SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

Learning Outcomes based Curriculum Framework

(LOCF)

For

F.Y.B.Sc. Zoology [Minor]

Undergraduate Programme

From

Academic year

2023-24

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.

This Learning Outcome-based Curriculum Framework (LOCF) supports the fundamental principle of providing quality education in India. Our focus is to involve young minds to participate, contribute and add value at each stage in the field of their study. The introduction of Choice Based Credit System (CBCS) has maximized the benefits of the newly designed curriculum in multiple folds.

The LOCF will certainly help teachers to envisage the outcome expected from the learners at the end of the programme. For students, it will be a guide which shows how this curriculum will help them acquire all the skills and knowledge which are essential in their personal and academic growth. Higher education qualifications such as Bachelor'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.

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 B.Sc. 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:

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
I	MJ I								
	MJ II								
	MN I	√	√	√					
	MN II	√	√	√					
	AEC I								
	AEC II								
	VEC								
	CC								
	OE								
II	MJ I								
	MJ II								
	MN I			√	√		√	√	
	MN II			√	√		√	√	
	AEC I								
	AEC II								
	VSC								
	IKS								
	CC								
	OE								

6. Structure of B.Sc. Zoology programme

The curriculum framework 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

*RM – Research Methodology

**OJT – On job training

BSc with Honours – 22 credits in Sem VII and VIII

BSc with Research – 22 credits in Sem VII and VIII

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 majors 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 an 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 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.

e) There is one each Minor stream course (MN) in semester III and IV. This Minor stream consists 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 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 semester I and II of two credits each.

c) Students can opt for one interdisciplinary Open Elective Course (OE) in each of semester III and IV of three credits 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 recognize 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 a 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.

6.1 Course Content

Sr. No	Semester	Course number	Course Code	Course title
1	I	MJ I		Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology
2		MJ II		Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology
3		MJ P		Practicals based on MJ I and MJ II
4		MN I	23USIZOMNINCE	Study of Non-Chordates
5		MN II	23USIZOMN2HAC	Hemichordates and Chordates
6		MN P	23USIZOMNP	Practicals based on MN I and MN II

7		AEC I		Communication in English Level I
8		AEC II		Modern Indian Language Level I (Hindi/Marathi)
9		VEC		Environmental Science I
10		CC I		NCC
11		CC II		Music/Yoga/Sports Training Program Level I/ Study Circle
12		OE		Social Media Advertising/ Introduction to microeconomics
13	II	MJ I		Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology
14		MJ II		Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology
15		MJ P		Practicals based on MJ I and MJ II
16		MN I	23US2ZOMN1LPR	Life Processes
17		MN II	23US2ZOMN2GEV	Genetics and Evolution

18		MN P	23US2ZOMNP	Practicals based on MN I and MN II
19		AEC I		Communication in English Level II
20		AEC II		Modern Indian Language Level II (Hindi/Marathi)
21		VEC		Environmental Science - II
22		IKS		Indian Cultural Heritage
23		CC I		NCC
24		CC II		Music/Yoga/Sports Training Program Level I/ Study Circle
25		OE		Indian Finance system and budget/ Brand Management

6.2 Credit distribution for B.Sc. Zoology

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
I	MJ I	Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology	2	1	3

	MJ II	Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology	2	1	3
	MN I	Study of Non-Chordates	2	1	3
	MN II	Hemichordates and Chordates	1	1	3
	AEC I	Communication in English Level I	2		2
	AEC II	Modern Indian Language Level I	2		2
	VEC	Environmental Science I	2		2
	CC I	NCC	1		1
	CC II	Music/Yoga/Sports Training Program Level I/ Study Circle	1		1
	OE	Social media advertising / introduction to microeconomics	2		2
	Total				**22**
II	MJ I	Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology	2	1	3

	MJ II	Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany/ Chemistry/ Geology	2	1	3
	MN I	Life Processes	2	1	3
	MN II	Genetics and Evolution	2	1	3
	AEC I	Communication in English Level II	2		2
	AEC II	Modern Indian Language Level II	1		1
	VEC	Environmental Science - II	2		2
	IKS	Indian Cultural Heritage	1		1
	CC I	NCC	1		1
	CC II	Music/Yoga/Sports Training Program Level I/ Study Circle	1		1
	OE	Indian Finance system and budget/ Brand Management	2		2
	Total				**22**

