

### Department of Zoology

Discipline Specific Core Course: Zoology

Sem	Theory/ Practical	Course Title	Teaching/ Practical Instruction hour/week	Total Hours/ Sem	Duration of Exam in hours	Assessment Marks			Credits
						Summative	Formative	Total	
V	Theory	Developmental And Reproductive Biology	4	60	3	80	20	100	4
	Practical	Developmental And Reproductive Biology	4	60	3	40	10	50	2
	OR								
	Theory	Immunology and Computational Biology	4	60	3	80	20	100	4
	Practical	Immunology and Computational Biology	4	60	3	40	10	50	2
	Elective	Human Health	4	60	3	80	20	100	3

V Sem

## Zoology

B.Sc., Semester – V (SEP) w.e.f. 2026-27

### Theory Syllabus

Course Title: <b>DEVELOPMENTAL AND REPRODUCTIVE BIOLOGY</b>	Course Code:
Total Contact Hours: 64	No. of Credits: T=4
L:P	4:0
Internal Assessment Marks: 20	Duration of SEE: 3 Hours
Semester End Exam Marks: 80	

#### Course Outcomes (COs):

At the end of the course, students will be able to:

1. Appreciate the biological systems.
2. Understand and maintain reproductive hygiene.
3. Explain events of fertilization and post fertilization modifications.
4. Describe the reproductive system in human beings.
5. Relate the phenomena of reproduction in closely related organisms.
6. Gain insights into ARTs.

Units	Description	Hours
1	Outline histology of male and female reproductive system of rat and human. Ultrastructure of gametes. Spermatogenesis: Kinetics and endocrine regulation, androgen synthesis and metabolism, Epididymis, sperm maturation, accessory reproductive structures. Oogenesis, Folliculogenesis, ovulation, Corpus luteum formation and regression, endocrine regulation, Menstrual cycle, Estrous cycle, Menarche and Menopause.	16
2	Fertilization, Recognition of sperm, egg and sperm attraction; acrosome reaction, Species-specific recognition, gamete fusion and prevention of polyspermy; fusion of genetic material, activation of egg metabolism, rearrangement of egg cytoplasm, (ex. Frog). Types of cleavage, blastula and gastrula of fruit fly. Morphogenetic movements: Epiboly, Emboly,	16

	Invagination, Involution, Ingression, Convergence, divergence, Delamination.	
3	Early development in Drosophila: Origin of anterior and posterior polarity, maternal effects of genes, segmentation genes, homeotic selector genes, Generation of dorso-ventral polarity. Axis formation in amphibia. Organogenesis of brain, limb, heart, hematopoiesis, kidney, extra-embryonic membranes. Gonadal hormones and mechanism of hormone action, steroids, prostaglandins, regulation of gonadotropin secretion in male and female.	16
4	Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation. Pregnancy, parturition and lactation. Infertility in male and female (human): causes, diagnosis and management. Assisted Reproductive Technology, Sperm banks, Frozen embryos, in-vitro fertilization, Embryo-transfer, EFT, IUT, GIFT, ZIFT, ICSI, PROST. Modern contraceptive methods.	16

**Suggested Reading:**

1. Adiyogi and Adiyogi, 1977, Reproductive biology of invertebrates, IBH, New Delhi.
2. Sarkar HBD, 1996, Principles of vertebrate reproductive biology
3. Saidapur S K, 1989, Reproductive cycle of Indian vertebrates
4. Lewis Wolpert, 2012. Principles of Development, Oxford Univ. Press
5. Slack J. M.W. Essential Developmental Biology, Blackwell.
6. Mary S. Tyler, 2000. Developmental Biology: A guide for experimental study, 2nd Edition, Sinauer Assoc. Inc. Sunderland, MA.
7. Fred H. Wilt and Sarah C. Hake, 2001. Principles of Developmental Biology, W.W. Norton & Comp. Inc. NY. 2004.
8. Scott F. Gilbert. 2014. Developmental Biology, 9th Edition, Sinauer Assoc. Inc. Sunderland, MA.

<b>Internal Assessment for Theory</b>	
<b>Assessment type</b>	<b>Marks</b>
First Test / Presentation / Project / Seminars / Assignment	10
Second Test / Presentation / Project / Seminars / Assignment	10
Total	20

**Theory Examination Question Paper Pattern for B.Sc**

**Semester-V**

**UG Degree Examination: 2025-26**

**(Semester Scheme-Revised NEP – 2024-25)**

Paper Code:	Paper Title: <b>Developmental and Reproductive biology</b>
Duration of Exam: 3 Hours	Max Marks: 80

<b>Section-A / «sÁUA-J.</b>	
A. Answer any TEN of the following questions. Each question carried two marks. F PÉ¼ÀV£À AiÀiÁªÀÁzÁzÀgÀÆ °ÀvÀÀÛ ¥Àæ±ÉßUÀ½UÉ GvÀÛj'. ¥Àæw ¥Àæ±ÉßUÉ JgÀqÀÄ CAPÀUÀ¼ÄÄ	10 x 2 = 20 Marks
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	
<b>Section-B / «sÁUA-©.</b>	
B. Answer any SIX of the following. Each question carries five marks. F PÉ¼ÀV£À AiÀiÁªÀÁzÁzÀgÀÆ DgÀÄ ¥Àæ±ÉßUÀ½UÉ GvÀÛj'. ¥Àæw ¥Àæ±ÉßUÉ LzÄÄ CAPÀUÀ¼ÄÄ	6 x 5 = 30
1. 2. 3. 4. 5. 6. 7. 8.	
<b>Section-C / «sÁUA-¹.</b>	
C. Answer any THREE of the following. Each question carries ten marks. F PÉ¼ÀV£À AiÀiÁªÀÁzÁzÀgÀÆ °ÀÄÆgÀÄ ¥Àæ±ÉßUÀ½UÉ GvÀÛj'. ¥Àæw ¥Àæ±ÉßUÉ °ÀvÀÀÛ CAPÀUÀ¼ÄÄ	3 x 10 = 30
1. 2. 3. 4. 5.	

*\*Note: All units to be considered while framing questions, equal weightage to be given for each unit.*

**Zoology**  
**B.Sc., Semester – V (SEP)**  
**Practical Syllabus**

Course Title: <b>DEVELOPMENTAL AND REPRODUCTIVE BIOLOGY</b>	Course Code:
Total Contact Hours: 64	No. of Credits: P = 2
Contact hours per week: 4	L:P (0:4)
Internal Assessment Marks: 10	Duration of SEE: 3 Hours
Semester End Exam Marks: 40	

**Course Outcomes (COs):**

At the end of the course, students will be able to:

1. Understand procedures of mounting embryos.
2. Carry out slide preparations of temporary mountings.
3. Develop the skills to distinguish different stages of development.
4. Gain the skills of designing the models of embryos.
5. Demonstrate the stages of development of an organism.
6. Describe life cycle of organisms.
7. Take up research in biological sciences.
8. Get a flavor of research by working on projects along with their writing skills.
9. Think and interpret individually and independently.

**Name of the Experiments**

1. Mounting of developmental stages of chick embryo.
2. Study of developmental stages and life cycle of Drosophila.
3. Study of whole mount and sections of developmental stages of frog through permanent slides (cleavages, blastula, gastrula, morula, neurula, tail bud stage, tailed larva and adult).
4. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages).
5. Study of contraceptive methods.
6. Spermatogenesis and oogenesis stages
7. Study of normal and abnormal sperms.
8. Preparation and mounting of chick embryo by window method.
9. Life cycle of Drosophila.
10. Working procedure of any two test kits used in clinical laboratory.
11. Any other related experiments based on the suitability (subject teacher to decide on consent with BoS members)

\*Note: Students should draw the diagrams rather than just pasting the pictures in the records. A minimum of 10 practical experiments to be performed by the student justifying the course title.

<b>Internal Assessment for Practical</b>	
<b>Assessment type</b>	<b>Marks</b>
Test / Presentation / Project / Seminars	5
Laboratory Performance / Participation	5
<b>Total</b>	<b>10</b>

**Semester End Practical Question Paper Pattern for UG Semester-V (Major)**

<b>Q. No.</b>	<b>Duration: 04 Hours</b>	<b>Max Marks: 40</b>
1	Major Experiment	12
2	Minor experiment	08
3	Spotting / Identification	10
4	Record Book / Journal Submission	05
5	Viva	05

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**Zoology**  
**B.Sc., Semester – V (SEP) w.e.f 2026-27**  
**Theory Syllabus**

Course Title: <b>IMMUNOLOGY AND COMPUTATIONAL BIOLOGY</b>	Course Code:
Total Contact Hours: 64	No. of Credits: T=4
L:P	4:0
Internal Assessment Marks: 20	Duration of SEE: 3 Hours
Semester End Exam Marks: 80	

**Course Outcomes (COs):**

At the end of the course, students will be able to:

1. Understand the immune response system.
2. Gain knowledge use of advanced techniques.
3. Carry out laboratory tests.
4. Distinguish and describe the role of different immune cells.
5. Apply statistical applications in hypothesis testing.
6. Describe antigen-antibody reactions.
7. Give scientific justifications on observed facts.
8. Establish interdisciplinary approach to biological processes.

Units	Description	Hours
1	Acquired immunity: Naturally acquired, artificially acquired and adaptive, Humoral and cell mediated immunity. Immunogens, haptens; Major Histocompatibility Complex: MHC genes, MHC and immune responsiveness and disease susceptibility. Biology of cells of the immune system: Hematopoiesis, Microphages (Neutrophils), Macrophages, T-Lymphocytes, B-Lymphocytes, Dendritic cells and NK cells. B-cell maturation, activation and differentiation; T-cell maturation, activation	16

	and differentiation and T-cell receptors. Cancer immunotherapy; autoimmune disorder.	
2	Antigen-antibody interactions: Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques: RIA, ELISA, Western blotting, ELISPOT assay, immune-fluorescence microscopy, flow-cytometry and immune-electron microscopy; CMI techniques: lympho-proliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock outs.	16
3	Introduction to biostatistics and its applications in Biology. Collection of biological data and types of variables. Probability concepts and distributions. Hypothesis testing and significance. Chi-square test, G-test of goodness of fit. Descriptive statistics: Measures of central tendency, Dispersion, Standard Deviation, Standard error, tabulation and graphical representation of data.	16
4	Students' t-test, independence, normality, homoscedasticity and heteroscedasticity, data transportation. One-way ANOVA, two-way ANOVA. Correlation of linear regression, Spearman rank correlation, curvi-linear regression. Analysis of covariance, multiple regression. Multiple comparisons and meta-analysis. Basic operating biostatistics tools and techniques: SPSS, MATLAB, MS-EXCEL, Graph pad PRISM, AI.	16

<b>Internal Assessment for Theory</b>	
Assessment type	Marks
First Test / Presentation / Project / Seminars / Assignment	10
Second Test / Presentation / Project / Seminars / Assignment	10
Total	20

**Suggested references.**

1. John McDonald. Handbook of Biological Statistics. Third edition, Sparky House Publishing, Baltimore, Maryland, USA.
2. Gerald Belle, Biostatistics: A methodology for the health Sciences. Second edition, Wiley Interscience, A John Wiley and sons inc. Hoboken, New Jersey.
3. Siegmund Brandt. Data Analysis: Statistical and computational methods for scientists and engineers. Fourth edition, Springer.
4. Stephen Looney. Biostatistical methods, volume 184. Humana Press, Totowa, New Jersey.
5. Wayne W Daniel. Biostatistics: a foundation for analysis in the health sciences.
6. Christian Heumann and Michael Schomaker Shalabh. Introduction to statistics and data analysis, Springer.
7. Massimiliano Bonamente. Statistics and analysis of scientific data, second edition, Springer.

