

# VIVEKANANDHA

**COLLEGE OF ARTS AND SCIENCES FOR WOMEN  
ELAYAMPALAYAM, TIRUCHENGODE (Tk.), NAMAKKAL (Dt.).**

An ISO 9001: 2015 Certified Institution

(Affiliated to Periyar University, Approved by AICTE, recognized u/s 2 (f) & 12 (B) & Re-accredited  
with 'A+' by NAAC)

*Recognized under section 2(f) and 12(B) of UGC Act, 1956*

An ISO 9001:2015 (Certificate Institution)



## **DEPARTMENT OF ZOOLOGY**

**B.Sc., ZOOLOGY**

## **SYLLABUS AND REGULATIONS**

**Academic Year – 2024-25**

**FOR CANDIDATES ADMITTED FROM  
2023-2024 ONWARDS UNDER  
AUTONOMOUS CBCS AND OBE PATTERN**

**VIVEKANANDHA EDUCATIONAL  
INSTITUTIONS**

Angammal Educational Trust  
Elayampalayam, Tiruchengode (Tk.),  
Namakkal (Dt.)

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**VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN  
(AUTONOMOUS)  
ELAYAMPALAYAM, TIRUCHENGODE - 637205**

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**DEPARTMENT OF ZOOLOGY**

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**PROGRAMME: B. Sc., ZOOLOGY**

**PROGRAMME CODE: UZO**

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**VISION**

- To evolve into a center of excellence in higher education through creative and innovative practices to social equity for women.

**MISSION**

- To provide sufficient learning infrastructure to the students to pursue their studies.
- To provide good opportunity for higher education and conducive environment to the students to acquire education.
- To provide quality academic programs training activities and research facilities.
- To facilitate industry-institute interaction.

**DEPARTMENT OF ZOOLOGY**

**VISION**

- Provide a sound education in basic science
- Transform society through the empowerment of women
- Provide inexpensive educational services to the weaker sections of society
- Inculcate respect for nature and concern for ethical values among students through good and scientific educational practices.
- Recognizing the essential roles of science and biology in the lives of citizens today and tomorrow, we emphasize biological literacy in our teaching and outreach programs.

**MISSION**

- To impart to the students the contemporary advancements in life sciences.
- To impart a global perspective and such skills among students that benefit humanity.
- To promote the discovery and broad communication of knowledge about the biology of animals including their taxonomy, evolution, physiology, cell, molecular and biochemical make up, interaction with their environments and its zoogeographical realms.
- To develop research aptitude and a scientific advancement.
- Reinvent ourselves in response to the changing demands of society with high moral values as a good citizen

**PROGRAMME SPECIFIC OUTCOMES:**

**PSO1 – Placement:**

To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.

**PSO 2 - Entrepreneur:**

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations

**PSO3 – Research and Development:**

Design and implement HR systems and practices grounded in research that complies with employment laws, leading the organization towards growth and development.

**PSO4 – Contribution to Business World:**

To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

**PSO 5 – Contribution to the Society:**

To contribute to the development of the society by collaborating with stakeholders for mutual benefit

**PROGRAMME OUTCOMES:**

**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study

**PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

**PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

**PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

**PO5: Analytical reasoning:** Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

**PO6: Research-related skills:** A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation

**PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team

**PO8: Scientific reasoning:** Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

**PO9: Reflective thinking:** Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

**PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

- PO 11 Self-directed learning:** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
- PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
- PO 13: Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to ones work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
- PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.
- PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/rescaling.

#### **IV. ELIGIBILITY FOR ADMISSION**

A candidate who has passed Higher Secondary Examination in Academic or vocational stream with Biology (Botany/Zoology/Chemistry) under higher secondary board of examination, Tamil Nadu or an examination accepted as Equivalent thereto

#### **V. DURATION OF THE COURSE**

- The course shall extend over a period of three academic years consisting of six semesters. Each academic year will be divided into two semesters. The first semester will consist of the period from July to November and the second semester from December to March.
- The subjects of the study shall be in accordance with the syllabus prescribed from time to time by the Board of Studies of Department of Zoology, Vivekanandha College of Arts and Sciences for Women (Autonomous) with the approval of Board members and Academic Council Members.

#### **VI. ELIGIBILITY FOR EXAMINATION**

A candidate will be permitted to appear for the end semester examination only on earning 75 % of attendance and only when his/her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

#### **VII. PATTERN OF QUESTION PAPER**

<b>PART A</b> : Choose the best answer (10 MCQ)	10 x 1 = 10 Marks
<b>PART B</b> : Answer all 5 Questions (Either or type)	5 x 7 = 35 Marks
<b>PART C</b> : Answer any 3 Questions (three out of five)	3 x 10 = 30 Marks

#### **VIII. INTERNAL ASSESSMENT STRUCTURE**

The performance of the students will be assessed continuously and the

Internal Assessment Marks for theory will be as under: Practical will be as under:

1. Average of two Tests - 15 Marks Marks	1. Model Exam - 25
2. Assignment - 5 Marks Marks	2. Observation Note - 10
3. Attendance - 5 Marks Marks	3. Attendance - 05
<b>Total</b> <u>                  </u> = <b>25 Marks</b>	<b>Total</b> <u>                  </u> = <b>40 Marks</b>

Passing minimum for Internal Assessment : 10 marks

Passing minimum of End Semester Examinations : 30 marks

### **GROUP PROJECT WILL BE AS UNDER**

Internal mark 40 marks should be given in the following pattern

Format of Project	: 10 marks
Quality of Work	: 10 marks
Mock Viva-Voce*	: 20 marks
<b>Total</b>	<b>: 40 Marks</b>

\*(Evaluated by Research Guide and Internal Examiner)

### **IX. Attendance Breakup for theory and Practical (Semester Pattern Practical)**

<b>Range of Attendance (%)</b>	<b>Marks</b>
76 % - 80 %	1
81 % - 85 %	2
86 % - 90 %	3
91 % - 95 %	4
96 % - 100 %	5

### **X. DISTRIBUTION OF MARKS**

#### **THEORY:**

Internal Assessment - 25 marks

External Examination - 75 marks

#### **PRACTICALS:**

Internal Assessment - 40 marks

External Examination - 60 marks

#### **GROUP PROJECT**

1. Each student shall select a topic for his/her Project work in consultation with his/her guide and the Head of the department.
2. The Project report should be submitted to the Controller of Examinations (UG Courses) through the Head of the Department one week prior to the commencement of the terminal Examinations. If a candidate fails to submit the project report within the stipulated time, he/she may be permitted to submit the same one day prior to date of *viva voce* examinations with late fee prescribed by the Principal. If the candidate fails to submit the project report one day prior to the date of *viva voce* examination, he/she may be permitted to submit the Project report within a period of one month from the date of conduct of *viva voce*, with extension fee

prescribed by the Principal. If the candidate fails to submit the project report even after that extension period, he/she will be treated with on par with failures and he/she has to do another project and to submit the report after six months by paying fee prescribed the Principal.

3. Each student shall submit 2 copies of his/her Project report for valuation.
4. The Project report shall contain a minimum of 25 pages excluding bibliography and appendices.
5. The Project report shall be valued for a total of 40 marks out of which the external examiner and the Guide share 20 marks each. The sum of marks awarded by both the examiners shall be considered to be the final mark. For a pass in the Project report, the student should secure a minimum of 18 marks. If a student fails to get the minimum pass mark in the Project report, he/she shall be permitted to resubmit his / her Project report once again within a period of 6 months from the date of publication of the result.
6. For those candidates who have passed in the evaluation of Project report, there will be a *viva voce* examination on the above. The *viva voce* carries a maximum of 20 marks and the guide and the external examiner will conduct it jointly. The student should secure a minimum of 10 marks for a pass in the *viva voce* examination, failing which he/she shall be required to reappear for the *viva voce* after a month from the date of *viva voce* already conducted but within a period of 3 months for which he/she will have to pay a fee as prescribed by the Principal.
7. For a pass in this paper as a whole, a student should secure a minimum of 50 percentage marks in internal mark, Project evaluation and *viva voce* put together.

## **XI. COMMENCEMENT OF THESE REGULATIONS**

The regulations are applicable for the students who are admitted during the academic year 2023 – 2024 and thereafter.

## **XII. Employments and higher studies Opportunities for B.Sc. Zoology students**

- Employment areas of B.Sc., Zoology includes: Zoological Museum, Field Surveyor, pharmaceutical companies, Environmental Agencies, Medical Laboratories, Veterinary Farms, Medical Representatives, Sales manager of bio-products, etc.,
- The graduates can seek admission in Master of Science where the student needs to go through the deep knowledge of science.
- B.Sc. course is globally agreeable where the students from science theme can pursue from any of the approved university.
- The graduates are eligible for admission in M.Sc., degree course in Zoology, Life Sciences, Marine Biology, Aquaculture, Forensic Science, Genetics, Microbiology, Biotechnology, Integrated Biology, Physiology, Aquaculture, Marine Biotechnology, integrated Ph.D, P.G diploma courses in lab technology, Radiology. U.G are eligible for B.Ed.,
- After completing B.Sc. Zoology, can specialize in various fields within zoology like Arachnology, Entomology, Arthropodology, Apiology, Cetology, Anthrozoology, Conchology, Ethology, Helminthology, Mammalogy, Neuroethology, Myrmecology, Nematology, Ornithology, Paleozoology, Malacology, Primatology, Herpetology etc.,

## **XIII. TRANSITORY PROVISION**

Candidates who were admitted to the UG course of study before 2022-2023 shall be permitted to appear for the examinations under those regulations for a period of three years i.e., up to and inclusive of the examination of April/May 2023 Thereafter, they

will be permitted to appear for the examination only under the regulations then in force

**VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN  
(AUTONOMOUS)**

**COURSE SCHEME AND SCHEME OF EXAMINATIONS  
DST – FIST SPONSORED DEPARTMENT OF ZOOLOGY**

**B.Sc. DEGREE COURSE IN ZOOLOGY**

**SYLLABUS UNDER CBCS PATTERN WITH EFFECT FROM 2023 - 2024 ONWARDS**

SEM	PART	SUB CODE	TITLE OF THE SUBJECT	Hrs.		Credit	MARKS		
				Lect.	Lab		CIA	EA	TOTAL
<b>SEMESTER – I</b>									
I	I	23U1LT01	Language (Tamil) – I	6		3	25	75	100
	II	23U1LE01	English - I	4		3	25	75	100
	III	23U1ZOC01	Invertebrata	6		4	25	75	100
	III	23U1ZOCP01	Core Practical I : Invertebrata		3	3	40	60	100
	III	23U1BOGE01	Allied Botany I	4		3	25	75	100
	III	23U1BOGEP01	Allied Botany Practical – I		3	2	40	60	100
	IV	23U1ENAC01	Soft Skill for Effective Communication	2		2	25	75	100
	IV	23U1VE01	Human values, health and Yoga	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>6</b>	<b>22</b>	<b>230</b>	<b>570</b>	<b>800</b>
<b>SEMESTER – II</b>									
II	I	23U2LT02	Language (Tamil) - II	6		3	25	75	100
	II	23U2LE02	English - II	6		3	25	75	100
	III	23U2ZOC02	Chordata	4		4	25	75	100
	III	23U2ZOCP02	Core Practical II: Chordata	-	3	3	40	60	100
	III	23U2BOGE02	Allied Botany II	4		3	25	75	100
	III	23U2BOGEP02	Allied Botany Practical – II	-	3	2	40	60	100
	IV	23U2CSAC02	Office Automation	2		2	25	75	100
	IV	23U2EVS01	Environmental Studies	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>06</b>	<b>22</b>	<b>230</b>	<b>570</b>	<b>800</b>
<b>SEMESTER – III</b>									
III	I	23U3LT03	Language (Tamil) – III	5		3	25	75	100
	II	23U3LE03	English - III	5		3	25	75	100
	III	23U3ZOC03	Cell Biology	4		4	25	75	100
	III	23U3ZOC04	Genetics	4		4	25	75	100
	III	23U3ZOCP03	Core Practical III : Cytogenetics	-	3	3	40	60	100
	III	23U3CHGE01	Chemistry for Biological Sciences I	4		3	25	75	100
	III	23U3CHAP01	Allied Chemistry Practical I	-	3	2	40	60	100
	IV	23U3ZON01	Sericulture (Elected by students)	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>6</b>	<b>24</b>	<b>230</b>	<b>570</b>	<b>800</b>



**VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN  
(AUTONOMOUS)**

**COURSE SCHEME AND SCHEME OF EXAMINATIONS  
DST – FIST SPONSORED DEPARTMENT OF ZOOLOGY  
B.Sc. DEGREE COURSE IN ZOOLOGY**

**SYLLABUS UNDER CBCS PATTERN WITH EFFECT FROM 2023 - 2024 ONWARDS**

SEM	PART	SUB CODE	TITLE OF THE SUBJECT	Hrs.		CRE DIT	MARKS		
				Lect	La b		CIA	EA	TOTAL
<b>SEMESTER – IV</b>									
IV	I	23U4LT04	Language (Tamil)- IV	5		3	25	75	100
	II	23U4LE04	English - IV	5		3	25	75	100
	III	23U4ZOC05	Developmental Biology	4		4	25	75	100
	III	23U4ZOC06	Environmental Biology	4		4	25	75	100
	III	23U4ZOCP04	Core Practical: IV Developmental Biology & Ecology	-	3	3	40	60	100
	III	23U4CHEA02	Allied Chemistry II	4		3	25	75	100
	III	23U4CHAP01	Allied Chemistry Lab II	-	3	2	40	60	100
	IV	23U4ZON02	Apiculture (Elected by students)	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>06</b>	<b>24</b>	<b>230</b>	<b>570</b>	<b>800</b>
<b>SEMESTER – V</b>									
V	III	23U5ZOC07	Animal Physiology	5		4	25	75	100
	III	23U5ZOC08	Evolutionary Biology	5		4	25	75	100
	III	23U5ZOC09	Microbiology	4		4	25	75	100
	III	23U5ZOCP05	Core Practical V: Animal Physiology, Evolutionary Biology & Microbiology	-	6	3	40	60	100
	III	23U5ZOE01	Biochemistry / Biophysics & Biostatistics	4		4	25	75	100
	III	23U5ZOE02	General & Applied Entomology /Medical Laboratory Technique	4		4	25	75	100
	IV	23U5ZOS01	Sericulture	2		2	25	75	100
	V		Internship	-		1			
<b>Total</b>				<b>24</b>	<b>06</b>	<b>26</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER – VI</b>									
VI	III	23U6ZOC10	Animal Biotechnology	5		4	25	75	100
	III	23U6ZOC11	Immunology	5		4	25	75	100
	III	23U6ZOCP06	Core Practical VI: Biotechnology & Immunology	-	6	3	40	60	100
	III	23U6ZOE03	Economic Zoology / Bioinstrumentation	4		4	25	75	100
	III	23U6ZOE04	Wildlife Biology & Conservation /Animal Behaviour	4		4	25	75	100
	IV	23U6ZOS02	Poultry Science	2		2	25	75	100
	III	23U6ZOPR01	Project	4		2	40	60	100
<b>Total</b>				<b>24</b>	<b>06</b>	<b>23</b>	<b>205</b>	<b>495</b>	<b>700</b>
<b>Grand Total</b>						<b>141</b>	<b>1315</b>	<b>3285</b>	<b>4600</b>

Semester- I / Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U1ZOC01</b>	<b>INVERTEBRATA</b>	Core	Y	-	-	-	4	6	25	75	100
<b>Learning Objectives</b>											
CO1	To understand the basic concepts of lower animals and observe the structure and functions.										
CO2	To illustrate and examine the systemic and functional morphology of various group of invertebrates.										
CO3	To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity.										
CO4	To compare and distinguish the general and specific characteristics of reproduction in lower animals.										
CO5	To infer and integrate the parasitic and economic importance of invertebrate animals										
UNIT	Details								No. of Hours	Course Objectives	
I	Introduction of Nomenclature – Level of organization in Animal Kingdom (Linnaeus). <i>Phylum</i> : Protozoa- General characters – Classification (up to order) – Type study – Paramecium – Structure and Reproduction. General topic – Nutrition in Protozoa, Protozoan disease and their control measures in Human- Malaria, Amoebiasis, Trypanosomiasis and Leishmaniasis.									CO1	
II	<i>Phylum</i> : Porifera- General characters – Classification (up to order) – Type Study– Ascon – Cellular structure and Reproduction. <i>Phylum</i> : Coelenterata (Cnidaria) - Classification (up to order) – Type Study - Obelia – Structure and life history. General Topics: Canal System in Sponges. Polymorphism in Coelenterates, Corals and Coral reefs.									CO2	
III	<i>Phylum</i> : Platyhelminthes – General characters – Classification (up to order) – Type study– Tapeworm - Structure, Life cycle and Reproduction. <i>Phylum</i> : Annelida – General Characters - Classification (up to order) – Type study – Earthworm – External morphology, Digestive system and Reproduction. General Topics: Helminth Parasites and diseases of Man.									CO3	
IV	<i>Phylum</i> : Arthropoda – General characters - Classification (up to order) – Type study – Prawn:– External morphology, Digestive system, Excretory system and Appendages of prawn. General Topics: Larval forms of Crustaceans. Economic importance of insects.									CO4	
V	<i>Phylum</i> : Mollusca - General characters – Classification (up to order) - Type Study – Pila - External morphology, digestive system and Nervous system. General Topic: Economic Importance of Mollusca <i>Phylum</i> : Echinodermata - General characters – Classification (up to order) – Type – Starfish – External morphology water vascular system in star fish. General Topic: Larval forms of Echinoderms.									CO5	
	<b>Total</b>										
<b>Course Outcomes ( INVERTEBRATA)</b>											
<b>Course</b>	On completion of this course, students will;										

<b>Outcomes</b>		
<b>CO1</b>	Understand the basic concepts of invertebrate animals and recall its structure and functions.	PO1
<b>CO2</b>	Illustrate and examine the systemic and functional morphology of various groups of invertebrata.	PO1, PO2
<b>CO3</b>	Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.	PO4, PO6
<b>CO4</b>	To compare and distinguish the various physiological processes and organ systems in lower animals.	PO4, PO5, PO6
<b>CO5</b>	Infer and integrate the parasitic and economic importance of invertebrate animals.	PO3, PO8
<b>TEXT BOOKS (Latest Editions)</b>		
1.	Ekambaranatha Iyer, 2000. A Manual of Zoology, 10 <sup>th</sup> edition, Viswanathan, S., Printers & Publishers Pvt Ltd	
2.	Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12 <sup>th</sup> edn. S. Chand & Co.	
3.	Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.	
<b>REFERENCES BOOKS (Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.	
2.	<b>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</b>	
3.	Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson	
4.	Hyman L.H, 1955. The invertebrates - Vol. I to Vol. VII – Mc Graw Hill Book Co.	
5.	Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams.	
<b>Web Resources</b>		
1.	<a href="https://www.nationalgeographic.com/animals/invertebrates/">https://www.nationalgeographic.com/animals/invertebrates/</a>	
2.	<a href="https://bit.ly/3kABzKa">https://bit.ly/3kABzKa</a> 3. <a href="https://www.nio.org/">https://www.nio.org/</a> 4. <a href="https://greatbarrierreef.org/">https://greatbarrierreef.org/</a>	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Course Code / Semester I	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks			
									CIA	External	Total	
23U1ZOC01	Invertebrata Lab Course	Core	Y	-	-	-	2	3	25	75	100	
<b>Learning Objectives</b>												
CO1	To identify the different groups of invertebrate animals by observing their external characteristics.											
CO2	To understand the organs, organ system and their functions in lower animals.											
CO3	To get knowledge about the different modes of life and their adaptation based on the environment.											
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.											
UNIT	Details								No. of Hours	Course Objectives		
I	<b>Major Dissection :</b> Cockroach: Nervous system, Reproductive system. Earthworm: Nervous System, Reproductive system. <i>Pila globosa</i> : Digestive system.									CO1		
II	<b>Minor Dissection:</b> Cockroach: Digestive System, Silkworm Silk Gland. <i>Pila globosa</i> : radula.									CO2		
III	<b>Mounting:</b> Earthworm: Body setae; Pineal setae. Freshwater muscle: Pedal ganglia.									CO3		
IV	<b>Mounting :</b> Cockroach: Salivary gland, Mouth parts - Honey Bee, Cockroach, House fly and Mosquito									CO4		
V	<b>Spotters :(i). Protozoa:</b> Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax <b>(ii). Porifera:</b> Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule <b>(iii). Coelenterata:</b> Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula <b>(iv). Platyhelminthes:</b> Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus, Taenia solium, Schistosoma haematobium <b>(v). Nematelminthes:</b> Ascaris(Male & Female), Dracunculus, Ancylostoma, Wuchereria <b>(vi). Annelida:</b> Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva <b>(vii). Arthropoda:</b> Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. <b>(viii). Mollusca:</b> Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva <b>(ix). Echinodermata:</b> Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva									CO5		
<b>Total</b>												
<b>Course Outcomes</b>												
<b>Course Outcomes</b>	On completion of this course, students will;											
<b>CO1</b>	Identify and label the external features of different groups of invertebrate animals.							PO1				
<b>CO2</b>	Illustrate and examine the circulatory system, nervous							PO1, PO2				

