

Punyashlok Ahilyadevi Holkar Solapur University, Solapur



Name of the Faculty: Science & Technology

New Education Policy 2020

Syllabus: Zoology

Name of the Course: M. Sc. I (Sem.– I & II)

(Syllabus to be implemented from June 2023)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur Structure of two year PG Program (M.Sc.) Degree

Framed according to

■ शासन निर्णय, उच्च व तंत्र शिक्षण विभाग, क्रमांक एनईपी-२०२२/प्र. क्र. ०९/विशि-३/शिकाना ,दिनांक२०/०४/२०२३
■ शासन निर्णय क्रमांक: एनईपी-२०२२ /प्र.क्र.०९ / विशि-३ /शिकाना, मंत्रालय, मंबई ४०० ०३२ , दिनांक: १६ मे, २०२३

~ About National Education Policy (NEP) – 2020 ~

With the directions and guidelines issued by **Government of Maharashtra resolution dated 20th April 2023 and 16th May, 2023** regarding the implementation of NEP at UG and PG level, thePunyashlokAhilyadevi Holkar Solapur University, Solapur has taken decision to implement NEP 2020 with Choice Based Credit System (CBCS) at Undergraduate level and Post Graduate level. This has been done to achieve the goals and objectives set in NEP-2020 such as- worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing undergraduate and post-graduate degree.

The CBCS provides an opportunity for the students to select from the prescribed courses comprising core, elective/minor or skill based. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations.

Outline of NEP:

The structure of the Three/Four-year bachelor's degree programme allows the opportunity to the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning in different institutions. The structure allows students to learn various components like:

(a) Major (Core) Subject (DSC): This comprises of Mandatory and Elective Courses that require students to achieve:

- Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses are offered in all four years;
- 2 credit course on Major Specific IKS shall be included under Major;
- Elective courses of Major will be offered in the third and/or final year;

- Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects are related to Major

(b) Minor Subject (18-20 Credits)

- The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether;
- The credits of Minor subjects shall be completed in the first three years of UG Programme

(c) Generic/ Open Elective Courses (OE) (10-12 credits)

- GE/OE are to be offered in I and/or II year;
- Faculty-wise baskets of OE shall be prepared by Autonomous College.
- OE/GE is to be chosen compulsorily from faculty other than that of the Major or as per the directions issued by NEP-Steering Committee

(d) Vocational and Skill Enhancement Courses (VSEC)

i) Vocational Skill Courses (VSC): (8-10 credits): Includes Hands on Training corresponding to the Major and/or Minor Subjects:

- To be offered in first three years;
- Wherever applicable vocational courses will include skills based on advanced laboratory practicals' of Major

ii) Skill Enhancement Courses (SEC): (06 credits)

- To be offered in I and II year;
- To be selected from the basket of Skill Courses approved by Autonomous College

(e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): (14 Credits)

i) AEC: (08 credits)

- To be offered in I and II year
- English: 04 Credits
- Modern Indian Language: 04 credits
- To be offered from the Basket approved by Autonomous College;

The focus for both languages should be on linguistic and communication skills.

ii) IKS: (2 Credits)

- To be offered in I Year
- Courses on IKS to be selected from the basket of IKS courses approved by Autonomous College

iii) VEC: 04 Credits

- To be offered in I year
- Value Education Courses (VEC) such as Understanding India, Environmental Science/Education, and

Digital and Technological Solutions.

(f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

- Internship/Apprenticeship corresponding to the Major (Core) Subject: (8 Credits)
- Field Projects/Community Engagement and Service (CEP) corresponding to the Major (Core) Subject (minimum 4-6 credits)

-To be offered in II and III years of UG Degree Programmes.

- Co-curricular Courses (CC) such as Health and Wellness, Yoga education, sports and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts: (8 credits)

-To be offered in I and/or II year

- Research Projects: (12 credits)

-To be offered in the final year for 4 year Honours with Research UG Degree

- **CREDIT:**

- Credit is a numerical value that indicates students work load (Contact Hours, Lab work, Seminar, Tutorials, Field work etc.) to complete a course unit. The contact hours are transformed into credits. Moreover, the grading system of evaluation is introduced for B.Sc. course wherein process of Continuous Internal Evaluation is ensured.

- **Theory:** ‘15 contact hours’ for theory course constitute ‘one credit’

- **Practical/Tutorial:** ‘30 contact hours’ for practical course constitute ‘one credit’.

- **Workshop based activities/Skill based activities:** Minimum 30 contact hours per credit in a semester is required

- **Internship/On-Job Training:** ‘30 contact hours’ per credit in a semester is required (1 credit/week)

- **Community Engagement and Service-CEP/Field Project:**‘30 contact hours’ per credit in a semester is required

- **Credit Framework under Three/Four Years UG Programme with Multiple Entry and Multiple Exit Options:**

The minimum and maximum credit structure for different levels under three or four year UG programme with multiple entry and multiple exit options are as given below:

Levels	Code	Qualification Titles	Credit Requirements		Semester	Year
			Minimum	Maximum		
4.5	100-199	UG Certificate	40	44	2	1
5.0	200-299	UG Diploma	80	88	4	2

5.5	300-399	Three Year Bachelor's Degree	120	132	6	3
6.0	400-499	Bachelor's Degree Honours OR Bachelor's Degree-Honours with Research	160	176	8	4
	500-599	First Year PG & or PG Diploma	40	44	2	1
6.5	600-699	PG Degree	80	88	4	2
8.0	700-799	Ph.D.	16+ Ph.D. Work		---	---

2. CHOICE BASED CREDIT SYSTEM (CBCS):

Each course carries a defined number of credits. The credits are based on the course structure, including the teaching mode and the number of contact hours for lecture, tutorial, and practical classes. One hour of theory/tutorial teaching per week equals one credit, and two hours of laboratory/demonstration classes per week equals one credit. Credits are considered based on the number of contact hours, course content, teaching methodology, allotted maximum marks.

While calculating the grading, one credit is equal to 25 marks in a semester. Thus, 4 credit courses will receive 100 marks, 2 credit courses will receive 50 marks, and a single credit course will receive 25 marks. The proportion of marks earned in a course and the credits given to that course will be used to calculate the Semester Grade Point Average (SGPA) or Cumulative Grade Point Average (CGPA).

General Education credit refers to a unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching [lecture or tutorial] or two hours of practical work/field work per week. Accordingly, one Credit would mean equivalent to 15 hrs' of theory or **30 hrs' of workshop/lab/Internship/OJT/FP/CEP/CC work per semester**. For the ease of calculation, the break-up of credits with respect to general education component is as in the table below:

Table 1: Break-Up of Credits and contact hours per credit is as follows

Sr. No.	One Credit	Number of Contact Hours
1	Theory	15 Contact Hours
2	Practical	30 Contact Hours
3	Experiential learning including relevant experience and professional levels acquired	30 Contact Hours

3. DEFINITIONS OF KEYWORDS:

- a) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
- b) **Choice Based Credit System (CBCS):** The CBCS will provides options for students to select courses from the prescribed courses (core, open elective, discipline elective, ability and skill enhancement language, soft skill courses and so on).
- c) **Course:** Usually referred to as ‘papers’ is a component of a programme. All courses need not carry the same weight. The courses will define learning objectives and learning outcomes. A course will be designed to comprise Contact Hours / tutorials / laboratory work / field work / project work / vocational training / viva / seminars / term papers / assignments/ presentations / self-study or a combination of some of these.
- d) **Credit-Based Semester System (CBSS):** Under the CBSS, the requirement for awarding a degree /diploma /certificate is prescribed in terms of the number of credits to be earned.
- e) **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. One credit is equivalent to one hour of lecture or tutorial or two hours of practical work/field work per week in a semester. It will generally be equal to 15 hours of instructions.
- f) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.
- g) **Credit Point:** It is the product of grade points and the number of credits for a course.
- h) **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, D and F.
- i) **Programme:** A programme leading to the award of a degree, diploma, or Certificate.
- j) **Semester:** Each semester will consist of over 15 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be generally scheduled from June to November and even semester from January to May.
- k) **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is the ratio of total credit points secured by a student in various courses registered in a semester and the full course credits taken during that semester. It shall be expressed up to two decimal places.
- l) **Cumulative Grade Point Average (CGPA):** It measures the overall cumulative performance of a student over all the semesters of a programme. The CGPA is the ratio of total credit points secured by a student in various courses in all the semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

m) **Transcript or Grade Card or Certificate:** Based on the grades earned, a graded certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured).

4. Eligibility Criteria:

A candidate should have bachelor's degree in Zoology/Life Sciences/Equivalent subjects (three years course after 10+2) from the recognised university

5. Examination and Evaluation:

As suggested in NEP 2020, continuous internal evaluation is proposed. Total evaluation proposed is **80:20** ratio for external: internal evaluation. There will be no internal evaluation for lab courses (Excluding project/dissertation).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Structure of Post Graduate Degree: M.Sc. Zoology:w.e.f. 2023-24

Level	Sem	Major		Minor	OE	SEC / VSC	AEC/IKS / CEC	RP/CC/ Internship /Apprenticeship/CEP/	Credits	Cum. Credits
		Mandatory	Elective							
6.0/400	I	DSC-1 Biosystematics (4Cr') & Practical-I (2Cr')	DSE-1 Techniques in Biology (4Cr') & Practical-I (2Cr')	Research Methodology (4 Cr')	---	---	---		---	44 PG Diploma in Discipline
		DSC-2 Cell and Molecular Biology (4Cr') & Practical-II (2Cr')	OR DSE-1 Economic Entomology (4Cr') & Practical-I (2Cr')	---	---	---	---		---	
	II	DSC-3 Embryology (4Cr') & Practical-III (2Cr')	DSE-2 Fishery Science (4Cr') & Practical-II (2Cr')	---	---	---	---	OJT/ In-house Project/ Internship/Apprenticeship (4 Cr')	---	
		DSC-4 Animal Physiology (4Cr') & Practical-IV (2Cr')	OR DSE-2 Applied Parasitology (4Cr') & Practical-II (2Cr')	---	---	---	---		---	
	Total 1 st Year	24	12	04	---	---	---	04	44	
Exit Option: Award of PG Diploma in Discipline with 44 Credits or Continue with Discipline										

Abbreviations:

Generic/ Open Electives:	OE
Vocational Skill and Skill Enhancement Courses:	VSEC
Vocational Skill Courses:	VSC
Skill Enhancement Courses:	SEC
Ability Enhancement Courses:	AEC
Indian Knowledge System:	IKS
Value Education Courses:	VEC
On Job Training: Internship/ Apprenticeship:	OJT
Field projects:	FP
Co-curricular Courses:	CC
Community Engagement & Service:	CEP
Research Methodology:	RM
Research Project:	RP

