FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: **2024-2025**	
1	**Course Code**	**ZOSE-11T**		
2	**Course Title**	**Developmental Biology**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if, any)**	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Understand of the fundamental processes involved in embryonic development, including cell differentiation, morphogenesis, and patterning ➢ Explain mechanisms underlying developmental processes, ➢ Learn reproductive techniques commonly used in developmental biology ➢ Aware of current trends and advances in developmental biology research, including emerging technologies. ➢ Understand the relevance of developmental biology in medicine or its role in development of diseases.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Gametes Biology:** Biology of sex determination and differentiation, Origin of primordial germ cells. Morphology of different types of gametes: Male gamete and female gamete. Formation of Gametes: Process of Spermatogenesis, Biochemical changes in spermatogenesis and control of spermatogenesis, Semination. Process of Oogenesis, Biochemical changes in Oogenesis and control of Oogenesis, Vitellogenesis: Structure and composition of yolk. Ovulation and ovum transport in mammals. Infertility in Male and female: Causes and Cure. Fertilization: external and internal fertilization, Recognition of gametes, capacitation, acrosome reaction, activation of egg metabolism, migration of pronuclei, amphimixis and post fertilization changes in the egg cytoplasm. Block to polyspermy. Parthenogenesis.	11
II	**Embryology:** Cleavage: pattern and mechanism of cleavage, physiology of cleavage. Mosaic and regulative development, Direct and indirect development, Body plan and symmetries. Germ layer differentiation. Tubulation. Morphogenesis: Epiboly, E mboly/invagination, involution and ingression. Fate maps: Methods of construction of fate map, fate map of Amphioxus, Amphibians and Chick. Formative movements, Metamorphosis: In Insect and in frog. Hormonal regulation of metamorphosis. Cell signaling, cell adhesion during tissue organization,lateral inhibition, induction, and recruitment. Organogenesis: formation of gut, heart, kidney and muscles, molecular mechanism involved. Pleuropotency.	11
III	**Developmental Biology: Organizer concept:** Types, characteristics & mechanism of organizer. Extra embryonic membranes: Development and functions in chick. Axis Formation in Drosophila, Metamorphosis in insect and in Frog. Hormonal regulation of metamorphosis. Placenta: Structure, functions and its types. Regeneration: Types- epimorphosis, morphollaxis and compensatory regeneration, mechanisms and physiological processes involved in regeneration, ability of regeneration in invertebrates and vertebrates, difference between embryogenesis and regeneration and tissue repair. Concept of competence, determination and differentiation and growth. Ageing and apoptosis.	11
IV	**Reproductive Technology and Reproductive Health: *In vitro* fertilization:** Artificial insemination (AI); Gamete intra-fallopian transfer (GIFT), Intra-cytoplasmic sperm injection (ICSI), Zygote Intra Fallopian Transfer (ZIFT), Test tube baby. Causes of Infertility. Multiple ovulation and embryo transfer technology (IVF and IVET), Pre implantation genetic diagnosis (PGD). Ethics in surrogacy. Teratology & teratogens: wound healing, birth defects, developmental brain disorders. Neuro degeneration. Endocrine Disruptors & Cancer. Causes of Sexually transmitted diseases: HIV/AIDS & Human Papilloma virus (HPV), Syphilis. Menstrual Disorders, Polycystic Ovarian Disease & Polycystic Ovarian Syndrome (PCOD & PCOS).	12
Keywords	*Spermatogenesis, Oogenesis, Gametes, Fertilization, Development, Cleavage, Fate maps, Organizers, Teratology*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- Agrawal V K, Evolution and Developmental Biology, S Chand Publication
- Verma P S, Agrawal V K, Chordate Embryology, S Chand Publication
- Arumugam N, Embryology , Saras Publication
- Shasrti K V, Shukla Vinita, Developmental Biology, Rastogi Publication

Reference Books Recommended –

- Gerhart, J. et al. (1997) Cells, Embryos and Evolution. Blackwell Science
- Gilbert, S.F. (2010) Developmental Biology (9th edition). Sinauer
- Wolpert, L. (2007) Principles of Developmental Biology (3rd edition). Oxford University Press

Online Resources–

- **https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==**
- **http://ndl.iitkgp.ac.in/he_document/aklectures/aklectures/4_3_2_1638?e=15|*|||**
- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/cnqxwmzey1w?e=1|*|||**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** **+20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**ZOSE-11P**		
2	**Course Title**	**Developmental Biology**		
3	**Course Type**	**Discipline Specific Elective Lab Course**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	**After successfully completing this course, the students will be able to-** ➢ Acquire knowledge of the fundamental processes involved in embryonic development, Types of eggs ➢ Explain developmental processes and identify various stages of development through study of permanent slides , ➢ Learn experimental techniques commonly used in developmental biology ➢ Aware of current trends and advances in developmental biology research, including emerging technologies.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	➢ Types of eggs based on quantity and distribution of yolk: sea urchin, insect frog, Chick. ➢ Comparative study of cleavage patterns in Frog and Amphioxus models. ➢ Study of cell movement, shape and size during morphogenetic movement of Blastulation, Gastrulation in Frog, Amphioxus, Chick through models and charts. ➢ Study of whole mounts and sections of developmental stages of frog through permanent slides: blastula, gastrula, neurula (Neural plate, Neural fold and Neural tube stages), tail-bud stage, tadpole (external and internal gill stages) ➢ Study of whole mounts of developmental stages of chick through permanent slides -18 hours, 24 hours, 33 hours, 48 hours, 72 hours and 96 hours of incubation ➢ Extra embryonic membranes of chick through models and charts. ➢ In vivo study of chick embryo development by windowing and candling methods. (Demonstration only) ➢ Some videos to develop understanding on the process of development. ➢ Group Discussion / Quiz /Seminar / Project related topics ➢ Prepare practical record	**30**
Keywords	*Types of eggs, Cleavage, frog, Chick Embryology, Chick Embryo Development Windowing*	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

- ***Lal S S, Vertebrate Practical***
- ***Phukan LunaDevelopmental Biology Practical, Mahaveer Publication***

Online Resources–

- **http://ndl.iitkgp.ac.in/he_document/swayamprabha/swayam_prabha/pttau909f8a?e=0|living%20chick%20embryos%20%E2%80%93%20observations|||**
- **https://egyankosh.ac.in/bitstream/123456789/16460/1/Unit-26.pdf**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS: