

Anekant Education Society's

**TULJARAM CHATURCHAND COLLEGE**  
**OF ARTS, SCIENCE & COMMERCE, BARAMATI.**  
**(AUTONOMOUS INSTITUTE)**



**SYLLABUS**  
**FIRST YEAR B. Sc. Zoology**  
**ACADEMIC YEAR 2019-2020**  
**SEMESTER-II**

**Anekant Education Society's  
TULJARAM CHATURCHAND COLLEGE  
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AUTONOMOUS**

**Scheme of Course Structure (CBCS) Faculty of Science  
Department of Zoology**

**Class: F.Y.B.Sc.**

**Pattern: 40 (IA) + 60 (EA)**

<b>Semester</b>	<b>Paper Code</b>	<b>Title of Paper</b>	<b>No. of Credits</b>
<b>Semester I</b>	ZOO: 1101	Animal Systematics and Diversity - I	<b>2</b>
	ZOO: 1102	Fundamentals of Cell Biology	<b>2</b>
	ZOO: 1103	<b>Zoology Practical-I</b>	<b>2</b>
<b>Semester II</b>	ZOO: 1201	Animal Systematics and Diversity - II	<b>2</b>
	ZOO: 1202	Genetics	<b>2</b>
	ZOO: 1203	<b>Zoology Practical-II</b>	<b>2</b>

IA\* - Internal Assessment

EA\*- External Assessment

**SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)**  
**Academic Year 2019 - 2020**

**Class: F.Y.B.Sc. (Semester– II)**

**Paper Code: ZOO: 1201**

**Paper: I**

**Title of Paper: Animal Systematics and Diversity – II**

**Credit: 2**

**No. of Lectures: 36**

**Learning Objectives:-**

- Develop a comprehensive understanding of the general characters and classification of Hemichordata, Urochordata, and Cephalochordata up to the order level.
- Explore the salient features and classification of Cyclostomata, Pisces (Chondrichthyes and Osteichthyes), and Amphibia up to the order level, emphasizing key characteristics and providing examples for each.
- Conduct a detailed study of the frog, including its systematic position, habitat, external characters, sexual dimorphism, digestive system, food, feeding, physiology of digestion, circulatory system, central nervous system, sense organs, and reproductive systems (male and female).
- Investigate specific topics related to Hemichordata, Urochordata, Pisces, and Amphibia, including their affinities, retrogressive metamorphosis, migration, accessory respiratory organs, scales, neoteny, and parental care.
- Develop the ability to integrate morphological features with functional aspects, understanding how structural adaptations contribute to the physiological and ecological roles of organisms within each subphylum and order.
- Encourage critical analysis by comparing and contrasting the characteristics, behaviours, and adaptations of different chordates.
- Apply acquired knowledge to real-world scenarios, such as understanding the significance of retrogressive metamorphosis, migration patterns, and parental care.

**Learning Outcomes:-**

After completion of this course students will be able to-

- CO 1: demonstrate a comprehensive understanding of the general characters and classification of Hemichordata, Urochordata, and Cephalochordata.
- CO 2: exhibit a deep knowledge of the salient features and classification of Cyclostomata, Pisces (Chondrichthyes and Osteichthyes), and Amphibia up to the order level.
- CO 3: conduct a thorough study of the frog, including its systematic position, habitat, external characters, sexual dimorphism, digestive system, food, feeding, physiology of digestion, circulatory system, central nervous system, sense organs, and reproductive systems (male and female).
- CO 4: demonstrating knowledge about their affinities, retrogressive metamorphosis, migration, accessory respiratory organs, scales, Neoteny, and parental care.
- CO 5: Integrate morphological features with functional aspects, illustrating how structural adaptations contribute to the physiological and ecological roles of organisms within each subphylum and order.
- CO 6: Critically analyse and compare characteristics, behaviour, and adaptations of different chordate groups.
- CO 7: acquired knowledge to real-world scenarios, such as understanding the significance of retrogressive metamorphosis, migration patterns, and parental care strategies.

