TEACHING PLAN: Developmental Biology

SCHOOL: SCHOOL OF BASIC & APPLIED SCIENCES (SOBAS), RAFFLES UNIVERSITY			
ACADEMIC SESSION: 2022 – 2025		FOR STUDENT'S BATCH: B.Sc. (CBZ) I Year (II- Semester)	
1	**Course No.**	ZOO - 104	
2	**Course Title**	Developmental Biology	
	Credits	**3**	
4	**Learning Hours**	**Contact Hours**	**40**
		Assessment	**22**
		Guided Study	**28**
		Total hours	**90**
		3 lectures per week	

5	**Course Objective**	1. Examine the historical development of embryology and grasp fundamental concepts in developmental biology. 2. Explore the different modes of experimental developmental biology, including epigenesis, preformation, mosaic, and regulative development. 3. Analyze the branches and significance of developmental biology, understanding its broader implications in the scientific domain. 4. Investigate the structure of mammalian ovum and sperm, studying spermatogenesis and oogenesis, as well as various types of eggs and egg membranes. 5. Examine fertilization processes, including parthenogenesis, changes in gametes, and the occurrences of monospermy and polyspermy. Evaluate the planes and patterns of cleavage. 6. Explore late embryonic development, focusing on the fate of germ layers, extra-embryonic membranes, implantation of the embryo in humans, and the structure, types, and functions of the placenta. 7. Investigate critical processes such as blastulation and fate-map construction in frog and chick embryos, as well as gastrulation up to the formation of three germinal layers. Additionally, delve into embryonic induction, neural induction, and the role of the grey crescent in neural induction. Understand regional specificity of primary inductor (organizers) and explore embryonic induction in different chordates. 8. Examine the chemical and genetic basis of neural induction, along with concepts related to competence, determination, and differentiation. 1. 9. Study the concepts of repair and regeneration, considering the degree of regenerative ability in non-chordates and chordates. Explore categories and mechanisms of regeneration, factors influencing regeneration, and the physiological processes involved in regeneration.
6	**Course Outcomes**	1. Demonstrate a comprehensive understanding of the historical development and basic concepts in embryology.

		2. Apply knowledge of experimental developmental biology, distinguishing between various developmental processes. 3. Recognize and articulate the branches and significance of developmental biology, showcasing awareness of diverse applications. 4. Evaluate reproductive structures and processes, including spermatogenesis, oogenesis, and fertilization. 5. Analyze late embryonic development, encompassing germ layers, extra-embryonic membranes, and placenta. 6. Apply acquired knowledge to critically examine embryonic processes in frog and chick embryos. 1. 7. Understand neural induction, the role of the grey crescent, and regional specificity in embryonic induction across chordates.

7.	Outline syllabus:				
7.01	Paper Code	Unit	Introduction	Reference number	Teaching methods
	Paper Code: ZOO-104	I	1. History and basic concepts : Historical review 2. Experimental Developmental Biology: Epigenesis, preformation, mosaic and regulative development 3. Branches and Significance of Developmental Biology		Providing them notes, elucidating all processes and mechanisms on a whiteboard, and conveying information through presentations (PPT) and videos.
		II	1. Generalized structure of mammalian ovum & sperm, spermatogenesis and Oogenesis, different types of eggs, egg membranes. 2. Fertilization, parthenogenesis, changes in gametes, monospermy and polyspermy, planes and and patterns of cleavage. 3. Late Embryonic development: fate of germ layers, extra-embryonic membranes, implantation of embryo in humans, placenta structure, types and functions of placenta.		--------do-------
		III	1. Process of blastulation and fate-map construction in frog and chick. 2. Gastrulation in frog and chick upto the formation of three germinal layers.		--------do-------

			3. Embryonic Induction (Primary organizers): Experimental evidences and characteristics, Neural Induction, role of grey crescent in neural induction, Regional specificity of primary inductor (organisers), Embryonic induction in different chordates 4. Chemical and genetic basis of neural induction		
		IV	1. Concepts of competence, determination and differentiation. 2. Repair and Regeneration: Concept, Degree of regenerative ability in non-chordates and 3. chordates, categories and mechanism of regeneration, control of regeneration, factors 4. affecting regeneration, physiological processes involved in regeneration.		--------do-------