SEMESTER-I

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSC-I: Biosystematics (Theory)

CREDIT: 04

MARKS: 100

CONTACT HOURS: 60

Unit No.	Title	Contact Hours
Unit- I	Definition and Basic Concept of Biosystematics and Taxonomy	(15)
	<ul style="list-style-type: none"> • Historical resume of systematic • Importance and applications of biosystematics in biology • International Code/Commission of Zoological Nomenclature (ICZN) 	
Unit- II	Trends in Biosystematics & Molecular Phylogenetics	(15)
	<ul style="list-style-type: none"> • Chemotaxonomy, Cytotaxonomy, Molecular taxonomy • Construction of phylogenetic trees: Introduction to distance method, Parsimony methods, Maximum likelihood methods • Phylogeny based on amino acid sequence and nucleic acid sequence 	
Unit- III	Dimensions of speciation and taxonomic characters	(15)
	<ul style="list-style-type: none"> • Mechanism of speciation in panmictic and apomictic species • Species concepts – category, different concepts, sub-species and other intra-specific categories • Theories of biological classification, hierarchy of categories • Taxonomic characters – different kinds, origin of reproductive isolation, biological mechanism, genetic incompatibility 	
Unit- IV	Procedures and keys in taxonomy	(15)
	<ul style="list-style-type: none"> • Taxonomic collection, preservation and curation process of identification. • Taxonomic keys- Introduction to dichotomous keys with example from insecta, recent developments in taxonomy (use of Bar Coding) • Systematic publications- different kinds of publications (reviews, revisions, monographs, short notes, new species, checklists etc.) • Process of typification of different zoological types (holotype, syntype, paratype, lectotype, neotype etc.) 	

Course Objectives:

- a) To classify organisms based on evolution
- b) To establish the phylogeny
- c) To evaluate the significance of diversity represented on Earth

Learning Outcomes: After successfully completing this course, the students will be able to:

- Collect, analyze and preserve the specimens for taxonomic studies.
- Use different equipments and traps for collection of sample from the field.
- Develop understanding on the diversity of life with regard to protists, non-chordates and chordates.
- Group animals on the basis of their morphological characteristics/ structures.
- Construct the taxonomic keys by observing morphological characters of animals
- Analyze the specimens and identify them by using new techniques used in modern taxonomy
- Develop critical understanding on how animals changed from primitive cell to a complex multicellular forms
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.
- Write scientific reports as required in the field of biosystematics.

Suggested Reading Material:

- Keto, M: The Biology of Diversity.
- Avise, J. C.:Molecular markers. Natural History and Evolution, Chapman and Hall, New York.
- Wilson, E. O.: Biodiversity, Academic Press, Washington.
- Simpson, G. G.: Principles of Animal Taxonomy, Oxford IBH Publishing Company.
- Mayer, E.: Elements of Taxonomy.
- Wilson, E.O.: The Diversity of Life. W. W. Northern and Company.
- Tikedar, B. K.: Threatened Animals of India, ZSI Publication, Calcutta.
- Mayer, E. : Principles of Systematic Zoology, M. Hill Publication.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSC-I: Practical-I: Biosystematics

CREDIT:02

MARKS :50

Sr. No.	Title of the Practicals'
1.	Collecting insect samples by using light traps / pit fall traps /Malaise trap/ Berlese Funnel
2.	Preservation of insect samples for taxonomic / systematic studies
3.	Construction of dichotomous keys by using museum specimens/insect specimens
4.	Calculation of diversity indices using zooplankton populations from fresh water resources.
5.	Statistical analysis of point of bird surveys
6.	Preparation and examination of protozoans from given samples
7.	Study of museum specimens: Invertebrates and vertebrate (30 specimens each)
8.	Study of types of invertebrate larvae -peculiarities and evolutionary significance
9.	Study of Reptilian Skulls with reference to evolutionary significance (with available samples from laboratory and using models/pictures)
10.	Submission of report based on visit to ZSI/ Sea shore/National Institute/Wild life Sanctuary/National Parks/water reservoirs.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSC-II: Cell and Molecular Biology (Theory)

CREDIT:04

MARKS:100

CONTACT HOURS: 60

Unit No.	Title	Contact Hours
Unit- I	Cellular membranes	15
	<ul style="list-style-type: none"> • Molecular composition, arrangement and function. • Dynamic nature of plasma membrane: Transport across the cell membrane- Passive and active transport, pumps, imports, symports and antiport. Transport across epithelia. • Membrane potential and nerve impulse. • Integrins and collagens. • Cell matrix and cell matrix adhesion. 	
Unit- II	Structural organization and function of intracellular organelles	15
	<ul style="list-style-type: none"> • Nucleus, Mitochondria, Endomembrane system and Lysosomes (Origin, ultrastructure and functions) • Microfilaments and microtubules- structure and dynamics • Cilia, Flagella- structure and dynamics • Microtubular organizing centres: centriole, kinetochore, basal bodies • Intermediate filaments: structure and function. Actin- binding proteins • Cell movement and cytoskeleton 	
Unit- III	Cellular organelles and Membrane trafficking	15
	<ul style="list-style-type: none"> • Endoplasmic reticulum, Golgi bodies: structure and function • Protein synthesis on free and bound polysomes • Membrane proteins and other proteins in ER with suitable examples • Post-translational modifications and protein sorting in Golgi apparatus. • Lysosomes types and functions • Biogenesis of mitochondria 	
Unit- IV	The Cell cycle and cell signaling	15
	<ul style="list-style-type: none"> • Cell cycle • Control of cell cycle • Mitosis and biology of cancer cells: Cancer cell morphology and properties; types of cancer-causes and treatment • Cell signalling systems: G-protein coupled receptor • Tyrosine Kinase receptor: Ras-MAP Kinase pathway, Hedgehog pathway, WNT signaling pathway 	

