

# K.K. UNIVERSITY

NALANDA, BIHAR-803115



## SCHOOL OF APPLIED SCIENCES

### Bachelor of Science (B.Sc.)

### ZOOLOGY

(Three Year Full Programme)

2024-2025

## PROGRAMME STRUCTURE & SYLLABUS

Under CBCS and NEP-2020



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**Programme Structure for B.Sc Zoology**  
**School of Applied Science**  
**Department of Zoology**  
**(Aligned with CBCS and New Education Policy-2020)**

<b>S. No.</b>	<b>Type of Course</b>	<b>Credits</b>
<b>1</b>	Core Course (CC)	<b>56</b>
<b>2</b>	Discipline Specific Elective Course (DSEC)	<b>18</b>
<b>3</b>	Open Elective Course ( OEC)	<b>32</b>
<b>4</b>	Ability Enhancement Courses (AEC)	<b>6</b>
<b>5</b>	Skill Enhancement Courses (SEC)	<b>8</b>
<b>Total Credit</b>		<b>120</b>



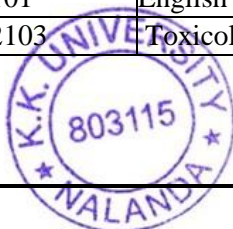
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**Credit Framework for B.Sc in Zoology  
(2024 - 25)**

Year	Semester	Type Of Course	Course Code	Course Title	L	T	P	C	
1	I	CC	BSZG 1101	Bio diversity I	3	1	0	4	
		CC	BSZG 1101 P	Practical: Bio diversity I	0	0	6	3	
		Choose Any Two Subjects (Open Elective I)							
		OEC	BSBTS 1101	Botany I	2	1	0	3	
			BSBTS 1101P	Practical: Botany I	0	0	2	1	
			BSCHS 1101	Chemistry I	2	1	0	3	
			BSCHS 1101P	Practical: Chemistry I	0	0	2	1	
			BSMBS 1101	Microbiology I	2	1	0	3	
			BSMBS 1101P	Practical-Microbiology I	0	0	2	1	
			BSBCS 1101	Biochemistry I	2	1	0	3	
	BSBCS 1101P	Practical- Biochemistry I	0	0	2	1			
	AEC	HNL 1101	Hindi	2	0	0	2		
	<b>Total</b>					<b>9</b>	<b>3</b>	<b>10</b>	<b>17</b>
	II	CC	BSZG 1201	Bio diversity II	3	1	0	4	
		CC	BSZG 1201P	Practical: Bio diversity II	0	0	6	3	
		Choose Any Two Subjects (Open Elective II)							
		OEC	BSBTS 1201	Botany II	2	1	0	3	
			BSBTS 1201P	Practical: Botany II	0	0	2	1	
			BSCHS 1201	Chemistry II	2	1	0	3	
			BSCHS 1201P	Practical Chemistry II	0	0	2	1	
			BSMBS 1201	Microbiology II	2	1	0	3	
			BSMBS 1201P	Practical-Microbiology II	0	0	2	1	
			BSBCS 1201	Biochemistry II	2	1	0	3	
	BSBCS 1201P	Practical- Biochemistry II	0	0	2	1			
	AEC	BSEVS 1201	Environmental Sciences	2	0	0	2		
	SEC	BSCS 1201	Communication Skill	1	1	0	2		
	<b>Total</b>					<b>11</b>	<b>3</b>	<b>10</b>	<b>19</b>
	III	CC	BSZG 2101	Chordata Evolution and Type Study	3	1	0	4	
CC		BSZG 2101P	Practical: Chordata Evolution and Type Study	0	0	6	3		
DSEC		BSZG 2102	Disease Biology	2	1	0	3		
Choose Any Two Subjects (Open Elective III)									
OEC		BSBTS 2101	Botany III	2	1	0	3		
		BSBTS 2101P	Practical: Botany III	0	0	2	1		
		BSCHS 2101	Chemistry III	2	1	0	3		
		BSCHS 2101P	Practical – Chemistry III	0	0	2	1		
		BSMBS 2101	Microbiology III	2	1	0	3		
		BSMBS 2101P	Practical-Microbiology III	0	0	2	1		
		BSBCS 2101	Biochemistry III	2	1	0	3		
BSBCS 2101P		Practical- Biochemistry III	0	0	2	1			
AEC	ENG 2101	English	2	0	0	2			
SEC	BSZG 2103	Toxicology	2	0	0	2			



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					<b>Total</b>	<b>13</b>	<b>4</b>	<b>10</b>	<b>22</b>	
<b>2</b>	<b>IV</b>	CC	BSZG 2201	Chordata Diversity, Comparative Anatomy	3	1	0	4		
		CC	BSZG 2201P	Practical: Chordata Diversity, Comparative Anatomy	0	0	6	3		
		DSEC	BSZG 2202	Embryology	2	1	0	3		
		Choose Any Two Subjects (Open Elective-IV)								
		OEC	BSBTS 2201	Botany IV	2	1	0	3		
			BSBTS 2201P	Practical: Botany IV	0	0	2	1		
			BSCHS 2201	Chemistry IV	2	1	0	3		
			BSCHS 2201P	Practical Chemistry IV	0	0	2	1		
			BSMBS 2201	Microbiology IV	2	1	0	3		
			BSMBS 2201P	Practical-Microbiology IV	0	0	2	1		
BSBCS 2201	Biochemistry IV		2	1	0	3				
BSBCS 2201P	Practical- Biochemistry IV	0	0	2	1					
SEC	BSZG 2203	Medical Parasitology	2	0	0	2				
<b>Total</b>					<b>11</b>	<b>4</b>	<b>10</b>	<b>20</b>		
<b>3</b>	<b>5</b>	CC	BSZG 3101	Mammalian Physiology	3	1	0	4		
		CC	BSZG 3102	Cell Biology & Biometry	3	1	0	4		
		CC	BSZG 3101P	Practical: Mammalian Physiology	0	0	6	3		
		CC	BSZG 3102P	Practical: Cell Biology & Biometry	0	0	6	3		
		DSEC	BSZG 3103	Biochemistry	2	1	0	3		
		DSEC	BSZG 3104	Endocrinology	2	1	0	3		
	SEC	BSZG 2105	Basic Lab Techniques	1	0	2	2			
	<b>Total</b>					<b>11</b>	<b>4</b>	<b>14</b>	<b>22</b>	
	<b>6</b>	CC	BSZG 3201	Genetics	3	1	0	4		
		CC	BSZG 3202	Evolution, Paleozoology & Zoogeography	3	1	0	4		
		CC	BSZG 3201P	Practical: Genetics	0	0	6	3		
		CC	BSZG 3202P	Practical: Evolution, Paleozoology & Zoogeography	0	0	6	3		
		DSEC	BSZG 3203	Animal Behavior	2	1	0	3		
DSEC		BSZG 3204	Biotechnology	2	1	0	3			
<b>Total</b>					<b>10</b>	<b>4</b>	<b>12</b>	<b>20</b>		
<b>Grand Total</b>					<b>120</b>					

**L-Lecture, T-Tutorial, P-Practical, C-Credits**



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**SEMESTER I**  
**Bio Diversity-I**  
**(Protists to Pseudocoelomates)**  
**(BSZH – 1101)**

**Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

**Course Outcome:**

**CO1:** Understand origin metazoans and classification based on development of coelom and larval stages.

**CO2:** Identify the invertebrates and classify them up to the class level.

**CO3:** Compare anatomy, physiology, and life cycles of representative species from each phylum.

**CO4:** Evaluate evolutionary relationship with help of comparative anatomy study among chordates.

**Course Objective:**

This course explores the diversity of life forms from phylum Protista through Pseudocoelomates, emphasizing the evolutionary progression of complexity in organisms. Students will examine the major groups of Protists, including their classifications, physiological traits, and ecological roles. The course then transitions to the study of Pseudocoelomates, focusing on their anatomical structures, developmental biology, and evolutionary significance.



