AC – 27/12/2023
Item No. – 6.5 (N)

As Per NEP 2020

University of Mumbai

Title of the program

A- U.G. Certificate in **Life Sciences**
B- U.G. Diploma in **Life Sciences**
C- B.Sc. (**Life Sciences**)
D- B.Sc. (Hons.) in **Life Sciences**
E- B.Sc. (Hons. with Research) in **Life Sciences**

Syllabus for

Semester – Sem I& II

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2024-25 Progressively)

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O: _____A**	**A**	**U.G. Certificate in Life Sciences**
	O: _____B	**B**	**U.G. Diploma in Life Sciences**
	O: _____C	**C**	**B.Sc. (Life Sciences)**
	O: _____D	**D**	**B.Sc. (Hons.) in Life Sciences**
	O: _____E	**E**	**B.Sc. (Hons. with Research) in Life Sciences**
2	**Eligibility** **O: _____A**	**A**	A candidate for being eligible to the degree course of Bachelor of Science should have passed XII standard examination of the Maharashtra Board of Higher Secondary Education or its equivalent in Science with biological or allied sciences as one of the subjects. **OR** Passed Equivalent Academic Level 4.0
	O: _____B	**B**	Under Graduate Certificate in Life Sciences **OR** Passed Equivalent Academic Level 4.5
	O: _____C	**C**	Under Graduate Diploma in Life Sciences **OR** Passed Equivalent Academic Level 5.0
	O: _____D	**D**	Bachelors of Life Sciences with minimum CGPA of 7.5 **OR** Passed Equivalent Academic Level 5.5
	O: _____E	**E**	Bachelors of Life Sciences with minimum CGPA of 7.5 **OR** Passed Equivalent Academic Level 5.5
3	**Duration of program** **R: _____**	**A**	One Year
		B	Two Years
		C	Three Years

		D	Four Years
		E	Four Years
4	**Intake Capacity** **R: _____**	**60 seats in one division.**	
5	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	**R: _____ Standards of Passing**	40% in each component.	
7	**Credit Structure** **Sem. I - R: _____A** **Sem. II - R: _____B**	Attached herewith	
	Credit Structure **Sem. III - R: _____C** **Sem. IV - R: _____D**		
	Credit Structure **Sem. V - R: _____E** **Sem. VI - R: _____F**		
8	**Semesters**	A	Sem I & II
		B	SemIII& IV
		C	Sem V & VI
		D	Sem VII& VIII
		E	Sem VII & VIII
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5
		D	6.0
		E	6.0
10	**Pattern**	Semester	

11	**Status**	New
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2024-25

Sign of the BOS Chairman
Dr. Ujwala Jadhav
The Chairman, Board of Studies in Life Sciences

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

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

Preamble

1) Introduction

This programme has been designed keeping in mind that the learners have been introduced to the science of life and are keen to explore this discipline. Life Sciences is a multidisciplinary programme and the concepts of life are understood by comparing and integrating examples from all biological sciences in a seamless experience.

The learner would discover that organisms have developed systems that maximize their utility and hence their existence and efficiency. The learner would also be directed to the fact that all organisms are aware of their surroundings and other life forms and exist as a part of a whole in dynamic harmony.

Practical studies during this course would help the learner to make use of principles in chemistry, physics, mathematics, statistics, bioinformatics and such allied disciplines in experiments using biological systems to estimate and interpret their results. Courses such as the Vocational Skill Course and the Skill Enhancement Course would further equip the learner to gain relevant skills and make them competent in the field of their choice.

The Indian Knowledge System course would enrich the studies in Life Sciences by bringing forth the knowledge packed in ancient texts, traditional medicine and practices and relate that data with the current scientific principles.

This course also provides the learner with an opportunity to relate concepts of allied disciplines to the Major subject by means of the courses in the Minor subject. The Open Elective course further allows the learner to tailor the scope of his or her education by broadly adding knowledge to the learner's major discipline or creating a special application niche in the outside world based on the learner's inherent forte. The On – the – job training concept would enhance the learner's skills and ready them for an opportunity in the real world.

2) Aims and Objectives

- To expose the learner to the diversity of biological organisms.
- To highlight the coexistence of the different lifeforms
- To relate and analyze inheritance of characteristics and traits of organisms.
- Todemonstrate that all organisms live as variations to a central theme of physiology and inheritance.
- To explain the concept of evolution and its theories.
- To outline the structure and various processes of the cell
- To understand the various biomolecules that play a role in the life processes.
- To make the learner aware of our environment and its challenges
- To appreciate the role of microbiota in human health and the environment.
- To enable design of methods to harness the power of biology in industry, health care and the environment.
- To impart hands-on methods of formulating, probing and analyzing problems or challenges regarding all aspects of biology.
- To estimate the significance of a study based on quantification and statistics.
- To make the learner proficient in scientific communication and dissemination of scientific research and concepts.

3) Learning Outcomes

- Summarize various forms of life and their mode of living.
- Explain the physiology of organisms
- Collect and analyze data of biological systems.

- Gain or improve skills related to their choice of study.
- improve current methods of operation
- Design a new method to mitigate challenges.
- Hone skills in niche areas of application
- Aware of skills and knowledge required be a contributing member of society and industry.

4) Programme Specific Outcomes:

PSO 1: Comprehend and evaluate basic biological concepts and integrate perspectives from diverse fields of biology.

PSO 2: Pursue higher education and research in various branches of biology such as genetics, evolution, cell biology, microbiology, physiology, biochemistry, immunology, developmental biology, neurobiology, ecology, biotechnology and bio-informatics.

PSO 3: Understand niches within human health and environmental domains wherein life science applications have the potential to bring about substantial and sustainable change.

PSO 4: Demonstrate proficiency in scientific fields such as biostatistics, bioinformatics and analytical techniques necessary for effective biological research; comprehend biotechnological processes used in industry and to foresee need-based entrepreneurship avenues in all fields of biology.

PSO 5: Comprehend and use information from varied scientific resources; evaluate and interpret graphical data; formulate testable hypotheses, design experiments and observational strategies in a laboratory setting; exhibit problem-solving skills and present scientific data in oral and written form.

PSO 6: Work in collaboration in a team, develop interpersonal communication.

