

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



B. Sc. Fifth Semester Biology Group

FAR WESTERN UNIVERSITY
Faculty of Science and Technology

Course Title: Basic Chemistry V
Course No.: CHM351
Nature of Course: Theory
Level: B. Sc.
Year: Third, Semester: Fifth

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 the basic concepts of chemistry in all three branches physical, organic and inorganic chemistry. Students will be familiarized with the fundamentals of the Phase Rule, Solutions and colloids. Furthermore, chemistry of carboxylic acid derivatives, *f*-Block elements and the Noble gases will be made familiarized to the students.

2. Course Objectives

The general objectives of the course are as follows:

- To acquaint the students with basic concepts of the Phase Rule, Solutions and colloids.
- To enable the students to understand the principles behind the basic chemistry of carboxylic acid derivatives and carbonyl alpha-substitution reactions
- To acquaint the students with chemistry of essential concepts of *f*-block elements and the Noble gases.
- 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"> ● Describe the concept of the phase rule. ● Explain one-component systems; Two-component systems of phase diagram. ● Describe Simple eutectic diagram. ● Explain diagram formation of compound with congruent melting point. ● Explain the concept behind Complete and Partial Miscibility in Solid States. ● Discuss the types of solutions and factors affecting solubility. ● Explain, derive and write applications of Henry's Law. ● Describe the theory behind Azeotropic mixture and explain its applications. ● Derive and Discuss The Nernst Distribution Law. ● Explain what is the solvent extraction and its applications. ● Explain the properties colloids. ● Discuss the concept double layers in colloids. ● Enable students to understand Zeta potential, electrophoresis, and electro osmosis. 	<p>Unit I: The Phase Rule (5) Concept of phase; Definitions; One-component systems; Two-component systems; Gibbs phase rule; Simple eutectic diagram formation of compound with congruent melting point; Complete and partial miscibility in solid states.</p> <p>Unit II: Solutions (5) Types of solutions: Factors affecting solubility; Ideal and non-ideal liquid mixtures; Distillation of binary liquids; Henry's Law, Azeotropes; Fractional distillation; Partially miscible mixture; The Nernst Distribution Law and applications; Distribution of solute between two phases; The Solvent extraction.</p> <p>Unit III: Colloids (5) Colloids; Colloidal dispersions; Properties of the colloids; Helmholtz and double layers in colloids; Zeta potential; Electrophoresis; Electroosmosis; Stability of suspensions; Precipitation of sols; Emulsions; Gels; Hardy Schutz law; Determination of molecular weight by osmometry, viscosity measurement and sedimentation method.</p>
<ul style="list-style-type: none"> ● Explain Carboxylic acid derivatives and their nomenclature ● Discuss Nucleophilic acyl substitution reactions ● Discuss relative reactivity of carboxylic acid derivatives, ● Explain Chemistry of acid halides, acid anhydrides, esters, amides and thioesters with mechanism and examples. ● Give introductory notes on polyamides, polyesters and biodegradable polymers. ● Introduce Keto-enol tautomerism with examples. ● Show how enols are formed and its alpha-substitution reactions with mechanism. ● Discuss alpha halogenation of aldehydes and ketones with mechanism. ● Describe Hell-Volhard-Zelinskii reaction with 	<p>Organic Chemistry Contents</p> <p>Unit I: Carboxylic Acid Derivatives (9) Carboxylic acid derivatives and their nomenclature; Nucleophilic acyl substitution reactions; Relative reactivity of carboxylic acid derivatives; Nucleophilic acyl substitution reactions of carboxylic acids; Chemistry of acid halides, acid anhydrides, esters, amides and thioesters; Polyamides and polyesters; Biodegradable polymers.</p> <p>Unit II: Carbonyl Alpha-Substitution Reactions (6) Keto-enol tautomerism; Formation of enols and mechanism of alpha-substitution reactions; Alpha halogenation of aldehydes and ketones; Hell-Volhard-Zelinskii reaction; Enolate ion formation; Reactivity of enolate ions; Direct alkylations of ketones, esters and nitriles; Biological alkylations.</p>

