SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094,2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर
४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अध्याससमंडळे विभाग: ०२३१- २६०९०९४. २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SU/BOS/Science/799 **Date: 08/ 11/ 2023**

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding Syllabi of M. Sc. Part- I Biotechnology (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of **M. Sc. Part- I Biotechnology** under the Faculty of Science and Technology **as per National Education Policy 2020 .**

Sr. No.	BOS	Syllabus Name
1	Biochemistry and Bio-Technology	M.Sc. Part- I Biotechnology

This syllabi and nature of question paper shall be implemented from the Academic Year **2023-2024** onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

(Dr. S. M. Kubal)
Dy Registrar

Encl : As above

Copy to : For Information and necessary action.

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Science (Biotechnology)

Under

Faculty of Science and Technology

(To Be Implemented From Academic Year 2023-24)

INDEX

1. **Preamble:**

As per the NEP 2020 guidelines this updated syllabus is prepared for first year post graduate students of Biotechnology. At this level, to develop their interest towards Biotechnology as applied science and also to prepare them for the academic and industrial exposure simultaneously. Introduction of life science subjects will help to form a basic foundation of concepts for students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their post-graduation. The units in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance.

2. **Duration:** Two Year Full Time Course with 4 semesters.

3. **Eligibility:**
   - B. Sc. with Biotechnology/Microbiology/Botany/Zoology/Biochemistry/Food Science and Technology/Nanoscience and Technology/Life Sciences as principle subjects/ B.Sc. Agri/B.E./M.B.B.S./B.Pharma.
   - Student has to qualify the entrance examination conducted by Shivaji University for the respective academic year.

4. **Medium of Instruction**: English

5. **Programme Structure**

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Biotechnology) Part – I (Level-6.0)

	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures /(Hours /week)	Practical (Hours/week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam Hours
Semester-I										
Major Mandatory Theory	MMT-101	4	--	4	80	32	3	20	8	0.5
	MMT -102	4	--	4	80	32	3	20	8	0.5
Major Elective Theory	MET-103 A **OR** MET-103 B **OR** MET-103 C	4	--	4	80	32	3	20	8	0.5
Major Mandatory Practical	MMPR -104	--	8	4	100	40	12	-	-	-
	MMPR -105	--	4	2	50	20	6	-	-	-
Research Methodology	RM-106	4	--	4	80	32	3	20	8	0.5
Total				22	470			80		
Semester-II										
Major Mandatory Theory	MMT-201	4	--	4	80	32	3	20	8	0.5
	MMT -202	4	--	4	80	32	3	20	8	0.5
Major Elective Theory	MET-203 A **OR** MET-203 B **OR** MET-203 C	4	--	4	80	32	3	20	8	0.5
Major Mandatory Practical	MMPR -204	--	8	4	100	40	12	-	-	-
	MMPR -205	--	4	2	50	20	6	-	-	-
OJT/FP	OJT-206 OR FP-206	--	--	4	--	--	--	100	40	0.5
Total				22	390			160		
Total (Sem I + Sem II)				44	860			240		

• MMT – Major Mandatory Theory • MMPR – Major Mandatory Practical • MET – Major Elective Theory • MEPR – Major Elective Practical • RM - Research Methodology • OJT/FP- On Job Training/ Field Project	• Total Marks for M.Sc.-I : **1100** • Total Credits for M.Sc.-I (Semester I & II) : 44 ***Separate passing is mandatory for University and Internal Examinations***
*Evaluation scheme for OJT/FP shall be decided by concerned BOS	
Requirement for Entry at Level 6.0: B. Sc. with Biotechnology/Microbiology/Botany/Zoology/Biochemistry/Food Science and Technology/Nanoscience and Technology/Life Sciences as principle subjects/ B.Sc. Agri/B.E./M.B.B.S./B.Pharma. Student has to qualify the entrance examination conducted by Shivaji University for the respective academic year.	
Requirement for Exit after Level 6.0: Students can exit after completion of Level 6.0 with Post Graduate Diploma in Biotechnology.	
Requirement for Entry at Level 6.5: Completion of Level 6.0	

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Biotechnology) Part – II (Level-6.5)

	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures + Tutorial (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-III										
Major Mandatory Theory	MMT-301	4	--	4	80	32	3	20	8	0.5
	MMT -302	4	--	4	80	32	3	20	8	0.5
	MMT -303	4	--	4	80	32	3	20	8	0.5
Major Elective Theory	MET-304 A **OR** MET-304 B	4	--	4	80	32	3	20	8	0.5
Major Mandatory Practical	MMPR -305	--	4	2	50	20	6	-	-	-
ResearchProject	RP-306	--	8	4	100	40	12#			
Total				22	470			80		
Semester-IV										
Major Mandatory Theory	MMT-401	4	--	4	80	32	3	20	8	0.5
	MMT -402	4	--	4	80	32	3	20	8	0.5
	MMT -403	4	--	4	80	32	3	20	8	0.5
Major Elective Theory	MET-404 A **OR** MET-404 B **OR** MET-404 C	4	--	4	80	32	3	20	8	0.5
ResearchProject	RP-405	--	12	6	150	60	18##	--	--	--
Total				22	470			80		
Total (Sem III + Sem IV)				44	940			160		

<table>
<tr><td>• MMT – Major Mandatory Theory
• MMPR – Major Mandatory Practical
• MET – Major Elective Theory
• MEPR – Major Elective Practical
• RP- Research Project</td><td>• Total Marks for M.Sc.-II : 1100
• Total Credits for M.Sc.-II (Semester III & IV) : 44
Separate passing is mandatory for University and Internal Examinations</td></tr>
<tr><td colspan="2"># Evaluation scheme for Research Project shall be decided by concerned BOS</td></tr>
<tr><td colspan="2">## Evaluation scheme for Research Project shall be decided by concerned BOS</td></tr>
<tr><td colspan="2">Requirement for Exit after Level 6.5:
Students can exit after completion of Level 6.5 with Post Graduate in Biotechnology.</td></tr>
</table>

Semester I		Semester II	
MMT-101	Cell Biology (4Cr)	MMT-201	Genetics and Immunology (4Cr)
MMT-102	Basics in Microbiology (4Cr)	MMT-202	Molecular Biology (4Cr)
MET-103A MET-103B MET-103C	Biomolecules and Instrumentations (4Cr) **OR** Microbial Diversity and Systematics (4Cr) **OR** Biostatistics and Computer (4Cr)	MET-203A MET-203B MET-203C	Cellular Metabolism (4Cr) **OR** IPR and Bioethics (4Cr) **OR** Animal Physiology and Endocrinology (4Cr)
MMPR -104	Lab Course I (4Cr)	MMPR -204	Lab Course III (4Cr)
MMPR -105	Lab Course II (2Cr)	MMPR -205	Lab Course IV (2Cr)
RM- 106	Research Methodology (4Cr)	OJT- 206 **OR** FP- 206	On Job Training (4Cr) **OR** Field Project (4Cr)
Semester III		**Semester IV**	
MMT-301	Plant and Animal Tissue Culture (4Cr)	MMT-401	Medical Biotechnology (4 Cr)
MMT-302	Genetic Engineering and Bioinformatics (4Cr)	MMT-402	Environment and Pharmaceutical Biotechnology (4 Cr)
MET-303	Industrial Biotechnology (4Cr)	MMT-403	Cancer Biology and Nanotechnology (4 Cr)
MET-304 A MET-304 B	Stem Cell Technology (4Cr) **OR** Clinical Research (4Cr)	MET-404A MET-404B MET-404C	Food and Agricultural Biotechnology **OR** Industrial Waste Management **OR** Quality assurance and validation
MMPR -305	Lab Course VI (2Cr)	RP-405	Research Project (6 Cr)
RP- 306	Research Project (4Cr)		

6. **A) Programme objectives**

- Reconstruction and redesigning of the courses to suite local needs
- To emphasize on applied aspects of biotechnology
- To develop aptitude of students in the field of research
- To enrich of basic knowledge in areas of Biotechnology
- To provide quality teaching and training in multidisciplinary areas of Biotechnology and nurture students to meet the needs of the society and industry.

- To cater to the national and global requirement of trained manpower in the area of Biotechnology.
- To create and sustain excellent research and teaching ambience for future leaders and innovators.
- To establish collaborations with other academic institutions at national and international levels to reinforce education and research activities.
- To train the students in technology-based entrepreneurship for socio-economic development.
- Skill development training to bridge the gap between academia and industry.