## Semester End Theory Question Paper Pattern for UG Semester-V (Major)

Paper Code:	Paper Title: <b>Immunology and Computational Biology</b>
Duration of Exam: 3 Hours	Max Marks: 80

<b>Section-A / «sAUÀ-J.</b>	
A. Answer any TEN of the following questions. Each question carried two marks. F PÉ¼ÀVÉÀ AiÀiÁªÀÀzÁzÀgÀÆ °ÀvÀÄÜ ¥Àæ±ÉBUÀ½UÉ GvÀÛj¹. ¥Àæw ¥Àæ±ÉBUÉ JgÀqÀÄ CAPÀUÀ¼ÄÄ	10 x 2 = 20 Marks
<ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> <li>8.</li> <li>9.</li> <li>10.</li> <li>11.</li> <li>12.</li> </ol>	
<b>Section-B / «sAUÀ-©.</b>	
B. Answer any SIX of the following. Each question carries five marks. F PÉ¼ÀVÉÀ AiÀiÁªÀÀzÁzÀgÀÆ DgÀÄ ¥Àæ±ÉBUÀ½UÉ GvÀÛj¹. ¥Àæw ¥Àæ±ÉBUÉ LzÀÄ CAPÀUÀ¼ÄÄ	6 x 5 = 30
<ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> <li>8.</li> </ol>	
<b>Section-C / «sAUÀ-¹.</b>	
C. Answer any THREE of the following. Each question carries ten marks. F PÉ¼ÀVÉÀ AiÀiÁªÀÀzÁzÀgÀÆ °ÀÄÆgÀÄ ¥Àæ±ÉBUÀ½UÉ GvÀÛj¹. ¥Àæw ¥Àæ±ÉBUÉ °ÀvÀÄÜ CAPÀUÀ¼ÄÄ	3 x 10 = 30
<ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> </ol>	

**Zoology**  
**B.Sc., Semester – V (SEP)**  
**Practical Syllabus**

Course Title: <b>IMMUNOLOGY AND COMPUTATIONAL BIOLOGY.</b>	Course Code:
Total Contact Hours: 64	No. of Credits: P = 2
Contact hours per week: 4	L:P (0:4)
Internal Assessment Marks: 10	Duration of SEE: 3 Hrs
Semester End Exam Marks: 40	

**Course Outcomes (COs):**

At the end of the course, students will be able to:

1. Understand and appreciate the computation biology.
2. Learn the structure and function of immunoglobulins.
3. Develop the skills to related statistical inference to the biological data.
4. Gain the skills in micro-preparation techniques.
5. Enhance knowledge on basic computer operating systems.
6. Demonstrate statistical tools using computer software.

List of Experiments
<ol style="list-style-type: none"> <li>1. Identification of WBC cells</li> <li>2. Total blood cell count (RBC and WBC)</li> <li>3. Estimation of haemoglobin using haemometer.</li> <li>4. Estimation of clotting and bleeding time.</li> <li>5. Study of structure and functions of immunoglobulins</li> <li>6. Identification of immune cells using charts.</li> <li>7. Study of immune deficiency disorders</li> <li>8. Study of cases of autoimmune disorders</li> <li>9. Introduction to basic operations using MS excel</li> <li>10. Calculating measures of central tendency using EXCEL</li> <li>11. Basic tools and techniques using SPSS</li> <li>12. Chi-square test for given data</li> <li>13. One-way ANOVA and two-way ANOVA</li> </ol>

*\*Note:* i) Students should draw the diagrams rather than just pasting the pictures in the records.

ii) Practicals are subject to the availability of resources and may be modified on consent with BoS members. At least 10 practical experiments covering the course title is advisable.