Course Objectives:

- a) To study the cell and its components
- b) To study molecular interactions within the cell
- c) To emphasize the cellular mechanisms

Learning outcomes: After successfully completing this course, the students will be able to:

- Understand the turnover of biomolecules in the cells.
- Learn the interaction of biomolecules within the cell.
- Learn the dynamics of cargo transport through different compartments of cell.
- Understand the properties of transformed cells.
- Learn the current practices used in treatments of cancer.
- Understand the mechanism of gene expression regulation and associated abnormalities.
- Use the inherent property of prokaryotes in the therapeutics.
- Understand the cascade of signal transduction and its implications in gene expression.

Suggested Reading Materials:

- B. Albert: The Molecular Biology of Cell. Garland Publishing Inc. New York and London.
- De Robertis: Cell and Molecular Biology. Saunders College Publishing, Philadelphia
- W. H. Elliot and D. C. Elliot: Biochemistry and Molecular Biology. Oxford University Press. Oxford, New York.
- Giese A. C.: Cell Physiology. Saunders College Publishing, Philadelphia
- P. C. Verma and V. K. Agrawal: Cell Biology, Genetics, Molecular Biology Evolution and Ecology. S. Chand and Company, New Delhi-55.
- SandhyaMitra: Genetic Engineering, Macmillan
- R. C. Dubey: A text Book of Biotechnology. S. Chand and Company, New Delhi-55.
- Mohan Arora: Genetic Engineering. Himalaya Publishing House
- Becker, Klein smith: The World of Cell. Pearson Education.
- Geoffrey M. Cooper: Cell-A Molecular Approach. ASM Press. Washington
- Gerald Karp: Cell and Molecular Biology. Willey International Edition
- Watson: Molecular Biology of the Gene. Pearson Education.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSC-II: Practical-II: Cell and Molecular Biology

CREDIT:02

MARKS :50

Sr.No.	Title of the Practicals'
1	Preparation of Metaphasic chromosomes using colchicine drug
2	Preparation/Demonstration of meiotic stages in the onion bud
3	Preparation of <i>Drosophila</i> culture to study of its life cycle and observation of morphological characters of male and female <i>Drosophila</i>
4	Demonstration of PolyteneChromosomes from salivary glands of <i>Chironomous/ Drosophila</i> larva using photograph or permanent slide
5	To perform cell fractionation for the isolation of nucleus from given sample/material
6	Demonstration of electrophoresis for the separation of serum proteins
7	Virtual Lab. For Cell Biology: using c-BioPortal
8	To study Cell Homeostasis using virtual lab.
9	To perform retrieval and analysis of protein sequence from protein database
10	To perform multiple sequence alignment and phylogenetic analysis based on DNA and protein sequences

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSE-I: Techniques in Biology (Theory)

CREDIT:04

MARKS:100

CONTACT HOURS: 60

Unit	Title	Contact Hours
Unit-I	Principles and uses of Analytical instruments	
	<ul style="list-style-type: none"> • Spectroscopy (Spectrophotometers, NMR, FTIR), Lasers in Biology and its applications, X-Rays in Biology and its applications, • Electron Microscope (TEM, SEM), • Cryopreservation of cells, tissues, organs and organisms, Cryotomy, Freeze drying and freeze fracturing techniques. 	(15)
Unit-II	Cell Culture Techniques	
	<ul style="list-style-type: none"> • Design and functioning of tissue culture laboratory, Culture media preparation, • Types of culture- monolayer, suspension, capillary culture units, feeder layers, cell secretions and metabolic harvesting Cell viability testing, • Cell characterization & Cell Transformation, Modern advances in cell culture techniques 	(15)
Unit-III	Separation techniques and Radio- Labelling techniques	
	<ul style="list-style-type: none"> • Chromatography-TLC, paper chromatography, HPLC • Electrophoresis and its types • column fractionation • Centrifugation: Ultracentrifugation and sub-cellular fractionation. • Cell separation by- flow cytometry • Radio-label techniques in biology • Radioactivity: Counter Geigometry and Scintillation Counter, Autoradiography 	(15)
Unit-IV	Advanced techniques in molecular diagnostics:	
	<ul style="list-style-type: none"> • DNA: sequencing-Principle and methods, next generation sequencing, genome sequencing, microarray • PCR: types of PCR, primer design, applications of PCR. 	(15)

Course Outcomes:

- a) To develop scientific technical expertise
- b) To familiarise with basic tools and techniques in biology
- c) To update new techniques in biology

Learning outcomes: After successfully completing this course, the students will be able to:

- Understand the purpose of technique, its proper use and possible modifications or improvements.
- Learn the theoretical basis of technique, its principle of working and its correct application.
- Learn the construction repair and adjustment of any equipment required for a technique.
- Learn the application and accuracy of technique.
- Learn the maintenance laboratory equipment/tools, safety hazards and precautions.
- Understand the technique of cell and tissue culture. Learn the preparation of solution of given percentage and molarity.
- Understand the process of preparation of buffer. Learn the techniques of separation of amino acids, proteins and nucleic acids.
- Understand the application of sequencing techniques in the field of molecular diagnostics.
- Learn the basics of PCR techniques in context to current scenario of pandemics.