	system and reproductive system of invertebrate animals.	
<b>CO3</b>	Differentiate and compare the structure, function and mode of life of various groups of animals.	PO4, PO6
<b>CO4</b>	To compare and distinguish the dissected internal organs of lower animals.	PO4, PO5, PO6
<b>CO5</b>	Prepare and develop the mounting procedure of economically important invertebrates.	PO3, PO8
<b>Text Books (Latest Editions)</b>		
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai	
2.	Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.	
3.	Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.	
4.	Lal, S. S., 2016. Practical Zoology Invertebrate, Rastogi Publications.	
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Course Code CC3 / Semester II	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23U2ZOC02	CHORDATA	Core	Y	-	-	-	4	5	25	75	100
<b>Learning Objectives</b>											
CO1	To understand the structures and distinct features of Phylum Chordata.										
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.										
CO3	To understand the economic importance of vertebrates										
CO4	To know about the adaptations of vertebrates										
CO5	To understand the evolutionary position of different groups of vertebrates										
UNIT	Details								No. of Hours	Course Objectives	
I	<b>Prochordates:</b> General Characters and Classification of Phylum Chordata. Origin of Chordata, Differences between non-chordates and chordates. Type study: <i>Amphioxus</i> - External Characters, Digestive, Excretory, Respiratory and Circulatory systems. General Topic: General characters, Affinities of Prochordates (Hemichordata, Urochordata, Cephalochordata).								12	CO1, CO2	
II	<b>Vertebrata and Pisces:</b> Vertebrata - Characteristics of subphylum vertebrata, Classification of Vertebrata upto Class level. Pisces - General characters and classification Agnatha ( <i>Petromyzon</i> ), - Pisces Type Study: <i>Scoliodon sorrakowah</i> - External Characters, Digestive, Excretory, Respiratory and Circulatory systems – Structure of Brain - Sense organs Reproductive System. General Topic: Accessory respiratory organs and Migration in fishes								12	CO1, CO2, CO4, CO5	
III	<b>Amphibia</b> : General characters and classification up to order- Origin of Amphibia Type study: <i>Rana hexadactyla</i> - External Characters, Digestive, Respiratory, Circulatory and Urinogenital systems -Structure of brain. General Topic: Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.								12	CO1, CO2, CO3, CO4, CO5	
IV	<b>Reptilia</b> : General characters and classification up to order- Type study – <i>Calotes versicolor</i> - External characters - Digestive, Respiratory, Circulatory and Urinogenital systems - Structure of Brain. General Topic: Snakes of India, Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification								12	CO1, CO2, CO4, CO5	
V	<b>Aves and Mammalia</b> : Ayes: General characters and classification up to order – Type study - <i>Columba livia</i> - External Characters - Digestive, Respiratory, Circulatory and Reproductive system - Structure of Brain. General Topic: Flight adaptations and Migration in birds. Mammalia: General characters and classification up to order. Type study: Rabbit - External Characters - Digestive, Respiratory, Circulatory, Excretory and Reproductive systems - Structure of Brain.								12	CO1, CO2, CO4, CO5	

	General Topic: Aquatic mammals, Dentition in mammals.	
	<b>Total</b>	<b>60</b>
<b>Course Outcomes</b>		
<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO1</b>	Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.	PO1
<b>CO2</b>	Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.	PO1, PO2
<b>CO3</b>	Analyze, compare and distinguish the developmental stages and describe the important biological process.	PO3, PO4, PO5
<b>CO4</b>	Correlate the different modes of life and parental care among different vertebrates.	PO3, PO5, PO6
<b>CO5</b>	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO2, PO3, PO5, PO8
<b>Text Books (Latest Editions)</b>		
1.	Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.	
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.	
3.	Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.	
4.	Ganguly, Sinha,. Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.	
5.	Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.	
2.	Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.	
3.	Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.	
4.	Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003, 477 pp.	
5.	Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp.	
6.	Pough H. Vertebrate life, VIII Edition, Pearson International.	
7.	Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan & Co., New York, 587 pp.	
8.	Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.	
<b>Web Resources</b>		
1.	<a href="http://tolweb.org/Chordata/2499">http://tolweb.org/Chordata/2499</a>	
2.	<a href="https://www.nhm.ac.uk/">https://www.nhm.ac.uk/</a>	
3.	<a href="https://bit.ly/3Av1Ejg">https://bit.ly/3Av1Ejg</a>	
4.	<a href="https://bit.ly/3kqTfYz">https://bit.ly/3kqTfYz</a>	
5.	<a href="https://biologyeducare.com/aves/">https://biologyeducare.com/aves/</a>	
6.	<a href="https://www.vedantu.com/biology/mammalia">https://www.vedantu.com/biology/mammalia</a>	
<b>Methods of Evaluation</b>		
<b>Internal</b>	Continuous Internal Assessment Test	25 Marks

<b>Evaluation</b>	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
<b>Total</b>		<b>100 Marks</b>
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	



Course Code / Semester II	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks			
									CIA	External	Total	
23U2ZOLC02	Lab Course II: Chordata	Core	Y	-	-	-	2	3	25	75	100	
<b>Learning Objectives</b>												
CO1	To understand the structures and distinct features of phylum chordata.											
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.											
CO3	To understand and compare the structure of various internal organs in different classes of vertebrates.											
CO4	To know about the classification, adaptations and affinities of chordate animals.											
UNIT	Details									No. of Hours	Course Objectives	
I	<b>Dissections:</b> Frog (Demo) / Fish: External features, Digestive system, cranial nerves 5 <sup>th</sup> , 9 <sup>th</sup> & 10 <sup>th</sup> Cranial nerves, Male and female urinogenital system.										CO1	
II	<b>Mounting:</b> Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).										CO2	
III	<b>Osteology:</b> Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvicgirdle, Forelimb, Hindlimb. Chelonia – Anapsid skull, Pigeon - skull and lower jaw, synsacrum.										CO3	
IV	<b>Specimen and Slides:</b> (i) <b>Hemichordata:</b> Balanoglossus, Tornaria larva (ii). <b>Protochordata:</b> Amphioxus, Amphioxus T.S. through pharynx (iii). <b>Cyclostomata:</b> Petromyzon, Myxine, Ammocoetus larva (iv). <b>Pisces:</b> Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid (v). <b>Amphibia:</b> Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotal larva (vi). <b>Reptilia :</b> Draco, Chamaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. (vii). <b>Aves:</b> Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down (viii). <b>Mammalia:</b> Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog										CO4	
V	<b>Embryology:</b> Stages in the development of Amphioxus, Frog and Chick- Placenta in shark and mammals.										CO5	
<b>Total</b>												
<b>Course Outcomes</b>												
Course Outcomes	On completion of this course, students will;											
CO1	Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.							PO1				
CO2	Explain the structural organization of various organs and systems in different classes of vertebrates.							PO1, PO2				
CO3	Analyse, compare and distinguish the morphological features and developmental stages of chordates							PO4, PO6				

<b>CO4</b>	Dissect and explain various organs and internal systems in different vertebrates and correlate its function.	PO4, PO5, PO6
<b>CO5</b>	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO3, PO8
<b>Text Books (Latest Editions)</b>		
1.	Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.	
2.	Verma P.S, 2000. A Manual of Practical Zoology: Chordates, S. Chand Limited, 627pp.	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.	
2.	Young, J.Z., 1972. The life of vertebrates. Oxford Uni. London.	
<b>Web Resources</b>		
1.	<a href="https://www.youtube.com/watch?v=b04hc_kOY10">https://www.youtube.com/watch?v=b04hc_kOY10</a>	
2.	<a href="https://bit.ly/3CzTEy8">https://bit.ly/3CzTEy8</a>	
3.	<a href="http://tolweb.org/Chordata/2499">http://tolweb.org/Chordata/2499</a>	
4.	<a href="https://www.nhm.ac.uk/">https://www.nhm.ac.uk/</a>	
5.	<a href="https://bit.ly/3Av1Ejg">https://bit.ly/3Av1Ejg</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	40 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	60 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

#### Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

S-Strong(3)

M-Medium (2)

L-Low (1)

**SEMESTER – III**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U2ZOC03</b>	<b>CELL BIOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.										
CO2	To understand how these cellular components are used to generate and utilize energy in cells.										
CO3	To understand the cellular components underlying mitotic cell division.										
CO4	To apply the knowledge of cell biology to selected examples of changes or losses in cell function.										
<b>UNIT</b>	<b>Details</b>							<b>No. of Hours</b>	<b>Course Objectives</b>		
I	<b>Tools and Techniques of Cell Biology:</b> Cell Fractionation, Homogenization, Centrifugation, Isolation of sub cellular Components. Histological techniques - Staining - Vital Stains. – Cytoplasmic and Nuclear Stains. Micro Technique Methods, Microscopes - Types - Light, Phase contrast, SEM, TEM - Units of measurement.							12	CO1, CO2		
II	<b>The Cell</b> - Cell theory - Viruses -Types and Structure - Bacteria – Bacterial membrane - Ultra structure of Plant & Animal cell - Cytoplasm - Structure and Composition, Function - Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.							12	CO1, CO2, CO4, CO5		
III	<b>Cell components</b> - Plasma Membrane Ultra Structure - Different Models - Functions - Ultrastructure, Composition and Function of Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles, Microtubules Microfilaments, Mitochondria and Microsomes.							12	CO1, CO2, CO3, CO4, CO5		
IV	<b>Nucleus</b> - Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - Nucleolus Cycle - DNA and RNAs - Protein Synthesis & regulation.							12	CO1, CO2, CO4, CO5		
V	<b>Cell Divisions and Cell Cycle</b> - Amitosis, Mitosis and Meiosis and their Significance - Cancer, Biology – Characteristics of cancer cells, types, theories on Carcinogenesis, Ageing of Cells – Apoptosis and Stem cell studies.							12	CO1, CO2, CO4, CO5		

