SANDIP UNIVERSITY

SANDIP UNIVERSITY

Courses of Study

2019-20

Msc Microbiology

IILP

SANDIP UNIVERSITY

School of Science

M.Sc (Part Time) 2018-19

Semester	Course I				Course II				Course III				Course IV				Course V				Course VI				Course VII				L	T	P	C	Contact Hours
I	Code				Code				Code				Code				Code				Code				Code								
	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C					
	4	0	0	**4**	4	0	0	**4**	4	0	0	**4**	4	0	0	**4**	0	0	4	**2**	0	0	4	**2**	0	0	4	**2**					
	PC				PC				PC				PC				PC				PC				UC				16	0	8	22	24
	MDT				IMB				CMB				EMM				MDTIMBL				CMBEMM				Seminar I								
II	Code				Code				Code				Code				Code				Code				Code								
	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C					
	4	0	0	**4**	4	0	0	**4**	4	0	0	**4**	4	0	0	**4**	0	0	4	**2**	0	0	4	**2**	0	0	4	**2**					
	PC				PC				PC				PCE1				PC				PC				UC				16	0	8	22	24
	PS				QBVQEP				MMV				DE1				PSQBVQEPL				MMVDE1L				Seminar II								

SANDIP UNIVERSITY

M.Sc (Part Time) 2018-19

Semester	Course I	Course II	Course III		Course V	Course VI	Course VII	L	T	P	C	Contact Hours
III	Code	Code	Code	Code	Code	Code	Code					
	L T P C	L T P C	L T P C	L T P C	L T P C	L T P C	L T P C					
	4 0 0 **4**	4 0 0 **4**	4 0 0 **4**	0 0 4 **2**	0 0 8 **4**	0 0 0 **2**	0 0 0 **0**					
	PC	PC	PCE2	PC	UC	UC		12	0	12	20	24
	EEEM	MBGE	DEII	**LAB V**	**Project Stage I**	Internship I						
IV	Code	Code	Code	Code	Code	Code	Code					
	L T P C						L T P C					
	0 0 32 **16**						0 0 0					
	UC							0	0	32	16	32
	Project Stage II & Viva Voce											
								4		6	8	
							Total	4	0	0	0	104

Department Elective I					
Microbiology					
Course Code	**Course**	**L**	**T**	**P**	**C**
1	Research Methodology, IPR, Environmental Protection Act.	4		2	6
2	Genetics	4		2	6
3					

Department Elective II					
Microbiology					
Course Code	**Course**	**L**	**T**	**P**	**C**
1	Immunology	4		2	6
2	Bioinformatics and Structural Biology	4		2	6
3					
4					

School of Science

FirstYear M.Sc Microbiology (Part Time)

Year: First Year **Semester: I**

Course: Microbial Diversity and Taxonomy **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.											

Prerequisite	• Introduction to microbiological concepts, terms etc.

Objectives	
1	To expand knowledge on Evolution and microbial diversity
2	To understand bacterial taxonomy
3	To study various classes of fungi in terms of their characteristic features.
4	To assimilate the concepts of unculturable bacterial diversity
5	To expand knowledge on Evolution and microbial diversity

Unit Number	Details	Hours
1	Differences in concept of 'species' in eukaryotes andprokaryotes. Definition of species in prokaryotes. Types of 'species' Evolution of species and concepts of speciation (in sexualand asexual organisms) Types of evolution (neutral, co-evolution); Types and levelsof selection; r and k selection; molecular clocks; phylogenyand molecular distances	**12 L**
2	The expanse of microbial diversity Estimates of total number of species Species Divergence and the measurement of microbial diversity. Measures and indices of diversity	12 L
3	Introduction to Bacterial Taxonomy The 5-Kingdom classification system The 3-Domain classification system Bergey's Manuals and the classification of prokaryotes.	12 L