6.3 Semester Schedule

Semester	Major Core Courses (MJ)	Minor Stream Courses (MN)	Ability Enhancement Courses (AEC)	Value Added Course (VEC)	Indian Knowledge System (IKS)	Co-Curricular Course (CC)	Open Elective (OE)
I	I] MN I Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany / Chemistry/ Geology 2] MN II Course from Biochemistry/ Physics/ Mathe	I]MJI Study of Non-Chordates 2] MJ II Hemichordates and Chordates	I] AEC I Communication in English Level I 2] AE II Modern Indian Language Level I	Environment Science I	-	I] NCC II] Music/ Yoga/ Sports Training Program Level I/ Study Circle	Social Media Advertising/ Introduction to microeconomics

	matics/ Physics/ Microbiology/ Botany / Chemistry/ Geology						
II	I] MN I Course from Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany / Chemistry/ Geology 2] MN II Course from	I] MJ I Life Processes 2] MJ II Genetics and Evolution	I] AE I Communication in English Level II 2] AE II Modern Indian Language Level II	Environment Science II	Indian Cultural Heritage	I] NCC II] Music/ Yoga/ Sports Training Program Level I/ Study Circle	Indian Finance system and budget/ Brand Management

	Biochemistry/ Physics/ Mathematics/ Physics/ Microbiology/ Botany / Chemistry/ Geology						

7. Detailed B.Sc. Zoology Syllabus

F. Y. B.Sc. Syllabus with effect from the Academic year 2023–2024

Syllabus – F. 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 I									
Minor Core courses THEORY									
I	Study of Non-Chordates	23USIZOMNINCE	2	30	2	15	20	30	50
II	Hemichordates and Chordates	23USIZOMN2HAC	2	30	2	15	20	30	50
Core courses PRACTICAL									
		23USIZOMJP	2	60			CIA		50
SEMESTER II									
Minor Core courses THEORY									
I	Life Processes	23US2ZOMNILPR	2	30	2	15	20	30	50
II	Genetics and Evolution	23US2ZOMN2GEV	2	30	2	15	20	30	50
Core courses PRACTICAL									
		23US2ZOMJP	2	60			CIA		50

F.Y. B. Sc. (ZOOLOGY) SEMESTER I
Minor Course- I
COURSE TITLE: Study of Non-Chordates and General Ecology
COURSE CODE: 23USIZOMNINCE
[CREDITS - 02]

Course learning outcomes
After the successful completion of the Course, the learner will be able to - 1. Discuss various levels of organization in the animal kingdom. 2. Classify the given non-chordate up to class level based on its characteristic features. 3. Summarize characteristics and classification of Arthropoda, Mollusca, and Echinodermata 4. Justify various minor phyla as connecting links

Module I	Levels of organization, Protista, Acoelomate and Pseudocoelomate metazoa	[15L]

Learning objectives

The module is intended to -

- Explain the basic concepts in levels of organization.
- Describe and classify kingdom Protista and Acoelomate and Pseudocoelomate metazoa phyla
- Discuss examples of each class.

Learning outcomes

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

- Differentiate between unicellular, multicellular, tissue and organ level of organization.
- Define - acoelomate, pseudocoelomate, coelomate organism and metamerism.
- Enlist the general characteristics of Kingdom Protista
- Describe general characteristics of Phylum Porifera to Acoelomate and Pseudocoelomate metazoa phyla
- Classify the examples of above-mentioned phyla up to class level