<ul style="list-style-type: none"> mechanism. Explain how enolate ion formation takes place as well as reactivity of enolate ions. Discuss reactions involving direct alkylations of ketones, esters and nitriles with mechanism. 	
	Inorganic Chemistry Contents
<ul style="list-style-type: none"> Explain general characteristics of the <i>f</i>-block elements. Describe electronic structure and oxidation states of the <i>f</i>-block elements. Explain abundance, isotopes, extraction and uses of the <i>f</i>-block elements. Explain various techniques of separation of lanthanide elements. Describe chemistry of different oxidation states of lanthanide elements. Describe chemistry of the noble gases in terms of electronic structure, occurrence, recovery and uses. Explain giving diagram structure and bonding in XeF₂, XeF₄ and XeF₆. 	<p>Unit I: <i>f</i>-Block Elements (10) The Lanthanide Series; Electronic Structure; Oxidation States; Abundance and isotopes; Extraction and Uses; Separation of lanthanide elements (precipitation, thermal reaction, fractional crystallization, complex formation, solvent extraction, valency change, ion exchange); Chemistry of (+iii) Compounds; Oxidation State (+iv); Oxidation State (+ii); Solubility; Colour and spectra; Magnetic properties.</p> <p>Unit II: The Noble Gases (5) Electronic structure; Occurrence and recovery; Uses of the elements; Chemical properties; Structure and bonding in XeF₂, XeF₄ and XeF₆.</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	10%	20	Practical Note copy	25%	20
(Details are given in the separate table at the end)		Quizzes	10%		Viva	25%	
		Attendance	10%		Experimental	50%	
		Presentation	10%				
		Term papers	10%				
		Mid-Term exam	40%				
		Group work	10%				
Total External	60	Total Internal	100%	20		100%	20
Full Marks 60+20+20 = 100							

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.

(2) 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.

Internal evaluation

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

2. 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.

3. 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.

4. 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.

5. Term paper: Term paper must be prepared by using computer in a standard format of technical writing and must contain the required number of pages. It should be prepared and submitted individually. The stipulated time for submission of the paper will be seriously taken as one of the major criteria of the evaluation.

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

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

8. 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
- Self-study
- Assignments
- Presentation by Students
- Term Paper writing
- 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. Unless and until the student clears one semester he/she will not be allowed to study in the following semesters.

5. Prescribed Texts

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

6. Reference

- ❖ F. Daniels, R. F. Alberty, Physical Chemistry, John Wiley & Sons, Latest Edition.
- ❖ Gilbert. W. Castellan, Physical Chemistry, Narosa Publishing House, 1985.
- ❖ R.T. Morrison, R.N. Boyd, Organic Chemistry, Prentice- Hall of India Pvt. Ltd., 2008.
- ❖ J. S. H. Pine, Organic Chemistry, McGraw Hill International Edition Series, New York, USA, 1987.
- ❖ F.A. Cotton, G. Wilkinson, C. Gaus, Basic Inorganic Chemistry, John Wiley & Sons (Asia) Pvt. Ltd., 2007.
- ❖ D. F. Shriver, P. W. Atkins, Inorganic Chemistry, W. H. Freeman and Co., London, 1999.
- ❖ 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 V
Course No.: CHM351
Nature of Course: Practical
Level: B. Sc.
Year: Third, Semester: Fifth

Credit: 1
Number of hours per week: 3
Total 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 phase rule and colloids.
- To enable the students to develop basic skills on two step organic preparation and natural product isolation.
- To enable the students to develop skill on qualitative analysis of simple inorganic analysis basing on spectrophotometer.
- To enable students to develop skill on obvervation, recording and interpretation of an experiment.

3. Specific Objectives and Contents

Students to perform experiments on critical solution temperature of phenol-water system; partition coefficient, the Nernst Equation, the Fractional distillation and preparation of colloids. Enable students to perform experiments on two step organic preparation and isolation of caffeine, lactose and camphor. Enable students to determine the hardness, phosphate, chromium and iron in a given sample of water

Physical Chemistry Content

1. Determination of critical solution temperature of phenol-water system and its composition.
2. Determination of partition coefficient of iodine in chloroform and water.
3. Verification of the Nernst Equation.
4. An experiment on Fractional distillation.
5. Preparation of lyophilic and lyophobic sols and study their properties.

