SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

Learning Outcomes based Curriculum Framework

(LOCF)

For

Second Year

B.Sc. Zoology Major

Undergraduate Programme

From

Academic year

2024-25

Vision & Mission

Mission:

- Equip the student with knowledge and skills of their chosen vocation,
- Inculcate values.
- Provide them opportunities for all round growth and prepare them for life.

Vision:

- To equip the students with advanced knowledge and skills in their chosen vocation.
- To provide value-based education and opportunities to students.
- To help them to face challenges in life.
- To nurture a scientific attitude, temperament and culture among the students.
- To continually review, develop and renew the approach to build India of the Founder's dream.

Goals and Objectives:

- To build a strong Academia-Industry bridge.
- To provide flexibility in the courses offered and proactively adapt to the changing needs of students and the society.
- To establish a centre for multidisciplinary activities.
- To mould individuals who would nurture the cultural heritage of our country and contribute to the betterment of the society.

Board of studies in Zoology

Undergraduate and Postgraduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Dr. Vikrant Deshmukh	Chairman	K J Somaiya college of science and commerce
Subject Expert nominated by Vice-Chancellor			
1	Dr. Meghana Talpade	Associate Professor	Mithibai College, vileParle
Research Scientist- Member			
1	Dr Ashok Jaiswar	Principal Scientist	CIFE, Mumbai
2	Dr Sabyasachi Sautya	Scientist and Assistant Professor	CSIR-NIO, Mumbai
Subject experts			
1	Dr Arshad Ali Haider	Assistant Professor	Maharashtra College, Mumbai Central
2	Dr Vaishali Somane	Associate Professor	MD College, Parel
Representative from Industry/corporate sector/allied area			
1	Mr. Amit Sharma	Deputy Technical Manager	Ultratech Environmental Consultancy and Laboratory, Thane
Meritorious Alumnus			
1	Ms. Roshni Yadav	MSc Oceanography 2018-19	K J Somaiya college of Science and Commerce
Faculty of the specialisation			
1	Dr Amol Patwardhan	Assistant Professor	K J Somaiya college of science and commerce

2	Ms. Shreya Patil	Assistant Professor	K J Somaiya college of science and commerce
3	Dr. Shanti Upadhye	Assistant Professor	K J Somaiya college of science and commerce
4	Ms. Chetana Kanekar	Assistant Professor	K J Somaiya college of science and commerce
5	Ms. Madhuri Padaya	Assistant Professor	K J Somaiya college of science and commerce
6	Ms. Roshni Yadav	Assistant Professor	K J Somaiya college of science and commerce
7	Ms. Meghna Verma	Assistant Professor	K J Somaiya college of science and commerce
8	Ms. Divya Sarang	Assistant Professor	K J Somaiya college of science and commerce
9	Mr. Rishiraj Duggal	Assistant Professor	K J Somaiya college of science and commerce

Foreword

Autonomy reflects efforts for excellence in academic performances, capability of self-governance and enhancement in the quality of education. In the year 2012, the UGC and University of Mumbai conferred the Autonomous Status to K J Somaiya College of Science and Commerce. Post this recognition and having several accolades to our credit, we made significant changes to our existing syllabi to reflect the changing business, industrial and social needs. A holistic education that provides opportunities to gain and share knowledge, experiment and develop beyond curriculum, is offered at our college.

An Autonomous college carries a prestigious image for the students and the teachers and we have made a collaborative attempt to maintain a high level of quality in the standard of education that we impart.

Structured feedback obtained from the students, alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi. The Board of Studies constituted for each department meets to carry out in depth discussions about different aspects of the curriculum taking into cognizance the recent trends in the discipline.

The IQAC team has facilitated the conduct of a number of workshops and seminars to equip the faculty with the necessary skill set to frame the syllabi and competencies to deliver the same. Training was also provided to employ innovative evaluation methods pertaining to higher cognitive levels of revised Bloom's taxonomy. This ensured the attainment of the learning outcomes enlisted in the syllabus. Audits are conducted to critically review the practices undertaken in

teaching, learning and evaluation. Innovative learning methodologies such as project-based learning, experiential learning and flip- class learning practiced by a committed fleet of faculty, supported by several hands have been our unique outstanding propositions. All efforts have been made to nurture the academic ambitions as well as the skills in co-curricular activities of the most important stakeholder i. e. student.

With sincere gratitude, I acknowledge the constant support and guidance extended by Shri Samir Somaiya, President- Somaiya Vidyavihar, and all the esteemed members of the Governing board and Academic council of the College. I also would like to acknowledge the Heads of the Departments and all the faculty members for their meticulous approach, commitment and significant contribution towards this endeavour for academic excellence.

Dr. Pradnya Prabhu
Principal

Acknowledgement

Syllabus Revision is an essential part of academic sustenance. This year, with the implementation of NEP 2020, we now have the added responsibility of delivering a curriculum that focuses on both- a sound knowledge base along with higher order skills that will support all round development and vocation of the learner. At the outset, I would like to thank our Principal Dr. Pradnya Prabhu for her guidance and support during the curriculum restructuring process. I am also deeply obliged to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am indebted to my young and vibrant colleagues in the Department of Zoology for their sincere and painstaking efforts during the compilation of the restructured syllabus as per the NEP 2020 guidelines.

Dr. Vikrant Deshmukh
Chairperson
Board of Studies in Zoology

Table of Contents

Preamble

This Learning Outcome-based Curriculum Framework (LOCF) supports the fundamental principle of providing quality education in India. We endeavour to mould young minds to participate, contribute and add value to every milestone in their path towards academic excellence. The introduction of Choice Based Credit System (CBCS) has maximized the benefits of the newly designed curriculum manifold.

The LOCF will assist teachers to envisage the outcome expected from the learners at the end of the programme. It will help them to strategize their teaching effectively. At the same time, this document will guide the students through the new curriculum and help them acquire all the skills and knowledge sets required for their personal and academic growth. Higher education qualifications such as the Master's degree Programme are awarded on the basis of demonstrated achievement of outcomes and academic standards; and this is the very essence of this curriculum.

Education is one of the most critical yardsticks in any country's development. The new National Education Policy (NEP) 2020 is an essential and comprehensive policy framework that aims to revamp the country's educational system from its foundation and to bring it at par with global standards. The larger aim of this policy is to transform the Indian education system by making it more inclusive, flexible and relevant to the changing needs of the society. Some of the key features of this policy are the introduction of vocational training, elective courses, emphasis on cultural studies, development of global skill sets and the promotion of multilingualism.

The policy seeks to bring about significant changes in the Higher Education structure, such as introducing a four-year undergraduate degree Programme,

establishing multidisciplinary education and research universities, pooled credit banks and creating a National research Foundation to promote and support research activities in various fields. The new education policy enables every student to get quality education irrespective of their socio-economic background, gender or disability. NEP 2020 enables teachers to use a variety of learning techniques and experiments.

In the current fast paced world, simply cascading the knowledge in the classroom is not sufficient especially when the global requirements keep changing. Every learner should be encouraged to exchange ideas and thoughts in a collaborative approach. This leads to developing an environment which is cognitive in nature and not a one-way information flow. Keeping all this in mind, the curriculum under Learning Outcome-based Curriculum Framework (LOCF) is designed.

1. Introduction

The B.Sc. Zoology program is developed by keeping in mind the interest of learners to explore the field of Zoology. The flexible framework helps to maintain the ethos of Zoology degree programmes through periodic programme review within a broad framework of agreed/expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. The program is planned in such a way that it allows flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of student's learning levels. Updating teaching, learning pedagogy and outcome-based education form the pillars of the programme.

2. Learning Outcome based Curriculum Framework

LOCF focuses on curriculum framework, curriculum aims, learning targets and objectives. The curriculum framework also provides examples of effective learning, teaching and assessment practices. As the curriculum development is a collaborative and an on-going enhancement process, the LOCF instructs periodic reviews and revisions of the curriculum in accordance with the ever-changing needs of students, teachers and society.

The framework describes how students are given exposure towards core knowledge of the subject, specialisation, choice based learning and other skill enhancement courses ensuring development of an integrated personality and employability. The template defines expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness along with specific learning course outcomes at the starting of each course. The Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. with Zoology will certainly be a valuable document in the arena of outcome-based curriculum design.

2.1 Nature and extent of B.Sc. Zoology

The B.Sc. Zoology programme under NEP is of four years duration with the learner being allowed multiple entry and exit. If the student completes the First Year successfully, he will receive a Certificate in Zoology. If he completes two years and exits, he will receive a Diploma in Zoology. At the end of the third year, he will receive a Degree in Zoology. If he chooses to continue in the subject, he may do a fourth year as an Honours Programme.

Each year is divided into two semesters. The degree program in Zoology is designed to include both classical core topics from basic branches like Taxonomy,

phylogeny, anatomy, physiology, ecology, evolution etc. along with applied branches such as genetics, biotechnology, biostatistics and animal husbandry. The Zoology programme thus strikes a perfect balance between fundamental and contemporary concepts. The scope of each topic varies with the nature of the specific branch. In our endeavour to improve the employability of graduates of the Zoology program, the curriculum offers courses on entrepreneurial skills in Zoology and its allied fields like eco-tourism, wildlife photography, aquaculture and zoo keeping.