B) Program Outcomes (POs)

The M.Sc., programme in Biotechnology is in high demand among life science programmes in the University. Successful completion of this programme will result in students;

- Having strong foundation in understanding of basic biology in both prokaryotic and eukaryotic systems at molecular level. Further the student will be able to learn cutting edge technology in the field of Biotechniques, Cell biology, Molecular Biology, Genetic Engineering, Bioinformatics, Plant, Animal and Microbial Biotechnology, Immunology, Nanotechnology, Medical, Pharmaceutical, Food and Environmental Biotechnology.

- Having hands-on practical skills along with their respective theoretical knowledge, this will help in their research carrier in academic institutions and industries.

- Having improved skills for teaching in academic institutions.

- Having competitive skills and spirit in the field of life sciences both in India and abroad for pursuing higher education.

7. Course Codes

Sr.	Course Name	Credit	Course code
M.Sc. Semester I			
Major Mandatory			
1	Cell Biology	4	MSU0325MML97G1
2	Basics in Microbiology	4	MSU0325MML97G2
3	Lab Course I	4	MSU0325MMP97G1
4	Lab Course II	2	MSU0325MMP97G2
5	Research Methodology	4	MSU0325RML97G
Major Elective			
6	Biomolecules and Instrumentations	4	MSU0325MEL97G1
	Microbial Diversity and Systematics		MSU0325MEL97G2
	Biostatistics and Computer		MSU0325MEL97G3
M.Sc. Semester II			
Major Mandatory			
1	Genetics and Immunology	4	MSU0325MML97H1
2	Molecular Biology	4	MSU0325MML97H2
3	Lab Course III	4	MSU0325MMP97H1
4	Lab Course IV	2	MSU0325MMP97H2
5	On Job Training	4	MSU0325OJ97H
	Field Project		MSU0325FP97H
Major Elective			
6	Cellular Metabolism	4	MSU0325MEL97H1
	IPR and Bioethics		MSU0325MEL97H2
	Animal Physiology and Endocrinology		MSU0325MEL97H3
M.Sc. Semester III			
Major Mandatory			
1	Plant and Animal Tissue Culture	4	MSU0325MML97I1
2	Genetic Engineering and Bioinformatics	4	MSU0325MML97I2
3	Lab Course V	4	MSU0325MMP97I1
4	Lab Course VI	2	MSU0325MMP97I2
5	Research Project	4	MSU0325RP97I
Major Elective			
6	Industrial Biotechnology	4	MSU0325MEL97I1
	Stem Cell Technology		MSU0325MEL97I2
	Clinical Research		MSU0325MEL97I3
M.Sc. Semester IV			
Major Mandatory			
1	Medical Biotechnology	4	MSU0325MML97J1
2	Environment and Pharmaceutical Biotechnology	4	MSU0325MML97J2
3	Cancer Biology and Nanotechnology	4	MSU0325MML97J3
4	Research Project	6	MSU0325RP97J
Major Elective			
5	Food and Agricultural Biotechnology	4	MSU0325MEL97J1
	Industrial Waste Management		MSU0325MEL97J2
	Quality assurance and validation		MSU0325MEL97J3

8. Syllabus

M. Sc. Biotechnology (Part I) (Level-6.0) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of course – MMT 101 Cell Biology
Course code- MSU0325MML97G1
Total credits- 4

Course Objectives:

- To make the student aware of basic concepts of cell, cell organelles.
- To make the student aware of basic concepts cytoskeleton
- To make the student aware of basics of cell membrane and membrane transport.
- To make the student aware of protein trafficking, cell signaling and cell cycle.

Course Outcome: After completing the credits students should gain knowledge about:

- Basic concepts of Cell and sub cellular structures
- Basic Concept of Cytoskeletal assembly.
- Basic Concept of Cell membrane and membrane transport.
- Basic Concept of protein trafficking, cell signaling and cell cycle.

		60 Hrs
Credit I	**Cell Structure and Cytoskeleton**	**15 Hrs**
	Cell Structure -Structure and functions of organelles (mitochondria, chloroplast, vacuoles, peroxisomes and lysosomes, nucleus and its components), Cell membrane – Plasma membrane types (animal, plant and bacterial) Cell cytoplasmic membrane system- structural and functional organization, extracellular matrix. **Cytoskeleton-** Introduction, Cytoskeletal elements, Microtubules- occurrence, structure, chemical composition, microtubule associated, proteins, HMW proteins, DAU proteins MTOC , assembly and disassembly of Microtubules, functions, Microfilaments- occurrence, structure, chemical composition, functions, Intermediate filaments(IF)- occurrence, structure, chemical composition, types of IF, functions Organization of cilia and flagella.	
Credit II	**Cell cycle**	**15 Hrs**
	Cell Cycle and its regulation, Cell differentiation, Cell death, phenomenon of apoptosis, autophagy, necrosis, cell transformation, Cell differentiation in plants and animals including terminal cell differentiation, Role of hormones and growth factors	
Credit III	**Cellular Transport**	**15 Hrs**
	Transport across plasma membrane and intra-cellular transport (vesicular and membrane transport) at molecular level, Ion channels and aquaporins. Structure of Plant Cell, Plant cell wall - primary and secondary, Plamodesmata structure and function Plastids - biogenesis, structure and types, Transepithelial Transport, Voltage-Gated Ion Channels and the Propagation of Action Potentials in Nerve Cells.	
Credit IV	**Protein trafficking and Cell signaling**	**15 Hrs**
	Protein trafficking-Secretary pathway-ER associated ribosomal translation, co-translational vectoral transport of nascent polypeptide chain to ER lumen. Transport to Golgi apparatus, secretary granules. Transport of proteins to- mitochondria, chloroplast, peroxisomes, nucleus and outside of cell.	

	Cell signaling- Introduction, general principles of cell signaling. Types of cell signaling-contact dependent signaling, autocrine, paracrine, synaptic, endocrine, gap junctions, combinatorial signaling. Cell surface receptor proteins and signaling- Ion channel linked receptors, G-protein linked receptors and enzyme linked receptors	

Reference Books: -

- Lodish H., Berk A, Kaiser C., KReiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., (2012) Molecular Cell Biology. 7th Edition, USA
- Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
- John H. Wilson (2008) Molecular Biology of the Cell: Problems Book, Garland Science
- Bruce Alberts, Alexander Johnson, Julian(2007)Molecular Biology of the Cell, 5th Edition
- Pawar C. B. Cell Biology.
- William V. Dashek (2017) Plant Cell Biology - CRC Press
- Geoffrey M. Cooper, Robert E. (2013), The Cell: A Molecular Approach, 6th edition
- Cell biology –De Robertis
- Cell biology-Genetics, molecular biology-P.S. Warma & Agarwal
- Genes- Lewin

Title of course – MMT 102 Basics in Microbiology
Course code- MSU0325MML97G2
Total credits- 4

Course Objectives:

- Define the science of microbiology and describe some of the general methods used in the study of microorganisms
- Describe some of the various activities of microorganisms that are beneficial to humans
- Principles of physical and chemical methods used in the control of microorganisms and apply this understanding to the prevention and control of infectious diseases.
- Appropriate laboratory and techniques to the isolation, staining, identification and control of microorganisms.

Course Outcome: After completing the credits students should gain knowledge about:

- Milestones in Microbiology,
- Characteristics of viruses and lytic cycle.
- Basic components of Nutrient medium and their role.
- Microbial Growth.
- Principles of sterilization.
- The Principles and procedures of staining microorganisms.