5. Credit Structure of the Program (Sem I, II, III, IV, V & VI)

Under Graduate Certificate in Life Sciences

Credit Structure (Sem. I & II)

	R:_____A								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC,SEC (VSEC)**	**AEC,VEC, IKS**	**OJT, FP, CEP, CC,RP**	**Cum. Cr./ Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
4.5	I	6 Evolution, Genetics and Ecology (4) Practical 1: Evolution, Genetics and Ecology (2)		-	2+2	VSC:2, SEC:2 VSC - 2 Basic and Advanced Microscopy (2) OR Scientific Communication (2) SEC – 2 Introduction to microscopic techniques. (2)	AEC:2, VEC:2,IKS:2	CC:2	22	**UG Certificate4 4**
	R:_____B									
	II	6 Introduction to Biomolecules and Cell Biology (4) Practical 2: Biomolecule and Cell Biology (2)		2	2+2	VSC:2,SEC:2 VSC- 2 Lab Management (2) Basic Microbiology (2) SEC - 2 The General Microbiome (2)	AEC:2, VEC:2	CC:2	22	
	CumCr.	12	-	2	8	4+4	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credit score NSQF course/Internship OR Continue with Major and Minor										

Under Graduate Diploma in Life Sciences

Credit Structure (Sem. III & IV)

	R:_____C									
5.0	III	8 Human Physiology I (2) Metabolism and Biochemical Pathways (2) Thermodynamics and Biocatalysis (2) Practical 3 (2)		4	2	VSC:2, Tools for Omics	AEC:2	FP:2 CC:2	22	**UG Diploma 88**
	R:_____D									
	IV	8 Human Physiology -2 (2) Introduction to Molecular Biology (2) Basic Biostatistics (2) Practical 4 (2)		4	2	SEC:2 Separation Techniques in Biology	AEC:2	CEP:2 CC:2	22	
	CumCr.	28		10	12	6+6	8+4+2	8 + 4	88	
Exit option: Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credit score NSQF course/Internship OR Continue with Major and Minor										

B.Sc. (Life Sciences)

Credit Structure (Sem. V & VI)

	R:_____E									
5.5	V	10 Genetics (2) Immunology (2) Industrial Biotechnology (2) Practical 5 (2) and Practical 6 (2)	4 A) Protein Purification (2) Practicals in Protein Purification (2) B) Applications of Biotechnology (2) Practical Biotechnology (2)	4 Evolution and Behaviour Minor Practical4		VSC:2 Microtomy and Histology		FP/CEP: 2	22	**UG Degree 132**
	R:_____F									
	VI	10 Basic Neuroscience (2) Environmental Biology (2) Developmental Biology (2) Practical 7 (2) and Practical 8 (2)	4 A) Nanotechnology (2) Practicals in Nanotechnology (2) B). Public Health and Epidemiology (4) C) Bioinformatics (2) Practical Bioinformatics (2)	4 Applied Biology Minor Practical5				OJT:4	22	
	Cum Cr.	48	8	18	12	8+6	8+4+2	8+6+4	132	
Exit option: Award of UG Degree in Major with 132 credits 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 – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Major Courses

Yr	Sem	T/P	Course Title	Credits	Hours	Total Credits
1	I	T	Evolution, Genetics and Ecology	4	60	6
		P	Practical 1: Evolution, Genetics and Ecology	2	60	
	II	T	Biomolecules And Cell Biology	4	60	6
		P	Practical 2: Biomolecules And Cell Biology	2	60	
2	III	T	Human Physiology I	2	30	8
		T	Metabolism and Biochemical Pathways	2	30	
		T	Thermodynamics and Biocatalysis	2	30	
		P	Practical 3: Physiology and Biochemistry	2	60	
	IV	T	Human Physiology II	2	30	8
		T	Introduction to Molecular Biology	2	30	
		T	Basic Biostatistics	2	30	
		P	Practical 4: Physiology, Molecular Biology and Biostatistics	2	60	
3	V	T	Genetics	2	30	10
		T	Immunology	2	30	
		T	Industrial Biotechnology	2	30	
		P	Practical 5: Genetics and Immunology	2	60	
		P	Practical 6: Industrial Biotechnology	2	60	
	VI	T	Basic Neuroscience	2	30	10
		T	Environmental Biology	2	30	
		T	Developmental Biology	2	30	
		P	Practical 7: Neurosciences and Developmental Biology	2	60	
		P	Practical 8: Environmental Biology	2	60	

Yr: Year Sem: Semester T: Theory P: Practical

Vocational Skill Courses

Yr	Sem	T/P	Course Title	Credits	Hours	Total Credits
1	I	T	Basic and Advanced Microscopy	2	15	2
		P	Practical Microscopy		30	
			OR			
		T	Scientific Communication	2	15	
		P	Preparation of Documents		30	
	II	T	Lab Management	2	15	2
		P	Practical in Laboratory Management		30	
			OR			
		T	Basic Microbiology	2	15	
		P	Practical Microbiology		30	
2	III	T	Tools for Omics	2	15	2
		P	Practical Bioinformatics		30	
3	V	T	Microtomy and Histology	2	15	2
		P	Practical Histology		30	

Yr: Year Sem: Semester T: Theory P: Practical

Skill Enhancement Courses

Yr	Sem	T/P	Course Title	Credits	Hours	Total Credits
1	I	T	Introduction to microscopic techniques	2	15	2
		P	Basic Microscopy		30	
	II	T	The General Microbiome	2	15	2
		P	Practical Microbiology		30	
2	IV	T	Separation Techniques in Biology	2	15	2
		P	Practical in Separation Techniques		30	

Yr: Year Sem: Semester T: Theory P: Practical

SEMESTER I

Paper Code	Unit	Description	Credits	Hours
Course		**Evolution, Genetics and Ecology**	4	60
Module 1	I	Evolution	1	15
	II	Genetics	1	15
Module 2	III	Biodiversity	1	15
	IV	Ecosystems	1	15
Course		**Practicals in Evolution, Genetics and Ecology**	2	60
		VOCATIONAL SKILL COURSES		
A		**Basic and Advanced Microscopy**	2	45
	I	Principles of Microscopy	1	15
	II	Practical Microscopy	1	30
		OR		
B		**Science Communication**	2	45
	I	Scope and Techniques	1	15
	II	Preparation of Documents.	1	30
		SKILL ENHANCEMENT COURSES		
A		**Introduction to microscopic techniques**	2	45
	I	Introduction to microscopic techniques	1	15
	II	Basic Microscopy	1	30

