products, recovery of energy from conversion products; Landfill sites: design and operation aspect of landfill sites; Overview of SW Management in Nepal

FAR WESTERN
UNIVERSITY FACULTY OF
SCIENCE AND TECHNOLOGY

Course Title: **Environmental Engineering**	Credit: **1**
Course Code: **ENV 361**	Number of hours per week: **3**
Nature of the Course: **Practical (Core Course)**	Total hours: **45**
Year: **Third**	Semester: **Sixth**

Practical Session for EE

1. Water quality analysis of wastewater (pH, EC, TSS, COD, BOD, Ammonia, TKN, TotalPhosphorus, Coliform bacteria, Relevant heavy metals)
    a. Municipal wastewater
    b. Industrial wastewater
2. Analysis of solid waste: household, commercial and municipal
    a. Physical – mass, volume, density, moisture content, physical classification, calorificvalue
3. Analysis of leachate from landfill sites (Temperature, pH, EC, Ammonia, BOD, COD,Relevant heavy metals)
4. Determination of TSP and PM_{10} Concentration in Ambient Air
5. Measurement and comparison of noise level (equivalent, percentile) in residential, public andwork places
6. Field Visits
    a. Field visit to water and wastewater treatment plants for water treatment and wastewater treatment technologies (*Students are required to submit field visit reportindividually*)
    b. Field visit to landfill sites for solid waste management technologies (*Students arerequired to submit field visit report individually*)
    c. Field visit to industries for air pollution control technologies (*Students are required tosubmit field visit report individually*)

FAR WESTERN UNIVERSITY FACULTY OF SCIENCE AND TECHNOLOGY

Course Title: **Research Methodology I**
Course No.: **RSM361**
Nature of the Course: **Theory**
Year: **Third**, Semester**: Sixth**
Level: **Undergraduate (B.Sc.)**

Credit: **3**
Number of hours per week: **3**
Total hours: **45**

Course Description

The course intends to enable the students to be acquainted with the basic concepts of Research Methodology. Students will be familiarized with the fundamentals of Research and its methods, Research design, Types of researches, Ethical standards, Proposal writing, etc.

Course Objectives

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

- to understand the importance of ethical standards and methods of scientific research
- to acquire sufficient basic knowledge in research methodology
- to apply this knowledge base for conducting researches
- to prepare research proposals

Course Contents

1. Introduction to Research: Objectives, Types, Approaches and significance of research and research methodology, Ethical issues and plagiarism [7]
2. Defining the Research Problem: Selecting and defining a problem, Necessity and techniques involved in defining a problem [4]
3. Research Design: Important features of research design, Concepts, Different research designs, Theoretical and experimental designs [7]
4. Design of Sample Surveys: Sampling errors, Sample survey and census survey, Types of sampling design [3]
5. Measurement and Scaling: Quantitative and qualitative data, Measurement scales, Sources of error, Measurement tools and scaling [7]
6. Data Collection and Preparation: Experimental and survey data, Primary and secondary data, Selection methods, Process of data preparation, Missing values and outliers, Statistics in research [9]
7. Statistical Analysis: Central tendency, Dispersion, Skewness, Correlations [8]

References and suggested readings

C. R. Kothari and G. Garg, Research Methodology: Methods and Techniques (Third edition), New Age International Publishers, India (reprint 2017)

Murray R. Spiegel and Larry J. Stephens,Statistics (Schaum's Outline Series) 4th edition, Tata McGraw-Hill Pub., India (2010)

P.K.Jha, D. D. Shakya, S. D. Joshi, R.P. Chaudhary and S.R. Shakya (eds.), Research Methods and Practice, Buddha Academic Publishers and Distributors, Kathmandu, Nepal (2004)

Ranjana Gupta and Deb P.Pandey, Research Methodology: Fundamentals and Practice, RatnaPustakBhandar, Kathmandu, Nepal (2007)

FAR WESTERN UNIVERSITY
Faculty of Science and Technology

Course Title: Chemistry VI
Course No.: CHM361
Nature of Course: Practical — Credit: 1
Level: B. Sc. — Number of hours per week: 3
Year: Third, Semester: Sixth — Teaching Hours: 45
(In laboratory course, 1 credit will amount to 3 hours of classes per week)

1. Course Description:

The course intends to enable the students to be skilful in the basic chemical laboratory techniques of physical, organic and inorganic branches of chemistry. Students will be introduced to scientific method of experimentation. They 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 the students to perform experiments on heat of neutralization, conductance, adsorption isotherms, determination of polymers' molecular weight and soap/detergents' cleansing action.
- To enable the students to perform experiments on different chromatographic techniques.
- To enable the students to develop skill on the preparation and characterization of inorganic complexes and water pollution parameter.

3. Specific Objectives and Course Contents:

Specific Objectives	Contents
• Enable the students to estimate the heat of neutralization of strong acid & strong base. • Enable the students to verify Onsager's equation & to estimate equivalent conductance at infinite dilution. • Enable the students to verify Freundlich & Langmuir adsorption isotherms. • Enable the students to determine the molecular weight of high polymeric materials. • Enable the students to compare the cleansing action of different soap & detergent available in local market.	**Unit I: Physical Chemistry Practical (15 hrs)** 1. To determine the heat of neutralization of HCl and NaOH. 2. To verify Onsager's equation and to determine the equivalent conductance of a strong electrolyte at infinite dilution. 3. To study the adsorption of acetic acid from aqueous solution by activated charcoal and to verify the Freundlich/Langmuir's adsorption isotherm. 4. To determine the molecular weight of a high polymer by viscosity measurement. 5. To determine the surface tension of soap and detergent solutions by drop number method and compare their cleansing action.
• Enable students to perform experiment of separation, identification and purification of organic compounds and natural products using different chromatographic techniques.	**Unit II: Organic Chemistry Practical (15 hrs)** 1. Separation of organic compounds (amino acids) by paper chromatography. 2. Separation of mixture of organic compounds by TLC. 3. Separation and identification of organic compounds by co-TLC. 4. Separation and purification of mixture of organic compounds by column chromatography. 5. Separation of natural products by chromatographic techniques.