2.2 Programme Education Objectives (PEOs)

The overall aims of bachelor's degree program in zoology are to:

1. Elucidate core knowledge and skills in Zoology.

2. Demonstrate innovative attitude and scientific temperament towards wildlife and nature at large.

3. Spread awareness about wildlife and related topics in the society.

4. Employ the knowledge of Zoology to environmental and entrepreneurial domains of society.

5. Display traits of global citizenship, empathy for all life forms and sustainability.

6. Develop a career in zoology and its allied branches.

7. Express their ideas clearly and concisely, both orally and in writing

8. Formulate their thoughts constructively and communicate effectively to people across society to emphasize their views

3. Graduate Attributes in Zoology

Attributes expected from the graduates of B.Sc. Zoology Programme are:

Attributes expected from the graduates of B.Sc. Zoology Programme are:

GA-1. Disciplinary knowledge: A deep understanding of the diversity of animals from the evolutionary, functional, and ecological perspective

GA-2. Scientific reasoning: Developing Skills specific to the study of animals such as making observations, generating and presenting data, experimental design, statistical analysis, writing reports, identifying species, mounting specimens, using microscopes and interpreting classification keys.

GA-3. Analytical reasoning: An appreciation of the uniqueness of Indian biodiversity and wildlife and to develop the ability to analyse, think, plan, execute and review this knowledge.

GA-4. Research-related skills: An awareness of the importance of research to the development of the discipline of Zoology and the curiosity to practice the same.

GA-5. Self-directed learning: An understanding of the gaps or deficits in the current knowledge and an attempt to fill those gaps. Entrepreneurial skills as an offshoot of interaction with several Industry experts and monetize the acquired knowledge.

GA-6. Communication Skills: Expertise in all forms of written, spoken, scientific and presentation skills. Personal skills in written and oral communication, analysis, problem solving and decision making.

GA-7. Leadership readiness/qualities: Curiosity, creativity and the ability to learn and to work both independently and effectively as part of a team. Gain life skills such as team work, leadership, patience as a result of group project participation.

4. Qualification descriptors

Upon successful completion of the programme, students receive a Bachelor's degree in Zoology. B.Sc. Zoology graduates of this department acquire knowledge pertaining to various core and applied branches under Zoology along with the development of Practical skills in this subject. The graduates are expected to demonstrate the extensive knowledge of various concepts in Zoology and their applications. The graduates are thus able to contribute to research and development, teaching, government, and public sectors.

This programme will establish a solid foundation for the student to pursue higher studies in Zoology such as Post Graduation or further research in the subject.
Undergraduate degree programmes of either 3 or 4-year duration, with multiple entry and exit points and re-entry options, with appropriate certifications such as:

- A UG certificate is awarded to students who opt to exit after completing 1 year (2 semesters) of study in the chosen fields of study with having secured 44 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
- A UG diploma is awarded to students who opt to exit after 2 years (4 semesters) of study with having secured 88 credits and in addition, they

complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

- A bachelor's degree is awarded after a 3-year (6 semesters) programme of study in major discipline with having secured 132 credits and minimum credit requirements as follows

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Core Course	48
2	Minor Stream Course	20
3	Discipline Specific Elective Course	06
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	20
10	Open Elective Course	10
Total		132

- A 4-year bachelor's degree (honours) is awarded after eight semesters programme of study with having secured 176 credits and minimum credit requirements as follows:
- If the student completes a rigorous research project in their major area(s) of study in the 4th year of a bachelor's degree (honours with research).

- Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Core Course	76
2	Minor Stream Course	24
3	Discipline Specific Elective Course	14
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	24
10	Open Elective Course	10
Total		176

The 4-year bachelor's degree programme is considered a preferred option since it would provide the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

Upon successful completion of the programme, students receive B.Sc. degree in Zoology. B.Sc. Zoology graduates of this department are expected to demonstrate the extensive knowledge of various concepts of Zoology and its application thus contributing in research, development, teaching, government and public sectors. This programme will establish a foundation for students to further pursue higher studies in Zoology. The list below provides a synoptic overview of possible employment areas provided by an undergraduate training in Zoology.

The list below provides a synoptic overview of possible career paths provided by an undergraduate training in Zoology:

1. Academics
2. Research
3. Eco tourism
4. Pharmaceutical Industry
5. Life science-based Industries
6. Food quality monitoring and packaging technology
7. Environmental monitoring and Analysis
8. Wildlife Photography
9. Wildlife Journalism
10. Animal Behaviour Psychology
11. Medical Laboratory Technology
12. Clinical Research Institutes
13. Entrepreneurship (Apiculture, Aquaculture, Vermiculture, etc.)
14. Government Service

Job Roles for B.Sc. Zoology graduate:

After graduation one can seek a professional career as:

1. Academicians
2. Researchers

3. Forest Officer

4. Eco tourism facilitators

5. Medical Representatives

6. Technicians in Industries/Laboratories

7. Officers/ Managers in Environmental monitoring, Quality Control and Packaging Technology

8. Wildlife Photographers

9. Wildlife Journalists

10. Animal Behaviour Psychologists

11. Entrepreneurs

12. Clinical Researchers

13. Data Analysts

Higher Education options for B.Sc. Zoology graduate:

1. M.Sc. in Zoology [by papers]

2. M.Sc. in Life Sciences

3. M.Sc. in Wildlife and Biodiversity Conservation

4. M.Sc. in Environmental Science

5. M.Sc. in Genetic Engineering

6. M.Sc. in Nutraceuticals

7. Integrated MSc – PhD in above specializations

8. M.Sc. by research in the above specializations

9. MBA in Hospital Management

10. B. Ed/M.Ed.

11. Paramedical Courses – Nursing, Lab Technician etc.

12. DMLT

13. L.L.B/ L.L.M in Wildlife laws, Environmental laws

14. B. Library Science

15. Clinical Research

16. Medical coding

The learners who complete three years of full-time study of an undergraduate programme of study will be awarded a bachelor's degree in Zoology.

5. Programme Specific Outcomes (PSOs)

After the successful completion of modules in different courses of B.Sc. Zoology, the learner will be able to:

PSO I: Identify and classify animals up to phylum and class level.

PSO II: Differentiate between various animal groups, their life processes and roles in nature.

PSO III: Perform practical techniques in Zoology.

PSO IV: Describe animal habitat requirements, behaviour and evolution.

PSO V: Explain biomolecules, anatomy, physiology, cytology, development, diseases of animals, applications of biotechnology and biostatistics.

PSO VI: Analyse the role of genetics and molecular biology in animal breeding, fishery biology, entomology and related research programmes.

PSO VII: Apply classical principles of zoology and environment to real vocations.

PSO VIII: Practise sustainable lifestyle and advocate conservation strategies.

5.1 Course Mapping

Semester	PSO / Course	I	II	III	IV	V	VI	VII	VIII
III	MJ I		√	√		√	√		
	MJ II		√	√		√	√		
	MN I								
	SEC			√		√	√	√	√
	VSC			√		√	√	√	√
	CC								
	OE								
	IKS	√			√			√	√
IV	MJ I	√		√	√	√	√		
	MJ II	√		√	√	√	√		
	MN I								
	SEC					√	√	√	√
	VSC					√	√	√	√
	CC								
	OE								
	FP	√	√	√				√	√

6. Structure of B.Sc. Zoology programme

The curriculum frame work is designed around the choice-based credit system (CBCS). The programme consists of three years UG having six semesters (two semesters per year) or four years UG (Honours) having eight semesters (two semesters per year).

Credit Distribution for Eight Semester is as follows:

Semester	MJ	DSE	SEC	VSC	MN	AEC	VEC	IKS	CC	OE	Total
I	6	-	-	-	6	4	2	-	2	2	22
II	6	-	-	-	6	3	2	1	2	2	22
III	6	-	3	2	4	1	-	1	2	3	22
IV	6	-	3	2	4	-	-	-	4	3	22
V	12	-	-	-	-	-	-	-	10	-	22
VI	12	6	-	4	-	-	-	-	-	-	22
VII	14	4	-	-	RM* 4	-	-	-	-	-	22
VIII	14	4	-	-	-	-	-	-	OJT** 4	-	22

*RM – Research Methodology

**OJT – On job training

To acquire a degree in B.Sc. Zoology a learner must study

1. **Major Core Courses (MJ):**

a) A course which is required to be opted by a candidate as a major core course. The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular subject or discipline.
b) Students may be allowed to change major within the broad discipline at the end of the second semester by giving her/him sufficient time to explore interdisciplinary courses during the first year.
c) There are sixteen Major Core courses (MJ), two each, in semesters I II, III and IV; and four each in semesters V and VI.
d) Each Major Core Courses is compulsory.
e) Each Major Core Course consists of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 1 credit for practical of two hours per week in every semester.
f) The purpose of fixing major core papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standards with other universities/institutions.