		60 Hrs
Credit I	**Morphology and cytology of Bacteria**	**15 Hrs**
	Morphology of Bacteria – Size, Shape, Arrangements. Cytology of Bacteria – Structure and functions of: Cell wall, Cell membrane, Capsule and slime, Flagella, Pilli, Nuclear material, Mesosome, Ribosome, Reserve food material and Endospore. General Characteristics of Certain Bacteria- Archaebacteria, Eubacteria, Actinomycetes, Rickettsia, Chlamydia, Mycoplasma. **Culture media and pure culture techniques:** Common components of media and their functions, Peptone,	

	Tryptone Yeast extract, NaCl, Agar and Sugar. Culture media Living Media- Lab animals, plants, bacteria, embryonated eggs, tissue cultures. Non-living media– i) Natural, ii) Synthetic, iii) Semi-synthetic, iv) Differential, v) Enriched, vi) Enrichment, vii) Selective. Methods for isolation of pure culture- i) Streak plate ii) Pour plate iii) Spread plate	
Credit II	**Sterilization:-**	**15 Hrs**
	Definitions of Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Asepsis, Sanitization. Methods of sterilization by- Physical agents**:** i) Temperature- dry heat, moist heat ii) Radiation- U.V, Gamma radiation iii) Bacteria proof filter- membrane filter. Chemical agents: - Phenol & Phenolic compounds, Alcohol, Heavy metals (e.g. mercury). Gaseous agents- Ethylene oxide, formaldehyde.	
Credit III	**Stains and staining procedures -**	**15 Hrs**
	Definition of dye and stain, Classification of stains – Acidic, Basic and Neutral. Principles, Procedure, Mechanism and application of staining procedures in Prokaryotes. Simple staining, Negative staining, Differential staining: Gram staining and Acid fast staining, Special staining: Capsule staining, cell wall staining, endospore staining, metachromatic granule staining. Principles, Procedure, Mechanism and application of staining procedures in Eukaryotes- Nuclear, Mitochondrial and chloroplast, Nucleic acid and protein staining. **Microbial growth:** Definition of growth, phases & growth curve a] Continuous culture b] Synchronous growth c] Diauxic growth. Effect of environmental factors on growth- Temperature, pH, osmotic pressure, hydrostatic pressure, surface tension, heavy metals, ultra violet light.	
Credit IV	**Introduction to Virology-**	**15 Hrs**
	General characteristics, Principles of Cultivation, Classification. Replication cycle of bacteriophages-lytic cycle of T4 bacteriophage, one step growth experiment, Lysogenic cycle of Lambda phage**.** Replication cycle of plant viruses- TMV, Lettuce necrosis yellow virus. Replication cycle of animal virus- Herpes, Reo, Influenza, Retro. Inhibition and inactivation of viruses. Antiviral chemotherapy. Role of viruses in oncogenesis.	

Reference Books: -

- Fundamentals of microbiology-Frobisher
- Microbiology-Pelczar
- General microbiology –Pawar &Daginawala
- Brock's Biology of Microorganisms. 11th Edition, (2006). Madigan MT, Martinko J. M. Pearson Education Inc. , USA
- L. M., Harley J.P., and Klein D.A. (2005). Microbiology Prescott,, 6th Edition. MacGraw Hill Companies Inc.
- Ananthnarayana, R. and C.E, JayaramPanakar, (1996), Text book of microbiology 5th edition Orient Longman.

- Davis B.D. ,Debacco, J.B. (1990), Microbiology, 4th edition Lippincott Co. NY, Zinsser, W. K Joklik, NY 1976, Microbiology 2nd Edition,
- Stanier R.Y., Adelberg E.A. and Ingraham, J. L(1987), General Microbiology, 5th edition Macmillan Press Ltd.
- Ingraham JL and Ingraham CA. 1999 Introduction to Microbiology. 3rd Edition, S.Chand (G/L) & Company Ltd; 2nd edition (12 October 1999)
- S. Jane Flint, Vincent R. Racaniello, Glenn F. Rall · 2015 Principles of Virology4th Edition Wiley.
- KubyImmunology, Judy Owen , Jenni Punt , Sharon Stranford., 7thedition (2012), Freeman and Co., NY
- S. M. REDDY. RAM REDDY, S.M. Reddy · 2012 Essentials of Virology SCIENTIFIC Publishers JOU.

Title of course – MET 103 A- Biomolecules and Instrumentation
Course code- MSU0325MEL97G1
Total credits- 4

Course Objectives:

- To make students aware of fundamentals of Biochemistry.
- To make the student aware of basics of chemical science in relevance to biological systems.
- To study working and instrumentation of instruments.
- To learn applicability of instruments in biology
- To understand concepts of bioinstrumentation

Course outcome:-: After completing the credits students should gain knowledge about:

- Fundamentals of biochemistry i.e. Nucleic acid, carbohydrates and lipids.
- Basic concepts of Instruments and its Application
- Application of this knowledge in the laboratory
- Handling the instruments during project.
- Principle behind the instruments.

		60 Hrs
Credit I	**Nucleic acids and Carbohydrates**	**15 Hrs**
	Nucleic acids: Tautomeric forms of bases and their implication in pairing of bases. Structure of polynucleotides, DNA structure, Structure of DNA double helix. R and L handed forms. A, B, C and Z forms of DNA. Types of RNA. Denaturation and Renaturation of DNA and Tm value. **Carbohydrates:** L forms and D forms of sugar. Reducing and non reducing sugars. Aldoses / ketoses. Alpha and Beta, ring forms of sugars. Glycosidic linkages. Sugar derivatives – sugar alcohol, amino sugars, dextro sugars, sugar acids Polysaccharides (starch, glycogen, cellulose).	
Credit II	**Proteins and Lipids**	**15 Hrs**
	Proteins: Structural features of amino acids, classification of amino acids, amino acids as buffers, Henderson Hasselbalch equation and its role in buffer formulation Peptide linkage, partial double bond nature of peptide bond. Determination of primary structure of polypeptide (N- terminal, C-terminal determination, method of sequencing of peptides), Structural classification of proteins: primary, secondary, tertiary, quaternary structures of proteins. Non-covalent interactions, Conformational properties of proteins, Polypeptide chain geometry, Resonance forms of the	

	peptide group, cis/trans isomers of peptide group Ramachandran plot. Secondary, Super-secondary Motif & Domain. Tertiary and Quaternary structures of proteins, (Myoglobin &hemoglobin). **Lipids:** Fatty acids – Types and nomenclature. Saturated and unsaturated fatty acids, Structure and function of Triglycerides, Phospholipids, Sphingolipids. Structure and function of steroids, terpenes, prostaglandins.	
Credit III	**Chromatography and Electrophoresis**	**15 Hrs**
	Chromatography: Introduction, Theory, Principle and applications of paper chromatography, thin layer chromatography. gel filtration, affinity, ion exchange chromatography, HPLC. **Electrophoresis:** Gel electrophoresis (Agarose, PAGE, SDS-PAGE), Discgel electrophoresis, High voltage electrophoresis,, Gradient electrophoresis, pulsed field electrophoresis, Immunoelectrophoresis, isoelectric focusing,.2-D gel electrophoresis.	
Credit IV	**Spectrophotometry**	**15 Hrs**
	Introduction, Principle, Instrumentation and Applications of U. V. visible spectroscopy, Microwave Spectroscopy, Fluorescence spectroscopy, IR, ESR, NMR, X-ray diffraction, mass spectrometry, ORD, CD.	

Reference Books: -

- Jeremy Berg, LubertStryer, (2012), Principles of Biochemistry, 7th Edition. New York: W.H. Freeman and company
- David Nelson & Michael Cox (2008) Lehninger, *Principles of Biochemistry*. 5th edition. New York:, W.H. Freeman and company,
- Satyanarayanan, U. and Chakrapani, U., (2007) *Biochemistry*, 3rd edition India: Uppala Author Publisher Interlinks,
- David Plummer,(2001). *An Introduction to Practical Biochemistry*, 3rd Edition, India: Tata McGraw Hill Edu.Pvt.Ltd.
- Biophysical Chemistry by Nath and Upadhya.
- Practical biochemistry principles and techniques by Wilson and Walker.
- Instrumental methods of chemical analysis by Chatwal and Anand.
- Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.
- Analytical Biochemistry by Holme.
- Spectroscopy by B.P. Straughan and S. Walker

Title of course – MET 103 B- Microbial Diversity and Systematics
Course code- MSU0325MEL97G2
Total credits- 4

Course Objectives:

- To study the microbiological diversity.
- To understand the process of identification of microbes.

Course Outcomes: After completing the credits students should gain knowledge about:

- Exploration of enormous biological diversity in the microbial world.
- Practical knowledge of microbial diversity from phylogenetic perspective.
- Contributions of specific microorganism makes to the Universe.