• Enable students to perform experiment to determine dissolved oxygen (DO) in water sample. • Enable students to prepare & characterize some important inorganic complexes.	**Unit III: Inorganic Chemistry Practical (15 hrs)** 1. Determination of dissolved oxygen (DO) in water sample by Winkler's iodometric method. 2. Preparation of cuprous thiourea complex. 3. Preparation of ferrous ammonium sulphate (Mohr's salt). 4. Preparation of potassium trioxalato chromate (III) trihydrate. 5. Preparation of potassium trioxalato ferrate (III) trihydrate and estimation of percentage of oxalate present in the complex.

Note: Before the start of an experiment, the teacher presents a lecture on the details of the experiment including the safety considerations. Each student will perform independently all the experiments prescribed in both practical class and examination. Students should complete all the experiments prescribed.

Students need to write a laboratory report on each experiment they perform and get them duly checked and signed by the concerned teacher. They should write their reports in a chemistry practical copy and to keep them neat and properly.

4. Prescribed Texts for CHM 363:

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 & A. Gurtu, **Advanced Physical Chemistry Experiments**, 4th Edition, Pragati Prakashan, 2008.
4. J. N. Gurtu & R. Kapoor, **Advanced Experimental Chemistry** (Vol I – III), S. Chand and Co., New Delhi, India, 1989. (Latest edition).
5. 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.
6. A. L, Vogel, **Qualitative Inorganic Analysis**, Prentice Hall, Latest Edition.
7. L. Shriner, R. C. Fusion & D. Y. Curtin, **The Systematic Identification of Organic Compounds, A Laboratory Manual**, John Wlley and Sons Inc, New York, USA , 1980. (Latest Edition).
8. N. S. Gnanapragasam & G. Ramamurthy, **Organic Chemistry– Lab Manual,** S. Viswanathan Co., Pvt., India, 1998.
9. **Vogel's Text Book of Inorganic Qualitative Analyses**, 4th Edition, ELBS, London, 1974. (Latest Edition).
10. P. N. Yadav, M. R. Pokhrel & S. Shrestha, **Advanced Practical Inorganic Chemistry,** Kshitiz Publication, Kahmandu, 2017.
11. N. M. Khadka, S. D. Gautam & P. N. Yadav, **A Core Experimental Chemistry for B.Sc.***,* Heritage Publication, Kathmandu, 2016.
12. M. K. Sthapit & R. R. Pradhananga, **Experimental Physical Chemistry**, Taleju Prakasan, Kathmandu, Nepal, 1998.
13. K. N. Ghimire, M. R. Pokhrel K. P. Bohara**, University Experimental Inorganic Chemistry**, Quest Publication, Kirtipur, Kathmandu, Nepal, 2008.

FAR WESTERN UNIVERSITY
Faculty of Science and Technology

Course Title: Chemistry VI F.M.: 100
Course No.: CHM361 P.M.: 45%
Nature of Course: Theory Credit: 3
Level: B. Sc. Number of hours per week: 3
Year: Third, Semester: Sixth Teaching Hours: 45

1. Course Description:

The course intends to enable the students to be acquainted with the basic concepts of chemistry in all three branches of physical, organic and inorganic chemistry. Students will be familiarized with fundamentals of the surface phenomena, polymer chemistry, carbonyl condensation reactions, amines, aromatic nitro-compounds, hydrogen and detailed studies of preparation, properties, bonding, structure and applications of some selected compounds of boron and silicon, interhalogens compounds and pseudohalogens.

2. Course Objectives:

The general objectives of the course are as follows:

- To acquaint the students with fundamentals knowledge of adsorption phenomena, its applications and polymer chemistry.
- To familiarize the students with carbonyl condensation reactions, amines, aromatic nitro-compounds.
- To acquaint the students with basic concept of hydrogen, its isotopes and hydrides.
- To enable the students to understand the detail of some important compounds of boron and silicon, interhalogens and pseudohalogens.

3. Specific Objectives and Course Contents:

Specific Objectives	Contents
• Explain the adsorption, absorption & sorption phenomena with examples. • Enable the students to differentiate between physical & chemical adsorption. • Describe different types of adsorption isotherms. • State the postulates, derivation, interpretation of Freundlich & Langmuir isotherms and their limitations. • Describe the postulates, equation & limitations of BET adsorption isotherm. • Enable the students to determine the surface area of solids using BET equation. • Outline main applications of adsorption. • Explain the structures of soap, detergents and their cleansing actions. • Enable the students to solve numerical problems related with adsorption.	**Physical Chemistry** **Unit I: Surface Phenomena (10 hrs)** Adsorption, absorption and sorption, physical and chemical adsorption, factors affecting the adsorption, types of adsorption isotherms, Adsorption isotherms: Freundlich and Langmuir adsorption isotherms (postulates, derivation, interpretation and limitation), Brunauer-Emett-Teller (BET) adsorption isotherm (postulates, equation and limitation), determination of surface area of solid adsorbents by BET method, applications of adsorption, soap and detergents, cleansing actions of soap and detergents, related numericals.
• Briefly explain the different types of polymers. • Describe the mechanism of addition, condensation, free radical and ionic polymerizations. • Discuss some important properties of polymers and their applications. • Define the degree of polymerization.	**Unit II: Polymers and Polymerization (5 hrs)** Introduction, types of polymers (homo- & copolymers, isotactic, atactic, syndiotactic, copolymers, natural organic and inorganic polymers), types of polymerization mechanisms (addition, condensation, free radical & ionic polymerizations), properties of

