University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई – ४०० ०३२
टेलिफोन नं. – ०२२ – ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७ दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने **शैक्षणिक वर्ष २०२५-२६** पासून **पदवी व पदव्युत्तर अभ्यासक्रम** विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई – ४०० ०३२
२७ मे, २०२५

(डॉ. प्रसाद कारंडे)
कुलसचिव

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
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19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
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4	P.A to all Deans of all Faculties
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To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	**Faculty of Humanities,** **Offg. Dean** 1. Prof.Anil Singh Dranilsingh129@gmail.com **Offg. Associate Dean** 2. Prof.Manisha Karne mkarne@economics.mu.ac.in 3. Dr.Suchitra Naik Naiksuchitra27@gmail.com
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4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
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6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

AC – 20/05/2025
Item No. – 6.2 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1 & 4 (Scheme – I)		
Name of the Programme – B.Sc. (Zoology)		
Faulty of Science		
Board of Studies in Zoology		
U.G. Second Year Programme	**Exit Degree**	**U.G. Diploma in Zoology**
Semester		**III & IV**
From the Academic Year		**2025-26**

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:_____**	**B.Sc. (Zoology)**
2	**Exit Degree**	**U.G. Diploma in Zoology**
3	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	**Standards of Passing** **R: _____**	**40%**
5	**Credit Structure** **R. SU-560C** **R. SU-560D**	**Attached herewith**
6	**Semesters**	**Sem. III & IV**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

Sd/-
Sign of the BOS Coordinator
Dr. Vaishali U. Somani
BOS in Zoology

Sd/-
Sign of the Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sd/-
Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science & Technology

Under Graduate Diploma in Zoology

Credit Structure (Sem. III & IV)

(B. Sc.) – Major & Minor

	R. SU-560C								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
5.0	III	**S1MJ5:** Cell Biology (2) **S1MJP3:** Laboratory Exercises on Cell Biology (2) **S1MJ6:** Biochemistry (2) **S1MJP4:** Laboratory Exercises on Biochemistry (2)	…	4	2	**VSC3a:** Pest control (2) **OR** **VSC3b:** Dairy Science (2)	AEC:2	FP: 2 CC:2	22	**UG Diploma 88**
	R. SU-560D									
	IV	**S1MJ7:** Genetics (2) **S1MJP5:** Laboratory Exercises on Genetics (2) **S1MJ8:** Molecular Biology (2) **S1MJP6:** Laboratory Exercises on Molecular Biology (2)	…	4	2	**SEC3a:** Intellectual Property Rights (2) **OR** **SEC3b:** Nature educator (2)	AEC:2	CEP: 2 CC:2	22	
	Cum Cr.	**28**		**10**	**12**	**6+6**	**8+4+2**	**8+2+2**	**88**	
Exit option; Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC –Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Community Engagement Project, CC – Co-Curricular, RP – Research Project]

Semester – III

Vertical – 1
Major

Syllabus
B.Sc. (Zoology)
(Semester – III)
Title of Paper: S1MJ5 Cell Biology

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	Cell biology is the study of the structure, function, and behavior of cells. Knowledge of cell biology is crucial for advancements in medicine, biotechnology, and genetics. It plays a key role in disease diagnosis, treatment, and addressing environmental challenges. Consequently, it has wide-ranging applications in fields such as cancer research, genetic engineering, agriculture, and many others. This dynamic field continues to evolve with discoveries in molecular biology and bioinformatics. Cell biology is closely linked to genetics, biochemistry, microbiology, biotechnology, and medicine. As a result, there is high demand for cell biologists in pharmaceuticals, healthcare, and biotech industries. Career opportunities include roles as research scientists, biomedical scientists, lab technicians, and positions in academia and biotech firms.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To discuss the structural and functional organization of cell with an emphasis on nucleus, plasma membrane and mitochondrion. • To describe the endomembrane system and cytoskeletal structures along with their functions.	
8	**Course Outcomes**: Upon completion of the course, the learners should be able to: • Identify and differentiate the cell organelles on the basis of their structure. • Compare functions of cell organelles and their significance.	

9	

Module 1: Cell Biology – I

1.1 Introduction to cell biology 1.1.1 Definition, history and scope of cell biology 1.1.2 Cell theory and its modern version 1.1.3 Prokaryotic and eukaryotic cell: size, shape and structure	3hrs
1.2 Plasma membrane 1.2.1 Plasma membrane – Fluid Mosaic model 1.2.2 Cell Junctions 1.2.3 Trans-membrane transport 1.2.4 Membrane receptors 1.2.5 Exocytosis and Endocytosis 1.2.6 Functions of plasma membrane	4hrs
1.3 Nucleus 1.3.1 Size, shape, and structure 1.3.2 Structure of nuclear membrane and pore complex 1.3.3 Nuclear lamina, formation of nuclear envelope 1.3.4 Nucleolus: General organization and functions 1.3.5 Functions of interphase nucleus	4hrs
1.4 Mitochondrion 1.4.1 Structure of mitochondrion 1.4.2 Functions of mitochondria 1.4.3 Bioenergetics • Chemical energy & ATP • Krebs's Cycle • Electron Transport Chain / Oxidative Phosphorylation	4hrs

Module 2: Cell Biology – II

1.5 Endomembrane System 1.5.1 Endoplasmic reticulum – Structure and Functions • SER • RER 1.5.2 Golgi apparatus – Structure and Functions 1.5.3 Lysosomes – Structure and Functions 1.5.4 Polymorphism in lysosomes 1.5.5 GERL system 1.5.6 Vacuoles – Structure, Functions and Types 1.5.7 Peroxisomes – Structure and Functions	11hrs
1.6 Cytoskeletal structures 1.6.1 Microtubules, microfilament and intermediate filaments 1.6.2 Cilia, Flagella and Sperm tail 1.6.3 Microvilli	4hrs

10	**References:** • De Robertis E.D.P, E.M.F. De Robertis Jr. (2010): Cell and Molecular Biology, Publisher Walters Kluwer, ISBN: 9788184734508. • Dr. C. B. Powar (2010): Cell Biology, Himalaya Publishing House, ISBN 978-9350246696. • Dr. P. S. Verma & Dr. V. K. Agarwal (2004): Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S Chand Publishing, ISBN 9788121924429. • Dr. P. S. Verma & Dr. V. K. Agarwal (2022): Cell Biology (Cytology, Biomolecules and Molecular Biology) LPSPE, S Chand Publishing, ISBN 978-9355011022. • Geoffrey M. Cooper (2018): The Cell: A Molecular Approach, Sinauer Associates is an imprint of Oxford University Press, ISBN 978-1605357072. • N. Arumugam (2019): Cell Biology and Molecular Biology, Saras Publication, ISBN 978-9386519627. • P. K. Gupta (2018-19): Cell and Molecular Biology, Rastogi Publications, ISBN 978-9350781548. • P. K. Gupta (2018-19): Cell Biology, Rastogi Publications, ISBN 978-9350781203. • S. C. Rastogi (2002): Cell Biology, New Age International Pub, ISBN 978-8122413977. • Singh Tomar, Cell Biology, Rastogi ISBN 9788171339693. • Suruchi Tyagi and Dr. Seema Awasthi (2022): A Textbook of Cytology, Dominant Publishers & Distributors (P) Ltd., ISBN 978-81-78886-16-9. • Veer Bala Rastogi (2021): A Text Book of Cell Biology and Genetics, Kedar Nath Ram Nath, ISBN 978-9380803524.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – III)
Title of Paper: S1MJP3 Laboratory Exercises on Cell Biology

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This hands-on practical course in cell biology provides students with essential laboratory skills to study cell structure, and function.
2	**Vertical:**	Major
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To enable learners to identify cell structures of prokaryotes and cell organelles of eukaryotes. • To enable learners to differentiate between prokaryotic cells and eukaryotic cells and measure cell-size by using oculometer. • To acquaint learners to different microscopic techniques used in cell biology.	
8	**Course Outcomes**: Upon completion of the course, the learners should be able to: • Recognize different cell structures of prokaryotes and cell organelles of eukaryotes. • Differentiate between prokaryotic cells and eukaryotic cells, and calculate cell-size of any given cell. • Justify a particular microscopic technique used to a particular cell type.	
9	1. Measurement of cell-size using oculometer and stage micrometer. 2. Study of the cell organelles (ultrastructure): • Nucleus (Euchromatic and heterochromatic) • Mitochondria (various shapes) • Golgi Bodies (various shapes) • Lysosomes (Multivesicular bodies, Residual Bodies) • Vacuoles • Centrioles • Rough Endoplasmic Reticulum (RER) 3. Study of permeability of cell through plasma membrane (osmosis in blood cells). 4. Study of prokaryotic cells (bacteria) by Crystal violet staining technique. 5. Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain. 6. Study of structure of Prions, Viroids, Bacteriophages and Mycoplasma with examples.	