<b>Internal Assessment for Practical</b>	
<b>Assessment type</b>	<b>Marks</b>
Test / Presentation / Project / Seminars	5
Laboratory Performance / Participation	5
<b>Total</b>	<b>10</b>

**Semester End Practical Question Paper Pattern for UG Semester-V  
(Major)**

<b>Q. No.</b>	<b>Duration: 04 Hours</b>	<b>Max Marks: 40</b>
1	Major Experiment	12
2	Minor experiment	08
3	Spotting / Identification	10
4	Record Book / Journal Submission	05
5	Viva	05

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**Zoology**  
**B.Sc., Semester – VI (SEP) w.e.f 2026-27**  
**Theory Syllabus**

Elective Course Title: <b>HUMAN HEALTH</b>	Course Code:
Total Contact Hours:	No. of Credits: 03
L:P	3:0
Internal Assessment Marks: 10	Duration of SEE: 3 Hours
Semester End Exam Marks: 40	

**Course Outcomes (COs):**

At the end of the course, students will be able to:

1. After completion the course, students will be able to have career opportunities in Medical and Health Services.
2. Manage health related issues at health centers.
3. Act as Biostatistician, Health care consultant, Epidemiologist, Occupational Health and Safety Specialist, Social and Community Service Manager, Health Education Specialist.
4. Gain awareness and knowledge on maintaining healthy habits.

Units	Description	Hours
1	Definition of health, Significance of public health and hygiene to prevent diseases: TB, Leprosy, Cholera, Chikungunya, Common cold, Flu, Dengue, Malaria, AIDS, Food poisoning, Dysentery. Health care and hand washing. Hygiene practice like personal, menstrual, oral, anal, hand hygiene etc. Communicable and non-communicable diseases with examples. Vectors and vector borne-diseases, prevention of vectors and control measures.	
2	Food and nutrition, diet, Balanced diet, WHO recommendations, malnutrition, under-nutrition, causes and prevention of obesity. Food borne diseases and control. Disorders caused by deficiency of	

	carbohydrates, proteins, lipids, minerals, vitamins, fibres and water. Food adulterants and laboratory tests to detect common food adulterants.	
3	Healthy life styles protocol: Measuring Blood Pressure, Blood sugar, Kidney health profile, Dialysis, ECG, EEG, Human blood cell count, normal urine and abnormal urine, stool, mental health, Sleep wake cycle, Osteoporosis, osteomalacia, osteoarthritis, bone mineral density. Memory and mental processes of nervous system. Regenerative and degenerative nervous system disorders. Drug abuse and menace of narcotics.	

### Suggested reading:

1. Aschengrau A, Seage G.R., (2013) Essentials of Epidemiology in Public Health Jones and Bartlett Publishers, Inc; 3rd edition
2. Bamji MS, Rao NP, Reddy V. (2017). Text book of human nutrition. (4th ed). Delhi: Oxford and IBH Publishing co. (P) Ltd.
3. Environmental Microbiology edited by I.L. Pepper, C.P. Gerba, T.J. Gentry. 3rd edition. Academic Press, USA. 2014.
4. Gibney (2004). Public health nutrition. Hoboken, NJ: Blackwell Publishing
5. N. Okafor. (2011) Environmental Microbiology of Aquatic and Waste Systems by Springer, USA.
6. Waste Water Microbiology by D.H. Bergey. 2nd Edition. Medtech, India. 2019.
7. Park, K. (2017), Preventive and Social Medicine, B.B. Publishers.
8. Engelkirk P.G. and Duben-Engelkirk J. (2015) Burton's Microbiology for the Health Sciences, 10th Ed. Wolters Kluwer Health.
9. Shanmugavel, G. and George, B (2021). Textbook of public health and hygiene. Darshan Publishers.

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