• Enable the students to solve numerical problems related with polymerization.	polymers, applications of polymers, degree of polymerization, related numericals.
• Explain the mechanism of condensation reactions of carbonyl compounds. • Describe Aldol condensation mechanism in different reaction condition. • Explain the applications of Aldol reaction in different sector of organic synthesis. • Discuss the mechanism and applications of Claisen condensation and Dieckmann reaction. • Describe the reactions of conjugated carbonyl compounds. • Discuss the mechanism of enamine forming reactions and their applications in organic synthesis. • Explain the reaction, mechanism and applications of Michael reaction in organic synthesis. • Describe the reaction and mechanism of Stork reaction with applications. • Discuss the reactions and mechanism of Robinson annulation reaction. • Explain the nomenclature of different organic amines. • Describe the physical & chemical properties of aliphatic & aromatic amines. • Discuss the application of Henderson-Hasselbalch equation in chemistry of amine. • Discuss the reaction and mechanism involving in the synthesis of amines. • Describe the Hofmann and Curtius reactions in the preparation of amine. • Discuss the reactions of amines with mechanism. • Describe the electrophilic substitution reactions and mechanism of amines with electrophile in aromatic amines. • Discuss the reaction, mechanism and applications of Sandmeyer and diazonium coupling reaction. • Explain the nomenclature and preparation of aromatic nitro compounds. • Describe the physical and chemical properties of nitrobenzene. • Explain the mechanism of nitration of aromatic nitro compounds. • Discuss the orientation and reactivity of nitrobenzene towards electrophilic substitution reaction. • Discuss the industrial preparation and utility of trinitrotoluene (TNT).	**Organic Chemistry** **Unit III: Carbonyl Condensation Reactions (7 hrs)** Carbonyl condensation: aldol condensation, carbonyl condensation versus alpha substitution, dehydration of aldol product: synthesis of enones, using aldol reactions in synthesis, mixed aldol reactions, intramolecular aldol reactions, Claisen condensation, mixed Clasisen condensation, intramolecular Claisen condensations: Dieckmann cyclization, conjugate carbonyl addition: The Michael reaction, carbonyl condensation with enamines: Stork reaction, Robinson annulation reaction, some biological carbonyl condensation reaction. **Unit IV: Amines (5 hrs)** Naming amines, properties of amines, basicity of amines, basicity of substituted aryl amines, biological amines and the Henderson-Hasselbalch equation, synthesis of amines, reduction of nitriles, amide, and nitro compounds, SN2 reactions of alkyl halides, reductive amination of aldehydes and ketones, Hofmann and Curtius rearrangements, reactions of amines, alkylation and acylation, Hofmann elimination, reactions of aryl amines, electrophilic aromatic substitution reaction, Diazonium salts: Sandmeyer reaction, diazonium coupling reaction. **Unit IV: Aromatic Nitro Compounds (3 hrs)** Preparation of aromatic nitro compounds by direct nitration, preparation, properties and reactions of nitrobenzene, orientation and reactivity of electrophilic substitution reactions of nitrobenzene, trinitrotoluene.
• Explain the isotopes of hydrogen. • Explain the isotope effect in hydrogen and its application. • Describe the types of binary compounds of hydrogen.	**Inorganic Chemistry** **Unit V: Hydrogen (3 hrs)** Composition of naturally occurring hydrogen, isotopes of hydrogen, isotope effect, hydrides: ionic, covalent, interstitial and intermediate hydrides.

• Describe the structure, bonding, applications and mode of preparation of some important compounds of boron and silicon. • Describe the types of interhalogen compounds. • Explain the nature of Pseudohalogens.	**Unit VI: Structure, Bonding, Preparation, Properties and Applications of the Following (6 hrs)** Borohydrides, boron trifluoride, borazines, silicates, silicones, interhalogen compounds and pseudohalogens.
• Explain the modern concept of electronegativity, electron affinity and ionization energies.	**Unit VII: Electronegativity, Electron Affinity and Ionization Energies (6 hrs)** Recent advances in electronegativity theory, choice of electronegativity system, group electronegativity, electronegativity equalization, ionization energy, electron affinity curves, anomalous electron affinity and ionization energies.

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

(4). Evaluation System

Undergraduate Programs

External Evaluation	**Marks**	**Internal Evaluation**	**Weightage**	**Marks**	**Viva-voce**	**Weightage**	**Mark**
End semester examination	60	Assignments	20%	20	Report and Presentation on any topic	50%	20
(Details are given in the separate table at the end)		Quizzes	10%		Presentation	25%	
		Attendance	20%		Viva	25%	
		Internal Exams	50%				
Total External	60	Total Internal	100%	20		100%	20
Full Marks 60+20+20 = 100							

(I).External evaluation:

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 Evaluation (Viva):

After completing the end semester theoretical examination, viva examination will be held. External examiner will evaluate report/presentation & take viva exam and will do above mentioned evaluation. Students should make a small report by relating any of the studied topics in the subject to some application areas/examples.

Reports can be made in groups. There will be an internal examiner to assist the external examiner. 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.

(II). 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. If a student fails to attend a formal exam/quiz/test, there won't be any provision for re-exam.

5. Prescribed Texts for CHM361:

1. S. H. Maron & C. Prutton, **Principles of Physical Chemistry**, Oxford and IBH Publication and Co., 1992.
2. P. Atkins & J. de Paula, **Elements of Physical Chemistry**, 5th Edition, Oxford University Press Inc., New York (Printed in India by Saurabh Printers Pvt. Ltd., New Delhi), 2009.
3. John McMurry, **Organic Chemistry**, 7th Edition, Brookes/Cole, 2008.
4. J. D. Lee, **Concise Inorganic Chemistry**, 5th Edition, John Wiley and sons. Inc., 2007.
5. James, E. Huheey, Ellen A. Keiter & Richard L. Keiter, **Inorganic Chemistry: Principles of Structure and Reactivity,** Addison Wesley Publishing House.