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## Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Protista, Parazoa and Metazoa</b> General characteristics and Classification up to classes Study of Euglena, Amoeba and Paramecium Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i> Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa.	12	1-3
II	<b>Porifera</b> General characteristics and Classification up to classes Canal system and spicules in sponges	8	4-5
III	<b>Cnidaria</b> General characteristics and Classification up to classes Metagenesis in Obelia Polymorphism in Cnidaria Corals and coral reefs	12	6-8
IV	<b>Platyhelminthes</b> General characteristics and Classification up to classes Life cycle and pathogenicity of <i>Fasciola hepatica</i> and <i>Taenia solium</i>	12	9-11
V	<b>Nemathelminthes</b> General characteristics and Classification up to classes Life cycle and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i> Parasitic adaptations in helminths.	12	12-14
<b>REVISION</b>			15

**Note: Classification to be followed from “Barnes, R.D. (1987). Invertebrate Zoology, V Edition”**

### **Reference Text Book:**

- Barnes, R. D. (1987). Invertebrate Zoology (5th ed.). Saunders College Publishing.
- Kotpal, R. L. (2010). Minor Phyla (11th ed.). Rastogi Publications.
- Jordan, E. L., & Verma, P. S. (2001). Invertebrate Zoology (13th ed.). S. Chand and Co. Ltd.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>



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- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Biodiversity I Practical**

### **BSZH – 1101 (P)**

#### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

#### **Course Outcome:**

**CO1:** Understand origin and classification based on development of coelom and larval stages.

**CO2:** Identify the invertebrates and classify them up to the class level through museum specimens and slides.

**CO3:** Compare anatomy, physiology, and life cycles of representative species from each phylum through dissection of specimen.

**CO4:** Evaluate evolutionary relationship with help of comparative anatomy study among chordates.

#### **Course Objective:**

This course offers a comprehensive exploration of non-chordate organisms, ranging from Protists to Pseudocoelomates. Through practical sessions, students will gain hands-on experience in identifying, dissecting, and studying the diverse forms and functions of these



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organisms.

### **Syllabus:**

<b>Unit</b>	<b>Content</b>	<b>Total No. of hours</b>	<b>No. of week</b>
<b>I</b>	<ul style="list-style-type: none"><li>• Study of whole mount of Euglena, Amoeba and Paramecium, Binary fission and Conjugation in Paramecium</li></ul>	16	1-4
<b>II</b>	<ul style="list-style-type: none"><li>• Examination of pond water collected from different places for diversity in protista</li></ul>	8	5-6
<b>III</b>	<ul style="list-style-type: none"><li>• Study of Sycon (T.S. and L.S.), <i>Hyalonema</i>, <i>Euplectella</i>, <i>Spongilla</i></li></ul>	8	7-8
<b>IV</b>	<ul style="list-style-type: none"><li>• Study of <i>Obelia</i>, <i>Physalia</i>, <i>Millepora</i>, <i>Aurelia</i>, <i>Tubipora</i>, <i>Corallium</i>, <i>Alcyonium</i>, <i>Gorgonia</i>, <i>Metridium</i>, <i>Pennatula</i>, <i>Fungia</i>, <i>Meandrina</i>, <i>Madrepora</i></li><li>• One specimen/slide of any ctenophore</li></ul>	12	9-11
<b>V</b>	<ul style="list-style-type: none"><li>• Study of adult <i>Fasciola hepatica</i>, <i>Taenia solium</i> and their life cycles (Slides/micro-photographs)</li><li>• Study of adult <i>Ascaris lumbricoides</i> and its life stages (Slides/micro-photographs)</li></ul>	12	12-14
<b>Laboratory Note Book</b>			15

### **Reference Text Book:**

- Kotpal, R. L. (2010). Minor Phyla (11th ed.). Rastogi Publications.
- Jordan, E. L., & Verma, P. S. (2001). Invertebrate Zoology (13th ed.). S. Chand and Co. Ltd.
- Lal, S. S. (2009). Practical Zoology Invertebrate. Rastogi Publications.
- Verma, P. S., & Agarwal, V. K. (2006). A Manual of Practical Zoology: Invertebrates. S. Chand & Company Ltd.

### **Online Resources:**

- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>



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## SEMESTER II

### Biodiversity II (Invertebrate Coelomate) BSZH - 1201

#### Program Outcome:

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

#### Course Outcome:

**CO1:** Understand classification based on various distinct characters.

**CO2:** Identify the invertebrates and classify them up to the class level.

**CO3:** Compare anatomy, physiology, and life cycles of representative species from each phylum.

**CO4:** Evaluate evolutionary relationship with help of comparative anatomy study among chordates.

#### Course Objective:

This course provides an extensive theoretical study of non-chordate coelomate organisms, including Annelids, Molluscs, Arthropods and Echinoderm. The course covers the taxonomy, morphology, physiology, development, and evolutionary significance of these groups. Through lectures, readings, and discussions, students will gain a deep understanding of the diversity and complexity of non-chordate coelomate animals.

#### Syllabus:



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Unit	Content	Total No. of hours	No. of week
I	<b>Introduction to Coelomates</b> Evolution of coelom and metamerism	4	1
II	<b>Annelida</b> General characteristics and Classification up to classes Excretion in Annelida	8	2-3
III	<b>Arthropoda</b> General characteristics and Classification up to classes Vision and Respiration in Arthropoda Metamorphosis in Insects Social life in bees and termites	16	4-7
IV	<b>Onychophora</b> General characteristics and Evolutionary significance	4	8
V	<b>Mollusca</b> General characteristics and Classification up to classes Respiration in Mollusca Torsion and detorsion in Gastropoda Pearl formation in bivalves Evolutionary significance of trochophore larva	16	9-12
VI	<b>Echinodermata</b> General characteristics and Classification up to classes Water-vascular system in Asteroidea Larval forms in Echinodermata Affinities with Chordates	8	13-14
<b>REVISION</b>			15

**Note: Classification to be followed from “Barnes, R.D. (1987). Invertebrate Zoology, V Edition”**

### **Reference Text Book:**

- Barnes, R. D. (1987). Invertebrate Zoology (5th ed.). Saunders College Publishing.
- Kotpal, R. L. (2010). Minor Phyla (11th ed.). Rastogi Publications.
- Jordan, E. L., & Verma, P. S. (2001). Invertebrate Zoology (13th ed.). S. Chand and Co. Ltd.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>



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- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Biodiversity II Practical**

### **BSZH – 1101 (P)**

#### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

#### **Course Outcome:**

**CO1:** Understand classification based on development of coelom and larval stages.

**CO2:** Identify the invertebrates and classify them up to the class level through museum specimens and slides.

**CO3:** Compare anatomy, physiology, and life cycles of representative species from each phylum through dissection of specimen.

**CO4:** Evaluate evolutionary relationship with help of comparative anatomy study among chordates.



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### Course Objective:

This course offers a comprehensive exploration of non-chordate coelomate organisms, ranging from Annelida to Echinodermata. Through practical sessions, students will gain hands-on experience in identifying, dissecting, and studying the diverse forms and functions of these organisms.

Unit	Content	Total No. of hours	No. of week
I	Study of Specimens: <b>Annelids</b> - <i>Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria</i> <b>Arthropods</b> - <i>Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta</i> , termites and honey bees <b>Onychophora</b> - <i>Peripatus</i> <b>Molluscs</b> - <i>Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus</i> <b>Echinodermates</b> - <i>Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon</i>	16	1-4
II	Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.	16	5-8
III	Mount of mouth parts and dissection of digestive system and nervous system of <i>Periplaneta</i> .	12	9-11
IV	Identification of larval forms (crustacean, mollusc and echinoderm).	12	12-14
<b>Laboratory Note Book</b>			15

### Reference Text Book:

- Kotpal, R. L. (2010). Minor Phyla (11th ed.). Rastogi Publications.
- Jordan, E. L., & Verma, P. S. (2001). Invertebrate Zoology (13th ed.). S. Chand and Co. Ltd.
- Lal, S. S. (2009). Practical Zoology Invertebrate. Rastogi Publications.
- Verma, P. S., & Agarwal, V. K. (2006). A Manual of Practical Zoology: Invertebrates. S. Chand & Company Ltd.