SEMESTER II

Paper Code	Unit	Description	Credits	Hours
		Biomolecules And Cell Biology	4	60
Module 1	I	Proteins and Nucleic acids:	1	15
	II	Carbohydrates and Lipids:	1	15
Module 2	III	Prokaryotic and Eukaryotic cells structure	1	15
	IV	Structure of cell wall and cell membrane	1	15
		Practicals in Biomolecules And Cell Biology	2	60
		VOCATIONAL SKILL COURSES		
A		**Laboratory Management**	2	45
	I	Laboratory Management	1	15
	II	Practical in Laboratory Management	1	30
		OR		
B		**Basic Microbiology**	2	45
	I	Introduction to Microbiology	1	15
	II	Practical Microbiology	1	30
		SKILL ENHANCEMENT COURSES		
		The General Microbiome	2	45
	I	The General Microbiome	1	15
	II	Practical Microbiology	1	30

Semester - I

Mandatory

Name of the Course: Evolution, Genetics and Ecology

Sr.No.	Heading	Particulars	
1	**Description the course : Including but not limited to:**	This course describes the different life forms, theories of their evolution, their coexistence and methods of inheritance of their traits and characteristics. This course will allow the learner to appreciate that all organisms are inter-related and the effects on one life form could manifest as a result in some other life form. It also underlines the importance of the environment on life.	
2	**Vertical :**	Major	
3	**Type :**	Theory	
4	**Credits :**	4 credits (1 credit = 15 Hours Theory in a semester)	
5	**Hours Allotted :**	60 Hours	
6	**Marks Allotted:**	100 Marks	
7	**Course Objectives(CO):** CO 1. To understand theories on the origin of life on earth. CO 2. To evaluate the evolution of organism from another. CO 3. To explore the genetic principles that direct inheritance CO 4. To interpret the principles of genetics that lead to evolution CO 5. To describe the variety of life forms CO 6. To illustrate the relationships between different organisms. CO 7. To understand the effect of environment on life.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. Understand and explain the various theories proposed for the origin of life on earth. OC 2. Compare the merits and demerits associated with creation – Myths to biochemical theories. OC 3. Correlate and analyze the relationship between micro evolution and macro evolution OC 4. To learn the Mendelian laws, monohybrid and dihybrid ratios. OC 5. To differentiate between Mendelian inheritance and modifications of Mendel's law. OC 6. To study different genetic disorders caused due to mutations. OC 7. Compare different types of diversities and their relevance to their habitats OC 8. Understand and explain the concepts related to biodiversity. OC 9. Identify and classify various threats to sustaining diversity. OC 10. Understand and evaluate the importance of national and international efforts in conserving biodiversity OC 11. Understand and explain the concepts related to ecosystems. OC 12. Compare the dynamics of different types of ecosystems.		

	OC 13. Understand and evaluate the importance of various factors governing ecosystems.	
9	**Modules:-** **Module 1**	**Lectures**
	Unit 1. Concepts of Evolution: **Origin of life:** Theories of origin of life: Overview of Creation myths/ Divine creation; Spontaneous generation; Cosmozoic hypothesis; Steady state; Biochemical origin. **Biochemical Theories**: Origin of macromolecules; Miller's experiment; RNA world. **Origin of cells**: Protocells; Coacervates; Microspheres; Prokaryotes, Eukaryotes. **Evolution:** **Pre-Darwinian ideas**; Darwin's theory of Natural Selection, evidences, and objections **Evidences for evolution**. **Speciation**: Concept of species: Physiological species, biological species, evolutionary species; Types of speciation: Allopatric, sympatric, and parapatric. Micro evolution, macroevolution, and significance of speciation	**15**
	Unit 2. Genetics: **Mendelian Inheritance:** Mendel's Laws of inheritance, Mono and Dihybrid ratios with problems, chi square –for 9:3:3:1; 3:1 and 1:1 ratios. **Concept of genes**- sickle cell anaemia / Thalassemia as an example to explain the **Chromosomal inheritance:** Sutton's hypothesis, sex-linked inheritance, study of human pedigrees (e.g. Sex linked dominant and recessive; autosomal dominant & recessive) Modifications of Mendel's laws and Mutations **Extensions of Mendel's laws:** Incomplete dominance, codominance Multiple genes; Multiple alleles: Blood group, Gene interactions and Epistasis (Various ratios) **Mutations:** Point Mutations, Chromosomal aberrations: Structural: deletion, duplication, inversion, translocation. Numerical: euploidy& aneuploidy (e.g. Downs, Turners. Klinefelter's, Cri- du-chat)	**15**
	Module 2	
	Unit 3. Biodiversity Introduction to Biodiversity - Definition, Concepts, Scope and Significance **Levels of Biodiversity** - Introduction to Genetic, Species and Ecosystem Biodiversity **Biodiversity Hotspots**- (One example of Indian and International biodiversity hotspot) **Value of biodiversity** - Direct and Indirect **Threats to Biodiversity** - Habitat loss **Conservation and management of Biodiversity**	**15**

	Conservation strategies: in situ, ex-situ, National parks, Sanctuaries and Biosphere reserves. **Introduction to International efforts**: Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program - World Conservation Monitoring Centre (UNEP- CMC) National Biodiversity Action Plan, 2002- 2003 Indian Wildlife (Protection) Act, 1972 Convention for International Trade of endangered species **Unit 4:Concept of Ecosystems and factors influencing them:** Ecosystem: Definition and components. Impact of abiotic factors on biota. **Biogeochemical cycles:** (Water, Oxygen, Nitrogen, Sulphur) **Freshwater ecosystem**: (Lentic and Lotic) **Food chain and food web in ecosystem:** (Fresh water and Grassland). **Ecological pyramids** -energy, biomass, and number. **Animal interactions** (commensalism, mutualism, predation, antibiosis, parasitism) Two Case Studies can be mentioned.	**15**
10 and 11.	**Text and Reference Books:** 1. The World of Biology (2008) 8th Edition, Solomon, E.P. and Berg, L.R. Sanders College publishing 2. Essential Biology (2008) 8th Edition, Campbell, N.A., Reece, J.B., Umy, L.A., and Cain, M.A. Pearson Benjamin Cummings 3. An Introduction to Genetic Analysis Ed: Griffiths A.J. et al (2000). Pub: W. H. Freeman(London) Seventh Edition 4. Essentials of Human Genetics, S.M.Bhatnagar, M.L.Kothari&L.A.Mehta, (1994), Orient Longman's Publication. 5. Invertebrate Zoology, Volume I- Jordan and Verma, S. Chand and Co 6. Invertebrate Zoology- P. S. Dhami and J. K. Dhami, R. Chand, and Co. 7. A Textbook of Zoology, Vol. II- T. Jeffery Parker and William. A. Haswell Low Price Publications 8. Biodiversity- K. C. Agarwal- Agro Botanica Publications. 9. Biodiversity- K.C.Agarwal- Agro Botanica Publication. 10. Wildlife Laws and its Impact on Tribes- Mona Purohit, Deep and Deep Publication. 11. Ecology and Environment- P. D. Sharma, R. K. Rastogi Publications 12. Introduction to Ecology- R. Dajoz 13. Evolution and Ecology. S. Chand Publications, New Delhi 14. Ecology and Environment- P. D. Sharma, R. K. Rastogi Publications 15. Introduction to Ecology- R. Dajoz	