4. References for CHM361:

1. S. Negi & S. C. Anand, **A Textbook of Physical Chemistry**, New Age International Pvt. Ltd., New Delhi, 1999.
2. A. Bahl, B. S. Bahl & G. D. Tuli, **Essential of Physical Chemistry**, Revised Multicolour Edition, S. Chand & Co. Ltd., New Delhi, 2012.
3. M. R. Senapati, **Advanced Engineering Chemistry**, 2nd Edition, Infinity Science Press LLC, Hingham, Massachusetts, 2007.
4. F. Daniels & R. F. Alberty, **Physical Chemistry**, John Wiley & Sons, Latest Edition.
5. R. T. Morrison & R. N. Boyd, **Organic Chemistry**, Prentice- Hall of India Pvt. Ltd., 2008.
6. J. S. H. Pine, **Organic Chemistry**, McGraw Hill International Edition Series, New York, USA, 1987.
7. F. A. Cotton, G. Wilkinson & C. Gaus**, Basic Inorganic Chemistry**, John Wiley & Sons (Asia) Pvt. Ltd., 2007.
8. D. F. Shriver & P. W. Atkins, **Inorganic Chemistry**, W. H. Freeman and Co., London, 2014.
9. B. R. Puri, L. R. Sharma & K. C. Kalia, **Principles of Inorganic Chemistry**, Shoban Lal Nagin Chand and Co., Delhi, India, 1996.
10. F.A. Corey and R.M. Giuliane, **Organic chemistry,** 8th Edition, Tata McGraw Hill Education Pvt.Ltd. 2012.

FAR WESTERN UNIVERSITY
Faculty of Science and Technology

Course Title: Chemistry VII — F.M.: 100
Course No.: CHM362 — P.M.: 45%
Nature of Course: Theory — Credit: 3
Level: B. Sc. — Number of hours per week: 3
Year: Third, Semester: Sixth — Teaching Hours: 45

1. Course Description:

The course intends to enable the students to be acquainted with the fundamental concepts of chemistry in all three branches of physical, organic and inorganic chemistry. Students will be familiarized with different molecular spectroscopic (rotational, vibrational, Raman, electronic and nuclear magnetic resonance) techniques, heterocyclic compounds and reaction intermediates, fertilizers and environmental pollution.

2. Course Objectives:

The general objectives of the course are as follows:

- To enable the students with basic theoretical and practical knowledge of rotational, vibrational, Raman, electronic and NMR spectroscopic techniques.
- To familiarize the students with basic knowledge of heterocyclic compounds and reaction intermediates.
- To acquaint the students with basic concept of technical method of preparation, importance and environmental impact of chemical and bio-fertilizers.
- To enable the students to understand the basic concept of air, water and soil pollution.

3. Specific Objectives and Course Contents:

Specific Objectives	Contents
• Discuss the basic knowledge of electro-magnetic radiation, origin and types of molecular spectra. • Enable the students with basic knowledge of rotational (microwave) spectroscopic technique, • Describe the concept of dipole moment and rotation spectra. • Explain rotational energy levels of a molecule. • State and explain the selection rules of rotational spectra. • Describe applications of rotational spectroscopy. • Enable the students with basic concept of IR spectroscopic technique. • Explain the energy levels of simple harmonic oscillator. • State and explain the selection rules of vibrational spectra. • Describe the effect of anharmonic motion and vibrational modes. • Explain the origin of pure vibrational and vibration-rotation spectra (P, Q, R braches). • Enable the students to apply IR spectra in various aspects.	**<u>Physical Chemistry</u>** **Unit I: Rotational & Vibrational Spectroscopy (8 hrs)** Electromagnetic radiation and spectra, atomic and molecular spectra, origin of molecular spectra, types of molecular spectra. *Rotational spectrum:* microwave spectrum, concept of dipole moment and rotation spectra, rotational energy levels of molecules, selection rule of rotational spectra, applications of rotational spectroscopy. *Vibrational spectrum:* infrared spectrum, energy levels of simple harmonic oscillator, selection rules of vibrational spectra, pure vibrational spectrum, effect of anharmonic motion, vibrational modes of molecules, vibration-rotation spectra, applications of infrared spectroscopy (structure elucidation & identification of a compound, determination of purity & force constant, reaction kinetic study and others), related numericals
• Describe the concept of polarizibility. • Explain pure rotational and vibrational Raman spectra of diatomic molecules.	**Unit II: Raman & Electronic Spectroscopy (4 hrs)** *Raman spectrum:* concept of polarizibility, pure rotational and