Suggested Reading Material:

- John, R.W. Masters: Animal Cell Culture. IRL Press.
- Robert Braun: Introduction of Instrumental Analysis. McGraw Hill International Editions.
- K. Wilson and K.H. Goulding: A Biologist Guide to Principles and Techniques of Practical Biochemistry. ELBS Ed.
- Pattabhi V.: Biophysics. Narosa Publishing House.
- Bisen P. S., Mathur: Tools and Techniques in Life Sciences. CBS Publishers and Distributors.
- Keith Wilson and John Walker: Practical Biochemistry. Cambridge low price edition.
- Cooper Cell: A Molecular Approach: Second Edition.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSE-I: Techniques in Biology (Practical)

Practical: 2 credits

Marks:50

Sr. No.	Title of Practicals
1	Principle and applications of different microscopes
2	To prepare Buffers of known pH and molarity and measurement of pH of various samples, Buffering capacity
3	Separation of sugars by paper chromatography.
4	Isolation of active ingredients from natural resources by using column chromatography.
5	Separation of amino acids by paper chromatography.
6	DNA extraction and isolation.
7	Principles of electrophoresis: Analysis of DNA samples by using gel electrophoresis.
8	DNA amplification by PCR
9	Principle and working of Colorimetry and spectrophotometry
10	Cell separation by density gradient centrifugation
11	Submission of report based on visit to National/Local Biotechnology Laboratory

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSE-I: Economic Entomology (Theory)

CREDIT:04

MARKS:100

CONTACT HOURS: 60

Unit No.	Title	Contact Hours
Unit- I	Apiculture:	15
	<ul style="list-style-type: none"> • Different types of bees:<i>Apis dorsata</i>, <i>Apis mellifera</i>, <i>Apis florea</i> and <i>Apis indica</i>. Stingless bees. • The Apiculture business: structure of artificial bee hive, method of cultivation, tools used, management of apiary. Disease of bees and their natural enemies. • Products: honey, wax, royal jelly, venom, propolis & economics of bee keeping. 	
Unit- II	Lac culture:	15
	<ul style="list-style-type: none"> • The lac insect, hosts, culture techniques. • Natural enemies of lac insects. Processing of raw lac to fine lac and uses of lac. • Management and economics of lac culture in business 	
Unit- III	Sericulture:	15
	<ul style="list-style-type: none"> • Different types of silk moths: Life cycle of Mulberry silk moth. • The Sericulture business: cultivation of mulberry, rearing of worms (procuring eggs, incubation, hatching and maintenance of larvae), overall management, diseases of silk worms. • Process of obtaining silk from cocoons and variations with reference to other silk moths; Uses of silk and economics of sericulture. 	
Unit- IV	Modern Trends in Pest Control:	15
	<ul style="list-style-type: none"> • Biological Control • Autocidal Control • Integrated Pest Management (IPM) 	

Learning outcomes: After successfully completing this course, the student will be able to:

- Identify and Understand Insects and its ecology.
- Learn about pest and pest management
- Learn more about Agro-ecosystem
- Learn about Forensic Entomology

Suggested Reading Materials:

- A textbook of Applied Entomology, Vol 2 – K. P. Shrivastava, 1996
- Elements of Entomology – Rajendra Singh
- A textbook of forest entomology -T. V. Sathe, 2009
- Morden Entomology – D. B. Tembhare 2nd edition, Himalaya presentation
- Principles of Insect morphology – Robert Snodgrass

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
DSE-I:Economic Entomology (Practical)

Practical: 2 credits

Marks:50

Sr.No.	Title of Practicals
1	Study of Apiculture: Indigenous and exotic breeds; Study of by-products of Apiculture and its economic significance.
2	Study of major agricultural pest: Pomegranates, Sugarcane, Jowar, Cotton, Brinjal.
3	Study of different types of mouth parts of different insect groups.
4	Identification of Mosquitoes using its morphological characters.
5	Study of different types of Insect larvae.
6	Study different types of Insect traps used for pest control in Agriculture.
7	To study types of insect pest in stored grains.
8	Study of traditional/organic methods used in agricultural pest control
9	Visit to agriculture site and study the community of Insects.
10	Submission of reportbased on visit on visit to Sericulture/Apiculture/Pomegranate/Jowar Research Centre/Local agro-ecosystem

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-I
Research Methodology (Theory)

Credits: 4

Marks:100

Contact Hours: 60

Unit No.	Title	Contact Hours
Unit-I	Foundations of Research	(15)
	<ul style="list-style-type: none"> • Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. • Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. • Research Process. Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues • Hypothesis – Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance 	
Unit-II	Research Design	(15)
	<ul style="list-style-type: none"> • Research Design: Concept and Importance in Research – Features of a good research design • Exploratory Research Design – concept, types and uses, • Descriptive Research Designs – concept, types and uses. • Experimental Design: Concept of Independent & Dependent variables. • Qualitative and Quantitative Research: Qualitative research, Quantitative research, Concept of measurement, causality, generalization, replication. Merging the two approaches. 	
Unit-III	Sampling of Research Data	(15)
	<ul style="list-style-type: none"> • Measurement: Concept of measurement, Problems in measurement in research, Validity and Reliability. • Levels of measurement: Nominal, Ordinal, Interval, Ratio. • Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample. Probability Sample: Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample: Practical considerations in sampling and sample size. 	
Unit-IV	Analysis of Research Data	(15)
	<ul style="list-style-type: none"> • Data Analysis: Data Preparation: Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis: Cross tabulations and Chi-square test including testing hypothesis of association. • Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism • Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for detection of Plagiarism 	

Learning outcomes: After successfully completing this course, the students will be able to:

- Research methodology and research aptitude.
- Its national and international significance.
- Methodology to file patent and other IPRs.