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Class test 1: 10 marks Class Test 2: 10 marks Quizzes, presentation, project, role play, creative writing, assignment etc: 10 marks Attendance and Participation: 10 marks. Total: 40 marks	Theory Exam: 60 marks. 2 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

Name of the Course: Practical 1: Evolution, Genetics and Ecology

Sr.No.	Heading	Particulars	Lectures
1	**Description the course : Including but Not limited to:**	This course allows the learner to probe the concepts of ecology, relationships between different life forms and inheritance of the characteristics and traits in a hands-on experimental format.	
2	**Vertical :**	Major	
3	**Type :**	Practical	
4	**Credits :**	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(CO):** To acquaint the learner with: CO 1. The Blood group system. CO 2. Differential staining methods. CO 3. To construct a pedigree chart using data.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. To detect blood group OC 2. To prepare a pedigree chart using information of blood groups of the family.		
9	**Modules:-** **Module 1**		
	1. Detection of ABO blood group. 2. Differential count of WBCs using Giemsa/ Lieishman stain. 3. Collection of blood group information from family and construction of pedigree charts**.** 4. Study of Barr body. 5. Compare between the Giant chromosome and Lampbrush chromosome. 6. Problems on Mendelian inheritance 7. Study of types of Corals - Brain, Organ pipe, Stag Horn, Mushroom coral 8. Study of bioluminescent organisms – *Noctiluca*, glow worm, fire fly, angler fish. 9. Mounting of scales of fish (placoid, cycloid and ctenoid) 10. Study of Adaptive radiation in Reptiles - Turtle, Tortoise, *Phrynosoma*, Draco) 11. Identification and differentiation of venomous and non-venomous snakes (Scales, Fangs, Bite marks, etc.)	**30**
	Module 2		
	1. Study of Types of feathers (contour, filoplume, down),	**30**

	beaks (Nectar feeding, Filter feeding), claws (perching, wading, swimming, hopping) in birds 2. Identification of birds - Coppersmith Barbet, Bulbul, Rose ringed Parakeet, Magpie Robin, two local birds. **3.** Field Report – To be done in a group of ten students (submission of written / typed report preferably along with photographs/ tables/ graphs. 4. Butterflies/ Fishes/ Migratory birds of localarea. **5.** Observations of fauna in the field (with reference to theorysyllabus). 6. Ecosystems: 7. Documentation / Study of the following (in a group); 8. Symbiosis (Termite and *Trychonympha*, hermit crab and sea anemone) 9. Camouflage (leaf insect, chameleon) 10. Cannibalistic mate-eating animals (Spider and Praying Mantis) 11. Animal architects: Termites, Harvester ant and Baya weaver bird	
10 and 11.	**Text and Reference Books:** 1. Russell , Peter J I Genetics 3rd edition, San Francisco : Benjamin Cummings publishers 2. Trigunayat M.M. and TrigunayatKritika, A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1, Scientific Publisher. 3. Singh Bineeta and Lal G.M. LaLPractical Manual of Genetics & Plant Breeding. ,ISBN: 9789390660513 paperback.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Viva: 10 marks. Journal: 05 marks Attendance/Participation: 05 marks. Total: 20 marks.	Practical: 30 marks 2.5 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

VOCATIONAL SKILL COURSES

Name of the Course: Basic and Advanced Microscopy

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	The course describes the various principles governing microscopy, the components of a microscope and methods of magnifying samples and staining methods to easily visualize components of a sample.	
2	**Vertical :**	Vocational Skill Course	
3	**Type :**	Theory and Practical	
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)	
5	**Hours Allotted :**	15 hours + 30 hours	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives(CO):** The course aims to: CO 1. Introduce learners to the principles, applications and skills of using light microscopy. CO 2. Introduce learners to principle and applications of other forms of microscopy such as Dark field, phase contrast,fluorescence. CO 3. Introduce learners to electron microscopy.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. Identify and describe the functions of different parts of a compound light microscope. OC 2. Use a compound light microscope to observe microscopic structures in a biological specimen. OC 3. Explain principles and applications of various microscopy techniques OC 4. Critically assess microscopy experiments and draw conclusions		
9	**Modules:-** **Module 1**		**Lectures**
	Principles of Microscopy: **A. Compound light microscope:** i. Magnification, resolution and numerical aperture ii. Components: Objective lenses, Eye pieces, Condenser iii. Methods of enhancing contrast **B. Other forms of Microscopy** i. Examples of stains ii. Phase contrast iii. Dark field microscopy iv. Fluorescence Microscopy		**15**

	C. Introduction to electron microscopy: i. Scanning Electron Microscopy (SEM) Transmission Electron Microscopy (TEM).		
	Module 2		
	Unit 2. Practical Microscopy: 1. Parts of compound light Microscope. 2. Use of low power lenses and high power objectives to observe plant and animal cells. a. Onion peel staining b. Buccal epithelial cell staining 3. Use of oil immersion lens to observe bacterial cells - a. Monochrome staining b. Gram Staining 4. Acridine Orange staining of yeast/onion/Blood smear- Fluorescence staining. 5. Demonstration of Phase contrast, Dark field Study and identification of TEM and SEM images of cells/organelles.		**30**
10 and 11.	**Text and Reference Books:** 1. Prescott's Microbiology (2020) 11th edition, Willey, J. M., Sherwood, L. Woolverton J. C. McGraw-Hill Education. 2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th edition, Wilson K.,Hofmann A., Walker, J.M., Clokie, S.Cambridge University Press 3. Experiments in biochemistry: a hands-on approach: a manual for the undergraduate laboratory. (2006). Taylor, L. E., Farrell, S. O., Ranallo, R. T. Cengage Learning. 4. Laboratory Manual in Biochemistry (2004) 2nd edition. Jayaraman, J. New Age International (P) Limited Publishers. **5.** Introduction to Practical Biochemistry. (2001) 3rd edition. Plummer, D. T., Tata McGraw Hill Publishing Company.		
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc.: 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks.	
14	**Format of Question Paper:** Details given at the end of the document.		