2. Minor Stream Course (MN):

a) A course is chosen by a candidate from the interdisciplinary stream as a minor course. Minor Stream courses help a student to gain a broader understanding beyond the major discipline.
b) Students who take a sufficient number of courses in interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline.
c) Students may declare the choice of the minor stream course at the end of the second semester after exploring various courses.
d) There are two each Minor stream course (MN), in semesters I and II. This Minor stream is comprised of 2 credits for theory ie. 30 hours; 2 lectures of

each 1 hr per week and 1 credit for practical of two hours per week in every semester.

e) There is one each Minor stream course (MN) in semester III and IV. This Minor stream is comprised of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 2 credits for practical of four hours per week in every semester.

f) Each Minor stream Courses is compulsory.

3. Ability Enhancement Courses (AEC)

a) The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.

b) Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills.

c) There are five AE courses in spread over three semesters (I to III).

d) Each student is supposed to take two AE in semester I - English language and Modern Indian language of 2 credits each.

e) There are two AE in semester 2 - English language of two credits and Modern Indian language of 1 credit.

f) There is one AE in semester 3 - Modern Indian language of 1 credit.

4. Value Education Courses (VEC)

a) The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes and values required to take appropriate

actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living.

b) The VEC courses offered are:

VEC I- Environmental Science I (2 credits) (Semester I),

VEC II- Environmental Science II (2 credits) (Semester II).

5. Co-Curricular courses (CC):

a) They are designed to provide skill-based knowledge and contain both lab/hands on training/field work.

b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.

c) There are two CC each in semester I to III – NCC (compulsory 1 credit course) and Other one from Music/Sports training program/Yoga/ Study Circle

d) There are three CC each in semester IV – NCC (compulsory 1 credit course), second one from Music/Sports training program/Yoga/ Study Circle of 1 credit and third one is Field project of 2 credits.

e) There are two CC semester V – Internship/ Apprenticeship (8 credit) and Field project (2 credit)

6. Open Elective (OE)

a) They are designed to provide multidisciplinary education.

b) Students can opt for one interdisciplinary Open Elective Course (OE) in each of the semester I and II of two credit each.

c) Students can opt for one interdisciplinary Open Elective Course (OE) in each of the semester III and IV of three credit each.
d) Open courses are offered in cognate disciplines by different departments in the college.

7. Indian Knowledge System (IKS)

a) They are designed to recognizes the rich heritage of ancient and eternal Indian knowledge and thought as a guiding principle.
b) Students can opt for one General IKS in semester II – Indian cultural Heritage of one credit.
c) There is one IKS based on major subject in semester III of 1 credit.

8. Skill Enhancement Course (SEC):

a) They are designed to provide skill-based knowledge pertaining to the Major course to the learner.
b) The main purpose of these courses is to provide life skills in hands on mode to increase employability.
c) There are Two skill enhancement courses offered. Each student is supposed to take one SEC in each semester III and IV of 3 credit each (2 credit theory and 1 credit practical).

9. Discipline Specific Elective Courses (DSE):

a) Elective courses offered under the major course subject of study.
b) There are two discipline specific elective courses (DSE), offered in semesters VI.

c) Each DSE course is of 2 credits theory and 1 credit practical in every semester.

10. Vocational Skill Course (VSC)

a) Vocational courses are designed to provide practical, hands-on training, competencies, and proficiency to students, ultimately enhancing their skills and employability.

b) These courses are tailored to prepare individuals for specific careers and industries.

c) There are two VSC offered, one each in semester III to IV, each one is of two credits.

d) There is one VSC offered in semester VI of 4 credits.

1. On Job Training (OJT)

a) On Job training of 4 credits is offered in semester VIII to enhance the specific skills and competencies required for a particular job

b) OJT bridges the gap between theory and practical application, promoting a deeper understanding of concepts.

2. Internship/ Apprenticeship

a) Internship/ Apprenticeship have a prominent role in linking higher education with the requirements of industry and the world of work. Students are offered internship/ apprenticeship embedded degree program to fulfil the objective of improving employability and forming robust industry academia linkage.

b) Internship/Apprenticeship of 8 credits is offered in semester V.

c) Field based learning /projects should provide opportunities for students to understand the different socio-economic contexts. It aims at giving the students exposure to development related issues in rural and urban settings.

d) Two field projects each 2 credits are offered one in each semester IV and V.

6.1 Course Content

Sr. No	Semester	Course number	Course Code	Course title
1	III	MJ I	24US3ZOMJICBI	Cell Biology
2		MJ II	24US3ZOMJ2BMC	Biomolecules - Proteins, Carbohydrates, Lipids and Nucleic acids
3		MJ P	24US3ZOMJP	Practicals Based on MJ I and MJ II
4		MN	-	Course from Biochemistry/ Physics/ Mathematics/ Microbiology/ Botany/ Chemistry/ Geology
5		MN P	-	Practicals based on Minor course
6		SEC	24US3ZOSECBIT	Biotechnology - Principle and Applications
7		SEC P	24US3ZOSECP	Practicals based on SEC
8		VSC	24US3ZOVSCP	Aquaculture Practices
9		IKS	24US3ZOIKSEZ	Ethnozoology
10		AEC	-	Modern Indian Language
11		CC	-	NCC, SP,FP

12		OE	-	Other stream
13	IV	MJ I	24US4ZOMJIGEC	General Ecology
14		MJ II	24US4ZOMJ2EMB	Embryology
15		MJ P	24US4ZOMJP	Practicals Based on MJ I and MJ II
16		MN I	-	Course from Biochemistry/ Physics/ Mathematics/ Microbiology/ Botany/ Chemistry/ Geology
17		MN P	-	Practicals based on Minor course
18		SEC	24US4ZOSECPAE	Parasitology and Epidemiology
19		SECP	24US4ZOSECP	Practicals based on SEC
20		VSC	24US4ZOVSCP	Economic Entomology
22		AEC	-	-
23		CC	-	-
24		OE	-	Other Stream
25		FP	24US4ZOFP	Field Project

6.2 Credit distribution for B.Sc. Zoology

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
III	MJ I	Cell Biology	2	1	3
	MJ II	Biomolecules - Proteins, Carbohydrates, Lipids and Nucleic acids	2	1	3
	MN	-	2	2	4
	SEC	Biotechnology - Principle and Applications	2	1	3
	VSC	Aquaculture Practices	-	2	2
	AEC	Modern Indian Language	1	-	1
	IKS	Ethnozoology	1	-	1
	CC	NCC/Sports/ others.	2	-	2
	OE	Other stream	3	-	3
	Total				**22**
IV	MJ I	General Ecology	2	1	3
	MJ II	Embryology	2	1	3
	MN	-	2	2	4
	SEC	Parasitology and Epidemiology	2	1	3
	VSC	Economic Entomology	-	2	2
	OE	Other Stream	3	-	3
	CC:NCC, SP:FP	CC + Field Project	2 + 2FP	-	4
	Total				**22**

6.3 Semester Schedule

Semester	Major Core Courses (MJ)	Minor Stream Courses (MN)	Ability Enhancement Courses (AEC)	Value Added Course (VAC)	Skill Enhancement Course (SEC)	Vocational skill Course (VSC)	Indian Knowledge System (IKS)	Co-Curricular Course (CC)	Open Elective (OE)
III	Cell Biology 24US3ZOMJICBI Biomolecules - Proteins, Carbohydrates, Lipids and Nucleic acids 24US3ZOMJ2BMC	MN I Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany / Chemistry/ Geology	Modern Indian Language	-	Biotechnology - Principle and Applications 24US3ZOSECBIT	Aquaculture Practices 24US3ZOVSCP	Ethnozoology 24US3ZOIKSEZ	NCC/ sports/ others	

IV	General Ecology 24US4ZOMJIGEC Embryology 24US4ZOMJ2EMB	I] MN I Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany / Chemistry/ Geology	-	-	Parasitology and Epidemiology 24US4ZOSECPAE	Economic Entomology 24US4ZOVSCP	-	2+2 FP 24US4ZOFP	

7. Detailed B.Sc. Zoology Syllabus

S. Y. B.Sc. Syllabus with effect from the Academic year 2024–2025

Syllabus – S. Y. B.Sc. Zoology

Course No.	Course Title	Course Code	Credits	Periods (1 Hr)	Module	Lectures per module (1 hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER III									
Core courses THEORY									
I	Cell Biology	24US3ZOMJICBI	2	30	2	15	20	30	50
II	Biomolecules - Proteins, Carbohydrates, Lipids and Nucleic acids	24US3ZOMJ2BMC	2	30	2	15	20	30	50
Core courses PRACTICAL									
	MJI+MJ2	24US3ZOMJP	2	60	-	-	CIE		50
Skill Enhancement Course SEC									
SEC	Biotechnology- Principles and Applications	24US3ZOSECBIT	2	30	2	15	20	30	50
Skill Enhancement Course SEC Practical									