	7. Study of microscopic techniques: • Simple Microscopy • Compound Microscopy • Phase contrast Microscopy • Fluorescence Microscopy • Scanning Electron Microscopy • Transmission Electron Microscopy • Immuno-Electron Microscopy	
10	**References:** • Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Lewis, J., Raff, M., ... & Walter, P. (2015). Essential cell biology. Garland Science. • Celis, J. E. (Ed.). (2006). Cell biology: a laboratory handbook (Vol. 1). Elsevier. • Chaitanya, K. V. (2013). Cell and Molecular Biology: A Lab Manual. PHI Learning Pvt. Ltd. • Cooper, G. M., & Adams, K. (2022). The cell: a molecular approach. Oxford University Press. • Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons. • https://www.egyankosh.ac.in/bitstream/123456789/68533/3/BBCCL-104.pdf	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – III)
Title of Paper: S1MJ6 Biochemistry

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	Biochemistry is the study of the chemical processes within and related to living organisms. It is essential for understanding the molecular basis of life and plays a critical role in drug development, disease diagnosis, and more. Biochemistry has applications in medicine, forensic science, environmental science, and many other fields, making it a fascinating and versatile discipline. It is closely interconnected with molecular biology, genetics, and pharmacology, which drives its high demand in industries such as pharmaceuticals, healthcare, food production, and research institutions. Career opportunities include roles in academia, research, biochemistry, clinical science, and more.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To examine the fundamental principles of biochemistry, including molecular interactions, water chemistry, and acid-base balance, and differentiate between micromolecules and macromolecules. • To analyze the structure, classification, and biological significance of carbohydrates, proteins, lipids, vitamins, and enzymes, and evaluate their roles in metabolism and clinical applications.	
8	**Course Outcomes**: Upon completion of the course, the learners should be able to: • Illustrate the chemical properties and interactions of biomolecules, compare different types of bonds, and apply concepts of pH and buffers in biological systems. • Interpret the structural organization of carbohydrates, proteins, and lipids, examine enzyme kinetics and inhibition mechanisms, and assess the biological significance of vitamins in physiological functions.	

9	**Module 1: Biochemistry-I**	
	1.1 Basics of Biochemistry 1.1.1 Types of bonds and their functions in biomolecules: ionic bonds, covalent bonds, non-covalent bonds hydrogen bonds, hydrophilic, electrostatic, Vander Waal forces 1.1.2 Structure of water and its physiochemical properties 1.1.3 Concept of acid, base, pH, pH scale buffer, Henderson-Hasselbalch equation 1.1.4 Concept of micromolecules and macromolecules	5hrs
	1.2 Carbohydrate 1.2.1 Carbohydrates: Definition, classification, nomenclature of carbohydrates 1.2.2 Monosaccharides: Cyclic structure and anomers, Glucose, Fructose 1.2.3 Oligosaccharides: Glycosidic bond formation, maltose, lactose 1.2.4 Polysaccharides: Structural and storage polysaccharide, cellulose, starch, glycogen, chitin 1.2.5 Biological role and clinical significance of carbohydrates	5hrs
	1.3 Proteins 1.3.1 Structure and properties of amino acids 1.3.2 Classification of amino acids 1.3.3 Peptide bond formation 1.3.4 Levels of protein structure and bond involved in stabilising the structures – primary, secondary (alpha and beta helix, random coil), tertiary and quaternary (collagen and haemoglobin) 1.3.5 Biological role of proteins	5hrs
	Module 2: Biochemistry-II	
	2.1 Lipids 2.1.1 Definition, classification, physical and chemical properties of lipids 2.1.2 Fatty acids – saturated fatty acids, unsaturated fatty acids and their nomenclature 2.1.3 Reactions of fatty acids – saponification, rancidity, esterification, hydrogenation 2.1.4 Triacylglycerols, phospholipids (cephalin and lecithin), waxes, steroids 2.1.5 Biological role and clinical significance of lipids	4hrs
	2.2 Vitamins 2.2.1 Definition and characteristics 2.2.2 Water soluble vitamins – Vitamin B complex and Vitamin C 2.2.3 Fat soluble vitamins – Vitamin A, Vitamin D, Vitamin E and Vitamin K 2.2.4 Biological significance of vitamins	3hrs
	2.3 Enzymes 2.3.1 Definition and classification of enzymes 2.3.2 Properties of enzymes 2.3.3 Enzyme kinetics 2.3.4 Inhibition, types of reversible inhibition 2.3.5 Factors affecting enzyme activity 2.3.6 Coenzymes, co-factors and isoenzymes 2.3.7 Application of enzymes	8hrs

10	**References:** • Ahil Chandra Deb (2001) Fundamentals of Biochemistry, New Central Book Agency, ISBN 978-8173811449. • A.V.S.S.R Rao, Rao Rama V S S, Suryalakshmi A (1994). A Textbook of Biochemistry, UBS Publishers, ISBN 9788186112847. • Biological Chemistry, 1998, Dr. B. M. Deoray, A.E Desai, Nirali Prakashan. • Dushyant Kumar Sharma (2010) Biochemistry, Alpha Science International Ltd. ISBN 978-1842655108. • Erice Conn, Paul Stumpf (2009). Outline of Biochemistry, John Wiley & Sons, ISBN 9788126509300. • Geoffrey L. Zubay (). Biochemistry, Addison-Wesley ISBN 978-0201090918. • Lehninger A.L. Nelson D.L. and Cox M.M (2013). Principles of Biochemistry, W. H. Freeman Publisher, ISBN 978-1464109621. • Lubert Stryer (1990). Biochemistry, W. H. Freeman & Co Ltd. ISBN 978-0716718437. • Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, Victor W. Rodwell, P. Anthony Weil (2022). Harper's Illustrated Biochemistry, Thirty-Second Edition, McGraw Hill / Medical ISBN 978-1260469943.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – III)
Title of Paper: S1MJP4 Laboratory Exercises on Biochemistry

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This practical course in biochemistry provides students with hands-on experience in analyzing the chemical processes essential to life. Through laboratory experiments, students will explore biomolecules, enzymatic reactions, metabolic pathways, and molecular interactions.
2	**Vertical:**	Major
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours for Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To develop practical skills in acid-base titration, buffer preparation, and pH measurement using various indicators and instruments. • To perform qualitative and quantitative analysis of biomolecules and evaluate enzyme kinetics and vitamin detection.	
8	**Course Outcomes**: Upon completion of this course, students will be able to: • Demonstrate pH measurement techniques, prepare buffers, and analyze acid-base titration curves. • Perform biochemical tests for carbohydrates, proteins, lipids, and vitamins, and evaluate enzyme activity under varying conditions.	
9	1. Preparation of titration curve for strong acid and strong base with the help of pH meter. 2. Determination of pKa for weak acid. 3. Preparation of buffer of different pH using Henderson-Hasselbalch equation. 4. Determination of pH of solutions using red cabbage indicator (Lemon juice, Aerated drink, Tap water, Baking soda, Soap water). 5. Qualitative analysis of carbohydrates (Fehling's test, Iodine test, Anthrone test). 6. Qualitative tests for proteins (Ninhydrin test, Biuret test, Millon's test). 7. Qualitative tests for lipids (Solubility test, Sudan III test, Oil Red O test). 8. Quantitative estimation of lipids by titrimetric method. 9. Detection of Vitamin C from various suitable fruits. 10. Effect of substrate concentration on Acid phosphatase enzyme activity. 11. Effect of enzyme concentration on Acid phosphatase enzyme activity. 12. Study of Osazone formation using suitable reducing sugar.	