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### **Online Resources:**

- Anatomy of earthworm: The dissection works (CD); Source – [www.scienclass.com](http://www.scienclass.com) ;
- Cockroach dissection- [www.ento.vt.edu](http://www.ento.vt.edu)
- <https://www.youtube.com/user/cecedusat>)
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **SEMESTER III**

### **Chordata Diversity and Type Study**

### **BSZH – 2101**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand classification of chordate based on development larval stages and specific characters.

**CO2:** Identify the vertebrates and classify them up to the class level.

**CO3:** Compare anatomy, physiology, and life cycles of representative species from each phylum.

**CO4:** Evaluate evolutionary relationship with help of comparative anatomy study among chordates.



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### Course Objective:

The diversity of the phylum Chordata, encompasses subphyla such as Hemichordata, Cephalochordata, Urochordata, and Vertebrata. The course focuses on the taxonomy, morphology, physiology, and evolutionary relationships within this diverse group.

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Origin of Chordata</b> General characteristics and outline classification Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata	8	1-2
II	<b>Protochordata</b> General characteristics of Hemichordata, Urochordata and Cephalochordata Study of larval forms in protochordates Retgressive metamorphosis in Urochordata	8	3-4
III	<b>Agnatha</b> General characteristics and classification of cyclostomes up to class	4	5
IV	<b>Pisces</b> General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Osmoregulation and Parental care in fishes	8	6-7
V	<b>Amphibia</b> Origin of Tetrapoda (Evolution of terrestrial ectotherms) General characteristics and classification up to order Parental care in Amphibians	8	8-9
VI	<b>Reptilia</b> General characteristics and classification up to order Affinities of <i>Sphenodon</i> Poison apparatus and Biting mechanism in snakes	8	10-11
VII	<b>Aves</b> General characteristics and classification up to order Archaeopteryx- a connecting link Principles and aerodynamics of flight, Flight adaptations and Migration in birds	8	12-13
VIII	<b>Mammals</b>	8	14-15



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General characters and classification up to order		
Affinities of Prototheria		
Adaptive radiation with reference to locomotory appendages		

**Classification to be followed from Young, J. Z. (2004), *The life of vertebrates* (3rd ed.). Oxford University Press.**

### **Reference Text Book:**

- Waterman, A. J. (1971). Chordate Structure and Function. The Macmillan Company.
- Romer, A. S., & Parsons, T. S. (1986). The Vertebrate Body (6th ed.). Saunders College Publishing.
- Kardong, K. V. (2019). Vertebrates: Comparative Anatomy, Function, Evolution (8th ed.). McGraw-Hill Education.

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Chordata Diversity and Type Study (Practical)** **BSZH – 2101 (P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.



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**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

**Course Outcome:**

**CO1:** Understand origin metazoans and classification based on development of coelom and larval stages.

**CO2:** Identify the vertebrates and classify them up to the class level through study of specimens.

**CO3:** Compare anatomy, physiology, and life cycles of representative species from each phylum through dissection of specimen.

**CO4:** Evaluate evolutionary relationship with help of comparative anatomy study among chordates.

**Course Objective:**

Course is designed to complement the theoretical aspects, providing hands-on experience in observing, identifying, and analyzing various chordate specimens. The practical sessions emphasize developing observational skills, understanding anatomical structures, and exploring functional adaptations.

**Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	<p><b>Study of Specimen</b></p> <ul style="list-style-type: none"> <li>• <b>Protochordata</b> <i>Balanoglossus, Herdmania, Branchiostoma</i></li> <li>• <b>Agnatha</b> <i>Petromyzon, Myxine</i></li> <li>• <b>Pisces</b> <i>Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetradon/ Diodon, Anabas, Flat fish</i></li> <li>• <b>Amphibia</b> <i>Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra</i></li> <li>• <b>Reptilia</b> <i>Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus</i></li> </ul>	32	1-8



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	<ul style="list-style-type: none"> <li>• <b>Aves</b> Study of six common birds from different orders</li> <li>• <b>Mammalia</b> <i>Sorex</i>, Bat (Insectivorous and Frugivorous), <i>Funambulus</i>, <i>Loris</i>, <i>Herpestes</i>, <i>Erinaceous</i>.</li> </ul>		
<b>II</b>	<ul style="list-style-type: none"> <li>• Key for Identification of poisonous and non-poisonous snakes</li> <li>• Types of beaks and claws in birds</li> </ul>	12	9-11
<b>III</b>	<ul style="list-style-type: none"> <li>• Dissection of Fowl head (Dissections and mounts subject to permission)</li> <li>• Power point presentation on anatomical study of any two animals from two different classes (may be included if dissections not given permission).</li> </ul>	12	12-14
<b>Laboratory Note Book</b>			15

### Reference Text Book:

- Lal, S. S. (2009). Practical Zoology Vertebrate. Rastogi Publications.
- Kotpal, R. L. (2012). A Textbook of Practical Zoology: Chordates. Rastogi Publications.
- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.

### Online Resources:

- Anatomy of shark: Shark dissection and anatomy (video)- [www.neosci.com](http://www.neosci.com)
- Anatomy of Chordates: The Vertebrate Dissection Guide Series (CD)–Learning Development Centre, University of Portsmouth
- Mammalian Physiology- [www.biopac.com](http://www.biopac.com)
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>



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**SEMESTER IV**  
**Comparative Anatomy & Embryology of Vertebrate**  
**BSZH – 2201**

**Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

**Course Outcome:**

**CO1:** Understand the anatomical structures and variations among vertebrate classes.

**CO2:** Discuss, explain various structure and function of vertebrate system.

**CO3:** Comprehend the fundamental processes of vertebrate embryonic development and their evolutionary significance.

**CO4:** Develop the ability to analyze and compare anatomical and embryological features, understanding their functional and evolutionary implications.

**Course Objective:**

This course explores the comparative anatomy and embryology of vertebrates, highlighting the structural and functional adaptations across different vertebrate classes. It covers the embryonic development stages, from fertilization to organogenesis, and compares anatomical features, such as skeletal, muscular, circulatory, respiratory, and nervous systems. This course integrates evolutionary concepts to understand the diversity and similarities among vertebrates, providing insights into evolutionary biology, developmental biology, and anatomy.



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## Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Integumentary System</b> Structure, functions and derivatives of integument	4	1
II	<b>Skeletal System</b> Overview of axial and appendicular skeleton, Jaw suspension, Visceral arches	8	2-3
III	<b>Digestive System</b> Alimentary canal and associated glands, dentition	4	4
IV	<b>Respiratory System</b> Skin, gills, lungs and air sacs; Accessory respiratory organs	8	5-6
V	<b>Circulatory System</b> General plan of circulation, evolution of heart and aortic arches	8	7-8
VI	<b>Urinogenital System</b> Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	8	9-10
VII	<b>Nervous System</b> Comparative account of brain Autonomic nervous system, Spinal cord, Cranial nerves in mammals	8	11-12
VIII	<b>Sense Organs</b> Classification of receptors Brief account of visual and auditory receptors in man	8	13-14
<b>REVISION</b>			15

## Reference Text Book:

- Lal, S. S. (2009). Practical Zoology Vertebrate. Rastogi Publications.
- Kotpal, R. L. (2012). A Textbook of Practical Zoology: Chordates. Rastogi Publications.
- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.