Subtopic	Title	Lecture distribution
1.1	**Unicellular organization**	
	1.1.1 Kingdom: Protista, Classification upto phylum level	2L
	1.1.2 Locomotion using Cilia, Flagella and Pseudopodia	1L
	1.1.3 Conjugation in Paramecium	1L
	1.1.4 Pathogenicity of *Plasmodium vivax*	1L
1.2	**Multicellular organization**	
	1.2.1 Colonization level- Phylum Porifera, Classification upto class level, Canal system and Spicules in Sponges.	3L
	1.2.2 Division of labour (tissue grade organization)- Phylum Cnidaria, Classification upto class level	1L
	1.2.3 Polymorphism in Cnidaria, Coral reefs and association with symbiotic algae	1L
1.3	**Triploblastic Organization** 1.3.1 Phylum Ctenophora - Characteristics and evolutionary significance	1L
	1.3.2 Triploblastic acoelomate and pseudocoelomate organization	2L
	1.3.2.1 Acoelomate organization - Phylum Platyhelminthes,	
	1.3.2.2 Pseudocoelomate organization – Phylum Nemathelminthes, Classification upto class level	1L
	1.3.3 Morphological and physiological adaptations for parasitic life.	1L
	1.3.4 Phylum Rotifera - characteristics	

References:

1. Invertebrate Zoology By E.l.jordan & Dr. P.s. Verma, S .CHAND & COMPANY PVT. LTD

2. Zoology, Stephen A. Miller and John P. Harley, Tenth Edition, McGraw Hill Education, 2016.
3. Invertebrates, Richard C. Brusca, Wendy Moore, Stephen M. Shuster, Third Edition, Sinauer Associates, Inc., Publishers USA, 2015.

Module II	Coelomate metazoa- Annelida to Echinodermata	[15L]

Learning objectives

The module is intended to -

- Illustrate the intricacies of classical zoology with respect to higher Non-Chordates and Minor Phylum.
- Describe the characteristics and classes of phylum Annelida, Arthropoda, Mollusca and Echinodermata
- Integrate the adaptive characteristics of animals belonging to minor Phyla.

Learning outcomes

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

- Elaborate the concepts of Classical Zoology.
- Catalog various higher order Non-chordates to their respective Phyla and classes.
- Investigate the reasons for a separate taxonomic group of minor phyla.
- Explain minor phyla as the evolutionary link between the major phyla.

Subtopic	Title	Lecture distribution
2.1	**Triploblastic coelomate organization -** 2.1.1 Phylum Annelida- General characteristics, Classification up to Class level 2.1.2 Reproduction in Earthworm, Heteronereis 2.1.3 Parasitic adaptations in Leech	2L 1L 1L
2.2	**Animals with jointed appendages -** 2.2.1 Phylum Arthropoda-General characteristics, Classification upto Class level	2L 1L

	2.2.2 Metamorphosis in butterfly 2.2.3 Phylum Onychophora - characteristics and evolutionary	1L
2.3	**Animals with mantle -** 2.3.1 Phylum Mollusca-General characteristics, Classification upto class level 2.3.2 Significance of mantle and Foot, 2.3.3 Torsion in Mollusca, Locomotion in Sepia	2L 1L 1L
2.4	**Animals with enterocoel** 2.4.1 Phylum Echinodermata-General characteristics, Classification upto class 2.4.2 Water vascular system in Seastar 2.4.3 Nutrition in Seastar	1L 1L 1L

References:

1. Modern Textbook of Zoology Invertebrates, R.L. Kotpal, 12th Edition, Rastogi Publication, January 2019.
2. Invertebrate Zoology, E.L. Jordan and P.S. Verma, 5th Edition, S. Chand Publication.
3. Invertebrate Zoology, Robert D. Barnes, Seventh Edition, Cengage Publication, January 2006

Question paper Template
F.Y. B. Sc. (Zoology) SEMESTER I

Minor Course- I

COURSE TITLE: Study of Non-Chordates and General Ecology

COURSE CODE: 23USIZOMNINCE
[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

F.Y. B. Sc. (ZOOLOGY) SEMESTER I
Minor Course- II
COURSE TITLE: Hemichordates and Chordates
COURSE CODE 23USIZOMN2HAC
[CREDITS - 02]

Course learning outcomes
After the successful completion of the Course, the learner will be able to - 1. Classify hemichordates, pisces and tetrapods up to order level. 2. Describe unique characteristics of Hemichordates, Protochordates and Vertebrates. 3. Identify the animals at least up to class level

Module I	Study of Phylum Hemichordata to Chordate Superclass Pisces	[15L]