• State and explain selection rules of Raman spectra. • Explain Franck-Condon principle & describe electronic transitions. • State and explain the selection rules of electronic spectra. • Discuss the applications of electronic spectroscopy.	vibrational Raman spectra of diatomic molecules, selection rules. *Electronic spectrum:* introduction, Franck-Condon principle, types of electronic transitions, selection rules, applications of electronic spectroscopy.
• Explain the basic principles of NMR. • Discuss about the electrons and nuclei in magnetic field. • Brief introduction of different NMR techniques of ^{1}H-NMR, ^{13}C-NMR, Fourier transform-NMR and electron magnetic resonance. • Describe the terms of chemical shift and spin-spin coupling constant to elucidate the structure of compounds.	**Unit III: NMR Spectroscopy (3 hrs)** Principles of nuclear magnetic resonance (NMR) spectroscopy, electrons and nuclei in magnetic field, NMR techniques, chemical shift, spin-spin coupling, applications of NMR spectra.
• Describe about the structure sources and utility of heterocyclic compounds. • Describe the sources of pyrrole, furan and thiphene. • Explain the chemical and physical properties of pyrrole, furan and thiphene. • Discuss the mechanism of electrophilic substitution reactions of pyrrole, furan and thiophene. • Discuss the structure and applications of tetrahydrofuran and differences between furan and THF. • Discuss the structure, sources and applications of pyridine in organic synthesis. • Explain the electrophilic and nucleophilic substitution reactions of pyridine. • Describe the aromatic characters of heterocyclic compounds. • Introduce the structure and applications of polycyclic heterocyclic compounds.	**Organic Chemistry** **Unit IV: Heterocyclic Compounds (7 hrs)** Introduction, sources of pyrrole, furan and thiophene, structure, preparation and properties of pyrrole, furan and thiophene, electrophilic substitutions in pyrrole, furan and thiophene (reactivity and orientation), tetrahydrofuran, structure of pyridine, source of pyridine compounds, reactions of pyridine, electrophilic substitution in pyridine, nucleophilic substitution in pyridine, aromaticity of heterocyclic compounds, polycyclic heterocycles.
• Explain the importance of study of different reaction intermediates in chemistry. • Discuss the stability, structure, generation, reactivity, fate and chemistry of carbocation, carbanion, carbene, nitrene free radical, benzyne, nonclassicalcarbonium ion and arenium ion. • Discuss the relative stability of different types of carbocations, carbaanions, free radicals. • Describe the utility of these reaction intermediates in the determination of mechanism of the reaction.	**Unit V: Reaction Intermediates (8 hrs)** Introduction, Stability, structure, generation, reactivity, fate and chemistry of carbocation, carbanion, carbene, nitrene free radical, benzyne, nonclassical carbonium ion and arenium ion.
• Explain the importance of chemical fertilizers. • Describe the role of major and micronutrient for plant. • Describe technical method of preparation of some major fertilizers.	**Inorganic Chemistry** **Unit V1: Fertilizers (6 hrs)** Chemical and bio-fertilizers, importance of chemical fertilizers, role of N, P and K as plant fertilizer, minor ingredients, industrial synthesis of

• Explain the nitrogen fixation and models for dinitrogen complexes. • Describe the major phosphate fertilizers. • Explain the environmental impact of the use of chemical fertilizers.	ammonia, manufacture of urea, nitrogen fixation, dinitrogen complexes, super phosphates and triple phosphates, environmental impact of synthetic fertilizers.
• Introduce the concept of environmental pollution. • Describe the sources of air pollution and types of air pollution. • Describe the type of gas pollutant and particulates. • Explain smog, acid rain, ozone depletion. • Describe the types and sources of water pollution. • Explain some pollution parameters. • Describe methods of waste water treatment. • Describe the sources of soil pollution and its control measure. • Explain the biodegradation and environmental impact of pesticides. •	**Unit VII: Environmental Pollution (9 hrs)** An introduction to the pollution in the air, water and soil. *Air pollution:* Sinks of atmospheric gases, major sources of atmospheric pollution, natural and anthropogenic sources. Classification of air pollutants based on a) origin b) chemical composition c) state of pollutants. *Gaseous pollutants:* NO_x, oxides of sulphur, oxides of carbon, hydrocarbons. *Particulates:* inorganic particulate and organic particulate. Smogs, acid rain, ozone depletion. *Water pollution:* Classification of water pollution, types and sources of water pollution, control of water pollution, pollution parameters: DO, BOD, COD, total alkalinity, Eutrophication, waste water treatment. *Soil pollution:* sources of soil pollution, control of soil pollution, wastes and pollutants in soil, pesticide and its biodegradation.

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

(4). Evaluation System

Undergraduate Programs

External Evaluation	**Marks**	**Internal Evaluation**	**Weightage**	**Marks**	**Viva-voce**	**Weightage**	**Mark**
End semester examination	60	Assignments	20%	20	Report and Presentation on any topic	50%	20
(Details are given in the separate table at the end)		Quizzes	10%		Presentation	25%	
		Attendance	20%		Viva	25%	
		Internal Exams	50%				
Total External	60	Total Internal	100%	20		100%	20
Full Marks 60+20+20 = 100							

(I).External evaluation:

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 Evaluation (Viva):

After completing the end semester theoretical examination, viva examination will be held. External examiner will evaluate report/presentation & take viva exam and will do above mentioned evaluation. Students should make a small report by relating any of the studied topics in the subject to some application areas/examples. Reports can be made in groups. There will be an internal examiner to assist the external examiner. 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.

(II). 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. If a student fails to attend a formal exam/quiz/test, there won't be any provision for re-exam.

5. Prescribed Texts for CHM362:

1. P. Atkins & J. de Paula, **Elements of Physical Chemistry**, 5th Edition, Oxford University Press Inc., New York (Printed in India by Saurabh Printers Pvt. Ltd., New Delhi), 2009.
2. S. H. Maron & C. Prutton, **Principles of Physical Chemistry**, Oxford and IBH Publication and Co., 1992.
3. John McMurry, **Organic Chemistry**, 7th Edition, Brookes/Cole, 2008.
4. J. D. Lee, **Concise Inorganic Chemistry**, 5th Edition, John Wiley and sons. Inc., 2007.
5. G. T. Miller Jr, **Living in the Environment: An Introduction to Environmental Science***,* Wardsworth Publication, California, USA, 1994.
6. A. K. De, **Environmental Chemistry**, New Age International Publishers, New Delhi, India, 2008.
7. J. March, **Advanced Organic Chemistry,** 4th Edition, John Wiley and Sons, 2001.

6. References for CHM362:

1. F. Daniels & R. F. Alberty, **Physical Chemistry**, John Wiley & Sons, Latest Edition.
2. Gilbert. W. Castellan, **Physical Chemistry**, Narosa Publishing House, 1985.
3. S. Negi & S. C. Anand, **A Textbook of Physical Chemistry**, New Age International Pvt. Ltd., New Delhi, 1999.
4. A. Bahl, B. S. Bahl & G. D. Tuli, **Essential of Physical Chemistry***,* Revised Multicolour Edition, S. Chand & Co.

Ltd., New Delhi, 2012.