SEC P		24US3ZOSECP	1	30	-	-	CIE		25
Vocational Skill Course									
VSC	Aquaculture Practices	24US3ZOVSCP	2	60	-	-	CIE		50
Indian Knowledge System									
IKS	Ethnozoology	24US3ZOIKSEZ	1	15	-	-	CIE		25
SEMESTER IV									
Core courses THEORY									
I	General Ecology	24US4ZOMJIGEC	2	30	2	15	20	30	50
II	Embryology	24US4ZOMJ2EMB	2	30	2	15	20	30	50
Core courses PRACTICAL									
	MJI+MJ2	24US4ZOMJP	2	60			CIA		50
Skill Enhancement Course SEC									
SEC	Parasitology and Epidemiology	24US4ZOSECPAE	2	30	2	15	20	30	50
Skill Enhancement Course SEC Practical									
SEC P		24US4ZOSECP	1	30	-	-	CIE		25
Vocational Skill Course									
VSC	Economic Entomology	24US4ZOVSCP	2	60	-	-	CIE		50
Field Project									

FP		24US4Z OFP	2	60	-	-	CIE	50

ZOOLOGY SEMESTER III
Core Course- I
COURSE TITLE: Cell Biology
COURSE CODE: 24US3ZOMJ1CBI
[CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to - 1. Elaborate on structure, function and disorders related to of Plasma membrane, Endoplasmic reticulum, Ribosomes, Golgi complex, Mitochondria, Lysosomes 2. Differentiate between various staining techniques, stains and microscope used in cell biology 3. Define and elaborate stages of mitosis, meiosis (normal and abnormal) and DNA replication 4. Describe the structure and functions of the nucleus and chromosome		
Module I	**Cell organelles**	**15L**
Learning objectives		

The module is intended to -

1. Introduce learner to various cell organelles and their functions

2. Make learner understand about various diseases related to cell organelles

3. Explain use of microscope and different staining techniques used in study of cell organelles to the learner.

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Elaborate on various cell organelles and their functions
2. Explain the cause of diseases which are related to cell organelles malfunctioning
3. Differentiate between different types of microscope and staining techniques used in cell biology

Subtopic	Title	15L
1.1	Introduction to cell structure: Eukaryotic and prokaryotic cell and structure and functions of - a. Plasma membrane b. Endoplasmic reticulum c. Ribosomes d. Golgi complex e. Mitochondria f. Lysosomes	6L
1.2	Cell organelles disorders: a. Cystic fibrosis b. Materially inherited diabetes and deafness c. Alzheimer's d. Parkinson's e. Congenital sucrase isomaltase deficiency f. Cartilage hair hypoplasia g. Fabry's disease	6L

1.3	Basic study of cell biology using microscope –types of microscopes and their applications. Different stains and staining techniques- a. Gram Staining b. Acid fast staining c. Capsule staining d. Differential staining	3L

Reference

- Cell biology by Gerald Karp 7th edition
- Cell Biology by P.S. Verma and V.K. Agarwal 7th edition
- e book: Biology 2e by Mary Ann Clark, Texas Wesleyan University, Matthew Douglas, Grand Rapids Community College and Jung Choi, Georgia Institute of Technology; OpenStax

Module II	Cell cycle and cell division	15L

Learning objectives

The module is intended to -

1. Explain to the learner the stage (normal and abnormal) in cell cycle, cell division and their significance

2. Familiarise the learner with important elements of the cell such as nucleus, chromosomes and DNA.

3. Make the learner understand the role of microtubular elements and cell poisons during cell division

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Schematically explain normal and abnormal cell cycle, its stages and features

2. Define mitosis and meiosis
3. Describe with labelled diagrams the stages of mitosis and meiosis
4. Explain with diagrams, structure and functions of the nucleus
5. Elaborate on the structure, types and role of chromosomes.
6. Enlist various models of replication.
7. Describe DNA replication in prokaryotes
8. Enumerate enzymes of replication in eukaryotes
9. State the effect of cell poisons on cell division, with examples

Subtopic	Title	15L
2.1	Cell cycle and its significance	2L
2.2	Deviation from normal cell cycle and its effects	1L
2.3	Study of nucleus and chromosomes Detailed structure of nucleus Fine structure of chromosome Types of chromosomes Karyotyping	4L
2.4	Replication of DNA during cell cycle Prokaryotic- Theta model Eukaryotic - Semi conservative Replication	4L
2.5	Study of microtubules	1L
2.6	Cell division: Meiosis and mitosis	3L

References

• Cell and Molecular Biology- DeRobertis 8th Edition

• Cell Biology, Genetics, Molecular Biology, Evolution & Ecology Paperback – 1 by Verma P.S. and Agarwal V.K.

Question paper Template
S.Y. B. Sc. (Zoology) SEMESTER III
Major Course- I
COURSE TITLE: Cell Biology
COURSE CODE: 24US3ZOMJ1CBI
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	10	10	-	-	-	25
II	5	10	10	-	-	-	25
Total marks per objective	10	20	20	-	-	-	50
% Weightage	20	40	40	-	-	-	100

ZOOLOGY SEMESTER III
Core Course- II
COURSE TITLE: Biomolecules - Proteins, Carbohydrates, Lipids and Nucleic acids
COURSE CODE: 24US3ZOMJ2BMC
[CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to - 1. Discuss the bond formation process of monomers and polymers 2. Classify and explain polymerization of proteins, carbohydrates, lipids, and nucleic acids 3. Elaborate on the structure and differences between DNA and RNA 4. Differentiate between different types of DNA and RNA		
Module I	**Study of Proteins and Carbohydrates**	**15L**
Learning objectives The module is intended to - 1. Introduce learner to macro and micro biomolecules		

2. Discuss various types of amino acids and their bond formation
3. Make learner aware of the biological functions of proteins and carbohydrates
4. Enlist different types of carbohydrates, and their biological functions

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Elaborate on different types of amino acids and their polymerization
2. Enlist the biological functions of proteins and their commercial importance
3. Classify different types of carbohydrates and the bond formation
4. Describe the commercial importance of carbohydrates

Subtopic	Title	15L
1.1	Biological macromolecules: Monomeric constituents, polymers, and significance of carbon.	1L
1.2	Proteins 1.2.1 Classification of proteins: Based on structure, function, composition, and solubility 1.2.2 Amino acids: Types based on functional groups. 1.2.3 Peptide bond formation 1.2.4 Properties of proteins 1.2.5 Biological role and commercially important amino acids and proteins	 1L 2L 1L 2L 1L
1.3	Carbohydrates 1.3.1 Structural characteristics and Glycosidic bond formation	1L 2L

	1.3.2 Classification of Carbohydrates: Mono, Oligo, and Polysaccharides 1.3.3 Monosaccharides: Glucose, fructose, galactose Disaccharides: Maltose, Sucrose, Lactose Polysaccharides: Starch, Glycogen, Chitin 1.3.4 Biological role and commercially important carbohydrate	3L 1L

References

- Biochemistry. U. Satyanarayana and U. Chakrapani. 2007. Third edition
- Fundamentals of Biochemistry. J. L Jain., S. Jain., N. Jain. 2007. Sixth edition

Module II	Study of Lipids and Nucleic acids	15L

Learning objectives

The module is intended to -

1. Introduce learner to lipids and nucleic acid structures
2. Discuss various types lipids, bond formation, and biological functions
3. Enlist different types DNA and RNA, and their biological functions

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Elaborate on different types of carbohydrates and their types
2. Enlist the biological functions of carbohydrates and their commercial importance
3. Discuss different types of nucleic acids, structure and function

Subtopic	Title	15L
2.1	Lipids	

	2.1.1 Fatty acids: Structure, types and properties	1L
	2.1.2 Mono-, di- and triglycerides	2L
	2.1.3 Phospholipids and sphingolipids	2L
	2.1.4 Sterols and waxes	1L
	2.1.5 Biological role of lipids and commercially significant lipids	1L
2.2	Nucleic acids-DNA and RNA	
	2.2.1 Chemical structure of nitrogenous bases, pentoses	1L
	2.2.2 Nucleosides and nucleotides	1L
	2.2.3 Polynucleotides: 3' 5' phosphodiester linkage	2L
	2.2.4 Watson - Crick Model of DNA and different forms of DNA	2L
	2.2.5 Types of RNA: m-RNA, t-RNA and r-RNA	1L
	2.2.6 Differences between DNA and RNA	1L

References

- Biochemistry. U. Satyanarayana and U. Chakrapani. 2007. Third edition
- Fundamentals of Biochemistry. J. L Jain., S. Jain., N. Jain. 2007. Sixth edition

Question paper Template
S.Y. B. Sc. (Zoology) SEMESTER III

Major Course- II

COURSE TITLE: Biomolecules - Proteins, Carbohydrates, Lipids and Nucleic acids

COURSE CODE: 24US3ZOMJ2BMC
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	10	10	-	-	-	25
II	5	10	10	-	-	-	25
Total marks per objective	10	20	20	-	-	-	50
% Weightage	20	40	40	-	-	-	100

ZOOLOGY SEMESTER III
Course: SEC
COURSE TITLE: Biotechnology - Principle and Applications
COURSE CODE: 24US3ZOSECBIT
[CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to - 1. Elaborate basic terminologies and achievements with respect to Biotechnology 2. Describe the working and applications of basic instruments used in the biotechnology laboratory. 3. Summarise various tools and techniques used in genetic engineering 4. Enlist various branches and applications of Biotechnology from the medical,food, forensic and enzyme Industry.		
Module I	**Basic Biotechnology**	**15L**
Learning objectives The module is intended to - 1. Recapitulate the history of biotechnology. 2. Emphasize on all the major breakthroughs in biotechnology. 3. Explain the layout of a biotechnology laboratory, basic laboratory practices and		

equipment.