10	**References:** • Jayaraman, J., & Jayaraman, J. (1981). Laboratory manual in biochemistry (Vol. 439). Delhi, India: Wiley Eastern. • Plummer, D. T. (1987). An introduction to practical biochemistry (pp. 236-237). London: McGraw-Hill Book Company. • Saxena, J., Baunthiyal, M., & Ravi, I. (2015). Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. Scientific Publishers. • Shanmugam, S., Kumar, T. S., & Panneer Selvam, K. (2019). Laboratory handbook on biochemistry. PHI Learning Pvt. Ltd.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Vertical – 4

VSC

Syllabus
B. Sc. (Zoology)
(Semester – III)

Title of Paper: VSC3a Pest Control

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	Pest control plays an important role in agriculture and household pest management. It is crucial for protecting public health by preventing disease transmission and maintaining ecological balance by preventing invasive species from disrupting ecosystems. Pest control technology is particularly beneficial to farmers, as it relates to various agricultural fields, including apiculture, sericulture, and vermiculture. The pest control industry faces a unique set of challenges and opportunities in managing pests. A career in pest control offers insight into the work of a pest control technician, a profession that is currently in high demand and provides stable job prospects for those pursuing this field.
2	**Vertical:**	VSC
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To explain the fundamental concepts of identification of pest and their control measures. • To impart the knowledge of Pest Monitoring Techniques, IPM practices and Chemical Control, Insecticides, and Formulations. • To acquaint learners to various insect pests and associated diseases, as well as calculate economic injury and threshold levels.	
8	**Course Outcomes:** Upon completion of the course, the learners should be able to: • Identify insect pests, their nature of damage and their control measures. • Demonstrate understanding preparation about doses/concentrations of insecticides. • Apply advanced technology for pest control.	

9	1. Estimation of insect population and damage caused using suitable sample techniques [Absolute estimates (Quadrat method, Line-transect method, Capture, Marking, Release and the Recapture Technique) and Relative estimates]. 2. Identification of Insect pests of field crops: Rice: Thrips (*Stenchaetothrips biformis*) and Brown plant leafhopper (*Nilaparvata lugens*) Wheat: Armyworm (*Mythimna separata*) and Wheat Aphid (*Macrosiphum miscanthi*) Mulberry: Pink mealy bug (*Maconellicoccus hirsutus*) and Leaf webber (*Diaphania pulverulentalis*) Mango: Mango stem borer (*Batocera rufomaculata*) and Mango Fruit fly (*Bactrocera (Dacus) dorsalis*) Banana: Banana weevil (*Cosmopolites sordidus*) and Fruit rust thrips (*Chaetanaphothrips signipennis*). 3. Study of non-insect pests of field crops: Birds, Crabs, Snails and Slugs, Millepedes, Mites, Rats and Squirrels. 4. Study of life cycle of rice weevil or flour beetle or suitable pest. 5. Study of Household pests: Cockroach, Termite, Bed bug, Mice and House fly. 6. Study pest surveillance methods such as field incidence, light traps, and pheromone traps. 7. Study on the distribution patterns of insects in crop ecosystems by • Regular / Uniform distribution • Random /Poison distribution • Clumped / Aggregated / Over-dispersed / Contagious distribution 8. IPM practices: Physical (Temperature, Sound, Controlled Atmospheres Irradiation) and mechanical methods (Hand picking, Use of Hand-nets and Bag-nets, Clipping, Pruning and Crushing, Sieving and Winnowing, Flaming and Burning). 9. IPM practices: Cultural (Crop rotation, Period of sowing, Irrigation, Pruning, Tillage and Fertilizer) and biological methods (Parasite, Parasitoid, Predator) 10. Calibration of different insecticides formulation by preparation of spray fluid and Pearson method. 11. Study the Pesticide appliances (Types of Sprayers and Types of Dusters) and their maintenance. 12. Visit near by a Farm field / Agriculture institute / Krishi Seva Kendra for collection of information about crop insect pests.
10	**Reference Books:** • A. D Imms (1977). A General textbook of entomology, Asia Publication, ISBN No.: 978-0412152108. • Alaka Prakash and Fennemore (2006). Applied Entomology, New Age Publishers, ISBN No.10. 8122418333; 13. 978-8122418330. • A. Woods, (1974). Pest control: A Survey, McGraw Hill, London, ISBN No. 10: 0470960019; 13: 978-047096001. • David and Ananthakrishnan (1978). General and applied Entomology, Tata McGraw Hill, ISBN No.10. 9780070434356; 13. 978-0070434356.

	• D. B. Tembhare, (2016). Modern Entomology, D. B. Himalaya Publishing House, Mumbai, ISBN No. 978-93-5051-828-1. • D. P. Abrol and Uma Shankar (2012). Integrated Pest Management: Principles and Practices, CABI, ISBN No. 1845938089, 9781845938086. • Jason H. Byrd and James L. Castner. (2001). Forensic Entomology-The utility of Arthropods in legal investigations, CRC Press, ISBN No. 843981202, 9780843981209. • Larry P. Pedigo (1996). Entomology and Pest Management, by Pearson Education, ISBN No. 13: 978-0133735314; 10: 0133735311. • Mary Louise Flint and Steve H. Dreistadt, (1998). Natural Enemies Handbook, UC Division of Agriculture and Natural Sciences, ISBN No. 0520218019, 9780520218017. • M. M. Trigunayat (2009). A manual of practical entomology, Scientific Publication, ISBN No. 10: 8172335660; 13: 9788172335663. • Pedigo L. P (1998). Entomology and Pest Management, III Edition. Prentice Hall, New Jersey, USA, 691p; ISBN No. 10: 013780024X; 13: 9780137800247. • Sathe T. V. (1998). Book Sericultural Crop Protection, Asawari Publication, ISBN No. 978-93-80224-008. • Sengupta, K., Govindaiah and Kumar. P (1991). Diseases and Pests of Mulberry and their Control. Central Sericultural Research and Training Institute, Srirampura, Mysore - 570 008. • T. V. Sathe and Jyoti M. Oulkar, (2010). Insect Pest Management: Ecological Concepts, Daya Publishing House, ISBN No. 9383048263; 9789383048267. • V. B. Awasthi. (2002). Introduction to general and applied Entomology, Scientific Publication, ISBN No. 81-7233-295-5. • V. B. Awasthi (2011). Agricultural insect pests and their control, Scientific Publication, ISBN No.: 9788172337148. • Wang, K. H., Uyeda, J and Sugano, J (2018). Banana Pest and Disease Management in the Tropical Pacific: A guidebook for banana growers. University of Hawaii at Manoa, Pp: 1-70. • William D. Hutchison, Rafael E. Cancelado and Edward B. Radcliffe, (2008). Integrated Pest Management: Concepts, Tactics, Strategies and Case Studies, Cambridge University Press, ISBN No. 9780511626463. • W. W. Kilgore and R. L. Doutt, (1967). Pest control: Biological, Physical and Selected Methods, Academic Press, New York, ISBN No.10: 012406650X; 13: 978-0124066502.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B. Sc. (Zoology)
(Semester – III)
Title of Paper: VSC3b Dairy Science