	Determinative Bacteriology (Phenetic Approach) Systematic Bacteriology (Phylogenetic Approach Polyphasic Approach	
4	The 6 Classes of Fungi. The differentiating characters among different Classes of fungi. The importance of morphological characters in fungal differentiation and classification.	12 L
5	Concept of 'unculturable' bacterial diversity. Strategies for culture of 'unculturable' bacteria. Culture independent molecular methods for identifying unculturable bacteria. Methods of extracting total bacterial DNA from a habitat and metagenome analysis.	12 L
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will be able to understand the concepts microbial taxonomy and methods of nomenclature.
CO2	Student will be able to use the knowledge for isolation and identification of microorganisms from variety of sources.
CO3	Student will be able to classify the microorganisms based on classical and advanced methods.
CO4	Student will be able to understand microbial diversity, species and estimation of various microbial species from different sources.
CO5	Student will be able to understand evolution of microbial species.

	Resources
Recommended Books	• Jacquelyn G. Black (2013) Microbiology: Principles and Explorations, 6th Edition, John Wiley & Sons, Inc., • Microbial Diversity: Form and Function in Prokaryotes, Published Online: 30 NOV 2007. DOI: 10.1002/9780470750490.ch1 • Ridley Mark (2004). Evolution. Blackwell Science Ltd. • 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).
Reference Books	• Sykes, G. and F. A. Skinner (Eds). Actinomycetales: Characteristics and Practical Importance. Society for Applied Bacteriology Symposium Series No. 2, Academic Press. 1973. • Jacquelyn G. Black (2013) Microbiology: Principles and Explorations, 6th Edition, John Wiley & Sons, Inc., • Lodder J. (1974). The Yeasts: A Taxonomic Study, North Holland Publishing Co. Amsterdam.

SANDIP UNIVERSITY

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: I**
Course: Instrumentation and Molecular Biophysics **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	• Introduction and basic concepts of instrumentation, analytical techniques • Basic concept related to biochemical and biophysical methods

Objectives	
1	To create general understanding of various bioanalytical methods.
2	To familiarize the students with principles of bioinstrumentation used in qualitative and quantitative analysis.
3	To develop the concepts and train the students to increase their competency
4	To develop analytical skills of students
5	To orient students towards biological research with the help of bioinstrumentation techniques

Unit Number	Details	Hours
1	**Laboratory Instruments:** Theory, Principle, Working and applications of: pH meter, Laminar air flow, Centrifuge machine types and Centrifugation: Differential, Rate Zonal, Isopycnic, Density gradient, Rotor types and Ultra centrifugation. Phase Contrast Microscope; Fluorescent Microscope; Scanning and Transmission Electron Microscopy.	**1**
2	**Chromatography Techniques**: Theory, principle, operation and applications of Paper Chromatography,TLC, HPTLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Gas Chromatography, and HPLC. **Electrophoretic Techniques**: Theory, Principle and Applications of Paper Electrophoresis, Poly Acrylamide Gel Electrophoresis (PAGE), Agarose Gel Electrophoresis. Principle and Applications of: Iso-electric Focusing	**2**
3	**Radio-isotopic Techniques** : Introduction to Radioisotopes and their Biological Applications, Radioactive Decay–Types and Measurement,	**3**

	Principles and Applications of GM (Geiger Muller) Counter, Solid and Liquid Scintillation Counter, Autoradiography, Radioimmunoassay (RIA), Radiation Dosimeters.	
4	**Molecular Biophysics:**Theoretical and experimental methods for determination of size of proteins, Physical nature of non-covalent interactions, Conformational properties of proteins, Ramachandran plot, secondary, super-secondary, tertiary and quaternary structures of proteins, Classification of three dimensional structures of proteins (motifs and fold domains) Protein structure/properties determination.	**4**
5	**Spectroscopies of Biomolecules and Biophysical Techniques** 1. UV/Visible spectroscopy- Instrumentation, Molar Absorptivities, Beer and Lamberts Law, Bathochromic and hypsochromic shifts. 2. Fluorescence spectroscopy- Instrumentation, Quantum Yield, Quenching, FRET, Binding and Folding studies. 3. Infrared spectroscopy- Principle , Instrumentation, Absorption bands, FTIR and its advantages 4. Circular Dichroism (CD) – Instrumentation, Circular polarization, Delta absorbance, Cotton Effect. 5. Mass spectroscopy: Principles of operation and types of spectrometers, ionization, Ion fragmentation, Mass analyzers, GC-MS, Biological applications, MALDI-TOF 6. X-ray crystallography: Isolation and purification of proteins, crystallization of proteins, instrumentation, acquisition of the diffraction pattern, basic principles of x-ray diffraction, Phase determination 7. NMR spectroscopy: Basic Principles of NMR, Chemical shift, Intensity, Line width, Relaxation parameters, Spin-spin coupling, Nuclear Overhauser Effect, NMR Applications in Biology	**5**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will be able to demonstrate an understanding of various instruments that are required in biological processes.
CO2	Student will be able to demonstrate the basic understanding of the instruments used for bilogical studies.
CO3	Student will be able to demonstrate the basic idea and applications of the instruments or techniques
CO4	Student will be able to introduce principle of basic techniques and train them to apply these concepts and ideas in technology .
CO5	Student will be able touse the knowlegde of techniques and develop the problem-solving approach.