Organic Chemistry content

1. Organic synthesis involving two steps (two experiments)
2. Isolation of lactose from milk.
3. Isolation of caffeine from tea.
4. Isolation of camphor from Eucalyptus leaves

Inorganic Chemistry Content

1. Determination of total permanent and temporary hardness in a given sample of water.
2. Determination of phosphate in a given sample of water specrophotometrically.
3. Determination of chromium in a given sample of water specrophotometrically
4. Determination of iron in a given sample of water specrophotometrically.

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.

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

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**.

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

Course Title: **Sustainable Development**

Credit: **3**

Course Code: **SSD 351**

Number of hours per week: **3**

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

Year: **Third**

Semester: **Fifth**

Level: **B.Sc.**

Course Objectives

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

1. Understand the concept of sustainable development and sustainable development goals.
2. Describe issues, approaches and economics of sustainable development.
3. Identify the practices and planning of sustainable development in Nepal.
4. Get insights on global and national policy framework on environmental sustainability.

Specific Objectives	Contents
<ul style="list-style-type: none"> • Understand the concept of sustainable development • Develop insights on formulation and importance of Sustainable Development Goals (SDGs) 	<p>Unit I: Introduction (3 Hrs)</p> <p>Concept of sustainable development; Evolution of sustainable development; Importance, scope and key indicators of sustainable development; from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs); Sustainability principles</p>
<ul style="list-style-type: none"> • Understand various issues and approaches of sustainable development • Understand the role of natural resources on sustainable development • Apply sustainability principles to solve environmental problems 	<p>Unit II: Sustainable Development (5 Hrs)</p> <p>Issues and approaches of sustainable development: Environmental issues and sustainable development; An overview of local, regional and global environmental issues; Natural resources and sustainable livelihoods; Application of sustainability principles for solving environmental problems</p>
<ul style="list-style-type: none"> • Understand relation between environment and economy • Know various methods for valuation of ecological services 	<p>Unit III: Economics of Sustainable Development (10 Hrs)</p> <p>Concept of resource economics; economic growth and development; Ecology and economy nexus in reference to environmental sustainability; Environmental limits of</p>

<ul style="list-style-type: none"> • Acquaint with the concept of green economy and green business • Understand the concept of human development, pillars of human development and human development index 	<p>economic growth; Communal properties and tragedy of commons; Economic valuation of ecological services (direct market, travel cost and contingent methods), cost benefit analyst; origin and development of green economy; Green business; Green design and design for environment; Human Development Approaches: Pillars of human development; Human Development Index (HDI)</p>
<ul style="list-style-type: none"> • Understand the concept of sustainable cities • Understand Nepal's national initiative on sustainable urban planning and urban governance 	<p>Unit IV: Sustainable Cities and Urban Management Initiatives (10 Hrs)</p> <p>Concept on sustainable cities; Sustainable urbanization; concept of inclusive urban development; Strategies for sustainable urbanization; Green infrastructure, Eco-cities, energy and water efficient cities; National: Nepal initiatives and urban governance; Urban planning, policies and institutions; Laws and policies related to urban issues</p>
<ul style="list-style-type: none"> • Understand the practices and planning of sustainable development in Nepal • Take insights on emerging priorities for sustainable development • Familiarize with the importance of education for sustainable development 	<p>Unit V: Sustainable Development in Nepal (10 Hrs)</p> <p>Practices and sustainable development planning in Nepal; Prospects and problems for sustainable development; Sustainable development in rural and urban areas; Planned development and developmental activities in Nepal; Emerging priorities for sustainable development; Eco-villages; eco-city development; Environmental design and sustainable community; Education for sustainable development (ESD)</p>
<ul style="list-style-type: none"> • Understand the shifting paradigms in development and policy regulations • Acquaint with the global and national initiatives on environmental sustainability • Map institutions and their roles and responsibilities in achieving the Sustainable Development Goals (SDGs) 	<p>Unit VI: Policy Framework on Environmental Sustainability (7 Hrs)</p> <p>Concept of development paradigms and shift to sustainable development and policy regulations; Global Initiatives towards environmental sustainability; National Initiatives towards environmental sustainability: environmental policies, plans and strategies and their effectiveness in Nepalese context; International and national environmental institutions, their role and responsibilities</p>