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	Dairy Science is a highly relevant and valuable course with numerous applications in the dairy industry. It encompasses the study of dairy farming, milk production, processing, and management. In India, the demand for professionals in dairy science is substantial, offering opportunities in both the government and private sectors. Career prospects include roles such as dairy farm manager, milk quality control supervisor, and dairy processing technologist. Graduates can also pursue careers in research and development, dairy extension services, or even start their own dairy businesses. Overall, a Dairy Science course provides a pathway to a rewarding and dynamic career in the dairy industry.
2	**Vertical:**	VSC
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To acquaint learners to the indigenous breeds, exotic breed and cross breeds. • To familiarize the learners to practical dairy science through activities, including projects, experiments, and farm visits.	
8	**Course Outcomes:** After successful completion of this Course learners will be able to: • Classify and identify cattle breeds, buffalo breeds, use knowledge about casting of farm animals, trimming of dairy cattle and shoeing of bullocks. • Develop entrepreneurial skills with confidence to establish and manage a dairy-based business.	
9	1. Classification of Cattle Breeds. • Milch breed: Gir, Sahiwal, Red Sindhi • Draught: Khillar, Dangi, Red Kandhari • Dual: Deoni, Hariyana • Exotic: Jersey, Holstein Friesian • Cross breed: Holdeo, Jerdeo 2. Study of buffalo breeds: • Murrah • Jaffrabadi • Nagpuri	

	• Pandharpuri • Surti 3. Study of casting of farm animals, trimming of dairy cattle and shoeing of bullocks. 4. Preparation and submission of report related to: cattle feed, vaccination schedule of dairy cattle, dairy animal diseases, cost of milk production, Dairy Farm layout. 5. Study of deworming of dairy cattle. 6. Study of milking of dairy animals (machinery). 7. Study of milk density by lactometer. 8. Measurement of pH of milk with suitable method. 9. Colorimetric estimation of total fat in the milk of different varieties by FeCl3 method. 10. To find adulteration in the milk – starch and urea. 11. Preparation of paneer, curd, ghee from milk. 12. Visit to dairy farm and preparation of project report.	
10	**Reference Books:** • C.P. Ananthakrishnan (1964). Milk products preparation and quality control, Indian Council of Agricultural Research ISBN 8138-2756-6. • C.P. Ananthakrishnan (1993). The technology of milk processing. Shri Lakshmi Publ., ISBN 978-9350302637. • Eckles, Combs, Harold Macy (1943). Milk and milk products. McGraw-Hill book Company ISBN 978-0758184597. • G. C. Banerjee (2019). Text Book of Animal Husbandry. Oxford & IBH Publishing Co Pvt. Ltd ISBN: 978-8120412606. • Gosta Bylund (2003). Dairy processing handbook. Tetra Pak Processing Systems AB Publication ISBN-10. 9163134276. • Jagdish Prasad (2016). Principles and practices of Dairy farm. Kalyani ISBN- 978-9327264302. • Lincoln M. Lampert (1998). Modern Dairy products. Chemical Publishing Co Inc., U.S. ISBN 978-0820602301. • Madan Mohan (1989). Dairy management in India. Mittal Publications. ISBN: 81-7099-124-6. • M. M. Roy (2018). Dairy Chemistry and Animal Nutrition, Sonali Publication, ISBN 978-8193699904. • Roy N K. (1991). A Textbook of Practical Dairy Chemistry, Kalyani Publishers, ISBN 978-8170964421. • Sukumar De (2001). Outlines of Dairy Technology, Oxford Publication, ISBN 978-0195611946. • W.C. Frazier (2017). Food microbiology, McGraw Hill Publication, ISBN- 978-1259062513. • Webb Johnson and Alfred Fundamentals (2005). Dairy Chemistry, CBS Publication, ISBN 978-8123911991.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Semester – IV

Vertical – 1
Major

Syllabus
B.Sc. (Zoology)
(Semester – IV)

Title of Paper: S1MJ7 Genetics

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	The course provides a strong foundation in genetics and molecular biology, covering key topics such as Mendelian inheritance, chromosomal mechanisms, and gene expression. It then progresses to more advanced subjects like mutations, genetic disorders. These concepts are crucial for breakthroughs in medical genetics, biotechnology, and forensic science. With the rising demand in healthcare, pharmaceuticals, and bioinformatics, the course opens up diverse career opportunities in research, diagnostics, and genetic counselling. Additionally, it complements studies in biotechnology, biochemistry, and environmental science, promoting interdisciplinary innovation and real-world applications.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To familiarize learners to the foundational principles of Mendelian inheritance and provide insight into the mechanisms of sex determination and sex linkage. • To acquaint learners to the genetic basis of chromosomal aberrations and genetic disorders, and acquaint the learners with advanced diagnostic techniques.	
8	**Course Outcomes**: Upon completion of this course, students will be able to: • Explain the foundational principles of Mendelian inheritance and gain insight into the mechanisms of sex determination and sex linkage. • Analyse the genetic basis of chromosomal aberrations and genetic disorders, along with identifying the advanced diagnostic techniques for these aberrations and disorders.	

9	**Module 1: Genetics – I**	
	1.1 Introduction 1.1.1 Definition, Scope and Importance of Genetics. 1.1.2 Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome, Cistron, Muton, Recon.	01hr
	1.2 Mendelism and heredity 1.2.1 Mendel's laws of inheritance (Law of segregation, Law of Dominance, Law of Independent Assortment) 1.2.2 Types of Genetic crosses (Monohybrid, Dihybrid, Test cross, Back cross) 1.2.3 Chromosomal basis of inheritance 1.2.4 Mendelian inheritance and Laws of Probability	4hrs
	1.3 Extension of Mendelism 1.3.1Dominance relationships: Complete Dominance, Incomplete Dominance and Co-dominance 1.3.2 Lethal Alleles (Dominant, recessive and intermediate lethal) 1.3.3 Multiple Alleles 1.3.4 Polygenic Inheritance 1.3.5 Epistasis 1.3.6 Pleiotropy	7hrs
	1.4 Linkage: Concept and Types – Complete and Incomplete	01hr
	1.5 Crossing Over: Stern's experiment, mechanism and types	01hr
	1.6 Extrachromosomal / Maternal inheritance	01hr
	Module 2: Genetics – II	
	2.1 Sex determination and sex linkages 2.1.1 Types of sex determination (XX/XO, XX/XY, ZZ/ZW and haplo-diploidy) 2.1.2 Genic balance theory 2.1.3 Environment and sex determination – *Bonelia* and crocodiles 2.1.4 Sex linked determination – Colour blindness, haemophilia, hypertrichosis of the ear 2.1.5 Sex-influenced and sex-limited traits	4hrs
	2.2 Nondisjunction and its implications 2.2.1 Deletion and its types 2.2.2 Duplication and its types 2.2.3 Inversion 2.2.4 Translocation	3hrs
	2.3 Genetic disorders 2.3.1 Inborn errors of metabolism (PKU, Alkaptonuria, Albinism, G6PD deficiency) 2.3.2 Single gene disorder (cystic fibrosis) 2.3.3 Multifactorial (Breast cancer) 2.3.4 Genetic imprinting / Uniparental disomy (Prader-Willi and Angelman syndrome)	4hrs
	2.4 Detection of disorders/diseases and chromosomal abnormalities 2.4.1 Karyotype 2.4.2 Banding (G, C, FISH)	2hrs

	2.5 Genetic counselling and Pedigree analysis (Symbols and types) 2.5.1 Genetic counselling (Introduction, process, ethical and legal issues) 2.5.2 Pedigree analysis (Symbols and types)	2hrs
10	**References:** • Fraser, G. R., Mayo, O. (1975). Textbook of Human Genetics. Blackwell Scientific. ISBN 9780632089901, 0632089903. • Griffiths, A. J. (2004). An Introduction to Genetic Analysis. WH Freeman and Company. ISBN 0716749394. • Hartl, D. L. (2018). Essential genetics and genomics. 7th edition. Jones & Bartlett Learning. ISBN 9781284152456, 1284152456. • Mange, E. J., Mange, A. P. (1999). Basic Human Genetics. United States: Sinauer Associates, Incorporated. ISBN 9780878934973, 0878934979. • Pierce, B. A. (2020). Genetics: a conceptual approach. 7th edition. Macmillan International Higher Education. ISBN 2019952819, 9781319297145. • Russell, P. J. (2009). Genetics. 3rd edition. San Francisco: Benjamin Cummings. ISBN 0321569768, 9780321569769. • Simmons, M. J., & Snustad, D. P. (2015). Principles of genetics. 7th edition. John Wiley & Sons. ISBN 1119142288, 9781119142287. **ONLINE TOOLS AND WEB RESOURCES** ● https://swayam.gov.in/courses/4922-genetics-and-genomics ● https://www.coursera.org/learn/genetics-evolution ● https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/ ● https://learn.genetics.utah.edu/	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – IV)
Title of Paper: S1MJP5 Laboratory Exercises on Genetics