5. R. T. Morrison & R. N. Boyd, **Organic Chemistry**, Prentice- Hall of India Pvt. Ltd., 2008.
6. J. S. H. Pine, **Organic Chemistry**, McGraw Hill International Edition Series, New York, USA, 1987.
7. F.A. Corey and R.M. Giuliane, **Organic chemistry,** 8th Edition, Tata McGraw Hill Education Pvt.Ltd. 2012.
8. F.A. Cotton, G. Wilkinson & C. Gaus**, Basic Inorganic Chemistry**, John Wiley & Sons (Asia) Pvt. Ltd., 2007.Edition, Tata McGraw Hill
9. D. F. Shriver & P. W. Atkins, **Inorganic Chemistry**, W. H. Freeman and Co., London, 2014.

FAR WESTERN UNIVERSITY

ZOOLOGY CURRICULUM (B.Sc.)

2074

SIXTH SEMESTER

Semester	Course Nature	Course Code	Course Title	Credit	Instruction hrs
VI	Theory	ZOO361	Evolutionary Biology, Zoogeography & Ethology	3	45
	Theory	ZOO362	Biochemistry & Immunology	3	45
	Practical	ZOO363	Related to ZOO361 & ZOO362	1	
				Total= 7	

Far-Western University

Faculty of Science and Technology

B. Sc. Syllabus of Zoology

Course Title: Evolutionary Biology, Zoogeography and Ethology **Credit 3**
Nature of the Course: Theory **Number of inst. hours per week: 3**
Course No: ZOO361 **Total instruction hours: 45**
Year: Third
Semester VI

Course Objectives:

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

- Understand the concepts and principles of evolution
- Know the patterns of distribution of animals
- Understand fundamental aspects of animal behavior.

Course Description:

A: Evolutionary Biology

Specific Objectives	Units & Course Contents
• Discuss the origin of life. • Explain the basic principles (variability, heritability, competition & selection) of organic evolution • Describe the basic patterns of evolution such as progressive and retrogressive. divergent, convergent, parallel evolution, co-evolution, micro, macro, mega and quantum evolution	**Unit 1 : Concept of Organic Evolution (1hr)** Origin of life, Principles of organic evolution, Patterns of evolution
• Discuss Lamarck's theory of evolution with criticism. • Describe Darwinism with its criticism. • Explain modern synthetic theory of evolution.	**Unit 2 : Theories of Evolution (3 hrs)** Lamarckism, Darwinism, Modern synthetic theory .
• Explain how does the fossil record provides the evidence for evolution. • Discuss how does the molecular evidence supports the theory of evolution. • Explain how does the distribution pattern of animals around the earth provides the evidences for evolution.	**Unit 3 : Evidences of Evolution (4 hrs)** Paleontological evidences, Molecular evidences, Biogeographical evidences, Comparative anatomical and Comparative embryological evidences.

• Discuss how does the comparative anatomy and embryology supports the theory of evolution.	
• Describe the types and causes of variations. • Explain the concept of gene pool and gene frequency. • Describe the Hardy-Weinberg law. • Explain the genetic equilibrium and genetic drift. • Explain the natural selection.	**Unit 4:Mechanism of Evolutionary Changes(4 hrs)** Variations, Population genetics (gene pool and gene frequency, Hardy-Weinberg law, genetic equilibrium and genetic drift), Natural selection (concept of selection: stabilizing, directional and disruptive with example) .
• Describe the types and modes of speciation • Explain the pre-mating and post mating isolating mechanisms.	**Unit 5: Products of Evolutionary Change (2 hrs)** Speciation and isolation
• Describe the causes and role of extinction in evolution.	**Unit 6: Extinction (1 hr)** Causes and role of extinction in evolution

B: Zoogeography

Specific Objectives	Units & Course Contents
• Discuss the basic concept of zoogeography based on historical and ecological perspective.	**Unit 1: Introduction (1 hr)** Introduction to zoogeography, Review of historical and ecological principles
• Describe the geographical distribution of animals. • Discuss the bathymetric distribution of animals. • Explain the distribution of animals on the basis of geologic time scale. • Discuss how the biotic and abiotic interactions influence species distribution.	**Unit 2: Animal Distribution (3 hrs)** Geographic, bathymetric, geological, and ecological.
• Discuss the concept and types of animal distribution.	**Unit 3: Patterns of Animal Distribution (2 hrs)** Cosmopolitan, endemic, disjunct /discontinuous and bipolar distribution.
• Discuss the dispersal and barriers with their types and impact on animal distribution	**Unit 4: Biogeographic Process (1hr)** Barriers and dispersal - types and their impact on animal distribution

• Explain the major zoogeographical regions with their climatic and faunal peculiarities.	**Unit 5: Zoogeographical Realms (4 hrs)** Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions - their climatic and faunal –peculiarities
• Discuss how the continental drift theory explains the distribution of animals. • Explain the theory of island biogeography with its criticism.	**Unit 6: Theories (3 hrs)** Continental Drift Theory. Theory of Island biogeography
• Describe the causes of appearance of seasonality in Cenozoic Era. • Explain the causes of glaciations. • Explain how did species survived in Ice age.	**Unit 7: Cenozoic Era, Climate Changes and Mammal Distribution (1 hr)** Causes of appearance of seasonality (fluctuation in temperature, cooling) in Cenozoic Era, Ice Age (causes of Glaciation; Milankovitch theory), and Effects of climate changes on mammalian distribution.

C: Ethology

Specific Objectives	Units & Course Contents
• Discuss the basic concept of science of animal behavior in relation to evolution and in terms of theory of natural selection.	**Unit 1: Introduction (1 hr)** An introduction to key concepts for studying animal behavior including evolution and natural selection
• Discuss how animals learn to adjust their behaviour to their environment, and how they use their mental abilities to solve practical problems. • Describe the types of learning.	**Unit 2: Learning and Development (5 hrs)** Instinct and learning in their biological setting, genetics and behavior, nervous system and behaviors, hormones and behavior development, experience and imprinting. Types of learning, habituation, classical and operant conditioning, comparison between classical and operant learning, other aspect of learning (advanced learning, insight learning and latent learning).
• Explain the various means animals use to send signals to each other, and how these signals are influenced by the environment and social context.	**Unit 3: Communication (2 hrs)** Introduction, means of communication (odor, sound, touch, vision, etc.) with examples.
• Discuss how animals find and exploit food resources, and how they avoid becoming food themselves.	**Unit 4: Feeding Behavior (2 hrs)** Food location, finding prey, optimality theory, optimal foraging and predation, defense strategies against predators, Territoriality and Group foraging.