References

1. Brundtland, G.H. (1987). *Our Common Future*. World Commission on Environment and Development. Oxford University Press, Delhi India.
2. Dahal, M. K. and Dahal, D. R. (1998). *Environment and Sustainable Development. Issues in Nepalese Perspective*. Nepal Foundation for Advanced Studies (NEFAS), Kathmandu.
3. Elliott, J.A. (1994). *An Introduction to Sustainable Development: The Developing World*. Routledge, London.
4. Field, B.C. (2001). *An Introduction of Natural Resources Economics*. McGraw Hill, Boston.
5. Furtado, D.R. and Belt, T. (2000). *Economic Development and Sustainability*. The World Bank, Washington, DC.
6. Joshi, J. (2009). *Regional Strategies for Sustainable Development in Nepal*, Lajmina Joshi, Kathmandu.
7. Mitlin, D. and Satterthwaite, D. (1994). "Cities and Sustainable Development", background paper, Global Forum '94, Manchester.
8. MoUD. (2015). *National Urban Development Strategy (NUDS), 2015 (Final Draft)*. Ministry of Urban Development, Government of Nepal, Kathmandu.
9. National Planning Commission (2015). *Sustainable Development Goals, 2016-2030, National (Preliminary) Report*. Government of Nepal, National Planning Commission, Kathmandu, Nepal
10. Price, C. and Tsouros A., eds. (1996). *Our Cities, Our Future: Policies and Action Plans for Health and Sustainable Development*. Healthy Cities Project Office, Copenhagen.
11. Rodney, R. (1994). *White Urban Environmental Management: Environmental Change and Urban Design*. John Wiley & Sons, Chichester.

Four Year B.Sc. (Semester) Program, Far-Western University, Course Structure of B. Sc. Zoology

Semester	Course Nature	Course Code	Course Title	Credits	Inst. Hrs
I	Theory	ZOO111	Systematics, Animal Diversity: Lower Non-Chordata	3	45
	Practical	ZOO111	„	1	
II	Theory	ZOO121	Animal Diversity: Higher Non-Chordata & Protochordata	3	45
	Practical	ZOO121	„	1	
III	Theory	ZOO231	Animal Diversity: Chordata	3	45
	Practical	ZOO231	„	1	
IV	Theory	ZOO241	Animal Physiology & Endocrinology	3	45
	Practical	ZOO241	„	1	
V	Theory	ZOO351	Cell & Developmental Biology	3	45
	Practical	ZOO351	„	1	
VI	Theory	ZOO361	Evolutionary Biology, Zoogeography & Ethology	3	45
	Theory	ZOO362	Biochemistry & Immunology	3	
	Practical	ZOO363	Related to ZOO361 & ZOO362	1	
VII	Theory	ZOO471	Genetics & Molecular Biology	4	60
	Theory	ZOO472	Wild Life & Conservation Biology	4	
	Practical	ZOO473	Related to ZOO471 & ZOO472	2	
Any one	Theory (Applied nature)	ZOO474	Animal Biotechnology	3	45
	Theory (Applied nature)	ZOO475	Toxicology	3	
	Theory (Applied nature)	ZOO476	Ecosystem Services & Geoinformatics	3	
VIII	Theory	ZOO481	Entomology & Parasitology	4	60
	Theory	ZOO482	Ecology & Fisheries Biology	4	
	Practical	ZOO483	Related to ZOO481 & ZOO482	2	
Any one (Interdisciplinary subject)	Theory (Interdis.subject)	ZOO484	Ethnobiology	3	45
	Theory (Interdis.subject)	ZOO485	Bioinformatics	3	
	Theory (Interdis.subject)	ZOO486	Bio-instrumentation	3	
				53/62	

One student has to study 53 credits of Zoology who prefers zoology as a major subject.