		60 Hrs
Credit I	**Taxonomy of Bacteria and Introduction to Bergey's Manuals**	**15 Hrs**

	Introduction to Bacterial Taxonomy, classification, 5-Kingdom classification system, 3-Domain classification system. Bergey's Manuals (History, development, current status). Determinative Bacteriology (Phenetic Approach). Systematic Bacteriology (Phylogenetic Approach Polyphasic Approach.	
Credit II	**Microbial diversity**	**15 Hrs**
	The expanse of microbial diversity. Estimates of total number of species. Species Divergence and the measurement of microbial diversity. Measures and indices of diversity.	
Credit III	**Diversity of Eubacteria**	**15 Hrs**
	Key features and significance of the following genera: Deeply Branching Bacteria: Thermotoga, Deinococcus. Proteobacteria: Classes and Types. Alphaproteobacteria: Rhizobium, Ricketssia. Betaproteobacteria: Neisseria, Thiobacillus. Gammaproteobacteria: Escherichia, Yersinia. Deltaproteobacteria: Myxococcus and Bdellovibrio. Epsilonproteobacteria: Campylobacter, Helicobacter. Zetaproteobacteria: Mariprofundus ferrooxydans. Non-Proteobacteria: Chlamydia, Spirochaetes. Gram Positive bacteria having genomes of low GC content: Firmicutes Clostridium, Bacillus. Tenericute Mycoplasma. Gram Positive bacteria having genomes of high GC content: Mycobacterium, Streptomyces	
Credit IV	**Diversity of Archae and Fungi**	**15 Hrs**
	General characteristics and outline classification of Archae. General characteristics of Methanogenic, Extremely Halophilic and Extremely thermophilic Archaeobacteria. Extremophiles: general characteristics of acidophilic, alkaliphilic, barophilic microorganisms. General characteristics and outline classification of Actinomycetes. Fungi: General characteristics and outline classification of fungi, Morphology of some common fungi - Mucor, Rhizopus, *Aspergillus*, *Penicillium* and *Fusarium*. Yeasts: General characteristics and outline classification of yeasts. General characteristics of Lichens and Mycorrhiza.	

Reference Books: -

- Breed and Buchanan. Bergey's Manual of Determinative Bacteriology. 8th Edition, 1974.
- Breed and Buchanan. Bergey's Manual of Determinative Bacteriology. 9th Edition, 1982.
- Breed and Buchanan. Bergey's Manual of Systematic Bacteriology. 2nd Edition, (Volumes. 1 –5) (2001 – 2003).
- Sykes, G. and F. A. Skinner (Eds). Actinomycetales: Characteristics and Practical Importance. Society for Applied Bacteriology Symposium Series No. 2, Academic Press. 1973.
- Keller M. and Zengler K. (2004) Tapping in to Microbial Diversity. Nature Reviews 2, 141-• 150.
- Pace N. (1997) A Molecular View of Microbial Diversity and the Biosphere, Science, 276, 734-740.
- Woese C. (1987), Bacterial Evolution. Microbiological Reviews, 221-271.

- James D. Oliver (2005). The Viable but Nonculturable State in Bacteria (2005). The Journal of Microbiology, 43, Special Issue, 93 – 100.

Title of course – MET 103 C- Biostatistics and Computer
Course code- MSU0325MEL97G3
Total credits- 4

Course Objectives:

- To understand data analysis of given samples.
- To understand concept of statistic and its use in biological field
- To understand the Office operations like Microsoft Word, Microsoft Excel and power point presentation.
- To study the Database management and their importance.

Course Outcomes: After completing the credits students should gain knowledge about:

- Basic fundamentals of the statistics.
- Analysis of data statistically
- Operating System.
- Data processing and presentation.

		60 Hrs
Credit I	**Basic concepts**	**15 Hrs**
	Definitions – statistics and biostatistics, population, sample, variable and the various types, statistic and parameter. Collection and presentation of data: primary and secondary data, collection of data –enumeration and measurement, significant digits, rounding of data, accuracy and precision, recording of data. Tabular and diagrammatic presentation – arrays, frequency distribution, bar diagrams, histograms and frequency polygons.	
Credit II	**Descriptive statistics and Sampling methods**	**15 Hrs**
	Descriptive statistics: measures of central tendency, dispersion, skewness and kurtosis. Probability: definition, elementary properties, types, rules, applications to biological problems, distributions – Binomial, Poisson, Normal, chi-square ($\chi 2$) distribution and test. Sampling methods: principles of sampling, necessity – merits and demerits, random sampling – lottery, geographical arrangement random number; deliberate or non-random sampling, stratified sampling, cluster sampling. Inference about populations: sample size, sampling distribution, standard error, estimation of population mean - confidence interval, Student's t- distribution and its applications (t- test).	
Credit III	**Data processing**	**15 Hrs**
	Word Processing : Introduction to MS Office components, Introduction and working with MS Word , Word basic commands, Formatting- text and documents, sorting and tables, introduction to mail-merge. Spread Sheets: Working with EXCEL- formatting, functions, chart features, Working with graphics in Excel, Excel functions, table operations.	
Credit IV	**Data Presentation**	**15 Hrs**
	Presentation with Power-Point: Power-point basics, creating presentation, working with graphics, show time, sound effects and	

	animation effects. Internet, E-mail, Discussion groups, Search tools, Web utilities, concept of E commerce, Application of E commerce. Database Management System:Need of database, data models-Hierarchical, Network, Relational, Object Oriented, SQL Commands DBMS-DDL, DML, DCL.	

Reference Books: -

- Goon A. M., Gupta M. K. and Dasgupta B.: Fundamentals of mathematical statistics vol. I & II. World Press, Calcutta.
- Gupta & Kapoor: Fundamental of mathematical statistics.
- Thingale T. K. and Dixit P. G. (2003): A text book of paper- I for B.Sc. I, Nirali Publication, Pune.
- Waiker and Lev: Elementary Statistical methods.
- Rohatgi V. K. and Sauh A. K. Md E. (2002) An Introduction to probability and statistics (John Wiley & Sons-Asia).
- Computer Fundamentals by P. K. Sinha
- C Application programs and Projects by Pramod Vasambekar
- Use of Computer from Vision Publication

Title of course – MMPR 104- Lab Course I (60 Hrs) 100 Marks
Course code- MSU0325MMP97G1
Total credits- 4

Course Objectives:
The students should be able to…

- Make students aware of basic techniques in cell biology and microbiology.
- Impart skill of observing the microscopic objects
- Provide hands on skill for preparation of media.
- Provide skill of isolation and characterization of microorganisms.

Course outcome: After completing the credits students should gain knowledge about:

- How to isolate cell organelles.
- Staining procedures and their applications.
- Culture media preparation, microbial cultivation and enumeration.
- Isolatation of bacteria, study their cultural and morphological characteristics.

Sr. No.	Name of the Practicals	Credits
1	Microscopic examination of bacteria by a. Monochrome staining. b. Gram staining c. Negative staining. d. Capsule staining. e. Cell wall staining. f. Endospore staining	**I**
2	Isolation, mounting and identification of Mold. a. *Aspergillus* b. *Penicillium*	
3	Preparation of culture media Peptone water, Nutrient broth, Mac Conkey's agar, Sabouraud's agar PDA	**II**
4	Enumeration of bacteria by total viable count from soil by spread plate technique and pour plate technique.	
5	Study of growth curve of bacteria.	

6	Isolation, colony characters, Gram staining & motility of *E.coli* from water sample and *Bacillus* sp. from soil.	
7	Isolation, colony characters, Gram staining & motility *Bacillus* sp. from soil.	**III**
8	Isolation, colony characters, Gram staining & motility *Staphylococcus sp*. from suitable sample.	
9	Study of enzymatic activity of amylase and protease.	
10	Study of H_2S production test.	
11	Isolation of chloroplast.	**IV**
12	Isolation of nucleus.	
13	Isolation of mitochondria	
14	Study of cell lysis.	

Title of course – MMPR 105- Lab Course II (30 Hrs) 50 Marks
Course code- MSU0325MMP97G2
Total credits- 2

Course Objectives:

- Make students aware of instruments.
- To make the student aware of basic concepts of estimations.
- To make the student aware of basics of chemical science in relevance to biological systems.
- To make the student aware of various techniques.

Course outcome: After completing the credits students should gain knowledge about:

- Independent use of various instruments with proper care
- Techniques for detection of common important analytes.
- Spectroscopy, chromatography and electrophoresis.
- Models should bring clarity in concepts of conformations of Biomolecules.
- Standardization and calibration of pH meter.