4. Make the learner understand various molecular separation techniques.

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Describe all major milestones in biotechnology
2. Elaborate the branches and applications of Biotechnology
3. Explain the working of various lab instruments and techniques used in biotechnology

Subtopic	Title	15L
1.1	Concept of Biotechnology and an overview of achievements and scope. 1.1.1 History of Biotechnology 1.1.2 Branches of Biotechnology – Green, Blue, White and Red 1.1.3 Recent breakthroughs in biotechnology-CRISPR Cas9	2L
1.2	Fundamentals of laboratory techniques in biotechnology 1.2.1 Design and layout of Biotechnology laboratory 1.2.1 Introduction to basic instruments – Principle, Working and Applications of BOD Incubator, Colony Counter, Magnetic Stirrer, Rotary Shaker and Laminar Air Flow.	5L
1.3	Molecular Separation Techniques: 1.3.1 Chromatography: Paper, Adsorption 1.3.2 Electrophoresis – Agarose and PAGE	2L

1.4	Introduction to r-DNA Technology- Gene manipulation techniques, 1.4.1 Terminologies- host, vector, transgene, chimera, clone, 1.4.2 Steps in gene cloning	1L
1.5	Tools of genetic engineering 1.5.1 Molecular Scissors- restriction enzymes, types, working 1.5.2 Molecular Sutures- DNA ligases 1.5.3 Cloning Vectors- plasmids, phages, cosmids	5L

References

- Textbook of Biotechnology by H.K.Das, 4th Edition. 2010. Publisher - John Wiley
- A textbook of Biotechnology by R.C.Dubey, 5th edition 2014. Publisher - S.Chand
- Biotechnology by U.Satyanarayana, Ist edition.2005, Publisher - Books and Allied Pvt Ltd.
- Biotechnology: Principles and Applications by S.C.Rastogi 2007. Publisher - alpha Science

Module II	Applications Of Biotechnology	15L

Learning objectives

The module is intended to -

1. Explain the methodology involved in creating transgenic animals.
2. Identify applications of biotechnology in various fields such as medical, food, environment and Enzyme industry.

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Define transgenic technology and elaborate on its applications.
2. Interpret cloning and weigh its pros and cons.
3. Explain gene therapy and elaborate its types.
4. Compare between ex vivo and in vivo therapy methods.
5. Identify various food products made using biotechnology principles.
6. Demonstrate enzyme immobilisation in the laboratory.

Subtopic	Title	15L
2.1	Transgenic Animal Technology - Methods of gene transfer 2.1.1 Microinjection 2.1.2 Embryonic Stem cells 2.1.3 Virus mediated transfer	3L
2.2	Gene therapy: Ex vivo and In vitro approach 2.2.1. Gene therapy for SCID (severe combined immune deficiency) 2.2.2 Gene therapy for Cystic fibrosis	3L
2.3	Food Biotechnology 2.3.1 Genetically Modified foods 2.32 Baking Industry- Bread Making 2.3.3 Brewery Industry- Wine making 2.3.4 Dairy Industry- Cheese making	3L
2.4	Forensic Biotechnology 2.4.1 PCR 2.4.2 DNA Fingerprinting	3L

2.5	Enzyme Biotechnology 2.5.1 Economically significant enzymes 2.5.2 Immobilization technology	3L

References

- Textbook of Biotechnology by H.K.Das, 4th Edition. 2010, Publisher - John Wiley
- A textbook of Biotechnology by R.C.Dubey, 5th edition 2014. Publisher - S.Chand
- Biotechnology by U.Satyanarayana, Ist edition.2005 Publisher - Books and Allied Pvt Ltd.
- Biotechnology: Principles and Applications by S.C.Rastogi 2007. Publisher - alpha Science

Question paper Template
S.Y. B. Sc. (Zoology) SEMESTER III
Skill Enhancement Course
COURSE TITLE: Biotechnology - Principle and Applications
COURSE CODE: 24US3ZOSECBIT
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	10	10	-	-	-	25
II	5	10	10	-	-	-	25
Total marks per objective	10	20	20	-	-	-	50
% Weightage	20	40	40	-	-	-	100

ZOOLOGY SEMESTER III
Course- VSC
COURSE TITLE: Aquaculture Practices
COURSE CODE: 24US3ZOVSCP
[CREDITS - 02]

VSC	Aquaculture

After the successful completion of the Course, the learner will be able to:

1. Explain the concept of aquaculture and different types of aquaculture practices in India and various types of fisheries such as molluscan fisheries, crustacean fisheries etc.
2. Summarise important capture fisheries of India with respect to their economic importance and crafts and gears used for fishing.
3. State different strategies involved in successful fin-fisheries, crustacean fisheries and molluscan fisheries system with examples
4. Identify the opportunities of financial independence by fish culturing methods and their products.

Learning objectives

The course is intended to -

1. Introduce the concept of aquaculture.
2. Enlist different types of aquacultures and Illustrate the examples of crafts and gears used in fisheries.
3. Summarise important capture fisheries of India.
4. Interpret different strategies involved in successful fin-fisheries, crustacean fisheries, and molluscan fisheries systems with examples.

5. Promote entrepreneurial skills and develop research aptitude

Learning outcomes:

After the successful completion of the Course, the learner will be able to -

1. Define aquaculture, types, and various aquaculture practices in India.
2. Recall the examples of different crafts and gears used in fisheries.
3. Explain the process of aquaculture systems such as fin-fisheries, crustacean and molluscan fisheries.
4. Conclude the strategies which can be used to enhance aquaculture systems from an economic point of view.

List of Practicals

1. Study of aquaculture and its types (integrated cultures, open cage cultures, pan cultures, freshwater and marine water cultures)
2. Study of Crafts and Gear used for commercial Fishing
3. Study of commercially important fishes and their Identification using keys (Rohu, Tilapia, Catla, Mrigal, Mackerel, Oil Sardine, Bombay Duck, Pomfret)
4. Study of commercially important crabs and their Identification using identification keys (*Scylla serrata, Portunus segnis, Portunus sanguinolentus*)
5. Quantitative Estimation of protein from fish muscle
6. Qualitative and quantitative Estimation of oil from fish muscle
7. Perform Organoleptic tests to determine quality of fish
8. Preparation of fish feeds
9. Problems based on carrying capacity
10. Morphometric studies of aquaculture organisms
11. Detection of ammonia in pond water
12. Determination of soil nitrogen and phosphorous
13. Field visit to aquaculture farms and report writing
14. Detecting ammonia concentration in various ponds (student project)

References

- Aquaculture and Fisheries. N. Arumugam, Saras Publications. Saras Publication. 2014. First edition
- Aquaculture: Farming Aquatic Animals And Plants, Edited by John S Luca and Paul C Southgate. 2013. John Wiley Publications. Third edition
- Aquaculture in India by S.D.Tripathi, W.S.Lakra, N.K.Chadha, 2018. Narendra Publishing House. First edition

Semester III
Major Course Practical
COURSE CODE: 24US3ZOMJP

Course I	Cell Biology

Learning objectives

The module is intended to make the learner -

1. Grasp the concept of osmosis using RBC/Egg./Potato
2. Discuss structure of cell organelles
3. Make learner understand about various diseases related to cell organelles
4. Explain stages of mitosis, meiosis and effect of drug on mitosis
5. Describe the process of mounting of mitochondria, nucleus and inactive X chromosomes.

Learning outcomes:

After the successful completion of the module, the learner will be able to -

1. Demonstrate concept of osmosis using RBC/Egg./Potato
2. Identify various cell organelles from their electron micrograph/ slide pictures/ 3D models
3. Explain various diseases related to cell organelles
4. Prepare slide containing stages of mitosis, meiosis and effect of drug on mitosis
5. Mount mitochondria, nucleus and inactive X chromosome from given sample

List of practicals
1. Study of Osmosis using RBCs/egg/potato 2. Study of ultrastructure of cell organelles using electron micrograph-Mitochondria, Endoplasmic reticulum, Golgi complex, Lysosomes 3. Study of cystic fibrosis, maternal inherited diabetes, blackfan diamond syndrome 4. Study of mitosis using onion/garlic root tip-squash preparation 5. Effect of drug Colchicine on onion root tip mitosis 6. Study of meiosis using onion bud/ tradescantia buds 7. Observation of single nucleus, polymorphonuclear neutrophils, micro and macronucleus in Paramoecium, micro nuclei in liver cells 8. Study of polytene chromosome from Chironomus larva 9. Mitochondria extraction from yeast cells 10. Observation of nucleus and inactivated X-chromosome from buccal cells/ observation of nucleus from onion peel 11. Observation of cell organelles using 3-D model simulation (https://sketchfab.com/tags/organelles)

Course II	Biomolecules – Proteins, Carbohydrates, Lipids and Nucleic acids
Learning objectives The practical is intended to - 1. Introduce the learner to various biochemistry lab experiments 2. Make the learner perform various tests for detection of proteins, carbohydrates and nucleic acids 3. Conduct separation of amino acids, starch and lipids.	
Learning outcomes After the successful completion of the practical, the learner will be able to	