**TOPICS:**

CONTENT	NO. OF LECTURES
<b>Unit 1: General characters and classification of following subphyla up to order with one Example:</b>	
1.1 Hemichordata	4
1.2 Urochordata	
1.3 Cephalochordata	
<b>Unit 2: Salient features and classification up to order</b>	4

<b>with one example of the following:</b>	
2.1 Cyclostomata 2.2 Pisces - (Chondrichthyes and Osteichthyes ) 2.3 Amphibia	
<b>Unit 3: Study of Frog:</b>	
3.1 Systematic position, Habit and habitat 3.2 External characters and sexual dimorphism 3.3 Digestive system, food, feeding and physiology of digestion 3.4 Circulatory system (lymphatic system not expected) 3.5 Central Nervous system 3.6 Sense organs 3.7 Reproductive systems (male & female)	18
<b>Unit 4:General topics:</b>	
4.1 Hemichordata: Affinities. 4.2 Urochordata: Retrogressive metamorphosis. 4.3 Pisces: Migration, Accessory respiratory organs and Scales. 4.4 Amphibia: Neoteny and Parental care	10

### REFERENCES

- Ganguly, BB., Sinha, A.K., Adhikari, S. (2021). Biology of Animals. New Central Book Agency, Kolkata.
- Prasad, S. N., & Kashyap, V. (2020). A Textbook of Vertebrate Zoology. New Age International.
- Dr. A. E. Desai and Dr. K. R. Pawar. (2017). Animal systematics and diversity – I & II.
- Crane, R. (2015). Creating Parker and Haswell's' A textbook of zoology'(1897). Script & Print, 39(4), 221-240.
- Verma, P. S. (2013). Chordate zoology. S. Chand Publishing.
- Lal, S. S. (2009). Practical Zoology Vertebrate. Rastogi Publications.
- J.R.B. Alfred and Ramakrishna. (2004). Collection, Preservation and Identification of animals. Zoological Survey of India Publications.
- Bhamrah, MS., Juneja, K. (2003). Introduction to Amphibia. Amol Publication, Delhi.
- Nigam HC. And Sobti, R., S.Chand and Co. New Delhi (2000). Functional Organization of chordates (part I and II).
- Mayr, E. (1998). This is biology: The science of the living world. Universities Press.
- Kershaw, DR., Redwood Burn Ltd., Trowbridge. (1983). Animal Diversity.
- Vidyarthi. (1968). Textbook of Zoology. Agrasia Publishers, Agra.
- Goodnight and others IBH Publishing Co. (1964). General Zoology.
- Young, JZ. (1907). Life of Vertebrates. III Edition, Clarendon Press, London.

### Course Articulation Matrix of ZOO: 1201 Animal Systematics and Diversity – II Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
<b>CO1</b>	3	2	1	2	2	2	2	2	2
<b>CO2</b>	3	3	2	3	2	3	2	2	2
<b>CO3</b>	3	3	1	3	2	2	2	2	3
<b>CO4</b>	3	2	2	3	3	2	2	2	2
<b>CO5</b>	2	3	2	2	3	2	2	2	2
<b>CO6</b>	2	2	1	2	1	3	2	2	2
<b>CO7</b>	3	2	2	3	2	3	2	2	2

**PO1 - Disciplinary Knowledge:**

CO1 demonstrates a comprehensive understanding of the general characters and classification of chordates, aligning with the acquisition of disciplinary knowledge.

**PO2 - Critical Thinking and Problem Solving:**

CO2 Exhibits deep knowledge and critical thinking skills in understanding and categorizing vertebrate diversity up to the order level.

**PO3 - Social Competence:**

CO3 involves primarily technical, the study of frog anatomy and physiology contributes to social competence by recognizing the diversity of organisms and their roles in ecosystems.

**PO4 - Research-related Skills and Scientific Temper:**

CO4 delving into specialized topics in chordate biology reflects research-related skills and a scientific temper in understanding specific aspects of different chordate groups.

**PO5 - Trans-disciplinary Knowledge:**

CO5 involves integrating morphology with function demonstrates trans-disciplinary knowledge, linking structural adaptations to functional aspects within each subphylum and order.