FAR WESTERN UNIVERSITY
ZOOLOGY CURRICULUM (B.Sc.)

2074

FIFTH SEMESTER

Semester	Course Nature	Course Code	Course Title	Credit	Instruction hrs
V	Theory	ZOO351	Cell & Developmental Biology	3	45
	Practical	ZOO351	„	1	45
				Total=	
				4	

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

Course Title: Cell & Developmental Biology

Credit 3

Nature of the Course: Theory

Number of inst. hours per week: 3

Course No: ZOO351

Total instruction hours: 45

Year: Third

Semester V

Course Objectives:

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

- Describe the structure and function of cell and cell organelles.
- Know the early embryonic development process of chordates.

Course Description:

A: Cell Biology

Specific Objectives	Units & Course Contents
<ul style="list-style-type: none"> ● Describe the structure of prokaryotic and eukaryotic cells. ● Can show the difference between prokaryotic and eukaryotic cells. 	<p>Unit 1 : Cell (2 hrs)</p> <p>General organization of Prokaryotic and Eukaryotic cells.</p>
<ul style="list-style-type: none"> ● Give the molecular organization and functions of the cell membrane. ● Describe the different modifications of plasma membrane. 	<p>Unit 2 : Plasma Membrane (2 hrs)</p> <p>Molecular organization. Functions. Modification of plasma membrane and intracellular junctions.</p>
<ul style="list-style-type: none"> ● Describe the types (granular and agranular), structure and functions of endoplasmic reticulum. ● Describe the Golgi apparatus and types of vesicles that arise from golgi membranes. ● Discuss various functions of Golgi complex in the cells. ● Give the structure and functions of lysosomes and peroxisomes. ● Enumerate the characteristic structural features of mitochondria that aid in their identification. 	<p>Unit 3 : Cytoplasmic Organelles (8 hrs)</p> <p>Structure and functions of Endoplasmic Reticulum, Golgi Complex, Lysosome, Peroxisome, Mitochondria and Ribosomes.</p>

<ul style="list-style-type: none"> ● Describe the structure and functions of ribosomes. ● Explain 70S and 80S ribosomes. 	
<ul style="list-style-type: none"> ● Give the ultra-structure of nucleus. ● Describe the nuclear envelop and the structure of its pores. ● Discuss nucleoplasm and chromatin fibres. ● Describe the structure and functions of the nucleolus. ● Discuss nucleo-cytoplasmic inter-relationship. 	<p>Unit 4: Nucleus (3 hrs)</p> <p>Nuclear envelope, nucleoplasm, chromatin fibres and nucleolus. Nucleo-cytoplasmic inter-relationship.</p>
<ul style="list-style-type: none"> ● Describe the structure of prokaryotic chromosomes. ● Discuss karyotype and its uses. ● Distinguish between heterochromatin and euchromatin. ● Describe Polytene and Lampbrush chromosomes. 	<p>Unit 5: Chromosomes (3 hrs)</p> <p>Autosomes and sex chromosomes. Structure. Karyotype. Euchromatin and heterochromatin. Giant chromosomes.</p>
<ul style="list-style-type: none"> ● Explain cytoskeleton. ● Describe the structures and functions of microtubules and microfilament in a cell. ● Describe the types, structure and cellular functions of intermediate filament. ● Make a comparison of three components of the cytoskeleton: microtubules, microfilaments and intermediate filament. ● Give the distribution, structure and functions of cilia and flagella. ● Differentiate between cilia and flagella. ● Describe the structure of the axoneme. 	<p>Unit 6: Cytoskeleton and Cell Motility (2 hrs)</p> <p>Organization and properties of microtubules, microfilaments and intermediate filament. Cilia and flagella.</p>
<ul style="list-style-type: none"> ● Discuss the stages of cell cycle. ● Describe the types of cell divisions and their biological significance. 	<p>Unit 7: Cell cycle and Cell division (2 hrs)</p> <p>Cell cycle, mitosis and meiosis.</p>

