Institute of Zoology
Faculty of Life sciences
University of the Punjab, Lahore
Course Outline

Programme	BS Zoology	**Course Code**	**ZOOL-402**	**Credit Hours**	2
Course Title	**Analysis of Development**				

Course Introduction

Development involves cell division, body axis formation, tissue and organ development, and cell differentiation (gaining a final cell type identity). During development, cells use both intrinsic, or inherited, information and extrinsic signals from neighbors to "decide on" their behavior and identity. This course is designed to understand the processes of differentiation, morphogenesis, histogenesis and organogenesis that refers to the production of tissues and organs through the interaction and rearrangement of cell groups, to perform various functions in an integrated way as each new organism develops. This course will also cover the abnormal development (Teratogenesis), as the development cannot be forced to go in the right direction.
Whereas other events correlate with mode of development (*metamorphosis* from a larval to adult stage) or individual trauma (*regeneration*). The course will investigate the roles of stem cells in tissue regeneration and other developmental therapies.

Learning Outcomes

On the completion of the course, the students will:

- Have detailed knowledge about cellular basis of morphogenesis, mechanisms of cellular differentiation and Origin and Migration of Germ Cells in Vertebrates.
- Provide understanding of the mechanisms of organogenesis, factors controlling growth and Hormones as Mediators of Development.
- Learn about the environmental assaults on human development
- Know about the developmental processes that lead to the establishment of the body plan of the vertebrates at the cellular and genetic level.
- Evaluate the different mechanisms integrate at the level of whole tissues, organs and organisms, and how they are functionally adapted in distinct developmental contexts.

	Course Content	**Assignments/Readings**
Week 1	**Concept of fate maps** • Fate maps of Sea urchin, amphibians, Birds and mammals	
	• Fate Map construction (dye marking, genetic labelling, transgenic DNA chimeras)	
Week 2	*Morphogenesis* • Differential cell affinity, • Cell adhesion molecules	
	Cell Signaling • Induction • Competence	
Week 3	**Paracrine Factors** • **T**he Inducer molecules • Signal transduction cascades	
	Juxtacrine factors • The Notch pathway	

Week 4	**Cell specification** • Autonomous specification • Morphogenetic determinants	
	• Conditional specification • Germ plasm theory • Syncytial specification	
Week 5	**Organogenesis** • Splitting of three basic germinal layers • Fate of Ectoderm germ layer	
	Neurulation • Primary Neurulation • Secondary Neurulation	
Week 6	**Development of Vertebrate eye** • The dynamics of optic development	
	• Cellular differentiation in eye • Neural retina & Lens formation	
Week 7	**Major Lineages of vertebrate mesoderm** • Chordamesoderm, paraxial mesoderm, intermediate mesoderm, lateral plate mesoderm • Fate of these mesoderm compartments	
	Origin and Migration of Germ Cells in Vertebrates; • Amphibians • Birds • Mammals	
Week 8	**Development of Mammalian gonads** • Primary & secondary sex determination	
	• Development of ovaries • Development of Testis	
Week 9	**Development of kidneys** • The progression of kidney types • Pronephros, mesonephros, metanephros	
	• Reciprocal interaction of developing kidney • Mechanism of reciprocal induction	
Week 10	**Fate of Endoderm germinal layer**	
	Development of Liver	
Week 11	**Development of Pancreas** •	
	Metamorphosis • Amphibian metamorphosis • Hormones as Mediators of Development	
Week 12	• Metamorphosis in insects • Ametabolous, hemimetabolous, holometabolous development • Genetic and hormonal control of insect metamorphosis	
	Regeneration • Epimorphic regeneration of salamander' limb	
Week 13	• Morphallactic regeneration in hydra	
	• Compensatory regeneration in mammalian liver	

Week 14	**Aging** • Environmental and epigenetic causes of aging	
	Teratogenesis • Principles of teratogenesis	
Week 15	• *Critical weeks in human gestational period* • Sensitivity of embryonic organs to teratogens	
	• Environmental factors as potent teratogens	
Week 16	**Developmental Therapies** • Anti-angiogenesis	
	• Therapeutic applications of embryonic stem cells	

Textbooks and Reading Material

1. Gilbert, S. F. 2013. Developmental Biology, Sinauer Associates, Sunderland, MA.
2. Klaus, K. 2001. Biological Development. 2nd Ed., McGraw-Hill.
3. Scott F. Gilbert and Michael J. F. Barres. 2016. Developmental Biology. Sinauer Associates, Sunderland, MA.
4. Jamie. A. Davies. 2014. Life Unfolding: How the Human Body Creates Itself. Oxford University Press, USA
5. Balinsky, B. I. 1985. An Introduction to Embryology, Saunders.
6. Oppenheimer, S.S. 1984. Introduction to Embryonic Development, Allen and Bacon.
7. Saunders, J. W. 1982. Developmental Biology, McMillan and company.
8. Ham, R. G., Veomett, M. J. 1980. Mechanism of Development. C. V.Mosby Co.

Teaching Learning Strategies

1. class lectures
2. class discussions
3. group work
4. Short videos/films

Assignments: Types and Number with Calendar

1. written assignments
2. class quizzes
3. presentation
4. class participation/attendance

Assessment

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