		<b>Total</b>	<b>60</b>
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	To understand and recall the basic structure, origin and development of cell organelles.	PO1	
<b>CO2</b>	To integrate and assess the biochemical, cytological and histological tools to infer cellular basis of organization.	PO1, PO2, PO3	
<b>CO3</b>	To analyze and differentiate organisms based on structure, composition and inter and intra cellular interactions.	PO3, PO4, PO5	
<b>CO4</b>	To explain the role of cells and cell organelles in various biological processes.	PO2, PO3, PO5, PO6, PO8	
<b>CO5</b>	To construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.	PO3, PO4, PO5, PO6, PO7, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.		
2.	Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.		
3.	VeerBala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250 001.		
4.	Verma, P.S. and V. K. Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S.Chand & co., New Delhi - 110 055, 567 pp.		
5.	Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.		
2.	Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.		
3.	DeRobertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Info med, Hong Kong, 734pp.		
4.	Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi – 110007, 495 pp		
<b>Web Resources</b>			
1.	<a href="http://www.microscopemaster.com/organelles.html">http://www.microscopemaster.com/organelles.html</a>		
2.	<a href="https://bit.ly/3tXwDSB">https://bit.ly/3tXwDSB</a>		
3.	<a href="https://bit.ly/3tWNpRX">https://bit.ly/3tWNpRX</a>		
4.	<a href="https://bit.ly/3AuYR9M">https://bit.ly/3AuYR9M</a>		
5.	<a href="https://rsscience.com/cell-organelles-and-their-functions/">https://rsscience.com/cell-organelles-and-their-functions/</a>		
<b>Methods of Evaluation</b>			
<b>Internal Evaluation</b>	Continuous Internal Assessment Test		25 Marks
	Assignments		
	Seminars		
	Attendance and Class Participation		

<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>		S	S	S	S			S
<b>CO 3</b>		S	S	S	S	S		S
<b>CO 4</b>		S	M			M		
<b>CO 5</b>				S	S	S		S

**S-Strong(3)    M-Medium (2)    L-Low (1)**

**SEMESTER - III**

Course Code CC5	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U3ZOC04</b>	<b>GENETICS</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To understand the structure and functions of nucleic acids in the cell.										
CO2	To know the causes and effects of mutations.										
CO3	To comprehend the importance of genetic variation in evolution.										
CO4	To know about the harmful effects of genetic variations in humans, their cumulative effect in human population and the molecular basis of variations.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Mendelian Genetics and Inheritance:</b> Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross; Interaction of genes: Incomplete dominance, co dominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups and coat colour in rabbit; extra chromosomal inheritance- shell coiling, kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man.							12	CO1, CO2		
II	<b>Linkage and Crossing Over:</b> Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: inference and coincidence, haploid mapping, somatic cell hybridization.							12	CO1, CO2, CO4, CO5		
III	<b>Cytogenetics:</b> Variation in chromosome number and structure: position effect, chromosomal mutation and evolution. Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion; radiation and chemical agents as mutagens; Detection of mutation - CIB method and muller-5 method.							12	CO1, CO2, CO3, CO4, CO5		
IV	<b>Human and Microbial Genetics:</b> Human genetics: Karyotype and ideogram; sex determination - Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis; diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics. Population genetics and evolution: gene pool, gene frequency and genotype frequency; Hardy-Weinberg law of equilibrium. Unit 5: Bacterial genetics : Conjugation, transformation, transduction and							12	CO1, CO2, CO4, CO5		

	chromosome mapping .		
V	<b>Molecular Genetics:</b> Insertion elements, transposable elements, retroelements; integrons and antibiotic resistance cassettes; the lactose system and operon model, tryptophan operon, role and relative positions of promoters and operators, feedback mechanism.	12	CO1, CO2, CO4, CO5
	<b>Total</b>	<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	Understand the basis of inheritance and expression of genes.	PO1	
<b>CO2</b>	Correlate changes in genetic makeup and phenotypic changes in progeny.	PO2, PO3, PO5	
<b>CO3</b>	Analyse the causes of variations in genetic material and predict the effect in a population using different techniques.	PO2, PO3, PO4, PO5, PO6	
<b>CO4</b>	Explain the role of cellular processes and different genetic elements in the expression of genes.	PO2	
<b>CO5</b>	Compile the factors which contribute to changes in gene expression and specify the changes which contribute to evolution.	PO1, PO3, PO4, PO5, PO6, PO8	
<b>Text Books (Latest Editions)</b>			
1.	David E Sadava, 1993. Cell Biology - Organelle Structure and Function, Jones Bartlett Publishers.		
2.	Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.		
3.	Lewin B., 2008. Genes IX, Jones and Bartlett publishers.		
4.	Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech		
5.	Verma P.S and Agarwal V.K., 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.		
6.	Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd.		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press.		
2.	De Robertis, E. D. P and E.M.F Robertis, 2017. Cell and Molecular Biology 8 <sup>th</sup> Edition, LWW.		
3.	Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.		
4.	Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.		
5.	Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.		
6.	Klug, W. S., Cummings, M. R., Spencer, C. A., 2012. Concepts of Genetics. X Edition. Benjamin Cummings.		
7.	Lodish, Harvey, Arnold Berk <i>et al</i> .,2007. Molecular cell biology. 6th edition, W. H. Freeman.		
8.	Russel, Peter J. 2013. iGenetics: A Molecular Approach, Pearson.		

9.	Strickberger M. W., 1995. Genetics, Prentice Hall India Learning Private Limited.	
<b>Web Resources</b>		
1.	<a href="https://go.nature.com/2XE8V1q">https://go.nature.com/2XE8V1q</a>	
2.	<a href="https://bit.ly/3zoTt6B">https://bit.ly/3zoTt6B</a>	
3.	<a href="https://bit.ly/2XAm7oa">https://bit.ly/2XAm7oa</a>	
4.	<a href="https://bit.ly/2XEbhxi">https://bit.ly/2XEbhxi</a>	
5.	<a href="https://bit.ly/3AB4bso">https://bit.ly/3AB4bso</a>	
6.	<a href="https://bit.ly/39pZSE4">https://bit.ly/39pZSE4</a>	
7.	<a href="https://www.genome.gov/genetics-glossary/Sex-Linked">https://www.genome.gov/genetics-glossary/Sex-Linked</a>	
8.	<a href="https://www.vedantu.com/biology/mutagens">https://www.vedantu.com/biology/mutagens</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2		S	S		S			M
CO 3			S	S	S	S		S
CO 4		S						
CO 5		S	S	S	S	S		S

**S-Strong(3)    M-Medium (2)    L-Low (1)**



**SEMESTER – III**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks			
									CIA	External	Total	
<b>23U3ZOCPO3</b>	<b>CORE PRACTICAL – III: CYTOGENETICS</b>	Core	Y	-	-	-	4	4	25	75	100	
<b>Learning Objectives</b>												
CO1	To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance.											
CO2	To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.											
CO3	To study the changes in genetic material and to predict and consider the consequences of those changes.											
CO4	To encourage students to report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.											
<b>Contents</b>												
<b>Experiments</b>												
<ol style="list-style-type: none"> <li>1. RBC counting</li> <li>2. WBC Counting</li> <li>3. Differential leucocyte count</li> <li>4. Preparation and Identification of slides of Mitotic divisions with onion root tips.</li> <li>5. Preparation and Identification of different stages of Meiosis in Grasshopper Testes.</li> <li>6. Buccal epithelium (Barr body) preparation.</li> <li>7. Staining and observation of polytene chromosomes in salivary glands of chironomous larva.</li> <li>8. Karyotyping (with the help of photographs) – normal male and female karyotypes.</li> <li>9. Study of karyotypes of different genetic syndromes.</li> <li>10. Blood grouping</li> <li>11. Culturing and Handling of Drosophila: a) Media Preparation b) Cleaning and Sterilization of bottles c) Handling of Drosophila</li> <li>12. Morphology and Sexual dimorphism, Study of at least five types of Drosophila, Body color mutant- Ebony body and Yellow body. Wing mutant- Curly wing and Vestigial wing. Eye color mutant- Bar eye, White eye, Sepia eye. Mounting of Sex Comb of Drosophila melanogaster.</li> </ol>												
<b>Course Outcomes</b>												
<b>Course Outcomes</b>	On completion of this course, students will;											
<b>CO1</b>	To describe, examine and interpret the organization of genomic material and to research theories of genetic inheritance.							<b>PO1</b>				

<b>CO2</b>	To prepare samples of genetic molecules and to determine their purity, structure and characteristics.	PO1, PO2
<b>CO3</b>	To experiment with genomic preparations and devise techniques to distinguish genetic material in different organisms to survey biodiversity.	PO4, PO6
<b>CO4</b>	To assess the changes in genetic material and to predict and consider the consequences of those changes.	PO4, PO5, PO6
<b>CO5</b>	To report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.	PO3, PO8
<b>Text Books (Latest Editions)</b>		
1.	Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.	
2.	Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.	
3.	Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.	
4.	Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.	
5.	Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.	
2.	Bancroft, J.D. and Gamble, M (2007) Theory and Practice of Histological Techniques, 6 th Edition, Churchill Livingstone.	
3.	Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.	
4.	John Kiernan (2008) Histological and Histochemical Methods: Theory and Practice, 4th edition, Cold Spring Harbor Laboratory Press.	
<b>Web Resources</b>		
1.	<a href="https://www.jove.com/">https://www.jove.com/</a>	
2.	<a href="https://vlab.amrita.edu/?sub=3&amp;brch=77">https://vlab.amrita.edu/?sub=3&amp;brch=77</a>	
3.	<a href="http://cbii-au.vlabs.ac.in/">http://cbii-au.vlabs.ac.in/</a>	
4.	<a href="https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html">https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html</a>	
5.	<a href="https://www.ibiology.org/biology-techniques/">https://www.ibiology.org/biology-techniques/</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	