## Online Resources:

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>



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## **Comparative Anatomy & Embryology of Vertebrate (Practical)** **BSZH – 2201 (P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand the anatomical structures and variations among vertebrate classes.

**CO2:** Discuss, explain various structure and function of vertebrate system.

**CO3:** Comprehend the fundamental processes of vertebrate embryonic development and their evolutionary significance.

**CO4:** Develop the ability to analyze and compare anatomical and embryological features, understanding their functional and evolutionary implications.

### **Course Objective:**

Course focuses on hands-on experiences that enhance the understanding of vertebrate anatomy and embryological development. This component includes dissection, microscopic examination, and comparative analysis of various vertebrate species. The practical sessions aim to develop observational skills, technical proficiency, and a deeper appreciation of vertebrate diversity and development.

### **Syllabus:**



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Unit	Content	Total No. of hours	No. of week
I	<ul style="list-style-type: none"> <li>• Study of placoid, cycloid and ctenoid scales through permanent slides/photographs</li> <li>• Carapace and plastron of turtle /tortoise</li> </ul>	8	1-2
II	<ul style="list-style-type: none"> <li>• Disarticulated skeleton of Frog, <i>Varanus</i>, Fowl, Rabbit</li> <li>• Mammalian skulls: One herbivorous and one carnivorous animal</li> </ul>	12	3-5
III	<ul style="list-style-type: none"> <li>• Dissection of rat to study arterial and urinogenital system (subject to permission)</li> <li>• Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)</li> </ul>	16	6-9
IV	<ul style="list-style-type: none"> <li>• Chick embryo development (24, 48, 72 hours)</li> <li>• Project on skeletal modifications in vertebrates (may be included if dissection not permitted)</li> </ul>	16	10-13
<b>Laboratory Note Book</b>			14-15

Classification to be followed from Young, J. Z. (2004), *The life of vertebrates* (3rd ed.). Oxford University Press.

### Reference Text Book:

- Lal, S. S. (2009). Practical Zoology Vertebrate. Rastogi Publications.
- Kotpal, R. L. (2012). A Textbook of Practical Zoology: Chordates. Rastogi Publications.
- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.

### Online Resources:

- Anatomy of shark: Shark dissection and anatomy (video)- [www.neosci.com](http://www.neosci.com)
- Anatomy of Chordates: The Vertebrate Dissection Guide Series (CD)–Learning Development Centre, University of Portsmouth
- Mammalian Physiology- [www.biopac.com](http://www.biopac.com)
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>



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## SEMESTER V

### Animal Physiology BSZH – 3101

#### Program Outcome:

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

#### Course Outcome:

**CO1:** Demonstrate comprehensive understanding of the basic physiological processes.

**CO2:** Demonstrate a comprehensive understanding of the digestion, respiratory, renal and circulatory system.

**CO3:** Explain the anatomical and functional role of different physiological systems.

**CO4:** Understand the concept of integration and interaction of physiological systems.

#### Course Objective:

Course provides an in-depth understanding of the physiological processes that occur in animals. It covers the mechanisms by which animals maintain homeostasis, adapt to their environments, and perform essential life functions. The course includes topics such as neurophysiology, muscle physiology, endocrinology, cardiovascular physiology, respiratory physiology, and renal physiology. It emphasizes the comparative aspects of physiology across different animal groups, highlighting the diversity of adaptations in response to environmental challenges.

#### Syllabus:



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Unit	Content	Total No. of hours	No. of week
I	<b>Physiology of Digestion</b> Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.	8	1-2
II	<b>Physiology of Respiration</b> Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration.	12	3-5
III	<b>Renal Physiology</b> Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance.	12	6-8
IV	<b>Blood</b> Components of blood and their functions; Structure and functions of haemoglobin, Haemostasis: Blood clotting system, Complement system & Fibrinolytic system, Haemopoiesis Blood groups: Rh factor, ABO and MN.	12	9-11
V	<b>Physiology of Heart</b> Structure of mammalian heart; Coronary circulation, Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses, Cardiac cycle, Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate; Electrocardiogram, Blood pressure and its regulation.	12	12-14
<b>REVISION</b>			15



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### **Reference Text Book:**

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Animal Physiology (Practical) BSZH – 3101(P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**



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**CO1:** Conduct hand- on experiments, dissection to understand animal physiology.

**CO2:** Determination of different physiological process through laboratory methodologies.

**CO3:** Identification and comment upon the different histological slides.

**CO4:** Present practical project/ assessment for animal physiology.

### **Course Objective:**

Course provides hands-on experience with experimental techniques and methodologies, focusing on understanding physiological processes in animals. The practical sessions aim to enhance students' observational skills, technical proficiency, and ability to analyze and interpret physiological data.

### **Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	<ul style="list-style-type: none"><li>• Determination of ABO Blood group</li><li>• Enumeration of red blood cells and white blood cells using haemocytometer</li></ul>	12	1-3
II	<ul style="list-style-type: none"><li>• Estimation of haemoglobin using Sahli's haemoglobinometer</li><li>• Determination of bleeding and clotting time</li></ul>	12	4-6
III	<ul style="list-style-type: none"><li>• Determination of O<sub>2</sub> uptake by Terrestrial animal</li><li>• Recording of blood pressure using a sphygmomanometer</li></ul>	12	7-9
IV	<ul style="list-style-type: none"><li>• Identification and comment upon the histological slides of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.</li></ul>	24	10-14
<b>Laboratory Note Book</b>			15

### **Reference Text Book:**

- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.
- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,



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### **Online Resources:**

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- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Cell biology & Biometry BSZH - 3102**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand cellular organelles, membranes, cytoskeleton and cell division.

**CO2:** Explore the molecular basis of cellular functions, such as protein synthesis, trafficking, and energy production.

**CO3:** Evaluate the mechanisms of signal transduction, gene expression, and cellular responses to external stimuli.

**CO4:** Analyze the application of descriptive and inferential statistics in analyzing biological data.



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### Course Objective:

Course combines the study of cell biology, focusing on the structure and function of cells, with biometry, which involves the application of statistical methods to biological research. The course covers key concepts in cell biology, including cellular organization, molecular mechanisms, signaling pathways, and cellular processes such as division and differentiation. The biometry component emphasizes the use of statistical tools to design experiments, analyze data, and interpret results in biological research.

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Overview of Cells</b> Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions	4	1
II	<b>Plasma Membrane</b> Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions	8	2-3
III	<b>Endomembrane System</b> Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	8	4-5
IV	<b>Mitochondria and Peroxisomes</b> Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain Chemi-osmotic hypothesis, Peroxisomes	8	6-7
V	<b>Cytoskeleton</b> Structure and Functions: Microtubules, Microfilaments and Intermediate filament	4	8
VI	<b>Nucleus</b> Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)	8	9-10
VII	<b>Cell Division</b> Mitosis, Meiosis, Cell cycle and its regulation	8	11-12
VIII	<b>Cell Signaling</b> GPCR and Role of second messenger (cAMP)	8	13-14
<b>Laboratory Note Book</b>			15



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## **Reference Text Book:**

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII, Edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular Biology of the Cell (4th ed.). Garland Science.

## **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Cell biology & Biometry (Practical) BSZH – 3102(P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that



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address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand light microscopy to observe cell morphology and organelles.

**CO2:** Preparation of cell samples and staining techniques

**CO3:** Analysis of cellular processes such as mitosis, meiosis, and apoptosis.

**CO4:** Applying statistical methods to biological data, enhancing their research capabilities

### **Course Objective:**

Course provides hands-on experience with laboratory techniques in cell biology and statistical analysis methods in biometry. This component aims to reinforce theoretical knowledge through practical application, enabling students to gain practical skills and experience.