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This hands-on practical course in genetics and molecular biology provides students with essential laboratory skills to study heredity, and molecular mechanisms governing life. Covering fundamental topics such as Mendelian inheritance, chromosomal organization, and gene expression, the course progresses to advanced concepts like mutations, and genetic disorders. Students will gain experience in DNA extraction, gel electrophoresis, and karyotyping.
2	**Vertical:**	Major
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours for Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To acquaint learners to genetic analysis techniques, including karyotyping, pedigree analysis, and chromosomal staining. • To develop skills in solving problems based on inheritance patterns, linkage, and genetic abnormalities.	
8	**Course Outcomes**: Upon completion of this course, students will be able to: • Demonstrate skills in genetic analysis through practical techniques such as chromosome staining, blood group identification, and linkage mapping. • Interpret and evaluate genetic disorders, inheritance patterns, and chromosomal abnormalities using problem-solving approaches.	
9	1. Observation of Barr bodies – staining and mounting. 2. Mounting of Polytene chromosomes from salivary glands of *Chironomus* larvae. 3. Calculation of Mitotic Index. 4. Identification of Blood groups. 5. Problems based on monohybrid, dihybrid, test cross and back cross. 6. Problems based on epistatic interactions including test cross and back cross. 7. Determination of linkage and cross-over analysis (through two-point test cross and three-point test cross data). 8. Identification and preparation of idiograms – Normal male, normal female.	

	9. Identification and preparation of idiograms –Turner's Syndrome, Klinefelter's Syndrome, Down's Syndrome, Patau's Syndrome, Edwards Syndrome, Cri-du-chat Syndrome, D-G Translocation. 10. Study of Mendelian traits in humans (Example: Cleft Chin, Dimples, Freckles, Hitchhiker's Thumb, Albinism, Widow's peak, etc.) 11. Pedigree analysis – identification of symbols and problems. 12. Interpretation of genetic formulae: Deletion, duplication, inversion and translocation.	
10	**References:** • Fraser, G. R., Mayo, O. (1975). Textbook of Human Genetics. Blackwell Scientific. ISBN 9780632089901, 0632089903. • Griffiths, A. J. (2004). An Introduction to Genetic Analysis. WH Freeman and Company. ISBN 0716749394. • Hartl, D. L. (2018). Essential genetics and genomics. 7th edition. Jones & Bartlett Learning. ISBN 9781284152456, 1284152456. • Mange, E. J., Mange, A. P. (1999). Basic Human Genetics. United States: Sinauer Associates, Incorporated. ISBN 9780878934973, 0878934979. • Pierce, B. A. (2020). Genetics: a conceptual approach. 7th edition. Macmillan International Higher Education. ISBN 2019952819, 9781319297145. • Pranab Kumar Banerjee (2011). Problems on Genetics Molecular Genetics and Evolutionary Genetics. New Central Book Agency; 2nd edition • Russell, P. J. (2009). Genetics. 3rd edition. San Francisco: Benjamin Cummings. ISBN 0321569768, 9780321569769. • Simmons, M. J., & Snustad, D. P. (2015). Principles of genetics. 7th edition. John Wiley & Sons. ISBN 1119142288, 9781119142287. **ONLINE TOOLS AND WEB RESOURCES** ● https://swayam.gov.in/courses/4922-genetics-and-genomics ● https://www.coursera.org/learn/genetics-evolution ● https://onlinelearning.hms.harvard.edu/hmx/courses/hmx-genetics/ ● https://learn.genetics.utah.edu/	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – IV)
Title of Paper: S1MJ8 Molecular Biology

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This course explores molecular biology, covering topics such as nucleic acid structure, genome organization, replication, gene expression, and mutations. It plays a crucial role in biotechnology, genetic engineering, and medical research, addressing industry needs in healthcare, pharmaceuticals, and forensic science. Career prospects include roles in research, diagnostics, and bioinformatics. Additionally, the course integrates with genetics, biotechnology, and biochemistry, fostering interdisciplinary progress.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To introduce learners to the structural organization and functional significance of nucleic acids. • To equip learners with knowledge of gene expression, mutation types, and recent advancements in molecular biology.	
8	**Course Outcomes**: Upon completion of this course, students will be able to: • Analyze and differentiate the structure, organization, and types of nucleic acids, including their role in heredity. • Apply molecular biology concepts to understand DNA replication, gene expression, and emerging technologies like PCR and DNA fingerprinting.	
9		
	Module 1: Molecular Biology – I	
	1.1 Nucleic Acids 1.1.1 Structure of Nucleic acids – DNA and RNA 1.1.2 A, B, Z forms of DNA, Supercoiled DNA, Relaxed DNA 1.1.3 Types of RNA – non-genetic (mRNA, tRNA and rRNA) and genetic RNA 1.1.4 Biological Significance of Nucleic acids	06hrs
	1.2 DNA as a Genetic Material	03hrs

	1.2.1 Griffith's transformation experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment	
	1.3 RNA as a Genetic Material: 1.3.1 TMV experiment	01hr
	1.4 Genome and Its Organization 1.4.1 Concept of gene, intron and exons, regulatory sequences 1.4.2 Packaging of DNA into chromosomes 1.4.3 Extrachromosomal DNA – Chloroplast DNA and Mitochondrial DNA	05hrs
	Module 2: Molecular Biology – II	
	2.1 DNA Replication 1.1.1 Prokaryotic 1.1.2 Eukaryotic	05hrs
	2.2 Gene Expression 2.2.1 Genetic Code with properties 2.2.2 Protein Synthesis	04hrs
	2.3 Mutation 2.3.1 Types of Mutation • Point mutations - substitution, deletion and insertion mutations • Substitution mutations - silent, missense and nonsense mutations, transition and transversion • Deletion and Insertion mutations - frameshift mutations 2.3.2 Mutagens – Physical and Chemical Mutagens	04hrs
	2.4 Recent advances in Molecular Biology 2.4.1 Polymerase Chain Reaction 2.4.2 DNA Fingerprinting	02hrs

10 References:

- Ankanccha Jain, Richa Jain and Saurabh Jain (2020). Basic Techniques in Biochemistry, Microbiology and Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-1493998609.
- Green, M. R., & Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045.
- Karp, G. (Year). Cell and molecular biology: A laboratory manual (8th ed.). Wiley. ISBN 978-1119553441.
- Madhuri, A. (2023). Molecular biology and microbial genetics with practicals. Divya Lakshmi Publishers and Distributors. ISBN 978-9391576233.
- Mamata Behera, M, Swain, R., Singh, A. P. (2024). A Practical manual on fundamentals of Genetics. Bigfoot Publications, ISBN 978-8197034770.
- N. Arumugam (2019). Cell Biology and Molecular Biology - Saras publications
- Robert J. Slater (1986). Experiments in Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-0-89603-082-4.
- Simmonds, P. J. R., & McAllister, S. W. (Year). Experiments in molecular biology. Pearson Education. ISBN 978-0321541161.
- Suchetha Kumari N (2018). Multidisciplinary Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323.
- Verma P.S. and Agarwal V.K. (2004). Molecular Biology- ISBN-13: 978-8121931915- S. Chand Publications.
- Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2004). Molecular biology of the gene (xth ed.). Pearson. ISBN 978-0805346428.