Name of the Course: Science Communication

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	This course explores the various forms of dissemination of scientific knowledge such as reports and journalism. It also would acquaint the learner with features of project proposals. The course would also emphasize on the concepts of plagiarism and ethics in scientific writing.	
2	**Vertical :**	Vocational Skill Course	
3	**Type :**	Theory and Practical	
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)	
5	**Hours Allotted :**	15 hours + 30 hours.	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives(CO):** The learner would be: CO 1. Relate the writing skills to the various professions in biomedical science. CO 2. Propose documents related to applications to various fields of science.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. Identify the documents required for a scientific publication. OC 2. Prepare the appropriate document(s) for scientific publications.		
9	**Modules:-**		**Lectures**
	Module 1		
	Unit 1. Scope and Techniques: Introduction, Types of science writing (Journalism, Education, Marketing, Scientific Publications, Research Documents and Regulatory Documents), Challenges in medical writing (Proficiency, Global Domain Expertise, Attrition rate, quality, training programmes), The Indian Scenario. Essential components in biomedical writing. Plagiarism and ethics in writing.		**15**
	Module 2		
	Unit 2. Preparation of Documents Research Papers (IMRAD model), Thesis writing, Report writing, Plagiarism. Editing Scientific material, Styles of Referencing, Use of Reference Managing Systems.		**30**
10 and 11.	**Text and Reference Books:** 1. Janice R. Matthews and Robert W. Matthews (2008): Successful Scientific Writing. Cambridge University Press 2. Linda Fossati Wood, MaryAnn Foote (2009): Targeted Regulatory Writing Techniques: Clinical Documents for Drugs and Biologics. Publisher Springer Basel AG. 3. Mimi Zeiger (2000): Essentials of Writing Biomedical Research		

	Papers. Second Edition 2nd Edition. Publisher - McGraw-Hill Professional. 4. Yellowlees Douglas, Maria B. Grant (2018): The Biomedical Writer What You Need to Succeed in Academic Medicine. Publisher - Cambridge University Press		
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc.: 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks. Theory: 15 marks 1 hour Practical: 15 marks 2 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

SKILL ENHANCEMENT COURSES

Name of the Course: Introduction to Microscopic Techniques

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	The course describes the various principles governing microscopy, the components of a microscope and methods of magnifying samples. The learners would gather skills to operate and use microscopes and use this to study microbes, plants and other biological samples including differential staining.	
2	**Vertical :**	Skill Enhancement Course	
3	**Type :**	Theory and Practical	
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)	
5	**Hours Allotted :**	15 hours + 30 hours	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives(CO):** The course aims to: CO 1. Introduce learners to the principles, applications and skills of using light microscopy. CO 2. Introduce learners to principle and applications of other forms of microscopy such as Dark field, phase contrast, fluorescer CO 3. Introduce learners to electron microscopy.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. Identify and describe the functions of different parts of a compound light microscope. OC 2. Use a compound light microscope to observe microscopic structures in a biological specimen. OC 3. Explain principles and applications of various microscopy techniques OC 4. Critically assess microscopy experiments and draw conclusions		
9	**Modules:-** **Module 1**		**Lectures**
	Principles of Microscopy: **A. Compound light microscope:** iv. Magnification, resolution and numerical aperture v. Components: Objective lenses, Eye pieces, Condenser vi. Methods of enhancing contrast **B. Other forms of Microscopy** v. Examples of stains		**15**

	vi. Phase contrast vii. Dark field microscopy viii. Fluorescence Microscopy **C. Introduction to electron microscopy**: ii. Scanning Electron Microscopy (SEM) Transmission Electron Microscopy (TEM).	
	Module 2	
	Unit 2. Skill based learning using microscopy: 6. Parts of compound light Microscope. 7. Use of low power lenses and high power objectives to observe plant and animal cells. c. Onion peel staining d. Buccal epithelial cell staining 8. Use of oil immersion lens to observe bacterial cells - c. Monochrome staining d. Gram Staining 9. Acridine Orange staining of yeast/ onion 10. Study and identification of TEM and SEM images of cells/organelles. 11. Demonstration of Phase contrast, Dark field 12. Demonstration of cytoplasmic streaming: *Hydrilla*	**30**
10 and 11.	**Text and Reference Books:** 6. Prescott's Microbiology (2020) 11th edition, Willey, J. M., Sherwood, L. Woolverton J. C. McGraw-Hill Education. 7. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018) 8th edition, Wilson K.,Hofmann A., Walker, J.M., Clokie, S.Cambridge University Press 8. Experiments in biochemistry: a hands-on approach: a manual for the undergraduate laboratory. (2006). Taylor, L. E., Farrell, S. O., Ranallo, R. T. Cengage Learning. 9. Laboratory Manual in Biochemistry (2004) 2nd edition. Jayaraman, J. New Age International (P) Limited Publishers. **10.** Introduction to Practical Biochemistry. (2001) 3rd edition. Plummer, D. T., Tata McGraw Hill Publishing Company.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc.: 10	Theory and Practical evaluation: 30 marks.

	marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.		
14	**Format of Question Paper:** Details given at the end of the document.		

Semester – II

Name of the Course: Biomolecules and Cell Biology

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	This course is the foundation of the basic units of a living cell and the biomolecules that help it function. It describes the structure of the cells of different life forms, its division and its biochemistry.	
2	**Vertical :**	Major	
3	**Type :**	Theory	
4	**Credits :**	4 credits (1 credit = 15 Hours for Theory in a semester)	
5	**Hours Allotted :**	60 Hours	
6	**Marks Allotted:**	100 Marks	
7	**Course Objectives(CO):** To acquaint the learner with: CO 1. The important biomolecules present in living organisms CO 2. The composition and structure of the biomolecules. CO 3. The function of these biomolecules.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. Summarize the important biomolecules of life. OC 2. Analyze the function of these molecules in living organisms OC 3. Explain the function of these molecules in light of their composition and structure. OC 4. Understand the basic structure of a typical prokaryotic and eukaryotic cell.		
9	**Modules:-** **Module 1**		**Lectures**
	Unit 1. Proteins and Nucleic acids: **Amino acids**: Structures, Classification based on R groups, and dietary requirements- essential, semi essential and non essential amino acids. **Proteins**: Classification based on hydrolytic products, Functions, Incomplete and complete proteins, Structural organization- Primary, Secondary, Tertiary, Quaternary levels. **Nucleic acids:** Structure of nucleosides and nucleotides, structure of nucleic acids (A,B,Z forms); the structure of DNA helps in its function as hereditary molecules**.** **Unit 2.** **Carbohydrates and Lipids:** Carbohydrates: Structure of Monosaccharides, Disaccharides,Oligosaccharides, Polysaccharides. Structure and function of animal and plant source- starch, glycogen, cellulose and chitin. Lipids: Classification, structure, function and properties of lipids (simple, derived and complex with one example each)		**15** **15**