### **Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	Preparation of temporary stained squash of grasshopper testes to study various stages of mitosis Study of various stages of meiosis.	16	1-4
II	Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.	16	4-8
III	Preparation of permanent slide to demonstrate: i. DNA by Feulgen reaction ii. DNA and RNA by MGP iii. Mucopolysaccharides by PAS reaction iv. Proteins by Mercurbromophenol blue/Fast Green	24	9-14
<b>Laboratory Note Book</b>			15

### **Reference Text Book:**

- Garg, P. K., & Sharma, P. (2014). Practical Biochemistry and Molecular Biology. Cambridge University Press India.
- Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology (7th ed.). Cambridge University Press.
- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.

### **Online Resources:**



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- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Biochemistry and Endocrinology**

### **BSZH - 3103**

#### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

#### **Course Outcome:**

**CO1:** Recall understanding of the chemical processes and molecular structures crucial to life.

**CO2:** Explain key metabolic pathways, their regulation, and their integration in various physiological states.

**CO3:** Evaluate hormone functions, endocrine gland roles, and the clinical aspects of endocrine disorders.

**CO4:** Integrate biochemical and endocrine knowledge to understand complex physiological processes and their disorders.

#### **Course Objective:**



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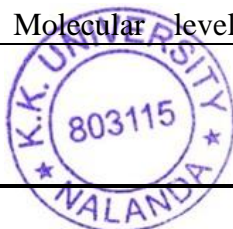
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Course explores the chemical processes and substances that are crucial to living organisms, with a particular focus on biochemical mechanisms and endocrine system functions. The biochemistry component delves into the structure, function, and metabolism of biomolecules such as proteins, lipids, carbohydrates, and nucleic acids. The endocrinology component examines the role of hormones in regulating physiological processes, the mechanisms of hormone action, and the impact of endocrine disorders on health.

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Overview of Metabolism</b> Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms.	8	1-2
II	<b>Carbohydrate Metabolism</b> Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis.	12	3-5
III	<b>Lipid Metabolism</b> $\beta$ -oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis	16	6-9
IV	<b>Protein Metabolism</b> Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids	16	10-13
V	<b>Oxidative Phosphorylation</b> Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System.		
VI	<b>Introduction to Endocrinology</b> History of endocrinology, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones		
VII	<b>Peripheral Endocrine Glands</b> Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis Hormones in homeostasis, Disorders of endocrine glands		
VIII	<b>Regulation of Hormone Action</b> Hormone action at Cellular level: Hormone receptors, transduction and regulation Hormone action at Molecular level: Molecular		



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	mediators, Genetic control of hormone action		
<b>Laboratory Note Book</b>			14-15

### **Reference Text Book:**

- Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Strauss, C. J. (2015). Biochemistry (8th ed.). W.H. Freeman and Company.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular Biology of the Cell (4th ed.). Garland Science.
- Guyton, A. C., & Hall, J. E. (2016). Guyton and Hall Textbook of Medical Physiology (13th ed.). Elsevier.
- Williams, R. H., & Wilkins, J. R. (2003). Endocrinology (6th ed.). McGraw-Hill Education.
- Sinha, S. K. (2011). Textbook of Biochemistry (5th ed.). McGraw-Hill Education India.
- Khatri, M. (2018). Human Physiology: Biochemistry and Endocrinology (2nd ed.). Pearson India.
- Saini, M., & Saini, N. (2012). Textbook of Biochemistry with Clinical Correlations. Jaypee Brothers Medical Publishers.
- Hadley, M.E. and Levine J.E. (2007). Endocrinology, 6th Edition. Pearson Prentice-Hall, Pearson Education Inc., New Jersey.

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Biochemistry & Endocrinology (Practical) BSZH 3103 – (P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.



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**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand and conduct Biochemical analysis of reducing sugar, starch, glycogen and amino acids

**CO2:** Identify and characterize endocrine glands

**CO3:** Dissect laboratory animal, locate and identify endocrine glands

**CO4:** Present practical project/ assessment for biochemistry and endocrinology

### **Course Objective:**

Course is designed to provide hands-on experience with laboratory techniques used in studying biochemical processes and endocrine functions. This component enhances students' ability to conduct experiments, analyze data, and apply theoretical knowledge to practical situations.

### **Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	<ul style="list-style-type: none"><li>Benedicts test for reducing sugar.</li><li>Molisch's test.</li><li>Iodine test for starch and glycogen.</li></ul>	16	1-4
II	<ul style="list-style-type: none"><li>Ninhydrin reaction for glycine / tyrosine I tryptophan.</li><li>Million's reaction for glycine / tyrosine / phenylalanine.</li></ul>	16	5-8
III	<ul style="list-style-type: none"><li>Dissect and display of Endocrine glands in laboratory bred rat*</li><li>Study of the permanent slides for all the endocrine glands</li></ul>	16	9-12
IV	<ul style="list-style-type: none"><li>Demonstration of Castration/ Ovariectomy in laboratory bred rat*</li></ul>	8	13-14



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	*If permission is granted		
Laboratory Note Book			15

### **Reference Text Book:**

- Garg, P. K., & Sharma, P. (2014). Practical Biochemistry and Molecular Biology. Cambridge University Press India.
- Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2016). Harper's Illustrated Biochemistry (31st ed.). McGraw-Hill Education.
- Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology (7th ed.). Cambridge University Press.
- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>



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**SEMESTER VI**  
**Genetics and Biotechnology**  
**BSZH - 3201**

**Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

**Course Outcome:**

**CO1:** Understand basic principle of Mendelian genetics, including inheritance patterns, dominant and recessive traits, and genetic linkage.

**CO2:** Explain the molecular basis of gene structure and function and understand gene regulation.

**CO3:** Evaluate key biotechnological methods such as PCR (Polymerase Chain Reaction), gel electrophoresis, and cloning.

**CO4:** Conduct study agricultural biotechnology, including genetically modified organisms (GMOs), pest resistance, and crop improvement.

**Course Objective:**

Course explores the fundamental principles of genetics including inheritance patterns, molecular genetics, and genetic variation, and applies these concepts to modern biotechnological techniques. The course covers classical genetics, molecular genetics, and the various applications of biotechnology in medicine, agriculture, and industry



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## Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Mendelian Genetics</b> Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex influenced and sex-limited characters inheritance.	8	1-2
II	<b>Linkage, Crossing Over and Chromosomal Mapping</b> Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination	8	3-4
III	<b>Mutations</b> Types of gene mutations (Classification), Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Gene mutation and molecular mechanism of its origin.	8	5-6
IV	<b>Extra-chromosomal Inheritance</b> Criteria for extra-chromosomal inheritance, Antibiotic resistance, Mitochondrial mutations, Kappa particles and Maternal effects	8	7-8
V	<b>Introduction to biotechnology</b> Concept and scope of biotechnology, Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).	8	9-10
VI	<b>Molecular Techniques in Gene manipulation</b> Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase Chain Reaction, DNA Finger Printing and DNA micro array.	8	11-12
VII	<b>Genetically Modified Organisms</b> Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection, Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock-out mice. Production of transgenic plants: <i>Agrobacterium</i> mediated transformation.	8	13-14



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Applications of transgenic plants: insect and herbicide resistant plants.		
<b>Laboratory Note Book</b>		15

### **Reference Text Book:**

- Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (2015). Introduction to Genetic Analysis (11th ed.). W.H. Freeman and Company.
- Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2013). Molecular Biology of the Gene (7th ed.). Pearson.
- Snustad, D. P., & Simmons, M. J. (2015). Principles of Genetics (7th ed.). Wiley.
- Gupta, P. K. (2009). Molecular Biology and Genetic Engineering. Rastogi Publications.
- Verma, P. S., & Agarwal, V. K. (2012). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (3rd ed.). S. Chand & Company Ltd.
- Satyanarayana, U. (2013). Biotechnology (2nd ed.). Books and Allied (P) Ltd.