**PO6 - Personal and Professional Competence:**

CO6 related to critical analysis and comparative study contribute to personal and professional competence by fostering a deeper understanding of evolutionary relationships and ecological significance.

**PO7 - Effective Citizenship and Ethics:**

CO7 involves applying biological concepts, such as understanding the significance of retrogressive metamorphosis, migration patterns, and parental care, aligns with effective citizenship and ethical considerations in the field of biology.

**PO8 - Environment and Sustainability:**

CO5 directly involves understanding environmental factors influencing migration patterns.

**PO9 - Self-directed and Life-long learning:**

Most COs involves continuous learning, especially as the fields of biology and ecology are dynamic.

**SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)**  
**Academic Year 2019 - 2020**

**Class: F.Y.B.Sc. (Semester– II)**

**Paper Code: ZOO: 1202**

**Paper: II**

**Credit: 2**

**Title of Paper: Genetics**

**No. of Lectures: 36**

**Learning Objectives:-**

- Understand, articulate the fundamental principles of Mendelian inheritance and apply Mendel's laws to predict and interpret genetic outcomes in practical scenarios.
- Apply knowledge of gene interaction and explore the concept of lethal genes in *Mus musculus*.
- Understand the medico-legal importance of the ABO, Rh-blood group system, polygenic inheritance and concept of pleiotropism
- Describe morphology classify chromosomes based on centromeric position and analyse structural and numerical chromosomal aberrations and their implications.
- Describe the morphology, sexual dimorphism, life cycle and investigate mutants of *Drosophila*.
- Understand and explain the genetic basis of syndromes such as Down's (Mongolism) and Cri-du-chat.
- Analyse sex chromosomal abnormalities (Klinefelter's and Turner's syndrome), inborn errors of metabolism (Albinism, Phenylketonuria, and Alkaptonuria) and importance of genetic counselling and its applications.

**Learning Outcomes:-**

After completion of this course students will be able to-

- CO 1: demonstrate a comprehensive understanding of Mendelian inheritance principles and their practical applications, showcasing the ability to predict and interpret genetic outcomes.
- CO 2: explain gene interaction concepts, including co-dominance and incomplete dominance, and apply this knowledge to predict phenotypic outcomes in various genetic crosses.
- CO 3: students will explore the concept of lethal genes in *Mus musculus*, analysing their impact on the phenotypes of mice.
- CO 4: define and illustrate the concept of multiple alleles, understand the medico-legal importance of blood group systems, and explain polygenic inheritance with examples, such as skin color in humans and sickle cell anemia.
- CO 5: describe chromosome morphology and composition, classify chromosomes based on centromeric position, and analyse structural and numerical chromosomal aberrations, showcasing mastery in chromosomal concepts.
- CO 6: describe the morphology, sexual dimorphism, and life cycle of *Drosophila* and investigate mutants, specifically focusing on eye, wings, and body color mutations.
- CO 7: perform and interpret human karyotyping, understand the genetic basis of syndromes, analyse sex chromosomal abnormalities and inborn errors of metabolism, and recognize the importance of genetic counselling, demonstrating a holistic application of human genetics knowledge.

**TOPICS:**

CONTENT	NO. OF LECTURES
<b>Unit 1: Introduction to Classical Genetics:</b>	
1.1 Mendelian Inheritance: Laws of heredity and their practical applications	4
1.2 Test cross and back cross	
<b>Unit 2: Gene Interaction:</b>	5