	Module 2	
	Unit 3: Overview of Prokaryotic and Eukaryotic cells structure **1. Cell Structure** a. Prokaryotic cell structure b. Eukaryotic cell structure **2.Virus:** Virus structure: Plant and Animal virus (One example: TMV and Adenovirus, Coronavirus) **3.Structure of cell wall:** Bacterial cell wall, Plant cell wall: Primary and secondary. **4. Cell Cycle and Cell Division:** a. Cell cycle (G0, G1, G2, M phases) b. Mitosis and Meiosis and their significance Overview of cell organelles: Structure and function: Nucleus, Endoplasmic Reticulum (Rough and Smooth), Golgi bodies, Mitochondria, Chloroplast, Lysosomes and Peroxisomes **Unit 4:**Cell membrane and Transport **Cell membrane:** Membrane models: Unit membrane and Fluid Mosaic Model of Singer and Nicholson. Membrane junctions: Tight, gap, desmosomes, septate. Cytoskeletal apparatus: Microtubules, microfilaments and intermediate filaments. **Membrane Transport:** a. Passive Transport: Simple diffusion, Facilitated diffusion (Carrier proteins, Channels), Osmosis (one example of each type of transport) b.Active Transport: Uniport, Symport, Antiport, Primary and Secondary active transport c. Bulk transport: endocytosis and exocytosis d. Membrane transport associated disease: Cystic fibrosis.	**15** **15**
10 and 11.	**Text and Reference Books:** **1.** David L. Nelson and Michael M. Cox (2021): Lehninger Principles of Biochemistry. 8th Edition. Publisher - W H Freeman & Co 2. Donald Voet, Judith G. Voet, Charlotte W. Pratt (2016): Fundamentals of Biochemistry. 5th Edition. Publisher - Wiley. 3. Molecular Biology of the Cell (2008) 5th Edition, Alberts, B.A., Johnson, A., Lewis, J., Roberts, M.R.K., Walters, P. Garland Science Publication 4. Molecular Cell Biology (2008) 6th Edition, Lodish, H., Berk, A., Kaiser, A.C. Krieger,M., Scott, M.P., Bretscher, A., Ploegh, A., Mortsudira, P. W.H. Freeman and Company, N.Y. 5. Cell and Molecular Biology-concepts and experiments (2005) 4th Edition, Karp, G.John Wiley and Sons Inc. 6. The World of Cell (2003) 5th Edition, Becker, W.M., Kleinsmith, L.J., Hardin, J. Pearson Education (Singapore) 7. The Cell - A molecular approach (2007) 4th Edition, Cooper, G.M., Hausman, R.E.ASM Press Washington, D.C.s	

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Class test 1: 10 marks Class Test 2: 10 marks Quizzes, presentation, project, role play, creative writing, assignment etc. 10 marks Attendance and Participation: 10 marks. Total: 40 marks.	Theory Examination: 60 marks. 2 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

Name of the Course: Practicals in Biomolecules And Cell Biology

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	This course enables the learner to visualize cell structure and their functions. It also describes experiments that would allow the localization and estimation of biomolecules in a cell or tissue. Principles of their estimation would also be covered in this course.	
2	**Vertical :**	Major	
3	**Type :**	Practical	
4	**Credits :**	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(CO):** To acquaint the learner with: CO 1. Techniques to locate the biomolecules in the tissue. CO 2. The function(s) of the biomolecules under study.		
8	**Course Outcomes (OC):** The learner would be able to: OC 1. The detection of the biomolecules in the sample. OC 2. To identify its localization in tissues. OC 3. Appreciate its function in these tissues.		
9	**Modules:-** **Module 1**		
	Unit 1. Biomolecules 1. Concentration and strengths of solutions 2. w/v, v/v, percentage, ppm, ppb, moles/L, molarity, normality, molality 3. Preparation and verification of solutions of desired strengths 4. Estimation of Protein by Biuret method. 5. Qualitative analysis of Carbohydrates (Glucose, Fructose, Maltose, Sucrose, Starch) and Protein. **Histochemistry:** 6. Localization of Proteins and Nucleic acids from the suitable system i. Proteins of peas / cockroach muscles ii. DNA and RNA from onion peel using methyl green and pyronin staining 7. Localization of Carbohydrates and Lipids; i. Starch grains of Potato / of seeds and other tubers ii. Fat bodies of Cockroach/Drosophila/lipids of groundnut		**30**
	Module 2		
	Unit 2. Cell Biology 8. Introduction to Microscopy 9. Cytoplasmic streaming in Hydrilla 10. Observation of different stages of mitosis in onion root tip. 11.Demonstration of osmosis (Hydrilla / Tradescantia / RBC). 12. Cell wall staining (*Sarcina/Bacillus*)		**30**

	13.Subcellular fractionation and marker enzymes (Mitochondria) 14. Study of Electron micrographs:- i. Mitochondria, Chloroplast, Nucleus ii. Lysosomes: Basement membrane/ junctions iii. Cilia: Both normal and pathological iv. Basement membrane/ junctions (Cilia or Flagella)		
10 and 11.	**Text and Reference Books:** 1**.** Cell Biology, Genetics, Molecular biology, Evolution and Ecology – P.S. Verma and V.K. Agarwal (2009), Publishers : S. Chand and Co.Ltd., 2. Biological Science, Taylor, Green and Stout., 3rd edn. Ed. R. Soper .(2005) Cambridge Univ. press 3. Biology A Modern Introduction, B.S.Beckett (1994), GCSE Edn. Oxford Univ. Press**.**		
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Viva: 10 marks. Journal: 05 marks Attendance/Participation: 05 marks. Total: 20 marks.	Practical: 30 marks 2.5 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