	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER -IV**

Course Code CC1	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U4ZOC05</b>	<b>DEVELOPMENTAL BIOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To create an awareness to the students about the theories, concepts and basics of Developmental Biology.										
CO2	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.										
CO3	To make an awareness of the induction, organizers and development of extra embryonic structures.										
CO4	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing										
CO5	To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Gametogenesis &amp; Fertilization</b> Basic concepts of developmental biology. Spermatogenesis- Structure & types of Spermatozoa. Oogenesis - Mammalian egg - Egg membranes. Types of egg. Fertilization – mechanism, theories and significance. Parthenogenesis - types and significance.							12	CO1		
II	<b>Blastulation &amp; Gastrulation</b> Cleavage - Planes and Patterns, Factors controlling cleavage. Blastulation –types of blastula. Morphogenetic movements - Gastrulation of frog & chick. Fate map and its construction.							12	CO2		
III	<b>Organogenesis</b> Development of Brain, Eye and Heart in frog. Development of Nervous system in chick. Foetal membranes in chick. Development of Pro, Meso, Metanephric kidneys. Placentation in Mammals.							12	CO3		
IV	<b>Applied Embryology</b> Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation – teratogenesis. Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo							12	CO4		
V	<b>Human embryology</b> Puberty, Menstrual cycle and menopause. Pregnancy – trimesters – development. Erythroblastosis foetalis. Twins – types. Birth Control; Adenomyosis, Fibroids,							12	CO5		

	Ovarian cysts, Endometriosis, Endometritis and Cervical cancer. Infertility – causes. Assisted Reproductive Technology, Amniocentesis.		
		<b>60</b>	
<b>Course Outcomes</b>			
<b>CO1</b>	To describe and illustrate the significance of cellular processes in embryonic development.	PO1	
<b>CO2</b>	To relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.	PO1, PO2	
<b>CO3</b>	To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.	PO4, PO6	
<b>CO4</b>	To distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.	PO4, PO5, PO6	
<b>CO5</b>	To justify and validate the role of environment and genetics in influencing embryonic development	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India		
2.	Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India.		
3.	Verma, P.S., Agarwal, V. K.2010.Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA.		
2.	Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK.		
3.	Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA.		
4.	Russ Hodge 2010. Developmental Biology, Facts on File, Inc., New York, USA.		
5.	Carlson, Bruce, M. 2009. Human embryology and Developmental Biology, Elsevier, Philadelphia, USA		
<b>Web Resources</b>			
1.	<a href="https://www.ncbi.nlm.nih.gov/books/NBK10052/">https://www.ncbi.nlm.nih.gov/books/NBK10052/</a>		
2.	<a href="https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html">https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html</a>		
3.	<a href="https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468">https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468</a>		
4.	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/</a>		
<b>Methods of Evaluation</b>			
<b>Internal Evaluation</b>	Continuous Internal Assessment Test		25 Marks
	Assignments		

	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)    M-Medium (2)    L-Low (1) B N**

**SEMESTER - IV**

Course Code CC10	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23U4ZOC06	<b>ENVIRONMENTAL BIOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To understand the structure and functions of the ecosystem.										
CO2	To explain the relationship between biotic and abiotic factors in an ecosystem.										
CO3	To know the causes and effects of climate change and habitat loss.										
CO4	To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Ecosystem</b> : Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers-Energy flow in the ecosystem-Ecological succession-Food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the following ecosystem : Forest ecosystem-Grassland ecosystem-Desert ecosystem-Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).							12	CO1		
II	<b>Population And Biological Cycles</b> : Structure and distribution – Growth curves - Groups, natality, Mortality -Density indices, Life study tables - factors affecting population growth -Carrying capacity. Population regulation and human population control. Complete and incomplete biogeochemical cycles - Sedimentary cycle.							12	CO2		
III	<b>Environmental Stresses And Management</b> :Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture,							12	CO3		

	industry and hygiene and their disposal. Bio indicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.		
IV	<b>Environmental Pollution:</b> Definition- cause, effects and control measures of: -Air pollution - Water pollution - Soil pollution -Marine pollution - Noise pollution - Thermal pollution -Nuclear hazards.	12	CO4
V	<b>Biodiversity Conservation:</b> Biodiversity crisis – habitat degradation, poaching of wild life. - Socio economic and political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement - Chipko Movement - Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests- National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management, Legislations for environmental Protection, Bio villages – sustainable utilization and development, Environmental ethics.	12	CO5
<b>Total</b>		<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	Understand the fundamental structure and functions of the ecosystem.	PO1	
<b>CO2</b>	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.	PO1, PO2	
<b>CO3</b>	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.	PO4, PO6	
<b>CO4</b>	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.	PO4, PO5, PO6	
<b>CO5</b>	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University.		
2.	Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.		
3.	Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.		
4.	Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.		



<b>References Books</b> (Latest editions, and the style as given below must be strictly adhered to)		
1.	Odum E.P.1983. Basic Ecology, Saunders, New York	
2.	Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.	
3.	Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.	
<b>Web Resources</b>		
1.	<a href="https://bit.ly/2VYWOM5">https://bit.ly/2VYWOM5</a>	
2.	<a href="https://bit.ly/2VZQFiT">https://bit.ly/2VZQFiT</a>	
3.	<a href="https://bit.ly/3kqdXYA">https://bit.ly/3kqdXYA</a>	
4.	<a href="https://bit.ly/39rvvgt">https://bit.ly/39rvvgt</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

#### Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong(3)

M-Medium (2)

L-Low (1)

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U4ZOC P04</b>	<b>CORE PRACTICAL IV: DEVELOPMENTAL BIOLOGY &amp; ECOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
<b>CO1</b>	To demonstrate an understanding of core ecological principles, and define scientific principles and concepts as related to environmental studies and sustainability.										
<b>CONTENTS</b>											
<b>Experiments</b>											
<ol style="list-style-type: none"> <li>1. Estimation of dissolved Oxygen,</li> <li>2. Dissolved carbon-di-oxide,</li> <li>3. Determination of pH in water samples,</li> <li>4. Determination of salinity of water samples,</li> <li>5. Determination of bicarbonate and carbonates.</li> <li>6. Study of planktons in water samples</li> <li>7. Study of intertidal fauna</li> <li>8. Mounting of Chick embryo</li> <li>9. Various stages of chick embryo (Permanent slide identification)</li> <li>10. Metamorphosis of frog</li> </ol>											
<b>Spotters</b>											
<ol style="list-style-type: none"> <li>1. Sea anemone on hermit crab.</li> <li>2. Plankton net.</li> <li>3. Mysis</li> <li>4. Daphnia</li> <li>5. Cyclops</li> <li>6. Cypris</li> <li>7. Nauplius Larva</li> <li>8. Use of Rain gauge</li> <li>9. Maximum and Minimum thermometer</li> <li>10. Sperm</li> <li>11. Ovum</li> <li>12. Early cleavage 2 &amp; 4 cell stage</li> <li>13. Yolk plug stage</li> <li>14. Blastula</li> <li>15. Gastrula</li> <li>16. Placenta</li> </ol>											

**SEMESTER - V**

Course Code CC9	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23U4ZOC07	ANIMAL PHYSIOLOGY	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To familiarise students with the principles and basic facts of Animal Physiology										
CO2	To give students an insight about the molecular and cellular basis of physiological functions in animals.										
CO3	To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.										
CO4	To make the students aware about how the structure-function relationships and its synchronisation with the molecular signals.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Nutrition &amp; Respiration</b> Nutrition: Digestion and absorption of carbohydrates, proteins and lipids. Minerals & Vitamins – their deficiency. Hormonal control of digestion. Types of Respiration, Respiratory pigments – structure of Haemoglobin, Transportation of gases – Bohr effect – Regulation of respiration – bronchitis, asthma – Physiological effects of smoking							12	CO1		
II	<b>Circulation &amp; Excretion</b> Blood – composition and functions, Mechanism of clotting. Types of Hearts – Heartbeat and its regulation – pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, Regulation of acid base balance, Excretory products, Osmoregulation in fishes.							12	CO2		
III	<b>Muscle &amp; Nerve Physiology</b> Types of muscles – Ultrastructure of striated muscle, Muscle contraction & properties, Neurons –							12	CO3		

	structure&types- Impulsepropagation,synaptictransmission,neurotransmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer’s disease, Parkinson’sdisease.		
IV	<b>Sense Organs</b> Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease - Olfactory,gustatoryandtactile sense organs	12	CO4
V	<b>Reproductive Physiology</b> Endocrine glands in man - Hormones, action and disorders - Feed-back mechanism,Outlinesofmechanismofhormonalactivity. Puberty,adolescence,pregnancy,parturition,lactation andbirth control.	12	CO5
<b>Total</b>		<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	beabletoexplainhowthevariousorgansystemsarecoordinatedand controlled.	PO1	
<b>CO2</b>	beabletolistthefunctionsofvariousorgansinrelationtophysiologicalprocess.	PO1, PO2	
<b>CO3</b>	be able todeveloptheideaofmultilevelcontrollingandfeedbackmechanisminrelationto various physiological functions.	PO4, PO6	
<b>CO4</b>	beabletounderstandthebasicphysiologicalprocessrelated toadaptation,metabolism and majorrequirements.	PO4, PO5, PO6	
<b>CO5</b>	be able to correlate and understand human physiology.	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.		
2.	Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp		
3.	Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.		
4.	Parameswaran, Ananta krishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p.		