	• Zhang. S., & Li, P. (2017). Essential experiments for molecular biology: A student's guide (Paperback). Medtech Publication. ISBN 978-9386479136.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – IV)
Title of Paper: S1MJP6 Laboratory Exercises on Molecular Biology

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This practical course in molecular biology provides students with hands-on experience in key laboratory techniques, including DNA/RNA extraction and estimation, and gel electrophoresis.
2	**Vertical:**	Major
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours for Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives**: • To develop practical skills in molecular biology techniques such as nucleic acid quantification, electrophoresis, and restriction mapping. • To develop analytical abilities in interpreting molecular biology data and problem-solving in genetic analysis.	
8	**Course Outcomes**: Upon completion of this course, students will be able to: • Perform and interpret quantitative estimation of DNA and RNA, and analyze nucleic acid ratios. • Demonstrate proficiency in molecular biology instrumentation and experimental techniques such as gel electrophoresis and restriction mapping.	
9	1. Colorimetric (quantitative) estimation of DNA by DPA method. 2. Colorimetric (quantitative) estimation of RNA by Orcinol method. 3. Calculation of RNA / DNA ratio from given data. 4. Identification of various Molecular Biology laboratory instruments – Gel electrophoresis instrument, Laminar Air flow, Gel Documentation System, DNA Sequencer, Microcentrifuge Cryogenic Freezer (Liquid Nitrogen or – 80°C Freezer), Thermocycler, Nano drop. 5. Demonstration of separation of Genomic DNA by Agarose gel electrophoresis. 6. Construction of restriction map by single and double digestion. 7. Problems based on Molecular Biology. 8. Visit to Molecular Biology Laboratory or Research Centre and submission of report.	

10	**References:** • Ankanccha Jain, Richa Jain and Saurabh Jain (2020). Basic Techniques in Biochemistry, Microbiology and Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-1493998609. • Green, M. R., & Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045. • Karp, G. (Year). Cell and molecular biology: A laboratory manual (8th ed.). Wiley. ISBN 978-1119553441. • Madhuri, A. (2023). Molecular biology and microbial genetics with practicals. Divya Lakshmi Publishers and Distributors. ISBN 978-9391576233. • Mamata Behera, M, Swain, R., Singh, A. P. (2024). A Practical manual on fundamentals of Genetics. Bigfoot Publications, ISBN 978-8197034770. • Robert J. Slater (1986). Experiments in Molecular Biology. Springer Protocols, Humana Press Inc., ISBN 978-0-89603-082-4. • Simmonds, P. J. R., & McAllister, S. W. (Year). Experiments in molecular biology. Pearson Education. ISBN 978-0321541161. • Suchetha Kumari N (2018). Multidisciplinary Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323. • Zhang. S., & Li, P. (2017). Essential experiments for molecular biology: A student's guide (Paperback). Medtech Publication. ISBN 978-9386479136.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

SEC

Syllabus
B. Sc. (Zoology)
(Semester – IV)
Title of Paper: SEC3a Intellectual Property Rights

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	Intellectual Property Rights (IPR) offer legal protection for innovations and creative works through patents, copyrights, and trademarks. Crucial for safeguarding innovation and promoting fair competition, IPR provides legal recognition and economic benefits to creators. It plays a vital role in industries such as biotechnology, pharmaceuticals, software, and the arts, garnering significant interest from businesses, researchers, and legal professionals. As a multidisciplinary field, IPR bridges law, business, science, technology, and the arts. Industries depend on IPR for competitive advantage, driving high demand for professionals such as patent attorneys, IP consultants, and trademark specialists.
2	**Vertical:**	SEC
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To explain the fundamentals and significance of Intellectual Property Rights (IPR). • To compare the different types of IPR: patents, copyrights, trademarks, designs, and acquire practical skills in procedures for registration, assignment, and licensing of copyrights and trademarks. • To analyse the legal framework for IPR protection acts and regulations and develop skills in drafting complete patent applications and specifications.	
8	**Course Outcomes:** Upon completion of the course, the learners should be able to: • Define and classify various types, differentiate between patents, copyrights, trademarks, and other forms of IP. • Explain the procedures for registration and licensing of copyrights and trademarks, including compliance with legal requirements. • Design patent specifications, including claims and technical descriptions.	

9	1. Introduction to IPR: 1.1 Definition, nature, classification 1.2 Protection of intellectual property 1.3 Importance of IPR. 2. Types of IPR: 2.1 Types of patent 2.2 Copyrights 2.3 Trademark 2.4 Designing of patent 3. Copyrights: 3.1 Origin, definition & types of copyrights 3.2 Registration procedure 3.3 Assignment & license 3.4 Terms of copyrights 3.5 Piracy, infringement, remedies, 4. Trademarks: 4.1 Concept of trademarks 4.2 Rationale behind the protection of trademarks 4.3 Trademark act 1940 4.4 Procedure for registration: submission of application. 5. Criteria for patentability and non-patentability; 5.1 Products and process patent 5.2 Software patents 5.3 Patenting of micro-organism 5.4 Rights of patentee 5.5 Procedure for granting a patent and obtaining patents. 6. Structure of Patent Complete Specification: 6.1 A provisional (or preliminary) patent application 6.2 Title of the invention 6.3 Abstract of the disclosure 6.4 Background of the invention / Prior Art 6.5 Description of the invention (Technical field, background information, summary of the invention, detailed description and drawings (If Applicable) 6.6 Claims 6.7 Alternative embodiment (Optional). 7. Case studies based on Indian patents (any 1). 8. Prepare a Literature survey / Patent survey on a suitable topic. 9. Prepare a draft claim based on an abstract on a suitable topic. 10. Prepare Patent Search Report (PSR) of a Case Study.
10	**Reference Books:** • Act 39 of 1970 as amended by the Jan Vishwas (Amendment of Provisions) Act 2022 dt. 11-8-23. The Patents Act, 1970 by Commercial law Publishers (India) Pvt. Ltd. • Act 47 of 1999 as amended by the Jan Vishwas (Amendment of Provisions) Act 2023 (18 of 2023), The trade mark Act 1999 by Universal LexisNexis. • Dr. B L Wadehra revised by Hemant Kumar Pandey Law Relating to Intellectual property by Universal LexisNexis.

	• Dr. B.L. Wadehra Intellectual Property Law, Universal Law Publishing Co. 6th Edition (2021). • Dr. V K Ahuja Law relating to Intellectual Property Rights 9. Third Edition) by Universal LexisNexis. • Lionel Bently & Brad Sherman Principles of Intellectual Property Law Oxford University Press Publication. 5th Edition (2022). • Mario Cimoli, Giovanni Dosi, Keith E. Maskus Intellectual Property Rights: Legal and Economic Challenges for Development by, Oxford University Press Publication. 1st Edition (2014). • Narayana P Intellectual Property Rights in India by, Eastern Law House Publication. 3rd Edition (2005). • Prabuddha Ganguli Intellectual Property Rights: Unleashing the Knowledge Economy by, Tata McGraw Hill Education Publication. 1st Edition (2001). • Robert Patrick Merges, John Fitzgerald Duffy Patent Law and Policy: Cases and Materials Carolina Academic Press. 8th Edition (2020). • Saurabh Bindal MCQ on Intellectual Property Law by Eastern Book Company (EBC) second Edition. • Siva Vaidhyanathan Intellectual Property: A Very Short Introduction, Oxford University Press Publication 1st Edition (2017). • V.K. Ahuja Law Relating to Intellectual Property Rights LexisNexis Publication. 3rd Edition (2022). • W.R. Cornish & David Llewelyn Intellectual Property: Patents, Copyright, Trade Marks & Allied Rights, Sweet & Maxwell Publication. 9th Edition (2019).	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