1. Explain functions of macromolecules 2. Estimate qualitative and quantitative estimation of proteins, carbohydrates, lipids 3. Demonstrate kit-based biomolecular analysis
List of Practicals
1. Paper chromatography for separation of amino acids. 2. Qualitative tests for proteins and carbohydrates 3. Quantitative estimation of protein by Folin- Lowry method from different varieties of egg 4. Quantitative estimation of glucose by GOD-POD kit method 5. Extraction and yield estimation of starch from potato 6. Estimation of Triglycerides from vanaspati/ghee by Phosphovanillin method 7. Extraction and qualitative detection of nucleic acids: DNA (SDS-NaCl extraction) 8. Extraction and qualitative detection of nucleic acids: RNA (Phenol extraction)

SEC Practicals
Course Code: 24US3ZOSECP

Title	Biotechnology - Principle and Applications
Learning objectives **The practical is intended to** 1. Develop basic laboratory skills in the learner. 2. Familiarise the learner with instruments in a biotechnology laboratory	

Learning outcomes

After the successful completion of the practical, the learner will be able to:

1. Identify various lab equipments
2. Perform aseptic techniques effectively
3. Separate pigments using chromatography technique
4. Immobilize invertase enzyme in Calcium Alginate beads
5. Demonstrate applications of various enzymes in Industry
6. Analyse the quality of milk based on bacterial load in the given sample.

List of Practicals

1. Introduction to basic laboratory safety practices, precautions, and safety rules.
2. Handling of common laboratory equipment (instrument and glassware): Burner, autoclave, centrifuge, colorimeter, electronic balance, homogenizer, water bath, electrophoresis apparatus.
3. Aseptic techniques:
i) Autoclaving and Packaging of test tubes, pipettes, petri plates, conical flask;
ii) Aseptic transfer of liquids between burners (only demonstration by instructor)
4. Identification with photographs: Methodology for transgenesis –
i) By microinjection into egg
ii) Transgenesis of embryonic stem cell
iii) Methodology for gene therapy for SCID or any human diseases
5. Adsorption chromatography using chalk to separate plants or any other pigments.
6. Preparation of beads of calcium alginate for immobilization using yeast cells and checking the activity of the entrapped cells [invertase assay].
7. To demonstrate fermentation of grape juice/sugar cane juice or any fruit juice by detection of alcohol generated during fermentation by benzoic acid).
8. Effect of Papain (raw papaya extract) as a meat tenderizer.
9. To evaluate the quality of milk by methylene blue reduction method.
10. Visit to Dairy/ Brewery/ Baking Industry and writing a report

ZOOLOGY SEMESTER III
Course- IKS
COURSE TITLE: Ethnozoology
COURSE CODE: 24US3ZOIKSEZ
[CREDITS - 01]

Course learning outcomes
After the successful completion of the Course, the learner will be able to - 1. Discuss interactions between animals and humans in ancient India 2. Illustrate importance of animals in medicine, art, cultural heritage 3. Elaborate on the history of domestication of animals

Module I	Ethnozoology	15L

Learning objectives

The module is intended to -

1. Make the learner aware of the ancient and modern interactions of animals and humans
2. Elaborate on the emphasis of animals in heritage, ritual and culture

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Explain the influence of animals in ancient and modern cultures of India
2. Elucidate the symbolism of animals in civilizations, festivals and folklore

Subunit	Title	15L
1.1	Animals in history - Influence of animals on ancient culture	2L
1.2	Domestication of animals in India - Hints of domestication seen in remains of ancient civilization Animals seen in toys, seals and coins	3L
1.3	Animals seen in Indian heritage - In caves, sculptures, panels In mythology as Vahanas, incarnations, Festivals like Pola, nagpanchami, In tradition for sacrifice, marriage	4L
1.4	Importance of animals in mediaeval Indian art and painting - Study of animal behaviour Emphasis of animals as elements of worship, dominance and war Portrayal of animals in miniature paintings	3L
1.5	Ancient use of animals in medicine Animals in indian folklore- Panchatantra Tales	3L

References

- Mite, Y. 2015. Nyida (Marriage Ceremony) of the Nyishi of Upper Subansiri District, Arunachal Pradesh. THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES.
- Vertebrates used for medicinal purposes by members of the Nyishi https://ethnobiomed.biomedcentral.com/articles/10.1186/1746-4269-7-13
- Ethno Zoological and Socio-cultural Aspects of Monpas of Arunachal - https://www.tandfonline.com/doi/abs/10.1080/09709274.2004.11905701
- Viraj Shah. Rock-cut Caves of Western Deccan
- Bhirud, Rashmi (Sarla) (2023) Animal depictions at Pitalkhora caves in northern Maharashtra, in Animals in Archaeology: Integrating Landscapes, Environment and Humans in South Asia
- The Indians - Histories of Civilizations. G.N. Devi. 2023. Rupa Publications India Pvt Ltd.
- SHIVENDRA B. KADGAONKAR. Migrant Animals of Trade and Commerce: The Two-Humped Camel in Early Indian Art. Bulletin of the Deccan College 56-57 (1996-1997)

ZOOLOGY SEMESTER IV
Core Course- I
COURSE TITLE: General Ecology
COURSE CODE: 24US4ZOMJIGEC
[CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to - 1. Describe the concept of ecology 2. Explain biotic and abiotic factors in ecosystem 3. Identify the type of ecosystem and its functioning 4. Elaborate on different zoogeographical realms and animal interactions		
Module I	**Introduction to Ecology**	**15L**
Learning objectives The module is intended to - 1. Make the learner attain knowledge of different branches of ecology 2. Make the Learner understand the concept of energy flow in relation to food chain 3. Gain knowledge of abiotic factors		
Learning outcomes		

After the successful completion of the module, the learner will be able to -

1. Identify the abiotic factors
2. relate the effects of abiotic factors on animals
3. categorise animals based on food chain and web

Subtopic	Title	15L
1.1	Ecology – definition, branches, composition	2L
1.2	Energy flow in an Ecosystem – energy generation, energy transfer, food chain and web	3L
1.3	Abiotic factors and their effect - Atmosphere, Topography, Light, Temperature, and Precipitation. Soil composition and profile	4L
1.4	Biogeochemical cycles – carbon, oxygen, nitrogen, phosphorus	6L

References

- Gadgil, Madhav and Ramchandra Guha (1995). Ecology and Equity. Penguin Book. 213 pp. ISBN 0-14-025761-6
- Kotpal, R.L. and N.P. Bali (1993). Concepts in Ecology. Vishal Publications, Jalandhar. 264 pp.
- Sharma, P.D. (1994). Ecology and Environment. Rastogi and Rastogi Publication. 519 pp. ISBN 81-7133-183-1
- Verma, P.S. and V.K. Agarwal (1999). Concepts of Ecology. Chand Publications. ISBN 81-219-1681-X. 264 pp.

- Odum, Eugene and Gary Barrett. (2005). Fundamentals of Ecology. Cengage Publications. ISBN 978-81-315-0020-0

Module II	Ecosystems, zoogeography and animal interaction	15L

Learning objectives

The module is intended to -

1. Attain a knowledge of types of ecosystems
2. Gain the knowledge of geographical distribution of various endemic animals and their characteristics
3. Make learner understand animal interactions

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Relate animal to its realm of occurrence
2. Categorise animals based on realms
3. Describe the interaction between animals on field

Module II	Title	15L
2.1	Ecosystem – definition, types – natural and artificial	1L
2.2	Types of natural ecosystems – Aquatic - Marine, estuarine and Freshwater Terrestrial- Forest, grassland, and desert biomes.	5L

2.3	Zoogeography – zoogeographical realms – Palearctic, Nearctic, Neotropical, Ethiopian, Oriental, Australian, Arctic	7L
2.4	Animal interactions – symbiosis, mutualism, commensalism, parasitism, predation, and antibiosis	2L

References

- Gadgil, Madhav and Ramchandra Guha (1995). Ecology and Equity. Penguin Book. 213 pp. ISBN 0-14-025761-6
- Kotpal, R.L. and N.P. Bali (1993). Concepts in Ecology. Vishal Publications, Jalandhar. 264 pp.
- Sharma, P.D. (1994). Ecology and Environment. Rastogi and Rastogi Publication. 519 pp. ISBN 81-7133-183-1
- Verma, P.S. and V.K. Agarwal (1999). Concepts of Ecology. Chand Publications. ISBN 81-219-1681-X. 264 pp.
- Odum, Eugene and Gary Barrett. (2005). Fundamentals of Ecology. Cengage Publications. ISBN 978-81-315-0020-0

Question paper Template
S.Y. B. Sc. (Zoology) SEMESTER IV
Major Course I
COURSE TITLE: General Ecology
COURSE CODE: 24US4ZOMJIGEC
[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	10	5	-	-	25

II	5	10	10	-	-	-	25
Total marks per objective	10	20	20	-	-	-	50
% Weightage	20	20	40	20	-	-	100