• Discuss the complexities of creating the next generation, from finding and competing for a mate to rearing offspring.	**Unit 5: Mating Systems and Parental Care (3 hrs)** Reproductive tactics, Monogamy, Polyandry, Polygyny, Female choice. female association;, offspring recognition, tolerance of siblings; adoption
• Discuss the costs and benefits of living with others, how complex social groups arise, and why some animals forego reproduction to help others breed	**Unit 6: Social Behavior (2 hrs)** Social units (solitary, pair, family, harem, matriarchy, oligarchy, arena, hierarchy, aggregation, caste system), advantage and disadvantage of group living, social dominance, primate social organization.

Far-Western University
Faculty of Science and Technology
B. Sc. Syllabus of Zoology

Course Title: Biochemistry and Immunology **Credit 3**
Nature of the Course: Theory **Number of inst. hours per week: 3**
Course No: ZOO362 **Total Instruction Hours: 45**
Year: Third
Semester VI

Course Objectives:

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

- Understand the overall basic concept of biophysics, amino acids, protein, carbohydrates, lipids etc.
- Know the biochemical function, classification, actions of enzymes, vitamins and hormones.
- Internalize the basic concept of immunology along the antigen-antibody interaction, functions of B and T cells.

Course Description:

A: Biochemistry **1.5 credits**

Specific Objectives	Units & Course Contents
• Understand the basic knowledge of pH, buffer, osmotic pressure, colloids, surface tension, absorption and viscosity.	**1. Biophysics (3 hrs)** Hydrogen ion concentration (pH), pH definition, Henderson-Hasselbalch equation. Basic concept of Buffers, Blood buffers, Indicators , Universal indicators for pH Acid-base balance Osmosis and Osmotic pressure: Osmotic pressure, Milli-equivalent, Gibbs Donnan Equilibrium Concept of colloids, Classification of colloids, Properties of colloidal solutions Surface tension, Role of surface tension, Absorption and Viscosity.
• Describe the basic structure, classification and functions of amino acids and proteins.	**2. Chemistry of Amino Acids and Proteins (4 hrs)** Structure, classification and functions ofamino acids. Structure, classification and functions ofproteins.

• Have basic knowledge of the structure of carbohydrates, their classification and functions along with the understanding of mucoproteins and glycoproteins.	**3. Chemistry of Carbohydrates (2 hrs)** Structure and classification of carbohydrates: Monosaccharides,Oligosaccharides, Diasaccharides,Polysaccharides. Functions of carbohydrates. Mucoproteins and Glycoproteins.
• Understand the structure of lipids, their classification & functions along with the antioxidant system and the process of lipid peroxidation.	**4. Chemistry of Lipids (4 hrs)** Structure, classification and functions oflipids Simple, Compound and Derived lipids. 4.3.Antioxidant system, Free radicals 4.4.Process of lipid peroxidation
• Elucidate the basic process of metabolism of proteins, carbohydrates, lipids and nucleic acid.	**5. Metabolism of Proteins, Carbohydrates, Lipids, and Nucleic Acids (4 hrs)** Metabolism of proteins Metabolism of carbohydrates Metabolism of lipids Metabolism of nucleic acids
• Explain basic knowledge about hemoglobin molecules and associated diseases in human. .	**6. Chemistry of Haemoglobin (2 hrs)** Porphins and Porphyrins Hemoglobin: Heme and globin parts, Functions of hemoglobin, Structure of hemoglobin, Hemoglobin variants, Breakdown of hemoglobin Methemoglobin, Myoglobin and Bohr effect Porphyria and Jaundice

• Recognize the basic concept of enzymes, vitamins and hormones in general.	**7. Basic Concept of Enzymes, Vitamins and Hormones (4 hrs)** Concept of enzymes, classification of enzymes and properties of enzymes. Characteristics of co-enzymes. Diagnostic value of plasma enzymes. Concept of vitamins, classification of vitamins. Some examples of deficiency diseases. Concept of hormones, hormone action, Group I(steroid) and Group II (peptide) hormones, Insulin, Glucagon, Triiodothyronine (T3) and Thyroxine (T4), Calcitonin

B. Immunology **1.5 credits**

Specific Objectives	Units & Course Contents
• Understand the fundamentals of immune system including antigen-antibody concept, their reaction, functions of T and B cells, and cytokines.	**1. Introduction to Immune System (6 hrs)** Basic concept and definition of immunology Natural and acquired immunity, Active and passive immunity Concept of antigen and antibody, Antigen- antibody reaction Origin of immune cells, Thymic positive and negative selection. T cells: Effector functions of T cells, Regulatory function of T cells B cells: Activation of B cells, Macrophages, Natural killer cells, Difference between T cells and B cells Concept, definition and brief description about cytokines Antibodies: Structure, Effect of proteolytic enzymes on antibodies (immunoglobulin), Isotype, Allotype and Idiotype antibodies, Antibody diversity, Hydridoma and monoclonal antibodies
• Understand the concept of clonal selection theory, MHC and complement system in immunology in general.	**2. Concept of the Clonal Selection Theory and Major Histocompatibility Complex (MHC) (4 hrs)**