B: Developmental Biology

Specific Objectives	Units & Course Contents
<ul style="list-style-type: none"> ● Explain the scope of embryology. ● Give an account on historical review of embryology. ● Explain different theories of development. 	<p>Unit 1: Introduction to Developmental Biology (2 hrs)</p> <p>Definition, scope, historical review & theories of developmental biology (theories of preformation, epigenesis, Bear's law, germplasm, mosaic, regulative and cell theory).</p>

<ul style="list-style-type: none"> ● Describe the estrous and menstrual cycles in mammals. ● Draw the diagram of a mature graafian follicle and label the parts. 	<p>Unit 2: Female Reproductive Cycles (2 hrs)</p> <p>Estrous and menstrual cycles in mammals.</p>
<ul style="list-style-type: none"> ● Discuss the origin and determination of primordial germ cells. ● Describe the process of spermatogenesis and give its significance. ● Define oogenesis. With the help of schematic diagrams, explain the various phases culminating in the formation of a mature egg (ovum) from female primordial germ cells. ● Enumerate the differences between spermatogenesis and oogenesis. 	<p>Unit 3: Embryonic Cell Differentiation & Gametogenesis. (4 hrs)</p> <p>Origin of primordial germ cells. Structure of male gonads (testes: the sites of spermatogenesis). Structure of female gonads (ovaries- the sites of oogenesis). Process of Spermatogenesis and Oogenesis.</p>
<ul style="list-style-type: none"> ● Give an illustrated account of the ultrastructure of the sperm of a mammal. ● Classify animal eggs based on amount and distribution of yolk giving suitable illustrations and examples. ● Describe yolk with its physico-chemical structure and role in determining various types of eggs. ● Explain polarity in eggs. Describe how polarity and symmetry are established during oogenesis and give their significance. 	<p>Unit 4: Sperms and Eggs (2 hrs)</p> <p>Morphology of spermatozoon. Variations in sperm structure. Sperm longevity. Yolk: functions & physico-chemical nature of yolk. Morphology of a generalized mature ovum. Polarity of the eggs. Types of eggs.</p>
<ul style="list-style-type: none"> ● Give an outline account of the process of fertilization and associated events with suitable illustrations. ● Describe the process of cortical reaction in sea urchin eggs. ● Give an account of metabolic changes occurring in a fertilized egg. 	<p>Unit 5: Fertilization. Parthenogenesis (2 hrs)</p> <p>Basic requirements, mechanism, significance of fertilization. Monospermic and polyspermic fertilization. Natural and artificial parthenogenesis. Significance of parthenogenesis.</p>
<ul style="list-style-type: none"> ● Explain the different planes of cleavage. ● Discuss various types of cleavage. 	<p>Unit 6: Cleavage (2 hrs)</p> <p>Characteristics, Planes, Patterns and types of cleavage. Role of yolk in cleavage</p>
<ul style="list-style-type: none"> ● Explain the various types of blastula with suitable illustrations. ● Explain fate maps and its construction using natural and artificial marking methods. ● Draw diagrams of fate maps of amphioxus, frog etc. 	<p>Unit 7: Morulation, Blastulation and Fate-maps (2 hrs)</p> <p>Morula and its formation. Blastula and its types. Fate-maps and its construction.</p>

<ul style="list-style-type: none"> ● Describe different types of morphogenetic movements occurring during gastrulation. 	<p>Unit 8: Gastrulation (2 hrs)</p> <p>Gastrular morphogenetic movements. Significance of gastrulation. Germ layers and their derivatives.</p>
<ul style="list-style-type: none"> ● Explain the process of early embryonic development in different animals. ● Describe the development of Amphioxus and frog up to gastrulation. ● Describe the development of chick up to the formation of primitive streak. ● Explain how the Hensen's node of chick is homologous to the dorsal lip of frog. 	<p>Unit 9: Early Embryonic Development (4 hrs)</p> <p>Early embryonic development of Branchiostoma (Amphioxus), frog, chick and human.</p>
<ul style="list-style-type: none"> ● Explain organizer phenomenon with special reference to the experiments of Brachet and Spemann & Mangold. ● Explain Brachet's experiment to show the importance of grey crescent region as the centre of organizer. ● Discuss the theories of organizer phenomenon. 	<p>Unit 10: Organizer Concept (1 hr)</p> <p>Introduction and theories. Role of organizers in development</p>