Sr. No.	Name of the Practicals	Credits
1	Introduction to Basic laboratory instruments.	**I**
2	Preparation of buffers (Phosphate buffer, acetate buffer) and determination of pH with pH meter.	
3	Verification of Beer-Lambert's Law.	
4	Estimation of reducing sugar.	
5	Estimation of total sugar.	
6	Spectrophotometric determination of nucleic acid and protein.	**II**
7	Separation and identification of plant pigments using Ascending paper chromatography.	
8	Separation of amino acid by Paper Electrophoresis.	
9	Agarose gel electrophoresis to separate DNA.	
10	SDS-PAGE for separation of protein.	

Title of course – RM 106- Research Methodology
Course code- MSU0325RML97G
Total credits- 4

Course Objectives:

- Know the basics of research
- Understand the philosophy behind the research
- Understand how define research problem
- Learn tools required while doing research.

Course outcome: After completing the credits students should gain knowledge about:

- Philosophy behind the research
- Defining research problem
- How to do research.
- Use of different tools required while doing research.

		60 Hrs
Credit I	**Research and Research Methodology: Strategies and Planning**	**15 Hrs**
	Introduction to research -Objectives of research, Motivation in research, Basic types of research (Descriptive vs. analytical, applied vs.fundamental, qualitative vs. quantitative and conceptual vs.empirical)Research approaches, Significance of research **Research Process: Formulating the research problem-** Selecting the research problem. Necessity of defining problem. Technique involved in defining a problem. **Extensive literature survey-**Search strategies **(**Methodology filters and PubMed filters). Quality of bibliographies/reference lists. Impact factor to assess research quality. Principal Bibliographic databases (PubMed, Old Medline, Cochrane Library, EMBASE, BIOSIS Previews, PsycINFO and ISI Web of Science). **Preparing the research design-** Need for research design, Features of good design, Important concept relating to research design, Different research designs. Basic principles of experimental designs. Classification of experimental designs (Informal and Formal experimental design). **Determining the sample design-**Steps in sample design , Criteria of selecting a sampling methods/procedure. Different types of sample designs (non-probability and probability sampling).	
Credit II	**Research Data Collection and Analysis**	**15 Hrs**
	Collecting the data- Data types, Repeatability, Reproducibility and Reliability, Validity (concept validity, internal validity and external validity) Methods of collecting primary data: Observation method, Interview method, through questionnaires, through schedules and other methods. Methods of collecting secondary data: Case study method. Measurement scales (nominal, ordinal, interval and ratio) **Analysis of data-** Data presentation by Tables and Graphs (Histogram, bar, pie and line). Measures of central tendency – Mean, Mode, median Measures of dispersion – Mean deviation,	

	Standard deviation and Variance **Hypothesis testing-** The concepts of null hypothesis and alternative hypothesis. P-value significance level. Type I and type II errors. One tailed and two tailed tests. Degrees of freedom. Tests of hypothesis (Parametric tests : z-test, t-test, and F test)	
Credit III	**Ethics in Biological Research**	**15 Hrs**
	Introduction to Research ethics Ethical theories and frameworks i) Consequentialism ii) Deontological ethics iii) Virtue ethics. Basic principles of human research ethics. The ethics of animal research International regulations. Basic principles for all medical research Rules for basic medical research projects. The role of research ethics committees. **Scientific conducts and Misconducts-** Characterization of scientific work by three norms 1) Internal norms 2) Linkage norms 3) External norms. Fabrication of data Plagiarism. Authorship issues (Exclusion from authorship, Gift authorship, Authorship achieved by coercion and Unsolicited authorship). Duplicate publication. Publication bias. Other form of misconducts. The investigation and punishment of scientific misconduct.	
Credit IV	**Essentials of Scientific Writing**	**15 Hrs**
	Research Communications: Purpose of science communication. Requirement of producing publications. Choosing a journal for publications. **Writing of Scientific Papers:** Characteristics of a good scientific paper **Structure of Research paper:** Title, Authors, Abstract, Introduction, Materials and methods, Results, Discussion, Conclusions, Acknowledgements and References, Citation ofreferences (textual citations and order of references), Listingreferences, foot notes and End notes, Figures, tables, captions andequations , Units of measurements. **Planning of Research paper writing:** The first draft of researchpaper, Revising the first draft, the second draft, the third draft,checking of references, figures and tables, proofreading andreporting statistics in the final manuscript. Style and language of research papers. Style and language of research papers **Review Articles-**Kinds of reviews. Literature search. Writing a review article: Introduction, Description of theliterature review, Headings in the middle review, Conclusions,Recommendations, Acknowledgement and References. **Research papers Publishing ethics :** Using other's words or data (Plagiarism) Not reporting other's work. Putting your name on work you did not carry out. Double publishing Multiple submissions. Publishing the same results many times. Failing to obtain approval from authors. Authorship. Copyright. Data fabrication. Fraud or error. Conference and Journal publishing **Fraudulent research :**Fabrication, falsification, plagiarism, failure to GA disclose conflict of interest, inefficiency, anonymity.	

Reference Books: -

- Laake, P., Benestad, H. B., & Olsen, B. R. (Eds.). (2007). *Research methodology in the medical and biological sciences*. Academic Press.
- Kothari C. R. Research Methodology –Methods and Techniques.NEW AGE INTERNATIONAL (P) LIMITED, PUBLISHERS
- Kirub, A. (2014). Essentials of scientific writing. ISBN: 978-99944-53-98-6
- Amin S Bredan and Frans van Roy. 2006. Writing readable prose. MBO reports 7,1 846 – 849
- Anderson PV. 1991. Technical Writing, a reader-centered approach, 2nd edition, Harcourt Brace Jovanovich.
- Brooke Crutchley. 1970. Preparation of manuscripts and correction of proofs. Cambridge University Press.
- Hath EJ. 1990. How to Write and Publish Papers in the Medical Science, 2nd ed. Williams &Wilkms; Baltimore.
- James DL, JD Lester.2010. Writing research papers. A complete guide.13th edition.
- Jean-Luc Lebrun. 2007. Scientific writing: a reader and writer's guide. World Scientific Publishing.
- Cohen J (1993) HH: Gallo guilty of misconduct. Science 259: 168–170.
- Tranoy KE (1988) Science and ethics. Some of the main principles and problems. In: Jones AKI (ed.) The Moral Import of Science. Essays on Normative Theory, Scientific Activity and Wittengenstein. Sigma, Bergen, pp. 111–136.
- Tranøy KE (1996) Ethical problems of scientific research: an action-theoretic approach. The Monist 79: 183–196.
- Nuffield Council on Bioethics (2005) The ethics of research involving animals – a guide to the report. Nuffield Council on Bioethics, London.
- Russell WMS, Burch RL (1959) The Principles of Humane Experimental Technique. Methuen, London, available at: http://altweb.jhsph.edu/publications/humane_exp/hettoc.htm
- Jennifer Peat. 2008. Scientific writing: easy when you know how. BMJ Books
- Scott EM, Waterhouse JM (1986) Physiology and the Scientific Method. Manchester University Press, Manchester.
- Garfield E (2006) The history and meaning of the journal impact factor. JAMA 295: 90–93. 17. Pitkin RM et al. (1999) Accuracy of data in abstracts of published research articles. JAMA 281: 1110–1111.Irfan Ali Khan and AtiyaKhanum, Fundamentals of Biostatistics. 3rd

Title of course – MMT 201- Genetics and Immunology
Course code- MSU0325MML97H1
Total credits- 4

Course Objectives:

- Understand the basics of genetics.
- Learn principles of Microbial genetics.
- Learn Human Immune system.

Course outcome: After completing the credits students should gain knowledge about:

- Cytogenetics with linkage, crossing over and chromosomal aberration.
- Microbial genetics.
- Antigen antibody reactions.
- Autoimmunity and strategies for treating autoimmune diseases.