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Genetics and Biotechnology (Practical) BSZH – 3201 (P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.



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**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand complex inheritance patterns such as polygenic traits and gene-environment interactions with help of Pedigree analysis.

**CO2:** Develop practical skills in modern biotechnological techniques and applications.

**CO3:** Evaluate working principle of modern biological tools and techniques.

### **Course Objective:**

Course provides hands-on experience with laboratory techniques used in genetic analysis and biotechnological applications. This component enhances students' ability to conduct experiments, analyze data, and apply theoretical knowledge to practical situations.

### **Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	Acetocarmine stained squash preparation of the onion root tips and testes of grasshopper and demonstrate stages of mitotic and meiotic divisions respectively.	8	1-2
II	Acetocarmine preparation of the giant chromosomes of the chironomus/drosophila larvae.	12	3-5
III	Genomic DNA isolation from <i>E. coli</i> Plasmid DNA isolation (pUC 18/19) from <i>E. coli</i> .	16	6-9
IV	To study following techniques through photographs a. Southern Blotting b. Northern Blotting c. Western Blotting d. DNA Sequencing (Sanger's Method) e. PCR f. DNA fingerprinting	16	10-13
<b>Laboratory Note Book</b>			14-15



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### **Reference Text Book:**

- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.
- Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2013). Molecular Biology of the Gene (7th ed.). Pearson.
- Snustad, D. P., & Simmons, M. J. (2015). Principles of Genetics (7th ed.). Wiley.
- Gupta, P. K. (2009). Molecular Biology and Genetic Engineering. Rastogi Publications.

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- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Paleozoology, Evolutionary history and Zoogeography BSZH - 3202**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.



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## Course Outcome:

**CO1:** Understand concepts related to evolution and mechanism and factors that affect the evolution of animals

**CO2:** Explain processes of fossilization and its significance

**CO3:** Conceptualizing the distribution of animal species and understand animal diversity across the globe

**CO4:** Analyze complex and overlapping interactions of animal biodiversity over evolutionary time scales.

## Course Objective:

The course delves into the study of fossilized animals, the evolutionary history of life on Earth, and the distribution of animal species across the globe. It covers the fossil record, phylogenetic relationships, and bio-geographical patterns, providing an integrated understanding of the factors shaping biodiversity over time.

## Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Evolution</b> Sources of hereditary variations and their role in evolution, Principles of evolution, Lamarckism, Neo-Lamarckism, Darwinism & Neo-Darwinism. Isolating mechanisms and their role in evolution. Mimicry and colouration. Introduction to population genetics and Hardy-Weinberg Law.	20	1-5
II	<b>Zoogeography</b> Zoogeographical realms of the world, their boundaries and climatic peculiarities. Characteristic & Peculiar fauna of Oriental, Ethiopian and Australian regions. Characteristics of Island fauna. Theories & Principles pertaining to animal distribution. Different geological eras of the world, their duration and climatic conditions.	20	6-10
III	<b>Paleozoology</b> Faunistic Peculiarities of Paleozoic, Mesozoic and Cenozoic eras. Fossils, their mode of formation & age determination. Fossil history of Horse & Man.	12	11-13
<b>REVISION</b>			14-15



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## **Reference Text Book:**

- Carroll, R. L. (1997). Patterns and Processes of Vertebrate Evolution. Cambridge University Press.
- Strickberger, M. W., & Hall, B. K. (2008). Evolution (4th ed.). Jones & Bartlett Learning.
- Cox, C. B., Moore, P. D., & Ladle, R. J. (2016). Biogeography: An Ecological and Evolutionary Approach (9th ed.). Wiley-Blackwell.
- Jain, P. C., & Anantharaman, M. S. (2000). Palaeontology: Evolution and Animal Distribution. Vishal Publishing Co.
- Rastogi, V. B. (2015). Organic Evolution. Rastogi Publications.
- Futuyma, D. J. (2017). Evolution (4th ed.). Sinauer Associates.

## **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Paleozoology, Evolutionary history and Zoogeography (Practical) BSZH – 3202-P**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.



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### **Course Outcome:**

**CO1:** Understand evolution of animals with concepts of analogy and homology.

**CO2:** Explain fossils with examples and implementation to record age

**CO3:** Analyze cladistics and phenetics.

**CO4:** Conduct practical project/ assessment for Paleozoology, Evolutionary history and Zoogeography

### **Course Objective:**

The practical component provides hands-on experience in paleontological methods, evolutionary analysis, and biogeographical studies. This component includes fossil analysis, phylogenetic reconstruction, and bio geographical mapping.

### **Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	Serial homology is exhibited by the appendages of prawn.	8	1-2
II	Homology and Analogy as exhibited by the wings of birds, bat and insect.	12	3-5
III	Adaptive radiation as exhibited by beaks of birds and dentition of mammals.	16	6-9
IV	Draw evolutionary tree	16	10-13
V	Study of Fossils. Identification and comments upon the specimens/slides.		
<b>Laboratory Note Book</b>			14-15

### **Reference Text Book:**

- Moore, R. A., & Carroll, S. P. (2014). Introduction to Biology: An Evolutionary Approach. McGraw-Hill Education.
- Hall, B. K., & Hallgrímsson, B. (2008). Strickberger's Evolution: The Definitive Textbook (4th ed.). Jones & Bartlett Learning.
- Browne, R. K., & Smith, E. (2001). Practical Skills in Biology (3rd ed.). Pearson Education.
- Freeman, S., & Herron, J. C. (2014).



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Evolutionary Analysis (5th ed.). Pearson.

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Mechanism of Evolution and Animal Behaviour BSZH - 3203**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Recall the adaptive significance of behavior and its role in survival and reproduction.

**CO2:** Explain the mechanisms behind complex animal behavior of social and sexual selection

**CO3:** Evaluate key concepts related to ethology like imprinting, habituation and FAP.

**CO4:** Apply how behavior contributes to the fitness of animals in their environments.

### **Course Objective:**



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Course explores the scientific study of how animals interact with their environment and other organisms. It covers the mechanisms, development, evolution, and functions of behavior across a wide range of species. The course integrates concepts from ethology, psychology, ecology, and evolutionary biology to understand the adaptive significance of behavior.

**Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	<b>Introduction to Animal Behaviour</b> Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen.	8	1-2
II	<b>Patterns of Behavior</b> Proximate and ultimate causes of behavior, Methods and recording of a behavior, Stereotyped Behaviors (Orientation, Reflexes); Individual Behavioral patterns; Instinct vs. Learnt Behavior Associative learning, classical and operant conditioning, Habituation, Imprinting.	12	3-5
III	<b>Social and Sexual Behavior</b> Social Behavior: Concept of Society; Communication and the senses; Altruism; Insects’ society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance. Sexual Behavior: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.	16	6-9
<b>REVISION</b>			14-15

**Reference Text Book:**

- Goodenough, J., McGuire, B., & Jakob, E. (2009). Perspectives on Animal Behavior (3rd ed.). Wiley.
- Alcock, J. (2013). Animal Behavior: An Evolutionary Approach (10th ed.). Sinauer Associates.
- Drickamer, L. C., Vessey, S. H., & Jakob, E. M. (2002). Animal Behavior: Mechanisms, Ecology, Evolution (5th ed.). McGraw-Hill.
- Verma, P. S., & Agarwal, V. K. (2000). Animal Behaviour. S. Chand & Company Ltd.



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- Gupta, P. K. (2014). Animal Behaviour. Rastogi Publications.
- Shukla, J. P., & Upadhyay, V. B. (2014). Principles of Animal Behaviour. Himalaya Publishing House.

### **Online Resources:**

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>

## **Mechanism of Evolution and Animal Behaviour (Practical)** **BSZH – 3203 (P)**

### **Program Outcome:**

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of Zoology.