Syllabus
B.Sc. (Zoology)
(Semester – IV)
Title of Paper: SEC3b Nature Educator

Sr. No.	Heading	Particulars
1	**Description of the course: Including but nt limited to:**	This course offers hands-on training in biodiversity identification, conservation ethics, wildlife observation, and ecological studies, equipping students with essential skills for environmental education, sustainable tourism, and conservation efforts. With the growing demand in eco-tourism, research, and conservation sectors, the course connects with Environmental Science and Wildlife Management, opening up career opportunities as nature educators, conservationists, eco-tourism guides, and researchers.
2	**Vertical:**	SEC
3	**Type:**	Practical
4	**Credit**:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To enhance learners' skills in applying responsible forest etiquette, administering first aid in wilderness settings, and utilizing wildlife photography techniques while observing and documenting wildlife behaviour. • To enable learners to analyze Indian forest ecosystems, biodiversity threats, and conservation strategies, including legal frameworks and protection measures, through case studies and field observations.	
8	**Course Outcomes:** Upon completion of the course, the learners should be able to: • Implement ethical forest practices, provide first aid in outdoor environments, and effectively use wildlife photography equipment to document species and habitats. • Evaluate forest types, biodiversity threats, and conservation strategies while interpreting wildlife behavior and legal frameworks for species protection.	
9	1. Practicing Forest Etiquette: A Guide for Responsible Nature Educators. (Dos and Don’ts during forest visit) 2. Introduction to Basic Equipments for Wildlife Photography: Camera (DSLR / Digital / Point & shoot), lenses, tripod, monopod, memory cards and batteries, smartphone, binoculars, weather protection gear. 3. Observation of social behaviour: alarm calls and mating calls in animals (birds, amphibians, mammals) (Based on field visits / recordings) . 4. Studying the tips to track Wildlife: Reading footprints and scat. 5. Common animal species found in Indian forests: Insects (weaver ant, tortoise beetle, Blue mormon butterfly, globe skimmer dragonfly, atlas moth, painted	

	grasshopper), Amphibians (Tree frog, Bull frog, skittering frog, common toad), Reptiles (Spectacled Cobra, Russel's viper, common sand boa, Indian rock python, wolf snake, checkered keelback snake, oriental garden lizard), Aves (bulbuls, mynas, babblers, parakeets, bee-eater, Asian koel, kingfisher, lapwing), and Mammals (Langurs, Bonnet macaques, grey mongoose, jackal, leopard, Indian flying fox). 6. Identification of marine intertidal fauna: Sea anemone, hermit crab, *Conus,* Mud skipper, Fiddler crab, *Chiton, Nereis, Chthalamus.* 7. Identification of homes and architectures designs by animals: Tailor bird nest, weaver bird nest, lapwing nest, bat crevices, ant pagoda, termite hill, harvester ant nest, orb-weaver spider web. 8. Submit a report on the study of Biodiversity Hotspots in India: • The Western Ghats • The Himalayas • Indo-Burma (Northeastern India) • Sundaland (Andaman and Nicobar Islands) 9. Submission of report on any one types of Indian Forests, and its related fauna. 10. Study of Indian Fauna Based on IUCN Red List Categories Examples of Indian Fauna for Each Category: • Extinct (EX) – Pink-headed Duck (*Rhodonessa caryophyllacea*) • Extinct in the Wild (EW) – Asiatic Cheetah (*Acinonyx jubatus venaticus*) • Critically Endangered (CR) – Snow leopard (*Panthera uncia*) • Endangered (EN) – Asiatic Lion (*Panthera leo persica*) • Vulnerable (VU) – Sloth Bear (*Melursus ursinus*) • Near Threatened (NT) – Purple frog (*Nasikabatrachus sahyadrensis*) • Least Concern (LC) – Indian Peafowl (*Pavo cristatus*) • Data Deficient (DD) – Slender racer snake (*Platyceps gracilis*) • Not Evaluated (NE) – Dromedary camel (*Camelus dromedarius*) 11. Preparation and submission of report on Wildlife Conservation Strategies in India: Case Studies and Impact Analysis (any one suitable example): • Project Tiger (Species-Specific Conservation) • Indian Rhino Vision 2020 (An initiative to increase the population of greater one-horned rhinos) • Olive Ridley Turtle Conservation at Velas Beach (Protected Area Conservation) • Nagaland Amur Falcon Conservation (Community-Based Conservation) • Captive Breeding of Gharials (Ex-Situ Conservation) • Vulture Conservation Project at Shriwardhan (Private Protected Area) 12. Visit to any National Park / Sanctuary / Zoo / Zoological Research Centre / Nocturnal Wildlife Observation / Marine intertidal zone/ Suitable habitat and submit a report.
10	**Reference Books:** • David C. Coleman (1998). Soil Ecology and Management, Blackwell Publishing, ISBN: 9780471196688. • D. Ehrenfeld (1994). Conservation Biology: A Primer for the Twenty-First Century, Oxford University Press, ISBN: 9780195078747. • Edward O. Wilson (1985). Biology of Conservation, Sinauer Associates, ISBN: 9780878936602. • G. S. Tiwari (2005). Wildlife Conservation and Management in India, Anmol Publications, ISBN: 9788126123647.

	• H. S. A. I. Kothari (1995) The Flora of India - Botanical Survey of India, ISBN: 9788187067135. • John Shaw (2007). The Nature Photographer's Complete Guide to Professional Field Techniques, Amphoto Books, ISBN: 9780817440596. • J. S. Singh (2006). Ecology: A Textbook for Environmental Science, APH Publishing Corporation, ISBN: 9788131300980. • K. M. Matthew (1981). Indian Flora – A comprehensive guide on plant species in India, Oxford University Press ISBN: 9780195607602. • K. S. R. Anjaneyulu (2002). Ecology of Indian Forests, I. K. International Publishing House, Pvt. Ltd, ISBN: 9788188237182. • K. S. Rao (1998). Indian Wildlife Laws: A Guide, Oxford University Press, ISBN: 9780195641057. • N. G. Hairston (2009). Introduction to Population Ecology, Wiley-Blackwell Publication, ISBN: 9781405145713. • N. N. Tiwari (1998). Environmental Education and Awareness, Ashish Publishing House, ISBN: 9788170249076. • S. S. Gupta (2014). Nature Photography: A Handbook, Natraj Publishers, ISBN: 9788176203546. • S. S. Purohit (2011). Ecology and Environmental Biology, Agrobios (India), ISBN: 9788177545690. • Thomas S. Elias (1980). Flora of the World, Harper & Row Publication, ISBN: 9780063182731. • Vernon R. Brown (2004). Environmental Education: A Resource Handbook, Routledge Publication. • William M. Adams (2004). The Conservation Handbook: Research, Management, and Policy, Blackwell Publishing, ISBN: 9781405106394.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)	

QUESTION PAPER PATTERN
(External and Internal)

S. Y. B. Sc. Zoology evaluation pattern and question paper pattern for semester end theory examination of major courses

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End Semester Examination
Continuous Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment, etc. (15 Marks), Overall performance (5 Marks) Total (20 Marks)	**As per paper pattern**	**01.00 hour**

Format of Theory Question Paper: Semester End Examination

Time 1 hr **Max. Marks 30**

Attempt any two out of four:

Q. 1. Answer the following:	
a. Module I	05
b. Module I	05
c. Module II	05
Q. 2. Answer the following:	
a. Module II	05
b. Module II	05
c. Module I	05
Q. 3. Answer the following:	
a. Module I	08
b. Module II	07
Q. 4. Answer the following:	
a. Module II	08
b. Module I	07

S. Y. B. Sc. Zoology Evaluation pattern and Question paper pattern for Semester End Practical Examination of Major Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End Semester Examination
Assignment / Objective question test / Project / Role play / Creative writing (10 Marks), Viva (5 marks) Overall performance (5 Marks) Total (20 Marks)	**As per paper pattern**	**2 hours**

Note: A certified journal is mandatory to appear for practical exam.

Format of Practical Question Paper

Time 2 hrs **Max. Marks 30**

Q.1 One Major experiment	10
Q.2 One Minor experiment	07
Q.3 Identification (any four)	08
Q.4 Journal & Viva	05

S. Y. B. Sc. Zoology Evaluation pattern and Question paper pattern for Semester End Practical Examination of Vocational Skill Courses and Skill Enhancement Courses

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End Semester Examination
Assignment / Objective question test / Project / Role play / Creative writing (10 Marks) Viva (5 marks) Overall performance (5 Marks) Total 20 Marks	As per paper pattern	**2 hours**

Note: A certified journal is mandatory to appear for practical exam.

Format of Question Paper:

Time 2 hrs **Max. Marks 30**

Format of question papers is specified for each VSC and SEC course separately.

University of Mumbai
S. Y. B. Sc. Zoology: Semester – III
Skeleton Question Paper pattern for Practical Examination
S1MJP3 Laboratory Exercises on Cell Biology

Duration: 2 hrs **Total Marks: 30**

Major **(10)**

Q.1 Measure the size of the given cell sample using oculometer and stage micrometer.