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

Course Title: Cell & Developmental Biology

Credit 1

Nature of the Course: Practical

Number of inst. hours per week: 3

Course No: ZOO351

Total instruction hours: 45

Year: Third

Semester V

- **Course Objectives:** To impart practical knowledge and better understanding on cell and developmental Biology

Course Contents :

1. Handling and use of various microscopes.
2. Demonstration and description of compound microscope. Measurement of size (length/breadth) by micrometry of any cell/organ/protozoa.
3. Study of cytological slides showing cell organelles and stages of cell divisions (mitosis and meiosis).
4. Study of Lampbrush Chromosome of any animal.
5. Study of the models and embryological slides of different stages of frog, chick and mammals.

Practical note book preparation as regular study.

Text and Reference Books

Balinsky, B.I. 1970. An Introduction to Embryology. W.B. Saunders, London.

DeRobertis D.P. and De Robertis Jr. E.M.F. Cell and Molecular Biology, Latest Ed. B.I. Waverly Pvt. Ltd., New Delhi.

Rastogi, S. C. 2001. Cell and Molecular biology. New Age International (P) Limited, Publishers: New Delhi, Bangalore, Calcutta, Chennai, Lucknow, Mumbai, India.

Verma, P.S. and Agarwal, V.K. Latest ed. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. Published by S.Chand & Company LTD, New Delhi India.

Verma, P.S. and Agarwal, V.K. Chordate Embryology; Developmental Biology. Published by S.Chand & Company LTD, New Delhi India.

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

Course Title: **Urban Environment**

Credit: **3**

Course Code: **ENV 351**

Number of hours per week: **3**

Nature of the Course: **Theory (Core Course)**

Total hours: **45**

Year: **Third**

Semester: **Fifth**

Objectives

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

- Understand an overview of urban environment, urbanization, urban growth and pattern
- Understand the socio-cultural and environmental issues of urbanization and acquire knowledge on urban environmental planning
- Know the concept of sustainable cities, strategies for sustainable urbanization, and urban management initiatives
- Analyze the urban area from scientific perspective and conduct research on present issues of urban environment

Objectives	Units, Contents and Lecture Hours
<ul style="list-style-type: none"> ● Understand fundamental concepts related to urban environment and urbanization ● Take insights on influencing factors and patterns of urban growth and urbanization in Nepal 	<p>Unit I: Introduction to Urban Environment and Urbanization (6 Hrs)</p> <p>Introduction to Urban environment; Concept and characteristics of urban areas; Trends, process and pattern of urbanization; Trend of urbanization in developed and developing countries; Influencing factors and patterns of urban growth and urbanization in Nepal.</p>
<ul style="list-style-type: none"> ● Understand various environmental issues in urban areas ● Acquaint with economic and ecological components of urbanization 	<p>Unit II: Urban Environnemental Issues (15 Hrs)</p> <p>Concept of urban ecology; Economic and ecological components of urbanization; Socio-cultural and environmental impacts; Urban poverty, slum and squatters; Environmental sustainability and urban health; Socio-economic challenges in urban areas, urban food security; Urban infrastructures; Urban environmental issues: Sanitation, drainage, water supply and solid waste management, traffic congestion, air and noise pollution, urban land use change and patterns.</p>