		60 Hrs
Credit I	**Evolution**	**15 Hrs**
	Origin of life. Theory of spontaneous generation, chemical evolution. Origin of organized structure, Theories of evolution-Lamarckism, Darwinism, neo-darwinism, modern synthetic theory & mutational theory. Evidences of evolution, natural selection. Concept of species and speciation, evolutionary forces for speciation. Hardy-Weinberg law. Molecular phylogeny. Interaction of gene-Epstasis, complimentary gene, duplicate gene. Linkage-Definition, coupling and repulsion hypothesis, linkage groups. Crossing over-Mechanism and theory.	
Credit II	**Microbial Genetics**	**15 Hrs**
	Transposable elements-IS elements, transposons and retroelements. Transposons in prokaryotes and eukaryotes, mechanism of transposition, uses of transposons. Plasmid- Types, Structure, properties and applications. Genetic recombination in bacteria-Definition, fate of exogenote in recipient cell, transformation, conjugation, transduction. Mechanism of recombination-The Holliday model, Messelson and Radding model, Double strand break repair model, Fox model for non reciprocal recombination.	
Credit III	**Immunology-I**	**15 Hrs**
	Types of immunity-i)Innate (specific and non-specific) ii) Acquired (Active and Passive), Types of Defense- a) first line of defense (barriers at the portal of entry, physical and chemical barriers) b) second line of defense (Phagocytosis– oxygen dependent and independent) c) third line of defense-specific defense mechanism. Complement- classical and alternative pathways and their regulation, Introduction to cells and organs of immune system-Organs of immune system-primary and secondary lymphoid organs structure and their role. Cells of immune system-a)broad categories of leucocytes, their role and properties b) B-lymphocytes c) T-cells-subsets d) other cells (APC, Null, NK)	
Credit IV	**Immunology-II**	**15 Hrs**
	Antigen- definition , nature, types of antigen, factors affecting	

	antigenicity. Antibody- definition, nature, basic structure of immunoglobulin molecule, major human immunoglobulin classes, properties and functions. Antibody diversity-introduction and theories. Immune response-primary and secondary immune response, theories of antibody production. MHC complex- Structure, function and presentation of peptide MHC complex. Antigen Antibody reactions-Principle and applications of a)agglutination b) precipitation c) complement fixation d) ELISA. Hypersensitivity- Concept and types with example. Autoimmune Diseases - Concept and types.	

Reference Books: -

- Strickberger MW, (2006) Genetics, Prentice Hall-India,
- Gardner, M.J. Simmons, D.P. Snustad(2006) Principles of genetics, 8th edition.
- Strachan & Read, Human (1999) Molecular Genetics, Wiley,
- David Freifelder& Stanley Maloy, Johncronan (1994). Microbial Genetics, Jones and Bartlett Publishers, 2nd edition.
- Roger Y Stanier, John L Ingraham, Mark, L. Wheelis, Rage, R. (1992). General Microbiology, 5th Edition, Mcmillan publications
- P.K.Gupta(1990). Genetics -A Text-book for University students, IInd edition ,Rastogi publications,
- C.Sarin ,(1985).Genetics ,Tata McGraw-Hill Publications,
- S. Jane Flint, Vincent R. Racaniello, Glenn F. Rall · 2015 Principles of Virology 4th Edition Wiley.
- Sudha Gangal and Shubhangi Sontakke (2013), Textbook of basic and clinical immunology, 1st edition, University Press, India.
- Kuby Immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7thedition (2012), Freeman and Co., NY
- The Elements of Immunology. F.H. Khan (2009), Pearson Education.
- David Male, Jonathan Brostoff Immunology, 7thedition (2006)

Title of course – MMT 202- Molecular Biology
Course code- MSU0325MML97H2
Total credits- 4

Course Objectives:

- Learn various advance concepts of Genomic organization.
- Know role of DNA in a range of gene expression and regulation.
- Study protein synthesis process
- Understand molecular biology in relevance to Biotechnology.

Course outcome: After completing the credits students should gain knowledge about:

- Advance concepts of Genomic organization
- Fundamentals of Molecular Biology.
- Gene expression, protein synthesis.
- Process of synthesis of proteins

		60 Hrs
Credit I	**Organization of Genome**	**15 Hrs**
	Organization of prokaryotic and eukaryotic genomes, Structure of chromatin, nucleosome, chromatin organization and remodeling, DNA reassociation kinetics (Cot curves), repetitive and unique	

	sequences, DNA melting and buoyant density, C value paradox and genome size, satellite DNA. Lyon hypothesis, Dosage compensation (Bar Body). Gene families, clusters, Pseudogenes, superfamilies, Organelle genomes (Mitochondria, Chloroplast).	
Credit II	**DNA Replication**	**15 Hrs**
	Experimental Evidences for DNA as a genetic material:- Griffith's Exp., Avery, Macleod, McCarty Exp., Blender Exp., RNA As a genetic material Gierer and Schram expt. Semi conservative model of replication. Direction of replication (Uni & Bidirectional). Prokaryotic and eukaryotic replication-Enzymes involved in replication, initiation, elongation and termination. Rolling circle model and telomere replication. Mitochondrial DNA replication.	
Credit III	**Transcription in prokaryote and Eukaryote**	**15 Hrs**
	Mechanism of transcription-Enzyme involved, initiation, elongation and termination. Inhibitors of transcription , Post transcriptional modification, Transcriptional control by hormones. Genetic Code- Properties of genetic code. Assignment of codons with Unknown sequences a) Polyuridylic b) Acid Copolymers method. Assignment of codons with known sequences a) Binding technique b) Repetitive seq. technique. Wobble Hypothesis, Variation in genetic code.	
Credit IV	**Translation in prokaryote and Eukaryote**	**15 Hrs**
	Structure and role of ribosome in translation, Amino acid t-RNA complex formation, Initiation, Elongation, termination of translation Inhibitors of translation. Post- translation modifications (Protein folding, Removal of Leader sequences, Phosphorylation, glycosylation, acetylation). Regulation of gene expression in prokaryote and eukaryote. Regulation of gene expression in prokaryote a) Lac operon b) Tryptophan operon c) Arabinose operon. Regulation of gene expression in eukaryote a) Promoter b) Enhancers c) Activators d) Repressor e) Co-Repressors. Regulation of gene expression at transcriptional and translation level.	

Reference Books: -

- Asif Nadeem, Faiz-Ul Hassan, Maryam Javed (2021), Introduction to Molecular Genomics, Bentham Science Publishers
- Nancy Craig, Rachel Green, Carol Greider, Orna Cohen-Fix (2014) Molecular Biology Principles of Genome Function 2nd Edition, OUP Oxford
- Benjamin Lewin (2012), Genes XI, 11th edition, Publisher - Jones and Barlett Inc. USA
- Weaver R (2011) Molecular Biology, 5th Edition, McGrew Hill Science. USA
- Burton E Tropp, Jones & Bartlett (2011), Molecular Biology: genes to proteins, 4th edition Learning, USA
- Keith Wilson, John Walker(2010) Principles and Techniques of Biochemistry and Molecular Biology7th Edition Cambridge University Press

- Pal J.K. and SarojGhaskadbi, (2009), Fundamentals of Molecular Biology, Oxford University Press. India
- James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2008) Molecular Biology of the Gene, 6th Edition,. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
- Richard M. Twyman, W. Wisden(1998) Advanced Molecular Biology: oncise Reference A C BIOS Scientific
- Brown T A (1995) A practical approach, Essential molecular biology, vol. I, IRL press, Oxford.

Title of course – MET 203 A- Cellular Metabolism
Course code- MSU0325MEL97H1
Total credits- 4

Course Objectives:

- To make students aware of fundamentals of metabolism.
- To make the student aware of basics of chemical science in relevance to biological systems.
- Acquire the knowledge about enzymes their structure, function and kinetics.

Course outcome: After completing the credits students should gain knowledge about:

- Interpret various biomolecules, pathways of the cell and their significance in metabolism.
- Structural, functional relations of enzymes.
- Applications of Immobilization of enzymes in industries.