5.	Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp.	
<b>References Books</b>		
<b>(Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.	
	Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.	
	Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.	
2.	Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.	
3.	Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp.	
4.	Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi.	
5.	Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp.	
6.	Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.210 pp	
7.	Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Sons, Inc. 1232 pp.	
	Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 pp.	
<b>Web Resources</b>		
1.	<a href="https://microbenotes.com/category/biochemistry/">https://microbenotes.com/category/biochemistry/</a>	
2.	<a href="https://www.stem.org.uk/resources/collection/3931/animal-physiology">https://www.stem.org.uk/resources/collection/3931/animal-physiology</a>	
3.	<a href="https://animalphys4e.sinauer.com">https://animalphys4e.sinauer.com</a>	
4.	<a href="https://nptel.ac.in/courses/102/104/102104042/">https://nptel.ac.in/courses/102/104/102104042/</a>	
5.	<a href="https://biochem.oregonstate.edu">https://biochem.oregonstate.edu</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	
	Assignments	
	Seminars	
	Attendance and Class Participation	
	25 Marks	
<b>External Evaluation</b>	End Semester Examination	
	75 Marks	
	Total	
	100 Marks	
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	

<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER- V**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U4ZOC08</b>	<b>EVOLUTIONARY BIOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	Evolutionary biology is a branch of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time.										
CO2	This course helps to understand the important processes, principles, and concepts on evolution.										
CO3	To provide adequate information on the Lamarckism - Neo Lamarckism – Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project.										
CO4	To explain the importance of the fossil records in evolutionary studies, and the role of phylogenetic studies in the wider context of biodiversity and conservation.										
CO5	In this course, we will apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases.										
UNIT	Details							No. of Hours	Course Objectives		
I	Inorganic and organic evolution-History of evolutionary thought, Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes.							12	CO1		
II	Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's Mutation theory – modern concepts of mutation - Mutation and their role in evolution - Animal colouration and Mimicry.							12	CO2		
III	Isolating mechanisms - Modes of speciation-Hybridization is an evolutionary catalyst- Law of Adaptive Radiation- Adaptive radiation in reptiles and mammals - Convergence and parallelism - Evolutionary constancy.							12	CO3		

IV	Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences -Palaeontological evidences – evolutionary genomics. Types of rocks - Geological time scale – Nature of fossils- Dating of fossils - Fossil records of man and fossil records of horse.	12	CO4
V	Natural selection in action in man- level of selection- Eugenics, Euphenics and Euthenics- Adaptation- Human Genome Project – Evolution and ethics.	12	CO5
<b>Total</b>		<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	To understand the Primordial earth and theories on origin of life	PO1	
<b>CO2</b>	To integrate and assess Lamarckism - Neo Lamarckism – Darwinism	PO1, PO2	
<b>CO3</b>	To analyse various fossil records of man and fossil records of horse, various types of rocks - Geological time scale.	PO4, PO6	
<b>CO4</b>	To explain the Nature of fossils- Dating of fossils, evidences of evolution, Adaptive radiation in reptiles and mammals,	PO4, PO5, PO6	
<b>CO5</b>	To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases.	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.		
2.	Lull, R.S. 2010. Organic evolution, The Macmillan, New York.		
3.	Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company		
4.	Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.		
5.	Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A text book of Organic Evolution, Nirali Prakashan,		
6.	Rastogi VB. 1991. Organic Evolution. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.		
7.	Stricberger, M.W., 1996. Evolution. Jones& Bartlett, USA		
8.	Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert’s Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.		



<b>References Books</b> (Latest editions, and the style as given below must be strictly adhered to)		
1.	Burns GW. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co.Inc.	
2.	Gardner EF. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.	
3.	Harth and Jones EW. 1998. Genetics – Principles and Analysis. Jones and BarHett Publ. Boston.	
4.	Levine L. 1969. Biology of the Gene. Toppan.	
5.	Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.	
6.	Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.	
7.	White MJD. 1973. Animal Cytology and Evolution. Cambridge Univ.Press.	
<b>Web Resources</b>		
1.	<a href="https://bit.ly/3nPD09m">https://bit.ly/3nPD09m</a>	
2.	<a href="https://bit.ly/3CHOdgL">https://bit.ly/3CHOdgL</a>	
3.	<a href="https://bit.ly/2XvcCXl">https://bit.ly/2XvcCXl</a>	
4.	<a href="https://bit.ly/2XAL1Vh">https://bit.ly/2XAL1Vh</a>	
5.	<a href="https://bit.ly/3zoU9Jl">https://bit.ly/3zoU9Jl</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
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<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER – V**

Course Code CC15	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U5ZOC09</b>	<b>MICROBIOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To become familiar with the foundation concepts of history of Microbiology										
CO2	To understand the structure and functions of a typical prokaryotic cell										
CO3	To gain the knowledge of microscopy and staining concepts										
CO4	To understand and implement disposal and safety measures										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Introduction to microbiology</b> History, scope, branches of microbiology. Contribution of Leeuwenhoek, Jenner, Pasteur, Koch, Fleming, Iwanowsky, Waksman, Luria, M. J. Thirumalachar, Subba Rao, Sambhu Nath De. Evolution of Microbial diversity. Systematic position: 5 kingdom classification of Whittaker and 3 kingdom classification of Carl Woese. Comparison of Bacteria, Archaea, Eukarya (tabular and diagrammatic). Controlling microbes.							12	CO1		
II	<b>Microscopy</b> Principles of microscopy ii. Compound microscope (Monocular and Binocular microscopes) – construction and function of parts, ray diagram of path of light, objectives, oculars, condensers, sources of illumination and uses iii. Dark field, Phase contrast and Fluorescence microscopes, Confocal microscopes, Atomic Force Microscope - principle, construction, ray diagram and applications iv. Electron microscopy – TEM and SEM – principle, construction, ray diagram and uses.							12	CO2		
III	<b>Introductory Mycology</b> General characteristics and outline classification of fungi, Morphology of some common fungi - Mucor, Rhizopus,							12	CO3		

	Aspergillus, Penicillium and Fusarium. Yeasts: General characteristics and outline classification of yeasts 3. General characteristics of Lichens and Mycorrhiza.		
IV	<b>Introductory Bacteriology</b> Classification of bacteria. Anoxygenic photosynthetic bacteria: general characteristics of purple bacteria and green bacteria. Oxygenic photosynthetic bacteria: General characteristics of Cyanobacteria – external and internal features, physiology and ecology. Magnetotactic bacteria- General characteristics, Magnetosomes, Enrichment and isolation of Magnetotactic bacteria. Types of staining.	12	CO4
V	<b>Introductory Virology</b> Virus Structure and Classification. Virus Entry and Viral Pathogenesis. Positive-strand RNA viruses: Picornaviruses, Flaviviruses, Togaviruses, Coronaviruses. Negative-strand and double-strand RNA viruses: Paramyxoviruses, Rhabdoviruses, Filoviruses, Bunyaviruses, Orthomyxoviruses and Reoviruses. DNA viruses: Parvoviruses, Polyomaviruses, Papillomaviruses, Adenoviruses and Baculoviruses, Herpes viruses and Poxviruses.	12	CO5
<b>Total</b>		<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	To understand history, relevance of microbiology and classification of bacteria	PO1	
<b>CO2</b>	To understand the working of various microscopes and their application	PO1, PO2	
<b>CO3</b>	To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes	PO4, PO6	
<b>CO4</b>	To understand the structure of bacterial cells, its organelles, physiology and behaviour.	PO4, PO5, PO6	
<b>CO5</b>	To learn different methods of staining bacteria and demonstrate proficiency in handling aseptic bacteriological specimen.	PO3, PO8	
<b>Text Books (Latest Editions)</b>			

1.	Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation , New Age International, New Delhi.	
2.	Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.	
3.	Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.	
4.	Greenwood D, Richard CD, John S and Peuther F (1992). Medical Microbiology, 16th edition. ELBS, Churchill living stone.	
<b>References Books</b> <b>(Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.	
2.	Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London.	
3.	Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.	
4.	Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi.	
5.	Pelczar .J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.	
6.	Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York.	
7.	Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited.	
8.	Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods 7th edition. Grange, Butter Worth, Oxford.	
9.	Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cumings Inc. California.	
10.	Pelczar MJ, Chan ECS and Krieg NR (1993). Microbiology 5th edition, Tata McGraw Hill.	
11.	Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.	
<b>Web Resources</b>		
1.	<a href="https://vlab.amrita.edu/?sub=3&amp;brch=73">https://vlab.amrita.edu/?sub=3&amp;brch=73</a>	
2.	<a href="https://learn.chm.msu.edu/vibl/">https://learn.chm.msu.edu/vibl/</a>	
3.	<a href="https://mvi-au.vlabs.ac.in/">https://mvi-au.vlabs.ac.in/</a>	
4.	<a href="https://virtuallab.tlc.ontariotechu.ca/intro.php">https://virtuallab.tlc.ontariotechu.ca/intro.php</a>	
5.	<a href="https://www.merlot.org/merlot/viewMaterial.htm?id=79694">https://www.merlot.org/merlot/viewMaterial.htm?id=79694</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	

	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER – V**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U5ZOCP05</b>	<b>CORE PRACTICAL V: ANIMAL PHYSIOLOGY, EVOLUTIONARY BIOLOGY &amp; MICROBIOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
<b>CO1</b>	To understand the physiological activities of animal kingdom.										
<b>CO2</b>	To relate the evolutionary changes to current context.										
<b>CO2</b>	To learn the culture of microbes.										
<b>CONTENTS</b>											
<b>Experiments</b>											
1. Survey of digestive enzymes in Cockroach.											
2. Counting of cockroach haemocytes using haemocytometer.											
3. Ptyalin activity in relation to temperature and pH in human saliva.											
4. Estimation of oxygen consumption in an aquatic and a terrestrial animal.											
5. Qualitative tests for identification of carbohydrates, proteins and lipids.											
6. Homologous and Analogous organs (Explain with specimen or picture).											
7. Connecting links – Trilobite, Peripatus and Archeopteryx.											
8. Bacterial Culture techniques – Streak plate, Pour plate											
9. Simple staining and Gram's staining.											
10. Mounting of Bread mold.											
11. Quality analysis of milk using Methylene Blue Reduction test (MBRT).											
<b>Spotters</b>											
1. Haemoglobinometer.											
2. Kymograph											
3. Spigmanometer											
4. BP apparatus (Digital)											
5. Sahli's apparatus											
6. Thermometer											

7. Adrenal gland
8. Thyroid gland
9. Islets of Langerhan's (Pancrease TS)
10. Muscles – Skeletal, Smooth and Cardiac muscle.
11. Homologous and analogous organs
12. Darwin's Finches
13. Any three fossils
14. Inoculation loop
15. Petriplate
16. Autoclave
17. Laminar air flow
18. Hot Air Oven
19. Incubator