OR

Q.1 Stain prokaryotic cells (bacteria) by Crystal violet staining technique.

Minor **(07)**

Q.2 Demonstrate permeability of cell through plasma membrane (osmosis in blood cells).

OR

Q.2 Stain eukaryotic cells (WBCs) from blood smear by Leishman's stain.

Q.3 Identify and describe. **(08)**

a) Nucleus (Euchromatic and heterochromatic) / Mitochondria (various shapes) / Golgi Bodies (various shapes)
b) Lysosomes (Multivesicular bodies, Residual Bodies) / Vacuoles / Centrioles / Rough Endoplasmic Reticulum (RER)
c) Prions / Viroids / Bacteriophages / Mycoplasma
d) Simple Microscopy / Compound Microscopy / Phase contrast Microscopy / Fluorescence microscopy / Scanning Electron Microscopy / Transmission Electron Microscopy / Immuno-Electron Microscopy

Q.4 Journal and Viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology: Semester – III
Skeleton Question Paper pattern for Practical Examination
S1MJP4 Laboratory Exercises on Biochemistry

Duration: 2 hrs **Total Marks: 30**

Major **(10)**

Q.1 Quantitatively estimate lipids by titrimetric method.

OR

Q.1 Demonstrate effect of substrate concentration on acid phosphatase enzyme activity.

OR

Q.1 Demonstrate effect of enzyme concentration on acid phosphatase enzyme activity.

OR

Q.1 Prepare titration curve for strong acid and strong base with the help of pH meter.

OR

Q.1 Prepare buffer of different pH using Henderson-Hasselbalch equation.

Minor 1 **(07)**

Q.2 Determination of pKa for weak acid.

OR

Q.2 Detect Vitamin C from various suitable fruits.

OR

Q.2 Demonstrate osazone formation using suitable reducing sugar.

Minor 2 **(08)**

Q.3 Qualitative analysis of Carbohydrates (any two).

OR

Q.3 Qualitative analysis of Proteins (any two).

OR

Q.3 Qualitative analysis of Lipids (any two).

OR

Q.3 Determine pH of solutions using red cabbage indicator (any four).

Q.4 Journal and Viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology: Semester – IV
Skeleton Question Paper pattern for Practical Examination
S1MJP5 Laboratory Exercises on Genetics

Duration: 2 hrs **Total Marks: 30**

Major

Q.1 a) Mount Barr bodies. **(06)**

b) Calculation of mitotic index. **(04)**

OR

Q.1 Mount polytene chromosomes from salivary glands of *Chironomus* larvae. **(10)**

Minor

Q.2. Interpretation of genetic formulae (2 problems). **(07)**

OR

Q.2 Identification and preparation of ideogram (any one syndrome). **(07)**
and explain the causes and characteristics of the same.

Q.3 a) Problem (any one) based on monohybrid, dihybrid, test cross and back cross, epistatic interactions, linkage and cross-over analysis. **(04)**

b) Identification of Pedigree symbols (any 4). **(04)**

OR

Q.3 Identify blood group of the given blood sample. **(08)**

OR

Q.3 Identify and describe (w.r.t. inheritance) of Mendelian traits in humans (any 4). **(08)**

Q.4 Journal and Viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology: Semester – IV
Skeleton Question Paper pattern for Practical Examination
S1MJP6 Laboratory Exercises on Molecular Biology

Duration: 2 hrs **Total Marks: 30**

Major **(10)**

Q.1 Colorimetric estimation of DNA by DPA method.

OR

Q.1 Colorimetric estimation of RNA by Orcinol method.

Minor **(07)**

Q.2 Construction of restriction map by single and double digestion.

OR

Q.2 Problems based on Molecular Biology (2 problems).

Q.3 Identify and describe. **(08)**

a) Gel electrophoresis instrument / Laminar Air flow
b) Gel Documentation System / DNA Sequencer
c) Microcentrifuge / Cryogenic Freezer (Liquid Nitrogen or -80°C Freezer)
d) Thermocycler / Nano drop

Q.4 Journal and Viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology
Skeleton Question Paper pattern for Practical Examination
VSC3a – Pest Control

Duration: 2 hrs **Total Marks: 30**

Major **(07)**

Q.1 Sampling techniques for estimation of insect population and damage by Population indices / Absolute estimates/ Relative estimates.

OR

Q.1 Study on the distribution patterns of insects in crop ecosystems by Regular / Uniform distribution / Random / Poison distribution / Clumped / Aggregated / Over-dispersed / Contagious distribution (Any Two).

Minor **(06)**

Q.2 Calibration of different insecticides formulation by preparation of spray fluid/ Pearson method.

OR

Q.2 Study of life cycle of rice weevil / flour beetle / suitable pest.

OR

Q.2 Study of IPM practices: Physical / Mechanical / Cultural / Biological methods.

Q.3 Identify and describe. **(08)**

a) Insect pest of field crops: Rice / Wheat / Mulberry / Mango / Banana
b) Non-insect pests of field crops: Birds / Crabs / Snails / Slugs / Millepedes / Mites / Rats / Squirrels
c) Household pests: Cockroach / Termite / Bed bug / Mice / House fly
d) Pesticide appliances: Types of Sprayers / Types of Dusters

Q.4 Submission of field visit report and viva **(04)**

Q.5 Journal and viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology
Skeleton Question Paper pattern for Practical Examination
VSC3b – Dairy Science

Duration: 2 hrs **Total Marks: 30**

Major **(07)**

Q.1 Colorimetric estimation of total fat in the milk of different varieties by $FeCl_3$ method.

OR

Q.1 To find adulteration in milk – Starch and Urea.

OR

Q.1 Preparation of Paneer / Curd / Ghee from milk.

Minor

Q.2a Estimation of milk density by lactometer. **(03)**

Q.2b Submission of report and viva on (any one) **(03)**
cattle feed, vaccination schedule of dairy cattle, dairy animal diseases, cost of milk production, Dairy Farm layout.

Q.3 Identify and describe **(08)**

a) Cattle breed
b) Cattle breed
c) Buffalo breed
d) casting of farm animals / trimming of dairy cattle / shoeing of bullocks / milking of dairy animals (machinery) / deworming of dairy cattle.

Q.4 Submission of field visit report and viva **(04)**

Q.5 Journal and viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology
Skeleton Question Paper pattern for Practical Examination
SEC3a – Intellectual Property Rights

Duration: 2hrs **Total Marks: 30**

Q.1 Write a Literature survey / Patent survey on the topic provided. **(09)**

OR

Q.1 Draft Claims based on the provided abstract of the topic. **(09)**

Q.2 Draft an application for Copyright. **(06)**

OR

Q.2 Identify the category and draft an application form for the Trademark. **(06)**

Q.3 Submit Patent Search Report (PSR) of a Case Study. **(10)**

Q.4 Journal and viva **(05)**

University of Mumbai
S. Y. B. Sc. Zoology
Skeleton Question Paper pattern for Practical Examination
SEC3b – Nature Educator

Duration: 2 hrs **Total Marks: 30**

Q.1 Identify and describe common animal species found in India. **(06)**
a) Insects / Intertidal fauna (any one)
b) Amphibians / Reptiles (any one)
c) Aves / Mammals (any one)

Q.2 Identify **(05)**
a) Basic Equipment for Wildlife Photography
b) Animal homes / architectural design
c) Forest Etiquettes
d) Identify the animal by its footprint / Pugmark / Scat
e) Animal of any IUCN category given in syllabus

Q.3 Submission of report on
a) Biodiversity Hotspots in India **(03)**
b) Wildlife Conservation Strategies in India: Case Studies and Impact Analysis **(03)**
OR
b) Type of forest and related fauna. **(03)**

Q.4 Project report **(08)**
Visit to any National Park / Sanctuary / Zoo / Zoological Research Centre / Nocturnal Wildlife Observation / Suitable habitat

Q.5 Journal and viva **(05)**

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-
Sign of the BOS Chairman
Dr. Vaishali U. Somani
BOS in Zoology

Sd/-
Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sd/-
Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science & Technology