**PO2:** Demonstrate an understanding of complex biological processes and explain how these relate to their function and survival.

**PO3:** Analyze zoological concepts to solve problems and further, utilize laboratory techniques to conduct experiments, collect data, and interpret results.

**PO4:** Apply complex biological data and critical thinking to draw valid conclusions.

**PO5:** Evaluate current scientific literature, theories, and research in zoology. Moreover, assess the impact of these progresses for academic advancement.

**PO6:** Design and conduct research work in zoology, including developing hypotheses, conducting experiments, and analyzing results that address present zoological challenges.

### **Course Outcome:**

**CO1:** Understand how to accurately observe and record animal behavior in various contexts.

**CO2:** Explain experiments in controlled environments to study specific behaviors.

**CO3:** Evaluate responses to stimuli to understand sensory and cognitive processes.

**CO4:** Conduct practical project/ assessment for animal behavior. Conduct field trip to observe wildlife in their natural habitat.



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### Course Objective:

The practical component involves hands-on experience with observing, recording, and analyzing animal behavior. This includes field studies, laboratory experiments, and data analysis.

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<ul style="list-style-type: none"><li>To study nests and nesting habits of the birds and social insects.</li></ul>	8	1-2
II	<ul style="list-style-type: none"><li>To study the behavioral responses of wood lice to dry and humid conditions.</li></ul>	12	3-5
III	<ul style="list-style-type: none"><li>To study geotaxis behavior in earthworm.</li><li>To study the photo taxis behavior in insect larvae.</li></ul>	16	6-9
IV	<ul style="list-style-type: none"><li>Visit to Forest/ Wild life Sanctuary/ Biodiversity Park/Zoological Park to study behavioral</li><li>Activities of animals and prepare a short report.</li></ul>	16	10-13
<b>Laboratory Note Book</b>			14-15

### Reference Text Book:

- Mohan, A., & Johal, A. S. (2011). Practical Zoology. Campus Books International.
- Alcock, J. (2013). Animal Behavior: An Evolutionary Approach (10th ed.). Sinauer Associates
- Martin, P., & Bateson, P. (2007). Measuring Behaviour: An Introductory Guide (3rd ed.). Cambridge University Press.
- Zentall, T. R., & Sherburne, L. M. (Eds.). (2008). Comparative Cognition: Experimental Approaches to Common Themes (Vol. 2). MIT Press.

### Online Resources:

- <https://ndl.iitkgp.ac.in/>
- <https://epgp.inflibnet.ac.in/#>
- <https://www.youtube.com/user/cecedusat>
- <https://www.education.gov.in/en/technology-enabled-learning-1>
- [https://cec.nic.in/cec/curriculum\\_class](https://cec.nic.in/cec/curriculum_class)
- <https://swayam.gov.in/>



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*A*

# B.Sc Zoology

## SUBSIDIARY PAPER

### SEMESTER I

#### Program Outcome:

**PO1:** Recall and recognize fundamental concepts, principles, and theories in diverse field of biology.

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### Botany-I

#### BSBT-S-1101

#### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	Algae: (1) General characteristics & classification of algae, (2) General characteristics of Cyanophyceae with reference to <i>Oscillatoria</i> and <i>Rivularia</i> , <i>Nostoc</i> , <i>Anabaena</i> , (3) Structure and life history of the following genera with reference to alternation of generation: <i>Volvox</i> , <i>Ocedogolnium</i> , <i>Coleochaete</i> , <i>Chara</i> , <i>Ectocarpus</i> , <i>Fucus</i> , <i>Batrachospermum</i> and	8	1-2



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	<p><i>Polysiphonia</i>.</p> <p>(4) Study of Economics importance of Algae.</p> <p>Fungi: (1) General Characters classification and Economic importance of Fungi, (2) Structures and life history of the following genera : <i>Synchytrium, Albugo, Erysiphe, Peziza, Ustilago, Puccinia, Alternaria, &amp; Cercospora</i>.</p>		
II	<p>Bryophytes : (1) General characteristics, classification and Economic importance of Bryophytes. (2) Structures and life history of the following genera with reference to comparative studies of gametophytes and sporophytes: <i>Marchantia, Pellia, Anthoceros, Sphagnum</i> and <i>Polytrichum</i>.</p> <p>Pteridophytes: (1) General characters and classification. (2) Stellar evolution. (3) Structures and life history of the following: <i>Psilotum, Lycopodium, Selaginella, Equisetum, Marselia</i> and <i>Azolla</i>.</p> <p>Fossils: Study of <i>Rhynia, Lepidodendron</i> and <i>Calamites</i>.</p>	12	3-5
<b>REVISION</b>			14-15

## HINDI –I

### HNL – 1101:

#### Syllabus:

- Hindi Bhasha ke Vibhinna Roop – Rashtra bhasha, Rjabhasha, Janbhasha.
- Tippan, Aalekhan, Sankshepa, Sarkari patra ke prakar, paribhashik shabdawali.
- Anuvaad ki paribhasha, prakar, Upyogita aur mahatva, Achhe Anuvaad ke Gun, Anuvaad prayog (Hindi se English me Anuvaad).
- Sabhashan Kala ka Artha, Sambhashan ke Vibhinn Roop – Vaartalap, Vyakhyan, Vaad-Vivaad, Ekaalap, Avaachik Abhivyakti, Jan Sambodhan, Sambhashan Kala ke Upaadana-Bhasha Gyan, Antaraal Dhvani (Volume), Lahaja (Accent).
- Sambhashan Kala ke Vibhinn Roop – Udgoshana, Sanchalan, Aankho Dekha Haal, Vachan Kala, Vaad- Vivaad Pratiyogita, Samuh samvaad.

#### Suggested Readings:

1. Karyalayeeya Hindi – Dr. Kailashnath Pandey – Prabhat Prakashan, New Delhi.
2. Prayojanmulak Hindi – Prayukti aur Anuvaad – Madhav Sonatakke
3. Anuvaad Vigyan – Bholanath Tiwari



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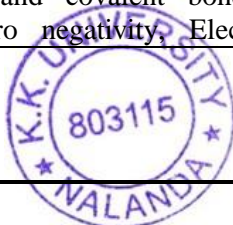
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4. Bhashan aur Sambhashan ki Divya shakti – Shri Ram Sharma Acharya – Yug Nirman Yojana Press, Mathura.
5. Bhashan Kala – Dr. Mahesh Sharma – GyanGanga Delhi.

**CHEMISTRY - I**  
**BSCH-S -1101**

Unit	Content	Total No. of hours	No. of week
I	<b>Physical Chemistry</b> <b>Gaseous State</b> <ul style="list-style-type: none"> <li>• Kinetic Theory of gases, Derivation of kinetic gas equation, deduction of gas law, calculation of gas constants and kinetic theory.</li> <li>• Types of solids, crystal forces, law of constancy of angles, seven crystal systems, law of rational indices, Bragg's Law, Lattice energy, Born-Haber cycle</li> </ul>	8	1-2
II	<b>Thermochemistry</b> <ul style="list-style-type: none"> <li>• Heat in chemical reactions, Reaction enthalpy, standard enthalpy changes.</li> <li>• Hess Law, Kirchoff Law</li> <li>• Bond energy and determination</li> </ul>	8	3-4
III	<b>Ionic Equilibrium</b> <ul style="list-style-type: none"> <li>• Ionic Product of water, pH, pK<sub>a</sub>, pK<sub>b</sub>, pK<sub>w</sub></li> <li>• Buffer solution, Idea of buffer solution in everyday life.</li> <li>• Solubility product and its application in salt analysis.</li> <li>• Specific conductance, Molar conductance, Equivalent conductance</li> </ul>	12	5-7
IV	<b>Inorganic Chemistry</b> <b>Atomic Structure and Bonding</b> <ul style="list-style-type: none"> <li>• Features of H-spectra and Bohr's theory.</li> <li>• Shapes of orbital's and their labeling, idea of quantum number</li> <li>• Pauli's Exclusion Principle, Hund's rule, Aufbau Principle</li> <li>• Electronic configuration of elements</li> <li>• Idea of ionic and covalent bonds, Ionization potential, Electro negativity, Electron affinity,</li> </ul>	16	8-11