Reference Books:

- Anderson, Durston and Polle (1970): Thesis and assignment writing, Wiley Eastern Limited.
- Vijayaakshmi, G. and Sivapragasam, C. (2008): Research Methods-Tips and Techniques, M.J. P. Publisher, Chennai.
- Malter, K. (1972): Statistical analyss in Biology, Chapman Hall, London.
- Kothari, C.R. (2012): Research Methodology: Mthods and Techniques. New Age Publ., New Delhi.

Semester-II

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
DSC-III: Embryology (Theory)

CREDIT:04

MARKS :100

CONTACT HOURS: 60

Unit No	Title	Contact Hours
Unit- I	Introduction to Embryology	15
	<ul style="list-style-type: none"> • Evolution of sexual reproduction in eukaryotes. • Study and types of eggs, blastula, gastrula and mechanism of formation of three germ layers in Amphioxus, Frog, Chick and Mammals. • Detailed molecular mechanism of fertilization 	
Unit-II	Early Embryonic Development	15
	<ul style="list-style-type: none"> • Basic concepts in development: Potency, commitment, specification, induction, competence, determination and differentiation. • Development up to gastrulation in human • Organization of nervous system, reproductive system; Cell aggregation and differentiation 	
Unit-III	Regulation of Development	15
	<ul style="list-style-type: none"> • Development of limbs in fishes, amphibians, reptiles, birds and Mammals • Genetic regulation of limb development in chordates 	
Unit- IV	Development of <i>Drosophila</i> and <i>Caenorhabditis elegans</i>	15
	<ul style="list-style-type: none"> • Regulation of development in <i>Drosophila</i>. • Cell apoptosis, its role in development of human limbs • Vulva formation in <i>Caenorhabditis elegans</i>. 	

Course Objectives

- a) To understand developmental biology
- b) To understand embryological developmental concepts
- c) To apply the knowledge of embryology in applied field

Suggested Reading Material:

- Turner, C. D. and Bangara, J. T.: General Endocrinology.
- Edwards, R. G.: Human Reproduction.
- Austen, C. R. and Short, R. V.: Reproduction in Animals.
- Longo, F. T.: Fertilization, Chapman & Hall.
- Mathur, Ramesh: Embryology, Anmol Publications.
- Morgan, T. H.: Embryology and Genetics. Agrobios India.

- Balinski: Introduction to Embryology.
- Scott, F. Gilbert: Developmental Biology –Sixth Edition, Sinaur Publications.

Learning outcomes: After successfully completing the course, the student will be able to :

1. Develop critical understanding of how a single-celled fertilized egg become an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
2. Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissue and organisms.
3. Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene network.
4. Understand that how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
5. Examine the evolutionary history of the taxa based on developmental affinities.
6. Understand the relevance of developmental biology in medicine or its role in development of diseases.
7. Understand the role of genes in developments of animals.
8. Students can explore molecular mechanisms of development as well as importance of cell-cell interactions in the cell lineage development.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
DSE-III:Embryology (Practicals)

Credits:2

Marks:50

Sr. No.	Embryology
1.	Demonstration of sperm motility and analysis
2.	Study of different phases of oestrous cycle in Rat (Using photographs/permanent slides)
3.	To demonstrate acrosomal development in rat testis by PAS method (using permanent slides)
4.	Study of sperm & egg of chick
5.	Study of blastula in Amphioxus, Frog, Chick and Mammals
6.	Study of gastrula in Amphioxus, Frog, Chick and Mammals
7.	Procedure to understand embryological stage of chick:18 hours/21 hours/24 hours/33 hours/48 hours/72 hoursby non-invasive method by non-invasive method
8	To observe and interpret metamorphic stages of insect egg with the help of models and submit the report
9	Observation of homeotic mutants of <i>Drosophila</i> byAntennapedia complex gene (using photographs)/ Ultrabithorax complex gene
10	Submission of report based on visit to IVF Centre/Medical college

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
DSC-IV: Animal Physiology (Theory)

CREDIT:04

MARKS:100

CONTACT HOURS: 60

Unit No	Title	Contact Hours
Unit-I	Physiology of Digestion	
	<ul style="list-style-type: none"> • Structure and function of Digestive glands • Physiology of digestion in the alimentary canal. • Absorption of carbohydrates, proteins, lipids • Metabolism of Carbohydrates, Proteins ad Lipids. • Vitamins • Hormonal control of digestion • Physiology of Stomach Ulcers: sings, symptoms, causes and treatment of ulcers 	15
Unit-II	Physiology of Respiration and Circulation	
	<ul style="list-style-type: none"> • Pulmonary Ventilation,Respiratory volumes and capacities • Transport of oxygen and carbon dioxide in blood • Structure of heart, origin and conduction of heart beat • Cardiac cycle and ECG • Composition of blood& mechanism of blood clotting • Physiology of Asthama: sings, symptoms, causes and treatment • Physiology of cardiovascular diseases: Cardiac arrest and coronary heart disease 	15
Unit-III	Physiology of Excretion	
	<ul style="list-style-type: none"> • Structure of nephron • Mechanism of urine formation and its regulation • Counter current Mechanism • Physiology of Kidney failure: sings, symptoms and causes of kidney failure • Treatment of kidney failure with dialysis 	15
Unit-IV	Physiology of Muscle and Nerve	