Vocational Skill Course

Name of the Course: Laboratory Management

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	This course deals with the establishment of protocols that make the research in the laboratory dependable and repeatable. It stresses on the importance of documentation of experiments, materials, protocols and maintenance of equipment.	
2	**Vertical :**	Vocational Skill Course	
3	**Type :**	Theory and Practical	
4	**Credits :**	2 credits (1 credit = 15 hours of theory and 30 Hours of Practical work in a semester)	
5	**Hours Allotted :**	15 Hours + 30 Hours	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives(CO):** CO 1. To describe protocols for dependable and repeatable experimental results. CO 2. To elaborate on practices in the laboratory that minimize the risk and improves safety of the laboratory personnel. CO 3. To choose methods of documentation to ensure adherence to protocols and techniques, and the quality and source of materials used.		
8	**Course Outcomes (OC):** OC 1. Understand Basic clinical laboratory setup as well as GLP. OC 2. Understand and analyze various errors and mistakes while using various equipment. OC 3. Use simple statistics for understanding quality control.		
9	**Modules:-** **Module 1**		**Lectures**
	Unit 1. Laboratory Management: **Good Laboratory Practice (GLP)** **i.** Introduction to the Standard Laboratory set up ii. General Safety guidelines iii. Decontamination and Disinfection. iv. Sterilization techniques v. Hazard analysis, Safety Data Sheets, and First Aid Kit. vi. Basic calculations for preparation of solutions vii. Total Quality Management: **Concepts of Accuracy and Precision.** **i.** Sensitivity and Specificity of protocols ii. Quality Control mechanisms, (Internal and External) iii. Preparation of lab report and cataloguing. IV. Basic principles of accreditation of labs, (ISO and NABL).		**15**

	Module 2		
	Unit 2: Practicals in Laboratory Management 1. Preparation and standardization of common reagents. 2. Standardization of balances, pipettes, and other common measurement devices. 3. SOP writing for common instruments 4. Monitoring of performances of common equipment like autoclave, incubators and maintaining records. 5. Preparation of QC charts of the collected data. 6. Visit to a commercial / research lab. 7. Group presentations on GLP and related aspects within college set-up.		**30**
10 and 11.	**Text and Reference Books:** **1.** Godkar, P.B. Godkar, P.D. (2014) "Textbook of Medical Laboratory Technology (Set of 2 Volumes): Clinical Laboratory Science and Molecular Diagnosis" Bhalani Publishing House. Skoog, D.A., Holler, F.J., Crouch S.R. (2018) "Principles of Instrumental Analysis" Cengage Learning. 2. Garcia L.S. (2014) "Clinical Laboratory Management" American Society for Microbiology Press. 3. McPherson R.A., Pincus, M. R. (2017) "Henry's Clinical Diagnosis and Management by Laboratory Methods" Elsevier. 4. Spector, David L. & Goldman, R.D. (2006) "Basic Methods in Microscopy: Protocols and Concepts from Cells: A Laboratory Manual" Cold Spring Harbor Laboratory Press.		
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc. 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks. Theory: 15 marks 1 hour Practical: 15 marks 2 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

Name of the Course: Basic Microbiology

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	This course introduces the learner to the microbial world, their types, structure, life cycle and also methods to isolate and recognize them. It also imparts knowledge on sterility techniques that are vital to microbiological experimentation.	
2	**Vertical :**	Vocational Skill Course	
3	**Type :**	Theory and Practical	
4	**Credits :**	2 credits (1 credit = 15 hours of theory and 30 Hours of Practical work in a semester)	
5	**Hours Allotted :**	15 hours + 30 hours	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives(CO):** To acquaint the learner with: CO 1. The microorganisms and their types, life cycle. CO 2. The importance of culture media and isolation techniques and preservation of cultures.		
8	**Course Outcomes (OC):** To identify the microorganisms. OC 1. To learn the life cycle and growth curve of microorganisms OC 2. To learn the importance of culture media, isolation and preservation techniques of microorganisms.		
9	**Modules:-** **Module 1**		**Lectures**
	Unit 1. Introduction to microbiology i. Microorganisms and their types. ii. Life cycle of bacteria eg. E.coli iii. Growth curve of bacteria eg.E.coli. iv. Culture media and types of culture media. v. Isolation techniques of bacteria (Streaking methods, spread plate and pour plate) vi. Preservation techniques of bacterial culture.		**15**
	Module 2		
	Unit 2: Practical Microbiology: i. Introduction to the Microscope**.** ii. Staining techniques:-Gram staining, cell wall staining etc iii. Sterilization techniques iv. Working principles of Instruments used in microbiology;-Hot air oven, Autoclave, Incubator, centrifuge, laminar flow etc. v. Isolation of microorganisms using streak plate technique. vi. Culture media preparation (Liquid media and solid media) in the		**30**

	laboratory. vii. Compare the compositions of the two different media (Basal media and differential media or enriched media).		
10 and 11.	**Text and Reference Books:** **1.** James.C.Cappuccino. 2017. Microbiology A laboratory manual. 11th edition, Pearson education publishers. 2. Kannan, N. 2003. Hand book of Laboratory culture media 1st edition, Panima publishing house. 3. Michael J.Pelczar Jr., E.C.S. Chan ,Noel R , Microbiology TMH 5th Edition. 4. Stanier, Ingraham et al		
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc.: 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks. Theory: 15 marks 1 hour Practical: 15 marks 2 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

SKILL ENHANCEMENT COURSES

Name of the Course: The General Microbiome

Sr.No.	Heading	Particulars	
1	**Description the course : Including but Not limited to:**	This course introduces the learner to the microbial world, their types, structure, life cycle and also methods to isolate and recognize them. It also imparts skills on aseptic techniques that are vital to microbiological experimentation.	
2	**Vertical :**	**SKILL ENHANCEMENT COURSES**	
3	**Type :**	Theory and Practical	
4	**Credits :**	2 credits (1 credit = 15 hours of theory and 30 Hours of Practical work in a semester)	
5	**Hours Allotted :**	15 hours + 30 hours	
6	**Marks Allotted:**	50 Marks	
7	**Course Objectives(CO):** To acquaint the learner with: CO 3. The microorganisms and their types, life cycle. CO 4. The importance of culture media and isolation techniques and preservation of cultures.		
8	**Course Outcomes (OC):** To identify the microorganisms. OC 3. To learn the life cycle and growth curve of microorganisms OC 4. To learn the importance of culture media, isolation and preservation techniques of microorganisms.		
9	**Modules:-** **Module 1**		**Lectures**
	Unit 1. Introduction to microbiology 1. Microorganisms and their types. *2.* Life cycle of bacteria eg. *E. coli* *3.* Growth curve of bacteria eg.*E. coli.* 4. Culture media and types of culture media. 5. Isolation techniques of bacteria (Streaking methods, spread plate and pour plate) 6. Preservation techniques of bacterial culture.		**15**
	Module 2		
	Unit 2: Skills in basic microbiology: 1. Introduction to the Microscope – parts and working. 2. Staining techniques: Gram staining and cell wall staining. Sterilization techniques: Working principles of Instruments used in microbiology;-Hot air oven, Autoclave, Incubator, centrifuge, laminar flow etc.		**30**