ZOOLOGY SEMESTER IV
Core Course- II
COURSE TITLE: Embryology
COURSE CODE: 24US4ZOMJ2EMB
[CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to - 1. Describe concepts of invertebrate and vertebrate embryology such as gametogenesis, fertilisation, cleavage, gastrulation and implantation. 2. Explain mechanism of early embryonic development in frog 3. Discuss developmental stages in chick 4. Compare the mechanism of development in frog and chick		
Module I	Concepts in Embryology	15L
Learning objectives The module is intended to - 1. Make learners understand the concepts of invertebrate and vertebrate embryology		
Learning outcomes		

After the successful completion of the module, the learner will be able to -

1. Describe concepts of invertebrate and vertebrate embryology such as gametogenesis, fertilization, cleavage, gastrulation.
2. Draw and label types of eggs, cleavage, blastula amd morphogenetic movements

Subtopic	Title	15L
1.1	Gametogenesis: Process of Spermatogenesis and oogenesis Structure of gametes significance of meiosis	3L
1.2	Fertilization: Process, types- internal and external, and significance of fertilization, Changes in gametes post fertilization, Blocks to polyspermy	3L
1.3	Types of eggs- Based on position and amount of yolk Egg membranes	2L
1.4	Planes and Patterns of cleavage	2L
1.5	Types of Blastula in different types of eggs	2L
1.6	Gastrulation and three germ layers, Fate maps	3L

References

- Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
- Raven, P. H. andJohnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.
- Carlson,BruceM(1996).Patten'sFoundationsofEmbryology,McGrawHill, Inc.
- Gilbert,S.F.(2006).DevelopmentalBiology,VIIIEdition,SinauerAssociates,Inc.,Publisher s, Sunderland, Massachusetts, USA.

Module II	Frog and Chick Embryology	15L

Learning objectives

The module is intended to -

1. Describe the processes in frog embryo development
2. Explain the learner the mechanism of embryological development in chick upto 72 hours of age

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Describe concepts of invertebrate and vertebrate embryology such as gametogenesis, fertilisation, cleavage, and gastrulation.
2. Explain mechanism of early embryonic development in frog and chick

Subtopic	Title	15L
2.1	Early embryonic development of frog up to gastrulation Cleavage, germ layer formation, neural tube formation	4L
2.2	2.2.1 Chick embryo development upto 72 hours - Cleavage, Blastoderm formation, Axis formation, Hypoblast formation, Epiboly, Primitive streak formation 2.2.2 Comparison of cleavage through gastrulation in frog and chick embryo	4L 1L
2.3	Development of Nervous system Development of Digestive system Development of extra embryonic membrane in chick embryo	2L 2L 2L

References

- Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.

- Raven, P. H. andJohnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.
- Carlson,BruceM(1996).Patten'sFoundationsofEmbryology,McGrawHill, Inc.
- Gilbert,S.F.(2006).DevelopmentalBiology,VIIIEdition,SinauerAssociates,Inc., Publishers, Sunderland, Massachusetts, USA.

Question paper Template
S.Y. B. Sc. (Zoology) SEMESTER IV
Major Course II
COURSE TITLE: Embryology
COURSE CODE: 24US4ZOMJ2EMB

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	10	10	-	-	-	25
II	5	10	10	-	-	-	25
Total marks per objective	10	20	20	-	-	-	50
% Weightage	20	40	40	-	-	-	100

ZOOLOGY SEMESTER IV
COURSE: SEC
COURSE TITLE: Parasitology and Epidemiology
COURSE CODE: 24US4ZOSECPAE
[CREDITS - 02]

Course learning outcomes
After the successful completion of the Course, the learner will be able to - 1. Explain the different terminologies related to Parasitology 2. Discuss the morphology, mode of infection, lifecycle, pathogenicity and control measures of protozoan and helminth parasite. 3. Elaborate on epidemiological triads, route of transmission of disease, Types of disinfectants 4. Describe Diagnosis, Transmission, Prevention, Control measures and treatment of eradicated diseases and communicable diseases

Module I	Parasitology	15L
Learning objectives The module is intended to -		

1. Introduce the concept of parasitology.

2. Explain the difference between protozoan and helminth parasites.

3. Elaborate on morphological stages and life cycle of several protozoan and helminth parasites.

4. Review on the host-parasite relationship.

5. Summarise the mode of transmission, pathogenicity, symptoms, preventive measures and treatment for diseases caused by several protozoan and helminth parasites.

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Define and enlist various parasites and hosts.
2. Distinguish between various types of parasites and hosts.
3. Explain the host-parasite relationship.
4. Classify several protozoan and helminth parasites with examples.
5. Describe morphological stages of various protozoan and helminth parasites.
6. Understand the life cycle of various protozoan and helminth parasites.
7. Discuss the mode of transmission, pathogenicity, symptoms, preventive measures and treatment for diseases caused by several protozoan and helminth parasites

Subtopic	Title	15L
1.1	Types of Parasites and Hosts: Parasites: Ectoparasite, Endoparasite, Monogenetic, Digenetic, Temporary, Permanent, Extracellular parasites, Intracellular, Facultative, Accidental. Types of Hosts: Definitive, Intermediate, paratenic, Reservoir. Host- parasite relationship.	4L
1.2	Study of Protozoan Parasites: Morphology, Mode of Infection, Lifecycle, Pathogenicity, Treatment, Control measures and Economics involved: *Entamoeba histolytica, Plasmodium vivax, Leishmania donovani and Giardia lamblia*	4L

1.3	Morphology, Mode of Infection, Lifecycle, Pathogenicity, Treatment, Control measures and Economics involved: a) Helminthes: Taenia solium, Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti. b) Arthropod: Head louse, Bed bug, Tick and Mite	7L

References

- Parasitology by K. D. Chatterjee, Thirteenth Edition, CBS Publishers and Distributors Pvt Ltd.
- Medical Parasitology by D.R.Arora and Brij Bala Arora, Fifth Edition, CBS Publishers and Distributors Pvt Ltd.
- Paniker's Textbook of Medical Parasitology, revised and edited by Soughata Ghosh, Foreword by Jagdish Chander, Eight Edition, Jaypee Brothers Medical Publishers (P) Ltd
- Textbook of Human Parasitology by Ramnik Sood, CBS Publishers and Distributors Pvt Ltd.
- Mueller, J. F. (1976). Parasitology, Protozoology and Helminthology
- Lilly, A. A., Mehlman, P. T., & Doran, D. (2002). Intestinal parasites in gorillas, chimpanzees, and humans at Mondika research site, Dzanga-Ndoki National Park, Central African Republic. International Journal of Primatology, 23(3), 555-573.
- Human Parasitology Book Fourth Edition 2012 Authors: Burton J. Bogitsh, Clint E. Carter and Thomas N. Oeltmann Gunn Gunn, A., & Pitt, S. J. (2012). Parasitology: an integrated approach. John Wiley & Sons.

Module II	Epidemiology	15L

Learning objectives

The module is intended to -

1. Explain various aspects of diseases their prophylaxis and treatment

Learning outcomes

After the successful completion of the module, the learner will be able to -

1. Explain the scope of epidemiology.

2. Identify symptoms of disease and describe its preventive measures.

Subtopic	Title	15L
2.1	Types of epidemiological studies	2L
2.2	Epidemiology of communicable diseases: common terminology	1L
2.3	Route of transmission, epidemiological triad; stages of diseases; screening for diseases.	3L
2.4	Types of Disinfection, Concurrent, Terminal, Precurrent, Prophylactic Methods of disinfection: natural, physical and chemical.	1L
2.5	Immunization: general measures, health education in India.	1L
2.6	Eradicated diseases: Smallpox, polio, plague.	2L
2.7	Epidemiology of Communicable diseases : Diagnosis, Transmission, Prevention, Control measures and treatment of a) Diseases of Viral Origin: Rabies, Dengue, Swine flu, COVID-19 b) Diseases of bacterial origin: TB, Leprosy, Leptospirosis.	5L

References

- Basic epidemiology by R. Beaglehole, 2nd Edition
- Public health and sanitation for sanitary inspectors and paramedical worker manual by All India Institute of local self-government
- Modern Epidemiology, Kenneth Rothman, 4th Edition

- Gordis Epidemiology, Moyses Szklo, 6th edition

Question paper Template
S.Y. B. Sc. (Zoology) SEMESTER IV

Skill Enhancement Course

COURSE TITLE: Parasitology and Epidemiology

COURSE CODE: 24US4ZOSECPAE

[CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	5	5	5	-	25
II	5	5	5	5	5	-	25
Total marks per objective	10	10	10	10	10	-	50
% Weightage	20	20	20	20	20	-	100

ZOOLOGY SEMESTER IV
Course- VSC
COURSE TITLE: Economic Entomology
COURSE CODE: 24US4ZOVSCP
[CREDITS - 02]

Course : VSC
Learning objectives The practical is intended to : 1. Develop understanding between economic entomology 2. Develop skills to culture beneficial insects, formation of several products that can be commercially used
Learning outcomes After the successful completion of the practical, the learner will be able to: 1. Identify and explain requirements for culture setup for economically beneficial insect 2. Perform culturing techniques for economically beneficial insect 3. Discuss controlling methods for economically harmful insects
List of Practicals 1. Identification of Economically beneficial and harmful insect: a. Beneficial insect: Honey bee, Silkworm and Lac Insect b. Harmful insect: Rice weevil, Locust, Termite and Aphid 2. Study of life cycle of honeybee, silkworm and lac insect