8.	Course Evaluation	
8.1	CA: 20%	
8.2	Attendance	5
8.3	Homework	-
8.4	Quizzes	5
8.5	Projects	-
8.6	Presentation	10
8.7	Any other	-
8.2	MTE	20%
8.3	End-term examination	60%
9.	Textbooks & References	
9.1	Textbook	-
9.2	References	Slack, J. M., & Dale, L. (2021). Essential developmental biology. John Wiley & Sons. Hall, B. K. (2012). Evolutionary developmental biology. Springer Science & Business Media. Grubb, B. J. (2006). Developmental Biology, Scott F. Gilbert, editor.
9.3	Video References	https://youtu.be/dTjK9e6MvXw?si=gzR9aJASnkcjCpA0 https://youtu.be/LaBE_5usNzE?si=so9-pByW0WX6-0A8 https://youtu.be/8-KF0rnhKTU?si=6vzDBKmeBiWurQ_X

Practical's: Zoology Lab - II (6 labs per week)

Outcome

Outcome	Unit 1.1	Unit 1.2	Unit 1.3	Unit 2.1	Unit 2.2	Unit 2.3	Unit 3	Unit 4.1	Unit 4.2
1	➔								
2		➔							
3			➔						
4				➔	➔	➔			
5					➔			➔	➔
6								➔	➔

Question Bank

1. What are the historical developments in embryology?
2. Differentiate between epigenesis, preformation, mosaic, and regulative development in experimental developmental biology.
3. Explain the branches and significance of developmental biology.
4. Describe the structure of mammalian ovum and sperm in detail.
5. Discuss the processes of spermatogenesis and oogenesis.
6. Explain the various types of eggs and egg membranes.
7. What are the key aspects of fertilization, parthenogenesis, and changes in gametes?
8. Differentiate between monospermy and polyspermy.
9. Outline the planes and patterns of cleavage in embryonic development.
10. What is the fate of germ layers in late embryonic development?
11. Describe the extra-embryonic membranes and the process of implantation in humans.
12. Explain the structure, types, and functions of the placenta.
13. Discuss the process of blastulation and fate-map construction in frog and chick embryos.
14. Describe the stages of gastrulation in frog and chick embryos up to the formation of three germinal layers.
15. Provide experimental evidence and characteristics of primary organizers in embryonic induction.
16. Explain the concept of neural induction and the role of the grey crescent in this process.
17. Discuss the regional specificity of primary inductors (organizers) in different chordates.
18. What is the chemical and genetic basis of neural induction?
19. Define competence, determination, and differentiation in embryonic development.
20. Explain the concepts of repair and regeneration in embryology.
21. Describe the degree of regenerative ability in non-chordates and chordates.
22. Discuss the categories and mechanisms of regeneration.
23. Explain the factors affecting regeneration and the control of regeneration.
24. Outline the physiological processes involved in regeneration.
25. Discuss embryonic induction in different chordates.

PROJECTS (To be given to group of students)

Embryonic Development Interactive Multimedia Guide:

Develop an interactive multimedia guide that covers the historical development, basic concepts, and various processes in embryonic development.

Include modules on experimental developmental biology, fertilization, late embryonic development, and embryonic induction across different chordates.

Incorporate visual aids, animations, quizzes, and explanatory videos to engage users and enhance their understanding.

Embryology Research Symposium:

Organize a symposium focused on recent advancements and research in embryology.
Invite researchers to present their work on topics such as experimental developmental biology, neural induction, and regeneration.
Facilitate discussions on the significance of developmental biology and its applications in various fields.

Embryo Development Workshop Series:

Design a series of workshops aimed at providing hands-on experience with embryonic development techniques.
Offer sessions on blastulation and fate-map construction in frog and chick embryos, gastrulation, and embryonic induction experiments.
Provide participants with the opportunity to conduct experiments, analyze results, and discuss findings with experts in the field.

Embryonic Development Educational App:

Create a mobile application that serves as a comprehensive educational tool for students studying embryology.
Include interactive modules covering topics such as sperm and egg structure, fertilization, germ layer development, and placenta formation.
Incorporate quizzes, flashcards, and virtual experiments to reinforce learning and assess understanding.

Regeneration Research Project:

Initiate a research project focused on understanding the mechanisms of regeneration in non-chordates and chordates.
Investigate factors affecting regeneration, such as genetic influences, environmental conditions, and physiological processes.
Collaborate with biologists, geneticists, and bioengineers to explore potential applications of regeneration research in tissue engineering and regenerative medicine.