	<ul style="list-style-type: none"> • Ultra-structure of smooth, skeletal and cardiac muscle • Neuromuscular Junction • Molecular and Chemical basis of muscle contraction • Structure of neuron • Resting membrane potential • Origin of Action potential • Propagation in myelinated and non myelinated nerve fibres • Physiology of Tetanus: symptoms and causes • Physiology of nervous disorders: sings, symptoms and causes of Alzheimers disease, Parkinsonsand Epilepsy 	15
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Course Objectives:

- a) To learn about structure and functions of systems
- b) To focus on understanding of physiology
- c) To develop critical thinking about issues of animal physiology

Learning Outcomes:After successfully completing this course, the student will be able to:

- Understand the process of digestion and control.
- Develop understanding in muscle structure and contraction mechanism.
- Learn the process of respiration and transport of gases.
- Understand kidney structure and regulation of urine formation.
- Understand heart structure and functioning.
- Understand functions of neurons

Suggested Readings:

- **Guyton, A.C. and Hall, J.E. (2011).** Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/W.B. Saunders Company.
- **Tortora, G.J. and Derrickson, B.H. (2009).** Principles of Anatomy and Physiology, XII Edition, John Wiley and Sons, Inc.
- **Widmaier, E.P., Raff, H. and Strang, K.T. (2008)**Vanders Human Physiology, XI Edition, McGraw Hill

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
DSC-IV: Animal Physiology (Practicals)

Credits:2

Marks:50

Sr.No.	Practicals'
1.	Study of activity of salivary amylase under optimum conditions.
2.	Study of activity of protease under optimum conditions.
3.	Study of activity of lipase under optimum conditions.
4.	Preparation of haemin crystals and hemochromogen crystals.
5.	Total count of RBC and WBC
6.	Estimation of Protein using suitable method
7.	Estimation of Carbohydrates using suitable method
8.	Estimation of lipids using suitable method
9.	Estimation of haemoglobin
10.	Analysis of ECG
11.	Submission of report based on visit to Blood Bank / Dialysis Centre

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
DSE-II: Fishery Science (Theory)

CREDIT :04

MARKS :100

CONTACT HOURS: 60

Unit.No.	Title	Contact Hours
Unit -I	General features of fishes	15
	<ul style="list-style-type: none"> • General characters and classification of fresh and marine water fishes. • Identification of larval stages of major carps with examples • Major keys for the identification of adult major carps • Types of fish scales 	
Unit-2	Aquatic ecosystems	15
	<ul style="list-style-type: none"> • Aquatic ecosystems: Characteristics and faunal diversity of - Fresh, brackish and marine water ecosystems • Identification of planktonic, nektonic and benthic fishes • Identification and general characters of Phytoplankton and Zooplankton • Role of planktons in fish culture 	
Unit-3	Aquaculture	15
	<ul style="list-style-type: none"> • Culture techniques of major carps • Breeding techniques, Induced breeding, breeding in happa • Types of fish culture - Cage culture, Monoculture, Poly culture • Types of hatcheries, hatching happa, Chinese hatchery 	
Unit-4	Economic importance of fishes and Amazing Fishes	15
	<ul style="list-style-type: none"> • Fish products and by- products • Fish preservation techniques • Coloration in fishes, physiology of coloration • Bioluminescence and physiology of light production in fishes • Venomous glands and electric organs in fishes 	

About course -The course deals with application of fisheries in food industry, its biology, aquacultural practices etc.

Learning outcomes:

- On the completion of the course, the students shall be able to Understand classification and biology of fish
- Learn morphology and physiology of fish
- To provide technical know-how of recent aquaculture practices

Suggested reading material:

1. Boyd, C.E. -Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Company, 1982.
2. Jhingran, V.G. -Fish and Fisheries of India. Hindustan Publishing Corporation India, 1982
3. Bardach, et. al. -Aquaculture – The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY, 1972.
4. Chondar, C.L. -Hypophysation of Indian major carps. Satish Book Enterprise, Agra, 1980.
5. Santhanam, R. et. al. -A Manual of Freshwater Aquaculture. Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
6. Karunasagar, I. -Aquaculture and Biotechnology. Oxford-IBH Publishers, New Delhi,
7. Govindan, T.K. -Fish Processing Technology, Oxford-IBH, 1985.
8. Shang, Y.C. -Aquaculture Economic Analysis – An Introduction. 1990.
9. Nikolsky, G.V. -Ecology of Fishes. Academic Press, NY, 1963.
10. Text book of Fisheries- Dr. V.B Sakhare

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus Semester-II
DSE-II:Fishery Science (Practicals)

CREDIT :02

MARKS :50

Sr. No.	Title of the Practicals
1	Studies on traditional fishing crafts and Gears
2	Temporary mounting of scales of fishes
3	Morphometric study of bony fishes
4	Preparation of salted fish by different methods
5	Aquaculture resources of World and India (Based on available data and maps)
6	Collection and identification of commercially important inland fishes
7	Collection of species of fresh water fishes
8	Estimation of hardness from fresh water reservoir
9	Collection and identification of fresh water Zooplankton
10	Identification of fresh water and marine water fishes (Using museum specimens)
11	Submission of report based on visit to Local Fish Market/Fishery Centre/ Any Aquatic Ecosystem

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
DSE-II: Applied Parasitology (Theory)