3. Study of external morphology of different castes of honey bee

4. Study of communication in honey bee

5. Study of leg in honeybee

6. Study of pre and post cocooning characteristics of *Bombyx mori*

7. Study of mouth parts of honeybee, silkworm and lac insect

8. The culture business:

   a. Apiculture: structure of artificial beehive, tools used in management of Apiary
   b. Sericulture: Laboratory setup and rearing of worm Lac culture
   c. Lac culture

(Study through model making and poster making)

9. Diseases in bees and their natural enemy

10. Diseases of silkworm

11. Natural enemies of Lac insect

12. Products from honeybee, silkworm and lac insect

13. Understanding Biological and chemical control methods for economically harmful insect (poster making, presentations)

14. Field visit to / workshop on culturing setup for honeybee, silkworm and lac insect and making a report

Semester IV
Major Course Practical

COURSE CODE: 24US4ZOMJP

Course II	General Ecology

Learning objectives

The practical is intended to -

1. Make the learner understand application of ecological studies
2. Expose the learner to various hands-on sampling techniques on field

Learning outcomes

After completing this practical, Learner will be able to -

1. Collect ecological data on field and decide sampling experiment
2. Relate animal to their zoogeographical distribution

1. Rapid field test for sulphate and nitrate content ,base deficiency of soil samples
2. Determination of carbonates in soil by rapid titration
3. Analysis of community by working out ecological indices (frequency/importance probability, rarity, fidelity, constancy, species diversity and Shannon- Weiner Index, Simpson's Index, Margalef's Index, Dominance)
4. Biodiversity sampling by Line transect method
5. Biodiversity sampling by Quadrat method
6. Study of social life of - Honey bee, Termite, Hanuman langur, Asian elephant
7. Study of fauna of different zoogeographic regions:
8. Palaearctic –Giant panda, Japanese snow Monkey
9. Nearctic- Virginia opossum, sea otter, raccoon
10. Neotropical- South American lungfish, lowland tapir/ Brazilian tapir, llama
11. Oriental- flying frog, gharial, flying lizard, Asian elephant, Indian porcupine,
12. Great Indian bustard, one- horned rhino
13. Ethiopian- African lungfish, ostrich, African elephant
14. Australian- duck- billed platypus, spiny ant eater, Australian lungfish, red kangaroo
15. Antarctic- penguins, Minke Whale, Antarctica midge, leopard seal

Suggested field work
1. Field visit for biodiversity sampling in different biomes 2. Recording of campus biodiversity

Course II	Embryology
Learning objectives: The practical is intended to - 1. Make learner understand the structure of various stages of frog embryology 2. Discuss the structure of male and female gametes	
Learning outcomes After completing this practical, Learner will be able to - 1. Identity the age of developing chick embryo 2. Identify different stages of frog embryo	
1. Study of developmental stages of Frog - whole mounts and sections through permanent slides. Cell stage (2,4,8,16) Late cleavage Embryo–(4mm,7mm) Egg (WM) Morula, Blastula, Gastrula, Neurala 2. Study of gametes – frog -sperm and ova through permanent slides or photo micrographs 3. Study of developmental stages of Chick embryo using permanent slides 4. Mounting of chick embryo and identify its age [Demonstration] 5. Comparative Study of invertebrate eggs- from photographs 6. Model making - eggs, cleavage, blastula, gastrula, morphogenetic movement 7. Visit to IVF lab	

Semester IV
SEC Practical
COURSE CODE: 24US4ZOSECP

Course: SEC	Parasitology and Epidemiology

Learning objectives:

The practical is intended to -

1. Discuss the causes and occurrence pattern of disease caused by protozoan, helminth and arthropod parasites

2. Describe the specimen of *Plasmodium vivax, Leishmania, Entamoeba histolytica* in stool sample of infected patient with the help of permanent slide.

3. Elaborate on the life cycle of selected protozoan and helminth parasites.

4. Introduce the concept of epidemiology triad, validity of screening test, and preventive measures of selected diseases.

5. Demonstrate the effect of chemical disinfectant on microorganisms

6. Explain use of BMI

Learning outcomes:

1. Explain various causes and occurrence pattern of disease caused by protozoa, helminth and arthropod parasite
2. Identify of *Plasmodium vivax, Leishmania, Entamoeba histolytica* in stool sample of infected patient
3. Discuss life cycle and parasitic adaptations of selected protozoan and helminth parasites
4. Design the epidemiological triad

5. Compare and contrast the effect of chemical disinfectant on microorganisms
6. Elaborate and measure BMI

1. Survey based on awareness of Diseases caused by protozoan, helminth and arthropod parasites
2. Case study of occurrence pattern of diseases (Flu) (https://pib.gov.in/)
3. Identification of permanent slides/photos of *Plasmodium vivax, Leishmania donovani, Entamoeba histolytica*
4. Study of life cycle of *Entamoeba histolytica, Plasmodium vivax, Leishmania, Giardia*
5. Study life cycle of *Taenia solium, Ancylostoma duodenale, Ascaris lumbricoides , Wuchereria bancrofti and Dracunculus medinensis*
6. Parasitic adaptation in Liver fluke, Pinworm, Guinea worm
7. Study of ectoparasites- Head louse, Bed bug, Tick, Mite
8. Preparation of preventive and control measure posters on epidemiological disease
9. Study and mounting of mosquito as vector
10. Measurement of BMI and its survey
11. Designing of Epidemiological triad from the given data
12. Calculation of validity (sensitivity, specificity and productive accuracy) of screening test
13. Comparison of effect of chemical disinfectant on microorganisms (Comparison of 2 disinfectant or 1 disinfectant)
14. Draft the control and preventive measure to be taken to eradicate the diseases from the region/ state or country by studying the causative agent, mode of infection and symptoms of given disease

8. Teaching learning process

The pedagogic methods adopted, involve direct lectures, tutorial discussions, as well as technology- supported presentations. We believe that education is interactive and all sessions between students and teachers are based upon reciprocity and respect.

I) The lectures (of 1 hr duration) delivered to one whole class at a time systematically deal with the themes of the syllabus. This constitutes the core of the teaching- learning process. The students are provided with bibliographic references and encouraged to go through at least some readings so that they could be more interactive and ask more relevant questions in the class. This also helps obtain knowledge beyond the boundaries of the syllabi.

2) Wherever needed, teachers use audio-video based technology devices (e. g. power point, YouTube videos) to make their presentations more effective. Some courses require that students see a documentary or feature film and course themes are structured so that discussions of these will further nuance the critical engagement of students with ideas introduced in their textual materials.

3) Remedial coaching, bridge courses are adopted to enhance the scope of learning for the learners. Remedial sessions are conducted to offer assistance on certain advanced topics. Bridge courses facilitate the development of a concrete basis for the topics to be learnt in the coming academic year.

.

9. Assessment Methods

- Assessments are divided into two parts: Continuous Internal Examination (CIE) and End Semester Examination (ESE).
- The Continuous Internal Examination shall be conducted by the Department for each semester for 20 M.
- The End Semester Examination shall be conducted by the College at the end of each semester. (30M) Duration: 1 hours
- End Semester Examination Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	5 M x 5 Q = 25 M	5 M x 3 Q = 15 M
2	II	5 M x 5 Q = 25 M	5 M x 3 Q = 15 M

Each question will have six sub questions a, b, c, d, e, f and out of which any three should be answered.

Evaluation pattern: Practical

- Continuous Assessment: a) 50 Marks for Practical 1 and Practical 3 b) 25 Marks for Practical 2 throughout the entire semester.
- Evaluation as per the following rubrics

Major Core Course	CIE/ Journal/ Spots/Quiz	Total	Minimum passing marks
Practical 1 (PI & PII)	50M	50 M	20M

Practical 2 (SEC)	25M	25 M	10M
Practical 3 (VSC)	50M	50M	20M

10. Programme and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicates year of implementation of syllabus (23- year of implementation is 2023-24)
2. Third letter 'U' designates an undergraduate.
3. Fourth letter 'S' designate Science discipline and the digit followed is for semester number (S1 – 1st Semester)
4. Letter 'ZO' is for Zoology discipline (ZO- Zoology). This forms the programme code 23USMB. For the further course codes programme code is amended as follows
5. To represent Major Core Course (MJ) followed by course number digit (1/2/3/4) and three lettered codes representing the title of the course.
6. To represent Minor Stream Course (MN) followed by course number digit (1/2/3/4) and three lettered codes representing the title of the course.
7. For Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'EVS'-Environmental science are used.
8. For Value Added course code, (VA) alphabets followed by a digit (1/2) followed by 'FOC'- Foundation course, 'EVS'-Environmental science are used.
9. For Indian Knowledge System course code, (IK) alphabets followed by a digit (1/2) followed by 'ICH'- Indian Cultural Heritage is used.
10. For Co-curricular course code, (CC) alphabets followed by a digit (1/2).
11. For Open Elective course code, (OE) alphabets followed by a digit (1/2).

12. 'P' followed by digit indicates practical course number. (Practical course number will be added for semesters only where there is more than one course.