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	Fajan's rule <b>Chemistry of the following elements</b> Li, Sn, Fluorine, Chlorine, Iodine		
V	<b>Organic Chemistry</b> <b>Structure and Mechanism</b> <ul style="list-style-type: none"> <li>Hybridization, bond angle, bond length, idea of bonds.</li> <li>Inductive effect, electrometric effect, mesmeric effect</li> <li>Bond fission and products.</li> </ul>	12	12-14
<b>REVISION</b>			15



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## SEMESTER II

### Program Outcome:

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## Botany-II MICROBIOLOGY AND PLANT PATHOLOGY BSBT-S-1201

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<ul style="list-style-type: none"><li>Historical background of Microbiology.</li><li>Techniques of isolation for micro-organisms and culture media preparation.</li></ul>	8	1-2
II	<ul style="list-style-type: none"><li>Modern concepts about bacterial cell.</li><li>Structure and nature of TMV and Bacteriophage.</li><li>Role of microbes in nitrogen fixation.</li></ul>	12	3-5
III	<ul style="list-style-type: none"><li>Industrial Importance of bacteria and fungi.</li><li>Microbial degradation of agricultural produce in storage. Role of Toxins and Enzymes in Plant</li></ul>	16	6-9



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	Diseases		
<b>IV</b>	<ul style="list-style-type: none"> <li>• Important plant diseases of Bihar, Etiology, symptoms and control of the following diseases:  (a) Late blight of potato (b) Loose smut of wheat  (c) Rust of linseed ( d) Red rot of sugarcane  (e) Citrus canker (f) Tobacco mosaic virus  (g) Tundu disease of wheat (h) Little leaf of brinjal.</li> <li>• Transmission of Plant viruses and control measures</li> </ul>	16	10-13
<b>REVISION</b>			14-15

## ENGLISH – I

### ENL-1201

#### **I. Prose:**

1. The Bet — Anton Chekov
2. Socrates and the Schoolmaster — F. L. Brayne
3. An Astrologer's Day — R. K. Narayan
4. The Gift of the Magi — O' Henry
5. With the Photographer — Stephen Leacock

#### **II. Spoken Communication:**

- 1) Meeting People, Exchanging Greetings and Taking Leave
- 2) Introducing Yourself
- 3) Introducing People to Others
- 4) Answering the Telephone and Asking for Someone
- 5) Dealing with a Wrong Number
- 6) Taking and Leaving Messages
- 7) Making Inquiries on the Phone
- 8) Calling for Help in an Emergency

**II. Grammar and Vocabulary: Articles, prepositions, modal auxiliaries, antonyms, synonyms, one-word substitutes.**

#### **IV. Written Communication: Summarizing**

## CHEMISTRY –II

### BSCH –S- 1201



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Unit	Content	Total No. of hours	No. of week
I	<b>Physical Chemistry</b> <b>Chemical Kinetics</b> (a) Rate of reaction, order and molecularity. (b) Expression for specific rate constant of first order reaction. (a) Half-life period and Units	8	1-2
II	<b>Colligative Properties</b> (a) Osmosis and its determination. (b) Vapour Pressure (c) Raoult's law of lowering vapour pressure (d) Relation between osmotic pressure and lowering of vapour pressure.	12	3-5
III	<b>Inorganic Chemistry</b> Principles involved in the volumetric and gravimetric estimation of Cu and Fe. Isotopes: Brief idea of detection and separation, Radiocarbon dating .	16	6-9
IV	<b>Organic Chemistry</b> <b>Nomenclature</b> (a) IUPAC Nomenclature of aliphatic and aromatic compounds Chemistry of monohydric alcohol and Grignard reagent Idea of purification of compounds, Chromatography	16	10-13
<b>REVISION</b>			14-15



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## SEMESTER III

### Program Outcome:

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## BOTANYIII

### BSBTS -2101

### Plant Physiology and Environmental Biology

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Plant Physiology:</b> <ul style="list-style-type: none"><li>• Water relation, Absorption of water and Salts</li><li>• Transpiration.</li><li>• Mineral nutrition - Role of major and minor element.</li></ul>	8	1-2
II	<ul style="list-style-type: none"><li>• Enzymes-Nature, properties &amp; Classification v. Photosynthesis Photophosphorylation</li><li>• calvin cycles and factors affecting Photosynthesis.</li><li>• Translocation of Organic substances.</li></ul>	12	3-5
III	<ul style="list-style-type: none"><li>• Respiration - Glycolysis, Krebs's Cycle and Factors affecting respiration.</li><li>• Nitrogen metabolism-Nitrogen fixation and</li></ul>	16	6-9



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	(f) Werner's theory		
<b>IV</b>	<b>Organic Chemistry</b> <b>Structure and Mechanism</b> (a) Different types of isomerism (b) Elementary and nucleophilic substitution at saturated carbon <b>Natural Products</b> (a) Carbohydrates Elementary idea of Alkaloids and Terpenoids	16	11-14
<b>REVISION</b>			15

## SEMESTER IV

### **Program Outcome:**

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**Botany-IV**  
**BSBT-S -2201**  
**Immunology**

**Syllabus:**

Unit	Content	Total No. of hours	No. of week
I	Overview of immune system: Historical perspective of Immunology, Early theories of Immunology, Haematopoiesis, Cells and organs of the immune system.	12	1-3
II	Innate and Adaptive immunity: Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural immunity, Active: Artificial and natural immunity, Immune dysfunctions.	12	4-6
III	Antigens: Antigen city and immunogenicity, immunizes, adjuvant and haptens, Factors influencing immunogenicity, B and T cell epitopes.	12	7-9
IV	Vaccines: Types of vaccines: Recombinant vaccines and DNA vaccines	16	10-13
<b>REVISION</b>			14-15

**ENGLISH – II**  
**ENL-2201**

**Syllabus:**

**Short Stories**

1. Maupassant - The Necklace
2. O. Henry - The Last Leaf
3. Catherine Mansfield - A Cup of Tea
4. R.K. Narayan - Selvi
5. MR Anand - The Lost Child
6. Jhumpa Lahiri - The Interpreter of Maladies
7. Shashi Deshpande - Hear Me Sanjaya!



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## II. Pieces of Prose

- a. James Bryce - Some hints of Public Speaking
- b. C.E.M. .Toad - A Dialogue on Civilization
- c. Hill - Principles of good writing
- d. Bapsi Sidhwa - Why do I write?
- e. Jawahar Lal Nehru - The Reawakening of India
- f. Subhash Chandra Bose - To Delhi, To Delhi
- g. Dr. Rukhmabai - Purdah - The Need for its Abolition

## III. Novel

Lord of the Flies - William Golding

# CHEMISTRY –IV

## BSCH-S- 2201

### Syllabus:

Unit	Content	Total No. of hours	No. of week
I	<b>Physical Chemistry</b> <b>Ionic Equilibrium</b> (a) Oswald's dilution law (b) Salt Hydrolysis (c) Theory of acid – base indicator		
II	<b>Chemical Kinetics</b> (a) Second order reaction, expression of rate constant. (b) Effect of temperature on reaction rate (c) Arrhenius equation		
III	<b>Inorganic Chemistry</b> (a) Chemistry of Group 4 elements (b) Idea of Major pollutants in environments	16	6-9
IV	<b>Organic Chemistry</b> Structure of Benzene and benzene Diazonium chloride Brief idea of Polymers, resins, drugs	16	10-13
<b>REVISION</b>			



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