CREDIT:04

MARKS :100

CONTACT HOURS: 60

Unit. No.	Title and Chapters	Contact Hours
Unit -I	General Parasitology: Introduction	15
	<ul style="list-style-type: none"> • Introduction, scope and branches of parasitology; host, parasite, vector, commensalism, mutualism and parasitism Classification general account on parasitic protozoans • Types of parasites & hosts: Ectoparasites, endoparasites and their subtypes; Intermediate and definite host and their subtypes • Host-parasite relationship: Host specificity: definition, structural specificity, physiological specificity, ecological specificity 	
Unit-2	Parasitic Protozoans: Trematodes: Helminths, Entomology	15
	<ul style="list-style-type: none"> • Classification and general account on parasitic protozoans • Study of Habit, habitat, life cycle, mode of infection, Pathogenicity and control measures of: <i>Plasmodium vivax</i>, <i>Enamoeba histolytica</i>, <i>Naegleria fowleri</i> (Brain Eating Amoeba), <i>Giardia lamblia</i>, <i>Trypanosoma spp.</i> 	
Unit-3	Parasitic Helminths-Trematodes, Cestodes and Nematodes	15
	<ul style="list-style-type: none"> • Primary and secondary host of trematodes, egg hatching, variation of life cycle in Monogenea and Digenea with examples • Morphology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of <i>Fasciolopsis buski</i> • Classification and general account on parasitic cestodes • Larval form of cestodes, comparative study of scolices in cestodes • Life cycle patterns of cestodes, Morphology, biology, mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis of <i>Hymenolepis nana</i>, <i>Taenia saginata</i> • Classification and general account on parasitic nematodes: Mode of transmission, pathogenicity, laboratory diagnosis and prophylaxis <i>Trichuri strichura</i>, <i>Dracunculus medinensis</i> 	
Unit-4	General topics in Parasitology	15
	<ul style="list-style-type: none"> • Study of following parasites: Morphology, life cycle, Pathogenicity, control measures of Head louse, tick, mite (<i>Sarcoptes scabiei</i>) • Zoonotic diseases: signs, symptoms and causes of Bird flu, Rabies and Toxoplasmosis • Controlling measures of insect parasites: environmental management, physical, chemical, biological and genetic measures 	

Learning outcomes:

- On the completion of the course, the students shall be able to Understand classification and biology of Parasites
- Learn morphology and life cycles of Paracites
- To provide technical know-how of recent human practices

Suggested reading material:

- Parasitology (Protozoology and Helminthology) Thirteenth Edition by K.D. Chatterjee
- Textbook of Veterinary Parasitology 5th Edition Kalyani Publication by B.B. Bhatia., K.M.L. Pathak., P.D. Juyal
- Textbook of Human Parasitology (Protozoology and Helminthology) C.B.S. Publication and Distribution by Romnik Sood
- Parasitology 5th Edition Arya Publication by C.P. Baveja., V. Baveja
- https://www.academia.edu/30595207/Panikers_Textbook_of_Medical_Parasitology_7th_Edition_2013_PDF

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus Semester-II
DSE-II: Applied Parasitology (Practicals)

CREDIT: 02

MARKS: 50

CONTACT HOURS: 60

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Sr. No.	Title of the Practicals
1	Identification and classification of parasites
2	To identify parasites with help of standard taxonomical keys
3	To study the basic information on following diseases: a. Malaria b. Dengue
4	To study following Nematodes: <i>Trichuristrichura</i> , <i>Dracunculusmedinensis</i> , <i>Brugiamalayi</i>
5	To study ectoparasites from herbivorous host
6	To identify characteristics of various stains and their property in parasitology
7	Study Visit : Pathology Laboratory/ Slaughter house/ Veterinary hospital
8	Preparation of temporary mount of different parasites from samples collected from visit
9	Demonstration of <i>C. elegans</i> as a model parasite
10	Submission of report based on visit to Pathology Laboratory/ Slaughter house/ Veterinary hospital

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
M.Sc. ZOOLOGY Part-I Syllabus (NEP) Semester-II
OJT/In-house Project/ Internship/ Apprenticeship

Credits: 4

Marks: 100

OJT/In-house Project/ Internship/Apprenticeship

Evaluation of **OJT/In-house Project/ Internship/ Apprenticeship** shall be as per the procedure evolved by the University from time to time.

The student shall opt for lab/ field projects / internship / apprenticeship. Lab work will be assessed for **30 hours per credit (Total=4 x 30 = 120 contact hours)**, and field projects / internship / apprenticeship will be internally assessed for 45 hours per credit under the supervision of faculty member.

The concerned department has to maintain the details of OJT/ In-house project/Internship/Apprenticeship for appropriate evaluation of students for grading and certification.

Important Note Concerning Dissection and Field Studies

As per the guidelines of '**UGC Resolution- D.O.No.F.14-6/2014 (CPP-II) dated 5th August, 2014**' it is mandatory to promote the students towards knowledge component for skill development, ICT based virtual dissections be promoted. As per the notification it is necessary to encourage field trips and observations without disturbing the biodiversity. For laboratory observations existing preserved specimens and permanent slides are shown for the knowledge component. Zoology Department should be empowered with ICT based tools, infrastructure, software components and enrich with high-quality internet facilities.

Students must follow instructions as instructed from respective institutes during various kinds of study tours, field trips, project work etc. Students are entirely responsible for any sort of personal injury, harm or unfortunate incident in case of students misconduct during the course of study.