**SEMESTER – V**

Course Code CC14	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23U5ZOE01	<b>BIOCHEMISTRY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To provide the knowledge about the biochemical change in living organism.										
CO2	To understand the structure and function of biomolecules										
CO3	To understand to importance of vitamins.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Carbohydrates</b> - Classification and Properties, Structure & Biological importance of monosaccharide (glucose, fructose, galactose and xylose), disaccharides (sucrose and lactose), polysaccharides (glycogen, starch and chitin).							12	CO1		
II	<b>Lipids</b> - Classification, structure, function and properties of simple, compound and derived lipids. Essential fatty acid and cholesterol.							12	CO2		
III	<b>Proteins– Classification</b> , Essential and Non-essential amino acids. Proteins- Classification based on structure and functions. Structural organization of proteins ( Primary, secondary, tertiary and quaternary structures) – Ramachandran plot.							12	CO3		
IV	<b>Vitamins</b> – Classification and functions. <b>Nucleic Acids</b> – Structure , composition of purines and pyrimidines. DNA- Double helix, denaturation & renaturation.RNA – types (mRNA. tRNA, rRNA and hnRNA).							12	CO4		
V	<b>Enzymes-</b> Definition, classification, active site, lock and key model, induced fit hypothesis, enzyme kinetics (MM & LB plot), factors affecting enzyme activity							12	CO5		
<b>Total</b>							<b>60</b>				
<b>Course Outcomes</b>											

<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO1</b>	To describe classification and importance of carbohydrates.	PO1
<b>CO2</b>	Familiar with biological significance of lipids.	PO1, PO2
<b>CO3</b>	Understand the role of biomolecules and their role in metabolic activities of animals.	PO4, PO6
<b>Text Books (Latest Editions)</b>		
1.	Satyanarayana,U and Chakrapani, U (2009) Essentials of Biochemistry, Books and Allied (P) Limited, Kolkata.	
2.	Vasudevan, D.M and Sreekumar,S. (2003) Text Book of Biochemistry, Jaypee Brothers Medical publishers (P) Ltd, New Delhi.	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Satyanarayana,U (2005) Biochemistry, Books and Allied (P) Limited, Kolkata.	
2.	Deb, A.C(2012)Concepts of Biochemistry , books and allied (P) Ltd. Kolkata.	
3.	Jain,J.L.,(2005) Fundamentals of Biochemistry, S.Chand & Co Ltd.	
<b>Web Resources</b>		
1.	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/</a>	
2.	<a href="https://www.isaaa.org/resources/publications/pocketk/40/default.asp">https://www.isaaa.org/resources/publications/pocketk/40/default.asp</a>	
3.	<a href="https://www.ncbi.nlm.nih.gov/books/NBK207574/">https://www.ncbi.nlm.nih.gov/books/NBK207574/</a>	
4.	<a href="https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf">https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf</a>	
5.	<a href="https://go.nature.com/3zAZmO9">https://go.nature.com/3zAZmO9</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	
	Assignments	
	Seminars	
	Attendance and Class Participation	
	25 Marks	
<b>External Evaluation</b>	End Semester Examination	
	75 Marks	
	Total	
	100 Marks	
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong (3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER – V**

Course Code CC14	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23U5ZOE02	<b>GENERAL AND APPLIED ENTOMOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	Understand basic knowledge on Classification of Insect Taxonomy.										
CO2	Learn the types of pest and predator Insects,										
CO3	Gaining the Knowledge Identification of Insects Key character										
CO4	Learn the basic knowledge of social insects and economic importance of insects.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>TAXONOMY OF INSECTS</b> Classification of Class Insecta - Key characters of insect, Economic importance of insects with example: Orders - Orthoptera, Odonata, Coleoptera, Diptera, Lepidoptera and Hymenoptera. Reasons for insects attaining pest status.							12	CO1		
II	<b>TYPES OF PEST IN AGRICULTURE</b> Life cycles of any four pests of Paddy, Groundnut, Cotton and Stored products –Nature of Damage and control measures, Life cycle of any two pests of cattle and poultry-control measures.							12	CO2		
III	<b>INSECT PEST OF STORED PRODUCTS</b> Household insects and their control- Cockroach, Lepisma and carpet beetle- Insect vectors of human diseases: brief account on vector biology, pathogens involved, disease transmitted by mosquito and control measure, housefly and flea. Insect vectors of plant diseases- white fly and leaf hoppers.							12	CO3		
IV	<b>BENEFICIAL INSECTS</b> Venomatic insects and social insects, Insects in medicine- Beneficial insects: predators- parasites- weed killers- soil builders- scavengers.							12	CO4		
V	<b>PEST MANAGEMENT</b> Classification of insecticides based on the mode of entry, mode of action and chemical nature- merits and demerits							12	CO5		

	of chemical methods of pest control, Pest resurgence. - Biological method of pest control, Integrated pest management (IPM)		
	<b>Total</b>	<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	To describe classification and importance of carbohydrates.	PO1	
<b>CO2</b>	Familiar with biological significance of lipids.	PO1, PO2	
<b>CO3</b>	Understand the role of biomolecules and their role in metabolic activities of animals.	PO4, PO6	
<b>Text Books (Latest Editions)</b>			
1.	Rajendra Singh, 2016. Elements of Entomology. 2 <sup>nd</sup> Edition: Rastogi publications, New Delhi.		
2.	Nalina Sundari, M.S. and Santhi, R. (2006) Entomology, MJP Publishers, Chennai.		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	David, B.V. (2001) Elements of Economic Entomology, Popular Book Depot, Chennai.		
2.	Dunston, P. Ambrose (2004) The insects: Structure, Function and Biodiversity, Kalyani Publications, New Delhi.		
<b>Web Resources</b>			
1.	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/</a>		
2.	<a href="https://www.isaaa.org/resources/publications/pocketk/40/default.asp">https://www.isaaa.org/resources/publications/pocketk/40/default.asp</a>		
3.	<a href="https://www.ncbi.nlm.nih.gov/books/NBK207574/">https://www.ncbi.nlm.nih.gov/books/NBK207574/</a>		
4.	<a href="https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf">https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf</a>		
5.	<a href="https://go.nature.com/3zAZmO9">https://go.nature.com/3zAZmO9</a>		
<b>Methods of Evaluation</b>			
<b>Internal Evaluation</b>	Continuous Internal Assessment Test		25 Marks
	Assignments		
	Seminars		
	Attendance and Class Participation		
<b>External Evaluation</b>	End Semester Examination		75 Marks
	Total		100 Marks
<b>Methods of Assessment</b>			
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions		
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview		
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain		
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate		

	between various ideas, Map knowledge
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong (3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER - VI**

Course Code CC14	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U6ZOC10</b>	<b>ANIMAL BIOTECHNOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.										
CO2	To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.										
CO3	To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.										
CO4	To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Fundamentals of Biotechnology:</b> Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications; r-DNA technology: Enzymes; Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Host cells; Gene cloning: steps in cloning, selection of clones – chromogenic substrate, antibiotics.							12	CO1		
II	<b>Techniques in Animal Biotechnology:</b> Isolation and purification: DNA and mRNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, DNA chips, microarray; PCR: principle, types and application; Gene library: screening with probes; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.							12	CO2		
III	<b>Transgenic Animal Technology:</b> Transgenesis: Concept,							12	CO3		

	transgenes, transgenic animal models - knockout mice, sheep; Applications of transgenesis : Molecular farming, Transgenic fishes, transgenic live stocks, and animals as bioreactors.		
IV	<b>Animal Biotech and Health Care:</b> Medical biotechnology: Monoclonal antibodies, recombinant vaccines –hepatitis B, hormones – insulin. DNA diagnostic systems: tuberculosis, AIDS, genetic diseases; Gene therapy: Ex vivo and in vivo, role in cancer treatment; CRISPR gene editing. Molecular markers: RFLP, RAPD, DNA fingerprinting and application.	12	CO4
V	<b>Applications and Ethics:</b> Human genome project: Mapping of human genome, applications, ethics; Industrial biotechnology: Bioreactors - Basic concepts of fermentation, bioreactor design, production of ethanol and streptomycin; Ethics: Socio ethical problem, recent trends in animal biotechnology, ethical implications.	12	CO5
	<b>Total</b>	<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.	PO1	
<b>CO2</b>	To develop and explain the protocols for genetically manipulating cells and produce transgenic animals	PO1, PO2	
<b>CO3</b>	To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.	PO4, PO6	
<b>CO4</b>	To choose the correct methods of transgenesis and to consider their use in improving animal husbandry nationally and globally	PO4, PO5, PO6	
<b>CO5</b>	To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.		



2.	Sasidhara, R., 2015. Animal biotechnology, MJP publishers.	
3.	Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.	
4.	Dubey S. K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.	
5.	Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication.	
6.	Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi.	
7.	Sambamurthy K., Ashutosh Kar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd.	
8.	Ramdoss P., 2009. Animal Biotechnology- Recent concepts and developments, MJP publishers.	
9.	Sathyanarayran U., 2008. Biotechnology, Books and Allied, Kolkata.	
10.	Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.	
11.	Rastogi S. C., 2007. Biotechnology: Principles and applications, Alpha Science publishers. Ranga, M.M., 2003. Animal biotechnology, Agrobios, New Delhi.	
<b>References Books</b>		
<b>(Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Veer Bala Rastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA.	
2.	Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.	
3.	Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA.	
4.	Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.	
5.	Ramawat, K.G and Shailey Goyal, 2009. Comprehensive biotechnology, S.Chand company, New Delhi, India.	
6.	Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley- Blackwell, UK.	
7.	Primrose S. B., 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.	
8.	Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK.	
<b>Web Resources</b>		
1.	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/</a>	
2.	<a href="https://www.isaaa.org/resources/publications/pocketk/40/default.asp">https://www.isaaa.org/resources/publications/pocketk/40/default.asp</a>	
3.	<a href="https://www.ncbi.nlm.nih.gov/books/NBK207574/">https://www.ncbi.nlm.nih.gov/books/NBK207574/</a>	
4.	<a href="https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf">https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf</a>	
5.	<a href="https://go.nature.com/3zAZmO9">https://go.nature.com/3zAZmO9</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	
	Assignments	
	Seminars	
		25 Marks

	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**Mapping with Programme Outcomes:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)**