2.1 Concept of gene interaction, co-dominance and incomplete dominance. 2.2 Complementary factors (9:7) 2.3 Supplementary factors (9: 3:4) 2.4 Inhibitory factors (13:3) 2.5 Duplicate dominant factors (15:1)	
<b>Unit 3: Lethal genes in <i>Mus musculus</i> (Mice)</b>	1
<b>Unit 4: Multiple Alleles and Polygenic Inheritance:</b>	
4.1 Concept, characteristics and importance of Multiple alleles, ABO & Rh-blood group system and its medico-legal importance. 4.2 Concept of polygenic inheritance with Reference to skin Colour in Human being. 4.3 Pleiotropism and Sickle cell anaemia	5
<b>Unit 5: Chromosomes:</b>	
5.1 Introduction to morphology and composition 5.2 Classification based on the centromeric position 5.3 Types of chromosomes (autosomes and sex chromosomes) 5.4 Chromosomal aberrations: Structural and Numerical Changes.	6
<b>Unit 6: <i>Drosophila</i> as Genetic model organism:</b>	
6.1 Morphology, Sexual dimorphism and Life cycle. 6.2 Mutants: eye, wings and body Colour (Two mutants of each type)	2
<b>Unit 7: Human genetics:</b>	
7.1 Study of human karyotype 7.2 Syndromes: a) Autosomal-Down's (Mongolism) and Cri-du-chat. b) Sex chromosomal abnormalities in human: Klinefelter's and Turner's syndrome 7.3 Inborn errors of metabolism: Albinism, Phenylketonuria and Alkaptonuria. 7.4 Genetic Counselling and its importance	6
<b>Unit 8: Sex-determination:</b>	
8.1 Introduction 8.2 Chromosomal theory of sex determination (XX-XY, ZZ-ZW, XX-XO & Haploid Diploid method) 8.3 Parthenogenesis and Gynandromorphism. 8.4 Environmental Sex Determination	4
<b>Unit 9.</b>	
<b>Sex linked inheritance in human:</b>	3
9.1 Inheritance of Colour-blindness, Haemophilia and Hypertrichosis	

### REFERENCES

- Russell, P. J., Hertz, P. E., McMillan, B., & Benington, J. (2020). *Biology: the dynamic science*. 3<sup>rd</sup> a. edition.
- Snustad, D. P., & Simmons, M. J. (2015). *Principles of genetics*. 6<sup>th</sup> edition John Wiley & Sons.
- Verma, P. S., & Agarwal, V. K. (2009). *Genetics, 9th edition (Multicolour Edition)*. S. Chand Publishing.
- Klug, W. S., Cummings, M. R., Spencer, C. A., Palladino, M. A., & Ward, S. M. (2009). *Concepts of genetics* 9<sup>th</sup> edition.
- Simmons, M. J., & Snustad, D. P. (2006). *Principles of genetics*. John Wiley & Sons. 8<sup>th</sup> edition.
- Watson, J. D., Baker, T. A., Gann, A., Bell, S. P., Levine, M., & Losick, R. M. (2004). *Molecular biology of the gene*. 5<sup>th</sup> edition.

7. Verma, P. S., & Agarwal, V. K. (2004). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*:
8. Gupta, P. K. (2000). *Genetics*. Rastogi publications
9. Dnyansagar, V. R. (1986). *Cytology and genetics*. Tata McGraw-Hill.

### Course Articulation Matrix of ZOO: 1202 Genetics

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	2	2	2	2	2
CO2	3	3	2	3	2	3	2	2	2
CO3	2	2	2	2	2	2	2	2	2
CO4	3	3	2	3	3	2	2	2	2
CO5	3	3	2	3	3	2	2	2	2
CO6	2	2	1	2	1	2	2	2	2
CO7	3	2	2	3	2	3	2	2	3

#### PO1 - Disciplinary Knowledge:

CO1 demonstrates a comprehensive understanding of Mendelian inheritance principles, aligning with the acquisition of disciplinary knowledge.

#### PO2 - Critical Thinking and Problem Solving:

CO 2 explains gene interaction concepts, showcasing critical thinking skills in understanding and applying genetic principles to predict phenotypic outcomes.

#### PO3 - Social Competence:

CO3 involves while primarily technical, understanding lethal genes contributes to broader social competence by recognizing the ethical considerations in genetic research.

#### PO4 - Research-related Skills and Scientific Temper:

CO4 involves depth knowledge of multiple alleles, blood group systems, and polygenic inheritance aligns with research-related skills and a scientific temper.