Learning objectives

This module is intended to -

- Identify key features of hemichordata
- Enlist the general characters of chordata
- Classify chordata with reasons
- Explain adaptations of chordata
- Identify examples of each class

Learning outcomes

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

- Enumerate the unique characteristics of Hemichordata
- Discuss unique features of Protochordates, Agnatha, Gnathostomata- Pisces
- Recognize diversity from Hemichordata, Protochordata till Pisces

Subtopic	Title	Lecture distribution
1.1	1.1.1 Natural scheme of animal classification 1.1.2 Basis of classification – symmetry, diploblastic and triploblastic organization, coelom	2L
1.2	Phylum Hemichordata – habit, habitat, characteristics, and classification. Features of tornaria larva	2L
1.3	Phylum Chordata - habit, habitat, characteristics, and classification.	1L
1.4	Subphylum Cephalochordata - habit, habitat, characteristics, and classification. Larva and metamorphosis	2L
1.5	Subphylum Urochordata - habit, habitat, characteristics, and classification. Larva and metamorphosis	2L
1.6	Characteristics of Subphylum Vertebrata	1L
1.7	1.7.1. Division Agnatha – Class Cyclostomata – habit, habitat, characteristics, and classification. 1.7.2.Extant and extinct species. Comparison with Gnathostomata.	2L
1.8	Superclass Pisces 1.8.1. Characteristics of pisces 1.8.2.Class Placodermi 1.8.3. Class Chondrichthyes (Subclass Selachii) 1.8.4. Class Osteichthyes (Subclass Actinopterygii – Chondrostei, Holostei, Teleostei; Subclass Sarcopterygii)	3L
References:		

- Chordate Zoology, E.L.Jordan, P.S. Verma, S. Chand & Company Ltd.
- The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press Third edition, 2006.
- Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar Campus Book International, First edition, 2005.
- The Phylum Chordata: Biology of Vertebrates and their Kin, 1987, H. H. Newman, Distributor Satish book enterprise, Agra.
- A text book of Zoology, 1984, R. D. Vidyarthi, S. Chand and Co., New Delhi.
- Comparative Anatomy of the Vertebrates, G. C. Kent, R. K Carr,9thEdn., 2001, McGraw Hill, Boston, USA.
- https://www.vedantu.com/animal/hemichordate
- https://www.embibe.com/exams/phylum-hemichordata/
- https://ucmp.berkeley.edu/chordata/cephalo.html
- https://www.vedantu.com/animal/cephalochordate
- https://www.encyclopedia.com/plants-and-animals/zoology-and-veterinary-medicine/zoology-general/urochordata
- https://www.notesonzoology.com/phylum-chordata/urochordata-characters-and-its-classification-zoology/3591
- https://www.vedantu.com/biology/cyclostomata
- https://www.faunafondness.com/super-class-pisces/
- https://collegedunia.com/exams/cyclostomata-characteristics-classification-and-examples-science-articleid-3365
- https://byjus.com/biology/pisces/
- https://edurev.in/t/94227/Pisces-Characteristics--Example--Classification-An

Module II	Study of Tetrapoda - Amphibia to Mammalia	[15L]

Learning objectives

This module is intended to -

- Describe basic classification of Tetrapoda up to order level.
- Explain various morphological adaptations evolved in them for better survival.
- Identify examples of each class

Learning outcomes

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

- Summarize the classification of Tetrapoda up to order level.
- Identify various Tetrapoda adaptations
- Compare between various classes of Tetrapoda

Subtopic	Title	Lecture distribution

1.1	Classification of tetrapods	1L
1.2	Class Amphibia – Characteristics and classification of Lissamphibia (Extant amphibians) – Order Gymnophiona, Order Urodela, Order Anura	2L
1.3	Class Reptilia - Characteristics and classification of extant reptilian orders – Order Rhynchocephalia, Order Squamata, Order Chelonia, Order Crocodilia	3L
1.4	Birds as glorified reptiles	1L
1.5	Class Aves – General characteristics	1L
1.6	Class Aves – Selected avian orders - Struthioniformes, Rheiformes, Casuariiformes, Apterygiformes, Passeriformes, Piciformes, Columbiformes, Galliformes, Anseriformes, Ciconiiformes, Falconiformes, Strigiformes	3L
1.7	Class Mammalia – General characteristics	1L
1.8	Class Mammalia – Selected mammalian orders - Monotremata, Marsupialia, Insectivora, Chiroptera, Primates, Rodentia, Legomorpha, Cetacea, Sirenia, Carnivora, Proboscidea, Perrisodactyla, Artiodactyla	3L