	The Clonal selection theory MHC) molecules: Class I molecule, Class II molecule, Class III molecule, MHC polymorphism Complement system: Activation of complement (i) Classical pathway and (ii) Alternative pathway.
• Know the basic cause and effect of disorders of human immunity.	**3. Disorder of human immunity (4 hrs)** Immunodeficiency: Inherited immunodeficiency (Chronic granulomatous disease) and Acquired immunodeficiency disease (AIDS) Autoimmunity: Systemic and organ-specific (localized) autoimmune disorders. Hypersensitivity, Four classes of hypersensitivity (Type I-IV)
• Describe the process of immunotherapy, immunosupression and various transplantations in human.	**4. Immunotherapy (8 hrs)** Concept of Immunotherapy: Immunotherapy and Cancer, Chemotherapy, Radiotherapy, Transplantation: Concept of transplantation, Conventional and modern transplantation MHC system and the rejection process, Way of modifying the rejection process HLA typing and Matching, Source and preparation of graft, Selection and preparation of the recipient, Monitoring the allograft response Non-specific immunosuppression, Specific immunosuppression, The blood transfusion effect Bone marrow transplantation and Autologous transplantation Recent trends and progress in transplantation

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Far-Western University

Faculty ofScience and Technology

B. Sc. Syllabus of Zoology

Course Title: Evo.Bio., Zoogeography, Ethology, Biochem. & Immunology

Nature of the Course: Practical **Credit 1**

Course No: ZOO363 **Number of inst. hours per week: 3**

Year: Third **Total instruction hours: 45**

Semester VI

- **Course Objectives:** To impart practical knowledge on Evolutionary Biology, Zoogeography, Ethology, Biochemistry & Immunology.

Course Contents:

Evolutionary Biology, Zoogeography and Ethology:

1. Study of types of fossils with the help of specimens/ charts/ photos.
2. Study of evidences of evolution- embryological, palaentological, and comparative anatomy (through charts).
3. Indicate Zoogeographical distribution of animals to respective zoogeographical realms on the world map.
4. Habituation in earthworms/mosquito larvae.
5. Study of social behavior in primate/insects.
6. Study of interspecific association between cattle and egrets.
7. Studies on learning behavior using mazes.
8. Study of animal communication.

Biochemistry and Immunology:

1. Measurement of pH of biological liquids with pH meter (Ion meter)
2. Measurement of pH of biological liquids with universal indicator paper
3. Isolation of casein as protein from cow/buffalo milk.
4. Detection of protein from chicken egg.
5. Detection of monosaccharide, disaccharide and polysaccharide from different given samples.
6. Solubility test of lipid from yellow part of chicken egg.
7. Solubility test of lipid from market oil.
8. Identification of blood group from B.Sc students
9. Identification of Rh factor from B.Sc students.

Case study and report writing.

Practical note book preparation as regular study.

Text and Reference Books

Evolutionary Biology, Zoogeography and Ethology:

Alcock, J. Animal Behavior: An Evolutionary Approach. Sinauer Associates. Arora, M.P. 2003. Animal Behaviour. Himalayan Publishing House.

Barton, N.H., Briggs, D.E.G., Eisen, J.A., Goldstein, D.B. and Patel, N.H. 2007. Evolution. Cold Spring Harbour Laboratory Press.

Darlington, P.J. Jr. 1952. Zoogeography: The Geographical Distribution of Animals. John Willey & Sons, New York.

Darwin, C. 1859. On the Origin of Life by means of Natural Selection. John Murray, London.

Drickamer, L.C., Vessey, S.H. and Jakob, E. Animal Behavior: Mechanisms, Ecology, and Evolution. Fifth edition. McGraw-Hill Publishers.

Drickamer & Vessey. 1986. Animal Behaviour – Concepts, Processes and Methods (2nd ed.) Wadsworth.

Hall, B.K. and Hallgrimsson, B. 2008. Evolution. IV Edition. Jones and Bartlett Publishers.

Kotpal, R.L. Modern Text book of Zoology: Vertebrates. Rostogi Pub., Meerut India. Lomolino, M.V.,

Riddle, B.R. and Brown, J.H. 2006. Biogeography. 3rd edition. Sinaeur, Sunderland, MA.

Lull, R.S. 1926. Organic Evolution. Macmillan, New York.

MacArthur, R.H. and Wilson, E.O. 1967. The Theory of Island Biogeography. Princeton University Press, Princeton.

MacDonald, G. 2003. Biogeography. Space.Time.and.Life. Wiley

Manning, A. & Dawkins, M.S. 1998. An Introduction to Animal Behaviour. Cambridge University Press.

Mcfarland : Animal Behaviour, Psychology, Ethology and Evolution (1985, Pitman). Rafferty, J.P. (ed),

2011.The Cenozoic Era: Age of Mammals**.** Britannica Educational Publishing.

Ridley, M. 2004. Evolution. III Edition. Blackwell Publishing.

Sanmbasivia, I., Rao, A.P.K. & Chelllappa, S. Animal Physiology and Ecology. S. Chand and Company.

Singh, H. Chatturvedi, C.M. 1999. Organic Evolution. Anmol publications, New Delhi. Verma, P.S. &

Agarwal, V.K. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company.

Biochemistry & Immunology:

Johnson, A.G. and Clarke, B.L. 2011. High-Yield Immunology, 2nd Edition. Lippincott Williams and Wilkins, A Wholters Kluwer Company.

Malhotra, V.K. 2012. Biochemistry for Students, 12th Edition. Published by Jaypee Brothers Medical Publishers (P) Ltd, 4838/24 Ansari Road Daryaganj, Delhi. Reeves, G. and Todd,

I. 2000. Lecture Notes on Immunology, the 4th Edition. Blackwell Science.

Singh, S.P. 2015. Text Book of Biochemistry, 6th Edition. Published by CBS Publishers and Distributors, New Delhi, India.

Vargas, J.E, Caughey, A.B., Tan, A. Li.J Z.2004. Blueprints Notes and Cases: Biochemistry, Genetics and Embryology. Blackwell, Publishing, USA.

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