**M-Medium (2)**

**L-Low (1)**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23U6ZOC11	IMMUNOLOGY	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system.										
CO2	To list basic mechanisms that regulate immune responses, describe the main steps in the generation of cells and organs of the immune system.										
CO3	To describe the basic mechanisms that provide innate immunity and antigen processing and presentation.										
CO4	To differentiate B and T cell receptors, organs, and microenvironments of the Immune System.										
CO5	To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Immune Cells and Organs:</b> Overview of Immune System - General concepts and Haematopoeisis. Cells of the immune system - T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils -Mast cells and dendritic cells. Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow; Secondary Lymphoid organs - Lymph nodes and spleen; Lymphatic tissues - Peyer's patches and Kupffer cells, MALT, GALT and CALT.							12	CO1		
II	<b>Innate and Adaptive Immunity:</b> Innate and Adaptive Immunity; Anatomical barriers, Inflammatory response, Cells and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral). <b>Receptors and Signaling:</b> Cytokines and Chemokines - General Properties of Cytokines and Chemokines. <b>Major Histocompatibility Complex (MHC):</b> Organization and inheritance of the MHC. Structure and cellular distribution of HLA antigens.							12	CO2		

III	<b>Antigen and Antibodies:</b> Antigens- Antigenicity and immunogenicity: Properties -foreignness, molecular size, heterogeneity. B & T epitopes, T-dependent and T-independent B cell responses. Antibodies: Structure, function and properties of the Immunoglobulins, Different classes of Immunoglobulins; antigenic determinants on antibodies (isotype, allotype and idiotype). Hybridoma technology - production of monoclonal antibodies and catalytic antibodies (abzymes).	12	CO3
IV	<b>Hypersensitivity and Autoimmune Diseases:</b> Hypersensitivity: classification and brief description of various types of hypersensitivities. Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases. Transplantation immunology: Types of grafts, immunologic basis of graft rejection, immunosuppressive therapy and clinical transplantation.	12	CO4
V	<b>Clinical Immunology:</b> Immunity and tumors- tumor antigens (TSTA and TAA), immune response to tumors. Tumor evasion of the immune system, Immunotherapy for tumors. Immunity against - viral, bacterial and parasitic infections. Vaccines: Types and uses - Immunization schedule for children.	12	CO5
<b>Total</b>		<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation.	PO1	
<b>CO2</b>	Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations.	PO1, PO2	
<b>CO3</b>	Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production	PO4, PO6	
<b>CO4</b>	Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases.	PO4, PO5, PO6	
<b>CO5</b>	Summarize immune responses against pathogens	PO3, PO8	
<b>Text Books</b>			

<b>(Latest Editions)</b>		
1.	Kuby, J, Punt, J, Stranford, S, Jones, Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.	
2.	Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing, USA, 576 pp.	
3.	Coleman, R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc Graw Hill Education India, 357 pp.	
4.	Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp.	
5.	Rao. C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp.	
<b>References Books</b> <b>(Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.	
2.	Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.	
3.	William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.	
4.	Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.	
<b>Web Resources</b>		
1.	<a href="https://www.aaaai.org/">https://www.aaaai.org/</a>	
2.	<a href="https://www.bsaci.org/">https://www.bsaci.org/</a>	
3.	<a href="https://www.immunology.org/">https://www.immunology.org/</a>	
4.	<a href="https://nptel.ac.in/courses/102/103/102103038/">https://nptel.ac.in/courses/102/103/102103038/</a>	
5.	<a href="https://microbenotes.com/category/immunology/">https://microbenotes.com/category/immunology/</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	25 Marks
	Total	75 Marks
		100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or	

	Presentations
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**Mapping with Programme Outcomes:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
<b>CO 1</b>	S							
<b>CO 2</b>	M	S						
<b>CO 3</b>				S		S		
<b>CO 4</b>				S	S	M		
<b>CO 5</b>			S					S

**S-Strong(3)**

**M-Medium (2)**

**L-Low (1)**

**SEMESTER – V**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U6ZOCPO6</b>	<b>ANIMAL BIOTECHNOLOGY &amp; IMMUNOLOGY</b>	Core	Y	-	-	-	4	4	40	60	100
<b>Learning Objectives</b>											
<b>CO1</b>	To understand the immunological aspects of animals.										
<b>CO2</b>	To demonstrate the molecular techniques										
<b>CONTENTS</b>											
<b>Experiments</b>											
<ol style="list-style-type: none"> <li>1. Isolation of DNA from goat liver.</li> <li>2. Agarose gel electrophoresis of DNA.</li> <li>3. Quantitative estimation of DNA by spectrophotometry</li> <li>4. Preparation of Serum components.</li> <li>5. Demonstration of antigen-antibody reaction using blood grouping.</li> <li>6. Immuno electrophoresis (Demo).</li> <li>7. Animal cell culture techniques.</li> <li>8. Demonstration of ELISA</li> <li>9. Isolation of Plasmid DNA from bacterial cells.</li> <li>10. PCR (Demo)</li> </ol>											

**SEMESTER – VI**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U6ZOE03</b>	<b>ECONOMIC ZOOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To study the economic importance of apiculture										
CO2	To study the importance of animal husbandries and aquaculture										
CO3	To know practices and economic importance of vermicast										
CO4	To learn recent developments in pharmaceuticals and animal health										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>APICULTURE &amp; LAC CULTURE</b> Types of honey bees – Diseases and pests of bees – Harvesting and processing of honey – Types of Honey, Maintenance of Apiary, Instruments used in Apiculture. Lac Culture : Types of Lac; Life cycle of Lac insect, Harvesting and Extraction of Lac; Uses and Enemies of Lac. Economic Importance							12	CO1		
II	<b>POULTRY</b> Types of birds for poultry – Bio-security measures followed in Poultry farms, Diseases and pests – Egg and meat production – Types of breeds rearing in animal husbandry (Cow, Sheep and Goats, Pigs) – Disease and parasites of animal husbandry. Economic importance.							12	CO2		
III	<b>AQUACULTURE</b> Aqua culture- Site selection and Construction, Pre stocking and post stocking management of Nursery, rearing and stocking ponds, Fish byproducts. Prawn culture - Methods of prawn fishing, Preservation - Fish and Prawn, Marketing of Prawn.							12	CO3		
IV	<b>VERMICULTURE</b> Species of earthworm used in vermiculture- Raw							12	CO4		



	materials for vermiculture- Compost Production. Natural enemies and their control measures-Harvesting of vermicompost and worms -Role of vermicompost in agriculture.		
V	<b>Dairy Farming</b> :Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common contagious diseases. Milk - Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.	12	CO5
	<b>Total</b>	<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	Understand the significance apiculture for the uplift of rural economy	PO1	
<b>CO2</b>	Create the self-employment opportunities to rural students through animal husbandry, aquaculture Vermiculture and Sericulture	PO1, PO2	
<b>CO3</b>	Know how to isolation of pharmaceuticals product from the animal sources	PO4, PO6	
<b>Text Books (Latest Editions)</b>			
1.	Banerjee, G.C. (2015), Animal Husbandry, Navyug Book International Publications		
2.	Jawaid, A. and Sinha, S. P. (2008) A Handbook of Economic Zoology. S. Chand Group Publishers, New Delhi.		
3.	Khan, A. A. (2007) Encyclopedia of Economic Zoology. 2 vols. Anmol Publications Pvt. Ltd., New Delhi.		
4.	Upadhyay, V.B. (2006) Economic Zoology. Rastogi Publications, Meerut, India.		
5.	Nigam, H.C. (2006) Modern Trends in Biology & Economic Zoology, Vishal Publishing. Co., Jalandhar.		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Jabde and Pradip V (2005) Text Book of Applied Zoology, Discovery Publishing House, New Delhi.		
2.	Shukla, G.S. and Upadhya, V.B. (2005) Economic Zoology, Rastogi Publications, Meerut, India.		
3.	Ravindranathan, K.R. (2003) Economic Zoology, Dominant Publishers & Distributors, New Delhi.		

4.	Yadav, M (2003) Economic Zoology. Discovery Publishing House, Rastogi Publications, Meerut.	
<b>Web Resources</b>		
1.	<a href="http://www.iaszoology.com/insect/">http://www.iaszoology.com/insect/</a>	
2.	<a href="http://download.nos.org/srsec314newE/PDFEL35B.pdf">http://download.nos.org/srsec314newE/PDFEL35B.pdf</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

**SEMESTER – VI**

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
<b>23U6ZOE04</b>	<b>WILD LIFE BIOLOGY &amp; CONSERVATION</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Learning Objectives</b>											
CO1	To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies										
CO2	To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations.										
CO3	To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>Biodiversity Extinction and Conservation Approaches</b> : Perspectives and Expressions. Identification and prioritization of Ecologically sensitive area (ESA). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation.							12	CO1		
II	<b>Theory and Analysis of Conservation of Populations</b> : Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity. Population viability analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species.							12	CO2		
III	<b>National and International Efforts for Conservation</b> :International agreements for conserving marine life, Convention on wetlands of International Importance (Ramsar convention), Conservation of Natural Resources.Overview of conservation of Forest &Grassland resources. CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts.							12	CO3		

IV	<b>Wildlife in India</b> : Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves.	12	CO4
V	<b>Management of Wildlife</b> : Distribution, status. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wild life Trade & legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics.	12	CO5
<b>Total</b>		<b>60</b>	
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO1</b>	Understand the significance apiculture for the uplift of rural economy	PO1	
<b>CO2</b>	Create the self-employment opportunities to rural students through animal husbandry, aquaculture Vermiculture and Sericulture	PO1, PO2	
<b>CO3</b>	Know how to isolation of pharmaceuticals product from the animal sources	PO4, PO6	
<b>Text Books (Latest Editions)</b>			
1.	Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York, p 478.		
2.	Aaron, N.M.1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.		
3.	Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun		
4.	Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi.		
5.	Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science.		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.		
2.	Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.		
3.	Goutam Kumar Saha and SubhenduMazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.		
4.	Gopal, Rajesh,1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.		

<b>Web Resources</b>		
1.	<a href="https://bit.ly/39oPj44">https://bit.ly/39oPj44</a>	
2.	<a href="https://bit.ly/3IHdEYJ">https://bit.ly/3IHdEYJ</a>	
<b>Methods of Evaluation</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	Total	100 Marks
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
<b>Analyze (K4)</b>	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	