References

- Modern textbook of Zoology – Vertebrates; Professor R.L. Kotpal; Rastogi publication; Third Edition 2012.
- Vertebrate Zoology; V. K. Agarwal; S.Chand Publication; 2012.
- Fundamentals of Zoology, Dr. K.C. Ghosh and Dr. B. Manna,New Central book Agency (P) Ltd.
- Chordate Zoology Volume II, Prof. N. Arumogam. Saras Publication.
- Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.

- Chordate Zoology, E.L.Jordan, P.S. Verma, S. Chand & Company Ltd.
- The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press Third edition, 2006.
- Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar Campus Book International, First edition, 2005.
- The Phylum Chordata: Biology of Vertebrates and their Kin, 1987, H. H. Newman, Distributor Satish book enterprise, Agra.
- A text book of Zoology, 1984, R. D. Vidyarthi, S. Chand and Co., New Delhi.
- Comparative Anatomy of the Vertebrates, G. C. Kent, R. K Carr,9thEdn., 2001, McGraw Hill, Boston, USA.
- https://www.faunafondness.com/class-amphibia/
- https://www.rmlscollege.ac.in/wp-content/uploads/2021/07/Classification-of-amphibia.pdf
- https://byjus.com/biology/amphibia/
- http://ppup.ac.in/download/econtent/pdf/SKULL%20TYPES%20IN%20REPTILES.pdf https://byjus.com/biology/reptilia/
- https://surendranathcollege.ac.in/new/upload/MANISH_KANTI_BISWASClassification%20of%20Reptilia2021-01-19Classification%20of%20Reptilia.pdf
- https://www.kngac.ac.in/elearning-portal/ec/admin/contents/4_18KPIZELZ1_20201205083250711.pdf,

Question paper Template
F.Y. B. Sc. (Zoology) SEMESTER I

Minor Course- II

COURSE TITLE: Hemichordates and Chordates

COURSE CODE 23US1ZOMN2HAC

[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

F. Y. B. Sc. (ZOOLOGY) SEMESTER I
Practical
COURSE CODE: 23USIZOMNP1
Credits- 02

Core course I	Study of Non-Chordates and General Ecology

1. Study of Unicellular organization - Amoeba, paramecium, Euglena, Plasmodium, Entamoeba.
2. Study of Metazoa - Types of Zooids in Porifera, Obelia colony, Types of polyp and medusa
3. Study of Acoelomate, Pseudocoelomate and Coelomate organization
4. Study of Types of symmetry, Segmentation and Cephalization
5. Mounting of foraminiferans shells, it's diversity and evolutionary significance
6. Identification of types of Spicules
7. Study of types of Coral reefs and Coral reefs in India
8. Study of life cycle of *Taenia solium* and *Ascaris*
9. Study of types of shells in Mollusca
10. Observation of Digestive, Reproductive system, ink gland, etc of Sepia
11. Study of Social life of wasp / ants / termite
12. Study of Crustacean larvae
13. Study of Echinoderm larvae and their affinities with Chordata

Suggested Field work/Project work- internal assessment

1. Morphometric analysis of molluscan shells
2. Diversity in campus- Spiders/ centipede/ millipede

Core	Hemichordates and Chordates

course II	

1. Identification of invertebrate Phyla - Identification of representatives animals each from Hemichordate, Urochordate and Cephalochordata
2. Identification of Cyclostomes
3. Identification of different subclasses of Pisces
4. Comparison between bony and cartilaginous fish
5. Study of fins in fish
6. Mounting of scales in fish
7. Study of beak in birds
8. Study of feet in birds
9. Study of feathers in birds
10. Comparison between amphibian orders
11. Study of Neoteny in amphibians
12. Comparison between turtle and tortoise
13. Comparison between alligator, crocodile, and gharial
14. Study of venomous and non-venomous snakes
15. Study of snake venom