#### PO5 - Trans-disciplinary Knowledge:

CO5 describing chromosome morphology and aberrations showcases knowledge that transcends disciplinary boundaries, linking genetic concepts to broader biological principles.

#### PO6 - Personal and Professional Competence:

CO 6 describing the morphology, sexual dimorphism, and life cycle of *Drosophila* contributes to personal and professional competence in understanding model organisms.

#### PO7 - Effective Citizenship and Ethics:

CO7 applying human genetics knowledge, including karyotyping and understanding syndromes, aligns with effective citizenship and ethical considerations in genetic counselling.

#### PO8: Environment and Sustainability:

CO7 requires students to consider the environmental impact of using animal abilities for human benefit.

#### PO9: Self-directed and Life-long learning:

CO7 requires students to explore new and innovative ways to use animal abilities for environmental sustainability and economic benefit.



**SYLLABUS (CBCS) FOR F.Y.B.Sc. ZOOLOGY (w. e. f. June, 2019)**  
**Academic Year 2019 - 2020**

**Class: F.Y.B.Sc. (Semester– II)**

**Paper Code: ZOO: 1203**

**Paper: III**

**Credit: 2**

**Title of Paper: Zoology Practical-II**

**No. of Practicals: Any 10**

**Learning Objectives:-**

- Understand the principles of taxonomy and classification in the context of diverse organisms, including Hemichordata, Urochordata, Cephalochordata, Cartilaginous fish, and Bony fish.
- Examine and describe the external characters of *Hoplobatrachus tigerinus*.
- Investigate sexual dimorphism, digestive system, and brain anatomy using models and charts.
- Learn and apply techniques for the temporary preparation of Placoid and Cycloid scales from preserved fish specimens.
- Acquire skills in measuring key morphometric parameters (Body length, Standard Length, Weight, Depth) in freshwater fish and explore the relationships between morphometric measurements and ecological adaptations.
- Develop observational skills and apply taxonomic keys for the accurate identification of specimens.
- Study and understand the genetic basis of hereditary disorders or inborn errors of metabolism, blood group inheritance in the human population and its clinical relevance

**Learning Outcomes:-**

After completion of this course, students will be able to-

- CO 1: demonstrate a comprehensive understanding of the principles of taxonomy and classification, explaining the placement of organisms within their respective phyla based on morphological and anatomical features.
- CO 2: describe the external characters of *Hoplobatrachus tigerinus* and analyze sexual dimorphism, digestive system, and brain anatomy using models and charts.
- CO 3: acquire proficiency in the temporary preparation of Placoid and Cycloid scales from preserved fish specimens.
- CO 4: demonstrate accurate measurement skills in determining key morphometric parameters also be able to interpret relationships between morphometric measurements and ecological adaptations.
- CO 5: develop effective observational skills and compile an animal album with photographs, showcasing the ability to accurately identify taxa using taxonomic keys.
- CO 6: gain a deep understanding of the genetic basis of two hereditary disorders or inborn errors of metabolism in the human population.
- CO 7: apply their knowledge of human blood groups, including ABO and Rh-factor, to understand the genetic basis of blood group inheritance and its clinical relevance.

**PRACTICALS:**

Sr. No.	Name of the practical	E / D
1	<b>To study the classification with reasons of the following:</b> Hemichordata- <i>Balanoglossus</i> Urochordata- <i>Hardmania</i> Cephalochordata- <i>Amphioxus</i> Cartilaginous fish- <i>Scoliodon</i> Bony fish- <i>Seahorse</i>	(D)
2	<b>Study of Morphology &amp; Anatomy of Frog (<i>Hoplobatrachus tigerinus</i>):</b> Study of external characters, sexual dimorphism, digestive System and brain of Frog with the help of model/ charts	(D)
3	<b>Temporary preparation of scales from Fishes:</b> Placoid and Cycloid Scales from preserved fishes.	(E)