		60 Hrs
Credit I	**Bioenergetics**	**15 Hrs**
	Metabolism:- Introduction to metabolism, anabolism & catabolism, catabolism & its three stages, types of metabolic reactions, Methods employed to study metabolism (by cell free extract, using auxotrophic mutants, radioisotopes), High energy compounds. Carbohydrates Metabolism:-Reactions and energetics of Glycolysis, Gluconeogenesis, TCA cycle, Glyoxylate cycle, HMP and its significance. Respiration:- Aerobic:-Flow of electrons in ETC, Redox potential components of ETC, Mechanism of ATP generation-Chemiosmotic hypothesis, ATP synthase complex. Anaerobic Respiration:- Alcoholic and Lactic acid fermentation.	
Credit II	**Photosynthesis**	**15 Hrs**
	Harvesting light energy General features of photophosphorylation, Light absorption, Reaction centers organization of photosystems in the thylakoid membrane. Hill reaction, The central photochemical event: Light-driven electron flow ATP synthesis by photophosphorylation, A proton gradient couples electron flow and Phosphorylation, Chloroplasts Evolved from endosymbiotic bacteria, Carbohydrate biosynthesis in plants and bacteria, Photorespiration, Calvin cycle (C3) and Hatch-Slack pathway, (C4) CAM pathways, Biosynthesis of starch and sucrose ,Synthesis of cell wall polysaccharides.	
Credit III	**Lipid Metabolism and Nitrogen fixation**	**15 Hrs**
	Lipid Metabolism: Biosynthesis of fatty acid with respect to Palmitic acid & degradation of fatty acid (β-oxidation) with	

	respect to Palmitic acid. **Nitrogen fixation-**Introdction, Symbiotic and non-symbiotic nitrogen fixation. Nitrogen cycle, Root nodule formation, Nitrogenase enzyme complex - azoferredoxin and molybdoferrodoxin. Physiological electron donors and mechanism of nitrogen reduction, Nif genes and its regulation, Nitrogen fixing bacteria used as biofertilizer.	
Credit IV	**Enzymology**	**15 Hrs**
	Enzymes: Introduction, IUB classification, active site, energy of activation, transition state hypothesis, lock and key hypothesis, Induced fit hypothesis, enzyme inhibition types competitive, non-competitive, un-competitive. M M equation, Brigg's and Haldane assumption and derivation, Line weaver- Burk plot, Eadie-Hofstee plot, Hanes and Eisenthal and Cornish- Bowden modifications of the MM equation to derive $K_{M,}$ Significance of MM equation and KM Enzyme inhibition – Basic concepts, Kinetics, Examples and significance of reversible and irreversible inhibition. Covalent modification of enzyme structure – Irreversible & Reversible modification Isoenzymes – Basic concept, methodsof detection, examples and their metabolic significance Immobilisation of enzymes – Basic concepts, methods used, properties of immobilized enzymes and their applications in industry, medicine, enzyme electrodes	

Reference Books: -

- Jeremy Berg, LubertStryer, (2012), Principles of Biochemistry, 7th Edition. New York: W.H. Freeman and company
- Nicholas C. P. (2009) *Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins*, Oxford University Press
- Erice Conn & Paul Stumpf, (2009), *Practical Biochemistry*,5th Edition, USA: John Wiley and Sons
- Donald Voet& Judith Voet, (2008) *Fundamentals of Biochemistry*, 3rd edition. USA: John Wiley and Sons Inc.,
- David Nelson & Michael Cox (2008) Lehninger, *Principles of Biochemistry.* 5th edition. New York:, W.H. Freeman and company,
- Satyanarayanan, U. and Chakrapani, U., (2007) *Biochemistry*, 3rd edition India: Uppala Author Publisher Interlinks,
- Reymond, J.L. (2005) Enzyme Assays and Enzyme Profiling: High Throughput Screening, Genetic Selection and Fingerprinting; Wiley VCH
- David Plummer,(2001). *An Introduction to Practical Biochemistry*, 3rd Edition, India: Tata McGraw Hill Edu.Pvt.Ltd.
- Nicholas C. P. and Stevens L. (2000) *Fundamentals of Enzymology, The Cell and Molecular Biology of Catalytic Proteins*, New York : Oxford University Press

Title of course – MET 203 B- IPR and Bioethics
Course code- MSU0325MEL97H2
Total credits- 4

Course Objectives:

- To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights.
- To identify the significance of practice and procedure of Patents.

- To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
- To learn the procedure of obtaining Patents, Copyrights, Trade Marks &Industrial Design.

Course outcome: After completing the credits students should gain knowledge about:

- Various forms of IPRs.
- Statutory provisions to protect particular form of IPRs.
- Rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc.
- Identification and protection of different forms of IPRs national and international level.

		60 Hrs
Credit I	**IPR**	**15 Hrs**
	General overview of Intellectual Property Rights and Patents, History of intellectual property rights in India, intellectual property, WIPO, WTO, Trade Related Intellectual Property Rights. Basic requirements of Patentability, Patentable subject matter, Types of patent (process and product), Procedure for obtaining Patent, Provisional and Complete specification. Plant variety protection. Protection of Biotechnological Inventions: Patenting of genes and DNA sequences, gene patents and genetic resources, patenting of life forms, IPR and development countries, broad patents in biotechnology.	
Credit II	**Copyright and trademarks**	**15 Hrs**
	Meaning and objectives of copyright, Rights conferred by registration of copyright, Infringement of copyright. Related rights-Distinction between related rights and copy rights. Intellectual theft, academic integrity. Basic Principles of Trademark, Rights conferred by Registration of Trademark, Infringement of Trademark. Selecting and evaluating trademark.	
Credit III	**Geographical indicators**	**15 Hrs**
	Geographical Indications-Objectives of Geographical Indications, Rights conferred, Infringement of Geographical Indications, International Position Indian Position, Bioprospecting and Biopiracy.	
Credit IV	**Biosafety and Bioethics**	**15 Hrs**
	Biosafety: Definition, objectives of biosafety guidelines, risk assessment, biosafety during industrial production, planned introduction of genetically modified organisms, biosafety guidelines in India. Good manufacturing practice and Good lab practices (GMP and GLP). National and international regulations for food and pharma products. Ethical implications of biotechnological products and techniques: Ethical research, plagiarism.	

Reference Books: -

- Intellectual Property Rights by Brigitte Anderson, Edward Elgar Publishing
- Intellectual Property Rights and the Life Sciences Industries by Graham Dutfield, Ashgate Publishing
- WIPO Intellectual Property Handbook

- Intellectual Property Rights by William Rodelph Cornish, David Clewelyn

Title of course – MET 203 C- Animal Physiology and Endocrinology
Course code- MSU0325MEL97H3
Total credits- 4

Course Objectives:

- To explain the roles of the endocrine system in maintaining homeostasis, integrating growth and development.
- To discuss the definition of a hormone in terms of its general properties.
- To describe the different classes and chemical structures of hormones.

Course outcome: After completing the credits students should gain knowledge about:

- Structures and functions of endocrine systems.
- Classification of hormones, their basic structure and their mechanism of action. Elaboration of morphological changes and the complications associated with the disruption of endocrine function.

		60 Hrs
Credit I	**Thermoregulation, Circulation and Cardiovascular System**	**15 Hrs**
	Introduction, Concept of Poikilothermy and Homeothermy, Survival Mechanism in Poikilotherms and Homeotherms, Cold Resistance and Cold Death, Heat Resistance and Heat Death, Respiratory Organs in Different Animals, Transport of Oxygen and Carbon dioxide, Respiratory Pigments. Types of heart, Concepts of Neurogenic and Myogenic Hearts, Cardiac cycle, ECG patterns in Mammals, Homeostasis and Blood Clot Formation.	
Credit II	**Physiology of Digestion and Excretion**	**15 Hrs**
	Introduction. Patterns of Digestion and Absorption in Animals. Role of Digestive Enzymes. Digestion, Absorption and Assimilation of Various Food Stuffs. Functions of Kidne. Types of Nitrogenous Wastes in Different Animal Groups and their Excretion. Urea production – Hans Krebs and Kurt Henseleit cycle, Urine Formation. Osmoregulation. Reptiles, Aves & Mammals. Physiology of Nervous system and Muscle stimulation. Objectives. Introduction. Structure of a Neuron. Generation of Nerve Impulsion and Propagation. Synaptic Transmission and Neurotransmitters. Concept of Sensory Receptors (Chemo and Photo). Structure, Kinds and Characteristics of Muscles. Mechanism of Muscle Stimulation and Contraction. Neuro - Muscular Junction.	
Credit III	**Hormones-I**	**15 Hrs**
	General classification of hormones – Peptide hormones, steroid hormones and derivatives of amino acids. Secondary messenger signaling – cAMP, Ca++, IP3, DAG cGMP **Pituitary Hormones** Hormones of anterior and posterior pituitary, Growth hormone – Gigantism, dwarfism and acromegaly, ACTH, TSH, prolactin, Vasopressin (ADH), Oxytocin and gonadotrophic hormones **Sex hormones** Estrogen, progesterone, testosterone functions. Menstrual cycle, and pregnancy.	
Credit IV	**Hormones -II**	**15 Hrs**