Suggested field work and Projects

1. Visit To Museum - Assignment submission for internal assessment
2. Campus Trail- Assignment submission for internal assessment
3. Visit to Zoo - Assignment submission for internal assessment

F.Y. B. Sc. (ZOOLOGY) SEMESTER II
Minor Course- I
COURSE TITLE: Life Processes
COURSE CODE: 23US2ZOMNILPR
[CREDITS - 02]

Course learning outcomes		
After the successful completion of the Course, the learner will be able to - 1. Describe the various processes taking place in animals 2. Explain each process in detail with respect to its evolution among animals 3. Elaborate the significance of all the life processes 4. Enlist examples of the various processes taught to them		
Module I	**Nutrition, Respiration and Excretion**	**[15L]**
Learning objectives The module is intended to - • Make the learner aware of the various processes involved in different animals and its significance to life		
Learning outcomes After the successful completion of the module, the learner will be able to - • Define the various life processes like nutrition, respiration and excretion • Explain each process in detail • Compare the processes between different animal groups • Describe the importance of the various life processes.		
Subtopic	**Title**	**Lecture distribution**

1.1	**Nutrition** 1.1.1 Concept of nutrition in animals, types of animals based on nutrition- Autotrophic, heterotrophic,parasitic, saprophytic herbivores, carnivores, omnivores ,sanguivores, 1.1.2 Types of Nutrition- phagocytosis, filter, deposit, fluid, bulk, suction 1.1.3 Stages - ingestion,digestion,absorption, assimilation, egestion 1.1.4 Examples of digestive systems - Cockroach, shark, pigeon, cattle.	1L 1L 1L 2L
1.2	**Respiration** 1.2.1 Introduction to respiration: definition and mechanism 1.2.2 Types of respiratory organs in the animal world- simple diffusion, spiracles, gills, skin, lungs 1.2.3 Concept of cellular Respiration, Aerobic, anaerobic, Significance of the various stages of respiration-glycolysis, TCA cycle, oxidative phosphorylation, ETC 1.2.4 Examples- Amoeba, cockroach, fish, frog, Pigeon, Rat	1L 2L 1L 1L
1.3	**Excretion** 1.3.1 Concept of excretion- metabolic waste, nitrogenous waste 1.3.2 Modes of excretion in the animal world- ammonotelism, uricotelism, ureotelism, guanotelism 1.3.3 Organs of excretion in the animal kingdom- contractile vacuoles, nephridia, malpighian tubule, renal gland, coxal gland, kidney 1.3.4 Examples -Amoeba, cockroach, fish, frog, pigeon, rat	1L 1L 2L 1L
Reference		

1. Chordate Zoology By E.l.jordan & Dr. P.s. Verma, S .CHAND & COMPANY PVT. LTD
2. Zoology For Degree Students , V K Agrawal, S. Chand
3. Invertebrate Zoology By E.l.jordan & Dr. P.s. Verma, S .CHAND & COMPANY PVT. LTD

Module II	Nervous system, Circulation and Reproduction	[15L]

Learning objectives

The module is intended to -

- Make the learner aware of the various processes involved in different animals and its significance to life

Learning outcomes

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

- Define the various life processes like Nervous system, Circulation and Reproduction
- Explain each process in detail
- Compare the processes between different animal groups
- Describe the importance of the various life processes.

Subtopic	Title	Lecture distribution
2.1	**Nervous system** 2.1.1 Nervous System- Definition, and Types of nervous system : Central Nervous System and peripheral nervous system. 2.1.2 Components of the nervous System: Brain, Spinal cord, Neuron and its types, ganglion 2.1.3 Types Of Nerves: Sensory Nerve, motor nerve, mixed neuron and autonomic nervous system 2.1.4 Reflex action and reflex arc, voluntary and involuntary	1L 1L 1L