4	<b>Morphometric study of any freshwater fish:</b> Measurements of Body length, Standard Length, Weight, Depth etc.	(E)
5	<b>Animals Album :</b> Collection of Any five Animals photographs with Identification, External Characters of the above mentioned taxa. ( <b>Activity based learning</b> )	(E)
6	<b>Study of Human Genetical Disorders:</b> Study of Any two hereditary Disorders / Inborn errors of metabolism from human population.	(D)
7	Profile of Any two Geneticists. ( <b>Activity based learning</b> )	(E)
8	<b>Study of human blood groups:</b> ABO and Rh- factor.	(E)
9	<b>Study of Karyotype:</b> Study of normal human karyotype from metaphase chromosomal spread picture	(E)
10	<b>Study of Human Genetical traits:</b> Tongue rolling, widow's peak, ear lobes, colour blindness and PTC tasters/ non tasters.	(E)
11	<b>Genetical Problems:</b> Based on Monohybrid, Dihybrid Cross & ABO Blood Group system.	(E)
12	<b>Study of <i>Drosophila</i>:</b> A) Culture of <i>Drosophila</i> B) External Characters, Sexual Dimorphism and Life Cycle, C) Mutants: Eye and wing mutants ( <b>any two of each</b> )	(E) (E) (D)
13	<b>Identification of Fish/Frog Specimen based on Taxonomic Identification Key</b>	(E)
14	<b>Compulsory Zoological Study Tour:</b> A Compulsory Visit to biodiversity spot / water body / Research institute / Vermicomposting unit and submission of report.	-

\*E=Experiment,

D=Demonstration

Maintenance of good laboratory record along with visit report by the student is mandatory.

#### REFERENCES:

1. Practical Zoology of Invertebrates by S. S. Lal.
2. Practical Zoology of Vertebrates by S. S. Lal.
3. Practical Zoology Vol-3 by N Arumugam and A. Mani.
4. Practical Zoology of Invertebrates by Jordan and Verma.
5. Practical Zoology of Vertebrates by Jordan and Verma.
6. Practical Zoology of Cell Biology by S. S. Lal.
7. *i* Genetics- Molecular Approach, 3rd Ed. by Peter J. Russell, Pearson.

#### Course Articulation Matrix of ZOO: 1203 Zoology practical-II

Weightage: 1: Partially related, 2: Moderately related, 3: Strongly related

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	1	1	1	2	2
CO2	3	3	2	2	1	2	1	2	2
CO3	2	2	2	1	1	1	1	2	2
CO4	2	3	2	2	1	2	1	2	2
CO5	2	2	3	1	2	2	2	2	2
CO6	3	3	2	2	2	2	3	2	2
CO7	3	3	3	2	2	2	2	2	2

**PO1: Disciplinary Knowledge:**

CO 1 aligns with developing disciplinary knowledge in taxonomy and classification.

**PO2: Critical Thinking and Problem Solving:**

CO 1 involves critical thinking to explain the placement of organisms based on morphological and anatomical features.

**PO3: Social Competence**

CO 3 involves understanding ecological roles enhances social competence by recognizing the interconnectedness of organisms in ecosystems and their impact on society.

**PO4: Research-related Skills and Scientific Temper**

CO 4 align with comparative anatomy analysis requires research skills and a scientific temper, contributing to a deeper understanding of organismal structures.

**PO5: Trans-disciplinary Knowledge**

CO 5 involves Integration of morphological, ecological, and evolutionary evidence transcends disciplinary boundaries, showcasing trans-disciplinary knowledge.

**PO6: Personal and Professional Competence**

CO 6 involves recognizing the role of taxonomy in conservation demonstrates personal and professional competence in environmental stewardship.

**PO7: Effective Citizenship and Ethic**

CO 7 involves understanding interconnected biological concepts promotes effective citizenship, ethical considerations.

**PO8: Environment and Sustainability:**

CO5: Identifying animals in your local environment can contribute to understanding their ecological roles and importance in maintaining biodiversity.

**PO9: Self-directed and Life-long learning:**

All COs require independent learning, research, and analysis, promoting self-directed learning.  
CO6: Learning about a prominent geneticist can inspire an interest in lifelong learning and scientific exploration.