<ul style="list-style-type: none"> ● To acquaint with concept of urban planning 	<p>Unit III: Urban Planning (12 Hrs)</p> <p>Principles of urban planning; planning process, methods and technique; Comprehensive planning; Green infrastructure; Concept of zoning and land pooling; Guided Land Development (GLD), Land Pooling and Nepalese experience; Role of environmental components in urban planning; Urban Planning in Nepal-Case Study</p>
<ul style="list-style-type: none"> ● Understand concept of sustainable urban development (SUD) ● Identify fundamentals of climate resilient urban development 	<p>Unit IV: Sustainable Urban Development (6 Hrs)</p> <p>Concept on sustainable cities; Sustainable urbanization; Concept of inclusive urban development; Strategies for Sustainable Urban Development (SUD); Eco-cities, energy and water efficient cities; Smart cities; Climate resilient urban development</p>
<ul style="list-style-type: none"> ● Understand various national and international initiatives on sustainable urban development ● Critically examine Sustainable Development Goal 11 on sustainable cities and communities 	<p>Unit V: National and International Initiatives on Sustainable Urban Development (6 Hrs)</p> <p>Policy and practice of sustainable urban development; Urban governance in Nepalese context; Urban planning, policies and institutions; Laws and policies related to urban issues; Development control of zoning regulations; SDG 11: Sustainable Cities and Communities</p>

References

1. Adhikari, A.D. (1998). Urban and environmental planning in Nepal. IUCN, Kathmandu.
2. Cities and Bio-diversity Outlook. (2013.) Action and policy: a global assessment of the links between urbanization, biodiversity, and ecosystem services. Secretariat of the Convention on Biological Diversity.
3. Mitlin, Diana and Satterthwaite D. (1994). "Cities and Sustainable Development", background paper, Global Forum '94, Manchester.
4. Mostafavi, M. and Doherty, G. (2010). Ecological urbanism. Harvard University Graduate School of Design, Baden.
5. MoUD. (2015). National Urban Development Strategy (NUDS), 2015 (Final Draft). Ministry of Urban Development, Government of Nepal, Kathmandu.
6. National Planning Commission, 2015: Sustainable Development Goals, 2016-2030, National (Preliminary) Report. Government of Nepal, National Planning Commission, Kathmandu, Nepal

7. Price, Charles and Tsouros A., eds. (1996). Our Cities, Our Future: Policies and Action Plans for Health and Sustainable Development. Healthy Cities Project Office, Copenhagen.
8. Rodney R. (1994). White Urban Environmental Management: Environmental Change and Urban Design. John Wiley & Sons, Chichester.
9. Thapa, G.B. and Devkota, S.R. (1999). Managing solid wastes in metro Kathmandu. Asian Institute of Technology, Bangkok.
10. UN-HABITAT. (2011). Global report on human settlements - cities and climate change: policy directions. United Nations Human Settlements Programme.
11. Viessman, W. and Hammer, M.J. (1998). Water supply and pollution control. Adison-Wesley Publication, Boston.

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

Course Title: **Urban Environment** Credit: **1**
Course Code: **ENV 351** Number of hours per week: **3**
Nature of the Course: **Practical (Core Course)** Total hours: **45**
Year: **Third** Semester: **Fifth**

Objectives

Upon the completion of the course, students will get field based practical knowledge on several aspects of urban environment management. The students will also get insights on preparing field reports.

Practicals

1. Field-based study to identify environmental issues and urban environmental planning (*Students will visit nearby urban areas/centres to identify all the major issues of the locality, rank them in order of importance and work on to assess the influence of the issues on urban environment planning. Each student has to prepare an individual report at the end of the study following the prescribed format of the university. Examples include solid waste management.*)
2. Discuss, design, and conduct field survey and review of local/national planning program and designs related to urban environmental quality (*Students will work in a group/team of 4-5 and conduct this field-based study under the supervision of a faculty. Each group/team will submit a group report following the prescribed format of the university.*)
3. Innovative solutions for your own urban living environment (*This follows an approach of 'Community Work'. Students will visit communities of their choice, interact with the local inhabitants, identify key issues of the locality and provide innovative solutions. Each student will work independently under the supervision of faculty/expert and prepare report following the prescribed format of the university.*)
4. Environmental Good Practices – a case study of any one municipality (or rural municipality if municipality is not feasible) of Nepal. (*Students will visit one municipality and assess good practices being undertaken by the municipality to improve the environmental quality. For example, many municipalities in*

Nepal have implemented 'Environmental Friendly Local Governance Program, EFLGP' under the auspices of Ministry of Federal Affairs and Local Development, MoFALD. If possible students will visit such municipalities and will carry out SWOT i.e. Strengths, Weaknesses, Opportunities and Threats analysis of the program.)