	response, working of synapse 2.1.5 Nervous System of Earthworm and Shark	 1L 1L
2.2	**Circulation** 2.2.1 Concept of circulation, circulatory fluids- water, hemolymph, blood and lymph. Functions of Circulatory system 2.2.2 Components of circulatory systems: heart, blood vessels: arteries, veins and capillaries 2.2.3 Types of Circulation- Single, double, Open and Closed 2.2.4 Types of heart- Neurogenic and myogenic heart, Structure of heart in Cockroach, shark, frog, crocodile, pigeon, rat	1L 1L 1L 2L
2.3	**reproduction** 2.3.1 Modes of Reproduction : Asexual and Sexual and its significance. 2.3.2 Asexual Reproduction - Binary Fission, Multiple Fission, Budding, Fragmentation, Regeneration and Parthenogenesis. 2.3.3 Sexual Reproduction - Reproductive Organs and their Functions 2.3.4 Process of Fertilization and its Types- Internal Fertilization and External Fertilization.	1L 1L 1L 2L

References:

1. Textbook of Animal Physiology by Dr. P. B REDDY.
2. Essentials of Animal Physiology by S. C. Rastogi.
3. Animal physiology by Dr. P. S. Verma and V. K. Agarwal

Question paper Template
F.Y. B. Sc. (Zoology) SEMESTER II

Minor Course- I

COURSE TITLE: Life Processes

COURSE CODE: 23US2ZOMNILPR
[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

F.Y. B. Sc. (ZOOLOGY) SEMESTER II
Minor Course- II
COURSE TITLE: Genetics and Evolution
COURSE CODE:23US2ZOMN2GEV
[CREDITS - 02]

Course learning outcomes
After the successful completion of the Course, the learner will be able to 1. Demonstrate basic concepts of genetics and Mendelian laws using crosses and examples 2. Recall Non-Mendelian inheritance and its types with examples. 3. Describe epistasis, lethal genes and cytoplasmic inheritance with examples 4. Elaborate the role of genetic counselor 5. recall the experiments based on origin of life 6. Discuss different evidence of evolution, significant concepts in evolution, evolutionary theories and stages of Horse, Elephant and Human evolution 7. analyze phylogenetic tree for given species

Module I	Genetics	[15L]

Learning objectives

The module is intended to -

- explain the concepts Mendelian and non Mendelian genetics and its application in day to day to day life

Learning outcomes

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

- Define basic Terminologies in genetics
- Demonstrate Mendelian laws of inheritance using different types of crosses

- Identify the type of epistasis
- Explain the concepts of lethal gene and extranuclear inheritance

Subtopic	Title	Lecture distribution
1.1	Introduction: Basic terminologies in genetics, Concept of Gene, Genotype, Phenotype, Allele, Dominant, Recessive	1L
1.2	Mendelian Genetics: 1.2.1 Mendel's Laws of inheritance of characters 1.2.2 Monohybrid and Dihybrid cross, Test Cross	3 L
1.3	Deviation from Mendel's laws of inheritance 1.3.1 Incomplete dominance, co- dominance 1.3.2 Gene Interaction- Epistasis: recessive, dominant, double recessive and double dominant epistasis	3L
1.4	Lethal genes and types 1.4.1 Dominant lethal genes 1.4.2 Recessive lethal genes 1.4.3 Conditional lethal genes 1.4.4 Gametic lethal genes	3L
1.5	Extranuclear inheritance 1.5.1 Cytoplasmic inheritance: Kappa particles in Paramoecium. 1.5.2 Maternal inheritance- shell coiling in Limnaea	3L
1.6	Applications of Genetics: Role of Genetic Counsellor	2L

Reference:

1. Genetics, Verma P. S. and Agarwal V. K., S. Chand and Co., New Delhi.

2. Genetics, fourth edition, Veer Bala Rastogi, Medtech, India.
3. Genetics, 2014, 4th rev Edn., 3rd reprint, Gupta P. K., Rastogi Publications, Meerut.
4. Fundamentals of Genetics, fourth edition, B.D Singh.
5. Genetics, 2004, Ist Edn. Sarin, C., Tata McGraw Hill, New Delhi.
6. Principles of Genetics, 2006, 8th Edn., Gardner E. J., Simmons M. J. and Snustad D. P., Wiley India Pvt Ltd.
7. Genetics, 1985, 3rd revised Edn., Strickberger M. W., Macmillan USA.