	Thyroid hormones Thyroxin (T3 & T4) its synthesis and regulation. Hyper and hypothyroidism, Graves disease, Myxoedema, Goitre and cretinism **Adrenal hormones** Adrenal cortical hormones – Glucocorticoids and mineralocorticoids, Cushings syndrome and Addisons disease, Adrenal medullary hormones – Epinephrine and nor- epinephrine – functions	

Reference Books: -

- Barington(1979) Hormones and evolution Vol I&II Academic press, New York.
- John F- Laycock and Peter H. Wise, Essential of Endocrinology
- Wiliaimas R.H.(1974). Textbook of Endocrinology V.Ed. Saunders Press, London .
- Endocrinlogy- Hadley 5. General endocrinology Bagrara and Tumer, W.B. Saunders.
- The Physiology of Reproduction , Vol I& II E.K .Nobil and JU. D.Neil, Raven Press, New York, 1988.
- Benjamin Levin-Gene VII, Oxford University Press. 8. Lodish et al Molecular Cell Biology

Title of course – MMPR 204- Lab Course III (60 Hrs) 100 Marks
Course code- MSU0325MMP97G1
Total credits- 4

Course Objectives:

- Understand the isolation techniques for DNA from various organisms.
- Study the microbial genetics.
- Know ELISA, Immunoelectrophoresis, Immunodiffusion techniques.

Course outcome: After completing the credits students should gain knowledge about:

- Isolate the DNA and RNA from any sources.
- Perform various immunological techniques
- Perform transformation, conjugation and transduction.

Sr. No.	Name of the Practicals	Credits
1	Eukaryotic DNA Isolation from - Plant Material and Animal Material.	**I**
2	DNA isolation from fungi.	
3	Plasmid isolation from *E. coli.*	
4	Determination of Tm of DNA.	
5	Isolation of RNA.	**II**
6	Genomic DNA isolation from bacteria.	
7	Isolation of Lac negative mutants of *E. coli*.	
8	Isolation of Streptomycin resistant mutants of *E. coli*.	
9	Study of conjugation.	**III**
10	Study of transformation	
11	Determination of U.V survival curve.	
12	Study of *Drosophila melanogaster*	
13	Examples on pedigree analysis.	**IV**
14	Radial and Double Immunodiffusion Techniques.	
15	Immunoelectrophoresis- (Qualitative).	
16	Widal test – Qualitative and Quantitative.	
17	ELISA-dot ELISA.	

Title of course – MMPR 205- Lab Course IV (30 Hrs) 50 Marks
Course code- MSU0325MMP97G2
Total credits- 2

Course Objectives:

- Provide hands on skill for estimation of various Biomolecules.
- Provide the practical skills for separation of proteins/enzymes through chromatography techniques.
- Perform enzyme activity.

Course outcome: After completing the credits students should gain knowledge about:

- Perform estimation of different Biomolecules.
- Apply advanced techniques in separation of proteins/enzymes.
- Apply advanced techniques in biological chemistry

Sr. No.	Name of the Practicals	Credits
1	Estimation of DNA and RNA	I
2	Estimation of protein.	
3	Estimation of Cholesterol.	
4	Separation and identification of amino acids using TLC.	
5	Quantitative estimation of specific activity of α amylase.	
6	Separation of Biomolecules by Gel Filtration Chromatography.	II
7	Purification of proteins /enzymes by Ion exchange chromatography.	
8	Study of salting in and salting out technique (α amylase).	
9	Study of effect of substrate concentration and determination of Vmax, KM (α amylase).	
10	Effect of pH and temperature on α amylase activity.	

OJT 206- On Job Training (OJT) MSU0325OJ97H
OR
FP 206- Field Project (FP) MSU0325FP97H
(60 Hrs) 100 Marks

Scheme of Teaching

Each theory paper have 4 lectures per week of 60 minute.
The practical's and research project will be conducted 3 hours per day for five days.
Seminar will be conducted for 2 hours per week.
There should be at least 15 weeks of actual teaching in each semester as per the UGC requirement.
The department should prepare academic calendar of teaching lecture hours.
Workload is as per UGC & State Govt. norms.

9. Examination Pattern

- The standard of passing Examination Ordinances and Rules will be applicable as per the existing system.
- The examination will be conducted as per the rules and regulations of Shivaji University which are applicable at that time.

A) Theory:-

- There shall be 100 marks for each course (paper). For each course 80:20 pattern shall be applicable, wherein 80 marks shall be for University Assessment (UA) (Time duration: 3 hrs.) and 20 marks for internal assessment (IA).
- There shall be separate passing for theory as well as internal examinations. Minimum 32 marks out of 80 required for passing UA and minimum 8 marks out of 20 required for passing
- The total marks for each semester examination is shall be 550.

B) Internal Assessment:-

- As per UGC guidelines there shall be continuous internal assessment for M.Sc. Programme.
- Internal Examination will be compulsory for all students. If a student fails/remains absent in internal Examination then he / she will have to clear the internal Examination in subsequent attempt/s.
- The internal examination of 20 Marks shall be conducted at the mid of the each semester. The nature of questions shall be MCQ / true / false /one sentence answer type question/ short answer type questions (Time duration: 30 minutes).

C) Practical Examination: -

- Practical exam will be conducted after theory exam.
- The core course practical (CCPR) examination shall be conducted semester wise with individual heads of passing with minimum 40% marks.
- The rules for practical examinations shall be as per respective BOS guidelines.

D) Research Methodology:-

- There shall be 100 marks for each course (paper). For each course 80:20 pattern shall be applicable, wherein 80 marks shall be for University Assessment (UA) (Time duration: 3 hrs.) and 20 marks for internal assessment (IA).
- There shall be separate passing for theory as well as internal examinations. Minimum 32 marks out of 80 required for passing UA and minimum 8 marks out of 20 required for passing
- The internal examination of 20 Marks shall be conducted at the mid of the each semester. The nature of questions shall be MCQ / true / false /one sentence answer type question/ short answer type questions (Time duration: 30 minutes).

E) On Job Training:

The student will submit his/her On Job Training report to the Teacher in Charge after completion of On Job Training. The department will conduct presentation cum viva for all the students. The internal evaluation committee/examiners will assess the On Job Training report and marks will be given.

F) Field Project:

The student will submit his/her Field Project report to the Teacher in Charge after completion of Field Project. The department will conduct presentation cum viva for

all the students. The internal evaluation committee/examiners will assess the Field Project report and marks will be given.

10. Nature of Question Paper: Total Marks: 80

a) University Theory Examination: Skeleton of theory question paper:

M.Sc. Part – I/Sem. – I Examination – 2023 (NEP - 2023)

Biotechnology

Title of the Subject

(Subject Code)

Day & Date: **Total Marks: 80**

Time:

Instructions:
1) Question No. 1 is **COMPULSORY**.

2) All questions carry **EQUAL** marks.

3) Solve any **FOUR** questions such that at least **TWO** questions must be from **EACH** section.

Q. 1 Objective (16 Marks) 16 one line answer type questions

SECTION-I

Q.2 Essay type question (16 Marks)

Q.3 Essay type question (16 Marks)

Q.4 Essay type question (16 Marks)

SECTION-II

Q.5 Write notes on (2 x 08 Marks) 2 sub-questions

Q.6 Write short notes on (4 x 04 Marks) 4 sub-questions

Q.7 Write short notes on (4 x 04 Marks) 4 sub-questions

b) Internal Theory Examination:

The internal theory examination of 20 marks will be conducted by Teacher in-charge of the respective subject during the semester. The internal examination theory will have 10/20 questions of 2/1 mark each. The internal theory paper will be solved on same question paper. Separate answer book will not be given. The examination time will

be 30 mins. The internal theory marks will be submitted or uploaded in the university examination portal as per the instructions given by the examination section of the university.

c) University Practical Examination:

The university practical examination will be conducted in the department immediately after the theory examinations. The duration of practical examination will be 4 days including inspection day. The examination for both practical papers will be conducted simultaneously. The day, date, nature of question paper, marks distribution and internal/external examiners will be decided by theory examination Chairman in consultation with practical paper in charge and laboratory staff. The separate sanction/approval will be required from examination section for practical examination time-table.

11. Equivalence of courses

Equivalency is not applicable for this course because this is newly started course implemented from academic year (2023-24).