	3. Culture media preparation (Liquid media and solid media) in the laboratory. 4. Media transfer under asceptic conditions. 5. Culture of organisms using different media (Basal media/ differential media/ enriched media). 6. Isolation of microorganisms using streak plate technique.		
10 and 11.	**Text and Reference Books:** **1.** James.C.Cappuccino. 2017. Microbiology A laboratory manual. 11th edition, Pearson education publishers. 2. Kannan, N. 2003. Hand book of Laboratory culture media 1st edition, Panima publishing house. 3. Michael J.Pelczar Jr., E.C.S. Chan ,Noel R , Microbiology TMH 5th Edition. 4. Stanier, Ingraham et al		
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**	
13	**Continuous Evaluation through:** Quizzes, class test, presentation, project, role play, creative writing, assignment etc.: 10 marks Journal: 05 marks Attendance and Participation: 05 marks. Total 20 marks.	Theory and Practical evaluation: 30 marks. Theory: 15 marks 1 hour Practical: 15 marks 2 hours	
14	**Format of Question Paper:** Details given at the end of the document.		

Examination and Standard of Passing:

A. Evaluation of the Major (mandatory) Theory courses: 100 marks.

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment).The evaluation pattern would be as follows:

Internal assessment: 40 marks.

a. Class test 1: 10 marks
b. Class Test 2: 10 marks
c. Quizzes, presentation, project, role play, creative writing, assignment etc. 10 marks
d. Attendance and Participation: 10 marks.

External Examination for Major (Mandatory) Theory Courses (4 Credits) – 60 Marks

- Duration: **2 Hours**
- Theory question paper pattern:

Question	Based on	Options	Marks
Q.1	Unit I	Any 1 out of 2 (1 or 1 a, b)	12
Q.2	Unit II	Any 1 out of 2 (2 or 2 a, b)	12
Q.3	Unit III	Any 1 out of 2 (3 or 3 a, b)	12
Q.4	Unit IV	Any 1 out of 2 (4 or 4 a, b)	12
Q5.	Unit I, II, III IV	Any 3 out of 6 (short notes)	12
		Total	**60**

B. Evaluation for Major (Mandatory) Practical Courses (2 Credits): 50 marks.

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment). The evaluation pattern would be as follows:

- Each practical course carries a **total of 50 Marks**, distributed as follows:

  Internal Assessment: 20 marks.

  The criteria would be as follows:

No.	Criterion	Marks
1	Journal	05
2	Viva	10
3	Attendance/ Participation	05
	Total	**20**

External Assessment: 30 Marks:
The practical question paper pattern would be as follows:

All questions are compulsory		
Question	Criterion	Marks
Q1.	Practical performance	20
Q2.	Spot Tests	10
	Total	**30**

- The duration of each practical course evaluation is 3hours.
- To be eligible for evaluation, students must complete a minimum of 80% of the practical work assigned in each core subject.
- It is mandatory for students to submit a certified journal at the time of the practical examination. The journal serves as a record of their practical work and is an essential component of the evaluation process.

C. Evaluation for Vocational Skill Course: 50 Marks

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment). The evaluation pattern would be as follows:

Internal Assessment: 20 marks.

Theory Component: 10 marks.
Quizzes, class test, presentation, project, role play, creative writing, assignment etc: 10 marks

Practical Component: 10 marks.
Journal: 05 marks
Attendance and Participation: 05 marks.

External Assessment: 30 marks.

Theory Component: 15 marks.

- Duration: **1 Hour**
- Theory question paper pattern:

Question No.	Unit	Question	Marks
Q1.	I	Any 1 out of 2 (1 or 1a, b)	12
Q2	I	Any 1 out of 2 (2 or 2a, b)	3
		Total	**15**

Practical Component: 15 marks.
Assessment of these questions would be done at the time of Major Practical External Assessment. The marks earned by the candidate would be added to the theory component to make a total of 30 marks of External Assessment.

Question No.	Unit	Question	Marks
Q1.	II	Practical Performance	10
Q2	II	Viva	05
		Total	**15**

Regulations regarding the scheme of exams, number of credits and standard of passing will be as prescribed by the University of Mumbai.

A student is said to have passed if he/she secures 40% of marks allotted in each head of passing. External evaluation of 30 marks and Internal evaluation of 20 marks are treated as separate heads of passing.

The Ten Point Grading System prescribed by the University of Mumbai will be as follows:

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

Team for Creation of Syllabus

Name	College Name	Sign
Dr. Ujwala Jadhav	Head, University Department of Life Sciences, University of Mumbai	
Dr. Indu Anna George	Professor, University Department of Life Sciences, University of Mumbai	
Dr.Tejashree Shanbag	Principal, K. C. College, Mumbai	
Dr. Prashant Ratnaparkhi	Head, Department of Life Science and Biochemistry, St. Xavier's College (Autonomous), Mumbai	
Dr. Nilima Gajbhiye	Head, Department of Life Science, RamnarainRuia Autonomous College, Mumbai	
Dr. Priya Sundarrajan	Professor, Department of Life Science and Biochemistry, St. Xavier's College (Autonomous), Mumbai	
Dr. KanchanChitnis	Associate Professor, Department of Life Science, RamnarainRuia Autonomous College, Mumbai	

Appendix B

Justification for B.Sc. (Life Sciences)

1.	Necessity for starting the course:	Life Sciences is a multi-disciplinary course. It exposes the learner to all aspects of biology seamlessly without compartmentalization of individual disciples in biology, chemistry, physics and the quantitative sciences. This encourages novel conceptual reasoning and challenges an inflexible traditional approach to biology. This would be a refreshing approach to mitigate the challenges faced by society at large.
2.	Whether the UGC has recommended the course:	YES
3.	Whether all the courses have commenced from the academic year 2024-2025	The courses are scheduled to begin from the academic year 2024 – 2025.
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	The self-financed courses would be run by permanent faculty and supported by visiting or guest faculty.
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	The course would be of four years. It would not be possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	60 seats for one division. Admissions will be held from 2024-2025 onwards
7.	Opportunities of Employability / Employment available after undertaking these courses:	The opportunities would include biology based industries and organizations such as health care, food and feed, environment etc. research opportunities and in the field of education.

Sign of the BOS Chairman
Dr. Ujwala Jadhav
The Chairman, Board of Studies in Life Sciences

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

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