Module II	Evolution	[15L]

Learning objectives

This module is intended to

- To make learners understand basic concepts, theories and applications of evolutionary biology

2.1	2.1.1 Origin of life: Miller- Urey Experiment, Oparin Haldane concept, 2.1.2 Spontaneous origin of life and experiments that disproved it: Francesco Redi's Experiment and Louis Pasteur's Experiment, 2.1.3 Big bang theory 2.1.4 Evidence of Organic Evolution i)Morphological and Anatomical Evidence- Homologous and Analogous organs, connecting links and vestigial organs ii) Palaeontological Evidence: Fossils, Types of Fossils, Process of Fossilization	1L 1L 1L 2L

2.2	2.2.1 Theories of evolution -	
	2.2.1.1 Darwin's theory of origin of life	1L
	2.2.1.2 Lamarck's theory of inheritance of Acquired characters	1L
	2.2.1.3 Hugo de Vries theory of Mutation	
	2.2.1.4 The theory of Modern synthesis	1L
	2.2.2 Elemental forces of evolution - Variation, Mutation, Migration, Selection, genetic drift	1L 2L
	2.2.3 Types of Natural selection	
	2.2.4 Characteristics of a Species, Speciation, types. Of speciation - Sympatric and allopatric, types of reproductive barrier and isolation	1L 1L
	2.2.5 Continental drift and its implications on evolution	
	2.2.6 Phylogenetic tree - Clade, branch, node, rooted and unrooted tree, monophyletic, paraphyletic and polyphyletic groups	1L 1L

References:

1. Strickberger's Evolution by Monroe W. Strickberger (Author), Brian K. Hall (Author), Benedikt Hallgrimsson (Author), Publisher - Jones & Bartlett; 4th edition (6 December 2007).
2. Textbook of Biodiversity, KV Krishnamurthy, Science Publishers, USA, 2010

Question paper Template

F.Y. B. Sc. (Zoology) SEMESTER II

Minor Course- II

COURSE TITLE: Genetics and Evolution

COURSE CODE:23US2ZOMN2GEV

[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

F. Y. B. Sc. (ZOOLOGY) SEMESTER II
Practical
COURSE CODE:23US2ZOMJP1
Credits- 02

Core course I	Life Processes

1. Effect of pH on activity of enzyme amylase
2. Detection of constituents of urine - normal and abnormal
3. Detection of Ammonia as excretory product of fish
4. Detection of Uric Acid from bird excreta
5. Study of Blood Pressure
6. Study of Electrocardiogram (ECG)
7. Study of T.S of Spinal cord
8. Study of blood smear- frog and human
9. Modes of Reproduction in Protista and their significance
10. Study of systems in Earthworm - Digestive, Reproductive, Nervous and Excretory.

Core course II	Genetics and Evolution

1. Problems based on Pedigree analysis
2. Problems in genetics based on Mendelian Inheritance
3. Problems based on epistasis
4. Evidence of evolution - analogy, homology, connecting links
5. Identification of fossils
6. Geological timescale and events of mass extinction
7. Carbon dating and its applications
8. Interpretation of Phylogenetic tree

9	Study of genetic drift

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

Evaluation Pattern: Theory

- Assessments are divided into two parts: Mid Semester Examination (MSE) and End Semester Examination (ESE).
- The Mid Semester Examination shall be conducted by the College at the Mid of each semester (20 M) – Duration: 30 Min.
- 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	3 M x 5 Q = 15 M
2	II	5 M x 5 Q = 25 M	3 M x 5 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 for 50 Marks throughout the entire semester.
- 50 Marks Evaluation as per the following rubrics

Major Core Course	CIE	Experimental Report	Viva	Total
MJ I	15 M	5 M	5 M	25 M
MJ I	15 M	5 M	5 M	25 M

10. Programme and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicate the year of implementation of syllabus (23- year of implementation is 2023-24).
2. Third letter 'U' designates undergraduate.
3. Fourth letter 'S' designates Science discipline and the digit following it is for semester number (S1 – Ist 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 code 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 code representing the title of the course.
7. For Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'EVS'-Environmental science are used.
8. For Value Education Course code, (VA) alphabets followed by a digit (1/2) followed by '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).