AC – 20/05/2025
Item No. – 6.6 (N) (1abc) Sem. III & IV

As Per NEP 2020

University of Mumbai

Syllabus for Minor Vertical – 2 (Scheme – II)		
Faulty of Science		
Board of Studies in Zoology		
Second Year Programme in Minor (Zoology)		
Semester	**III & IV**	
Title of Paper	**Sem.**	**Total Credits 4**
Cytology	III	2
Laboratory Exercises on Cytology		2
Title of Paper	**Sem.**	**Total Credits 4**
Genetics and heredity	IV	2
Genome and Gene Expression		2
Laboratory Exercises on Genetics and Nucleic acids		2
From the Academic Year	**2025-26**	

Semester – III
Minor

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

Title of Paper: Cytology

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	Cytology 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:**	Minor (M2)
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.	

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Module 1: Cytology – 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: Cytology – II

2.1 Endomembrane System 2.1.1 Endoplasmic reticulum – Structure and Functions • SER • RER 2.1.2 Golgi apparatus – Structure and Functions 2.1.3 Lysosomes – Structure, Functions and Types 2.1.4 Polymorphism in lysosomes 2.1.5 GERL system 2.1.6 Vacuoles – Structure and Functions 2.1.7 Peroxisomes – Structure and Functions	09hrs
2.2 Cytoskeletal structures 2.2.1 Microtubules, microfilament and intermediate filaments 2.2.2 Cilia, Flagella and Sperm tail 2.2.3 Microvilli	04hrs
2.3 Cell division 2.3.1 Cell cycle 2.3.2 Cell division: Mitosis, and Meiosis	02hrs

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Reference Books:

- 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: Laboratory Exercises on Cytology

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This hands-on practical course in cytology provides students with essential laboratory skills to study cell structure, and function.
2	**Vertical:**	Minor (M2)
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 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 8. Mounting of cells for observation of mitosis using suitable material (Onion root tips) 9. Mounting of cells for observation of meiosis using suitable material (*Tradescantia* buds)	
10	**Reference Books:** • 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. • https://www.egyankosh.ac.in/bitstream/123456789/68533/3/BBCCL-104.pdf • Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.	
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
Minor

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

Title of Paper: Genetics and heredity

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	The course provides a strong foundation in genetics and heredity, 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:**	Minor (M2)
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 and Heredity– 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.	01 hr
	1.2 Mendelism and heredity 1.2.1 Mendel's laws of inheritance (Law of segregation, Law of Independent Assortment) 1.2.2 Test cross, Back cross 1.2.3 Chromosomal basis of inheritance	4hrs
	1.3 Extension of Mendelism 1.3.1 Dominance 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	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 2.1.4 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

<table>
<tr><td>10</td><td colspan="2">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/</td></tr>
<tr><td>11</td><td>Internal Continuous Assessment: 40%</td><td>External, Semester End Examination 60% Individual Passing in Internal and External Examination</td></tr>
<tr><td>12</td><td>Continuous Evaluation through:
Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment etc. (at least 3)</td><td></td></tr>
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Syllabus
B.Sc. (Zoology)
(Semester – IV)
Title of Paper: Genome and Gene Expression

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This course explores Genome and Gene Expression, 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:**	Minor (M2)
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.	

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Module 1: Genome and Gene Expression – 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 1.2.1 Griffith's transformation experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment	03hrs
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: Genome and Gene Expression – II

1.1 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.
- 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.
- Research Methods - A Practical Manual - A Practical Manual. Paras Medical Books. ISBN 9789386480323.
- 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 Green, M. R., & Sambrook, J. (2013). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press. ISBN 978-1621821045. • 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: Laboratory Exercises on Genetics and Nucleic acids

Sr. No.	Heading	Particulars
1	**Description of the course: Including but not limited to:**	This hands-on course covers key concepts in molecular biology, including nucleic acid estimation, genome organization, replication, gene expression, and mutations. It is essential for fields like biotechnology, genetic engineering, and medical research, meeting industry demands in healthcare, pharmaceuticals, and forensic science. This course provides a comprehensive understanding of molecular biology, encompassing nucleic acid structure, genome organization, replication, gene expression, and mutations. Graduates can pursue careers in research, and diagnostics. Furthermore, the course facilitates interdisciplinary advancements.
2	**Vertical:**	Minor (M2)
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 enable learners to analyze genetic inheritance patterns and apply bioinformatics tools in molecular research. • To develop practical skills in molecular biology techniques, including nucleic acid extraction, detection, and cytogenetic analysis.	
8	**Course Outcomes**: Upon completion of this course, students will be able to: • Demonstrate proficiency in DNA/RNA extraction, staining, and molecular detection techniques. • Analyze and interpret genetic data, including inheritance patterns, chromosomal abnormalities, and molecular biology applications.	
9	1. Extraction by SDS method and detection of DNA by DPA method from liver tissue. 2. Extraction by phenol method and detection of RNA by Orcinol method from liver tissue. 3. Observation of Barr bodies – staining and mounting. 4. Study of Mitotic Index. 5. Problems based on monohybrid, dihybrid, test cross and back cross.	

	6. A) Identification and preparation of idiograms – Normal male, normal female. B) 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. 7. Study of Mendelian traits in humans. 8. Pedigree analysis (identification of symbols and problems). 9. Calculation of RNA / DNA ratio from given data. 10. 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. 11. Problems based on Molecular Biology. 12. Visit to Molecular Biology Laboratory / 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)	

QUESTION PAPER PATTERN
(External and Internal)

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

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for Semester End Examination
Continuous Evaluation through: Quizzes, Class Tests, Presentation, Project, Role play, Creative writing, Assignment, etc. (10 Marks), Viva (5 marks) Overall performance (5 Marks) Total (20 Marks)	**As per paper pattern**	**01.00 hour**

Format of Theory Question Paper: Semester End Examination

Time 1.0 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 Minor Course

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for Semester End Examination
Continuous Evaluation through: Assignment / Objective test (10 Marks), Viva (5 marks) Overall performance (5 Marks) = 20 Marks	**As per paper pattern**	**2 hrs**

Format of Practical Question Paper: Semester End Examination

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

University of Mumbai
S. Y. B. Sc. Zoology: Semester – III
Skeleton Question Paper pattern for Practical Examination
S2MNP Laboratory Exercises on Cytology

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.

OR

Q.1 Mount the given tissue to show Mitosis / Meiosis.

Minor **(07)**

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

OR

Q.2 Stain eukaryotic cell (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)**

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S. Y. B. Sc. Zoology: Semester – IV
Skeleton Question Paper pattern for Practical Examination
S2MNP Laboratory Exercises on Genetics and Nucleic acids

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

Q.2 a) Identification and preparation of idiogram of the normal / syndrome and explain the causes and characteristics of the same (any one). **(04)**

b) Mounting of Barr bodies. **(03)**

OR

Q.2 a) Problems (any one) based on monohybrid/ dihybrid/ test cross /back cross. **(04)**

b) Calculation of RNA : DNA ratio from given data. **(03)**

OR

Q.2 a) Problems on Molecular Biology (any one). **(04)**

b) Calculation of mitotic index. **(03)**

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

a) Mendelian trait in humans

b) Pedigree symbol

c) Gel electrophoresis instrument / Laminar Air flow / Gel Documentation System / DNA Sequencer

d) Microcentrifuge / Cryogenic Freezer (Liquid Nitrogen or – 80°C Freezer) / Thermocycler / Nano drop

Q.4 Journal and submission of report on visit to Molecular Biology Laboratory / Research Centre. **(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 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