Resources	
Recommended Books	• Clive Dennison (2002) *A guide to protein isolation*, KluwerAcademic Publishers

	• Pattabhi, V. and Gautham, N. (2002) *Biophysics.* KluwerAcademic Publishers, New York and Narosa PublishingHouse, Delhi. • David J Holme, Hazel Peck (1998) *Analytical Biochemistry*,3rd ed ., Prentice Hall, Pearson Education Limited, HarlowEngland. • Rodney F. Boyer (2000*) Modern Experimental Biochemistry*3d edition,Benjamin Cummings. • Nölting, B. (2006) *Methods in modern biophysics.* SecondEdition. Springer, Germany. • Wilson Keith and Walker John (2005) *Principles andTechniques of Biochemistry and Molecular Biology,* 6th Ed.Cambridge University Press, New York. • Pattabhi, V. and Gautham, N. (2002) *Biophysics.* KluwerAcademic Publishers, New York and Narosa PublishingHouse, Delhi. • Rolf Ekman, Jerzy Silberring, Ann Westman-Brinkmalm,Agnieszka Kraj (2009) *Mass spectrometry: instrumentation,interpretation, and applications*, John Wiley & Sons,Inc.,Canada. • Irwin H. Segel (1976) *Biochemical Calculations: How to SolveMathematical Problems in General Biochemistry,* 2nd Edition.John Wiley & Sons. • Nölting, B. (2006) *Methods in modern biophysics.* SecondEdition. Springer, Germany. • Pattabhi, V. and Gautham, N. (2002) *Biophysics.* KluwerAcademic Publishers, New York and Narosa PublishingHouse, Delhi. • Cavanagh John *et.al.* (1995) *Proteins NMR Spectroscopy:Principles and Practice*, Academic Press. • Keeler, J. (2002) *Understanding NMR Spectroscopy.* JohnWiley & Sons, England. • Drenth, J. (2007) *Principles of protein X-ray crystallography.*3rd Ed. Springer, Germany. • Nölting, B. (2006) *Methods in modern biophysics.* SecondEdition. Springer,Germany. • Cotterill, R. M. J. (2002) *Biophysics: An Introduction.* JohnWiley & Sons, England.
Reference Books	• David J Holme, Hazel Peck (1998) *Analytical Biochemistry*,3rd Ed., Prentice Hall, Pearson Education Limited, HarlowEngland. • Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006)*Biochemistry.* 6th Edition. Freeman, New York. • Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry.* 3rd Ed. Brooks/ Cole, Publishing Company, California • Cotterill, R. M. J. (2002) *Biophysics: An Introduction.* JohnWiley & Sons, England. • Christof M. Niemeyer and Chad A. Mirkin (2006)*Nanobiotechnology*, John Wiley & Sons. • Daniel L. Feldheim and Colby A. Foss, Jr. *(2002) Metalnanoparticles synthesis and characterization and applications*Marcel Dekker, Inc. • Mahendra Rai and Nelson Duran (2011) *Metal nanoparticles inMicrobiology*, Springer Verlag Berlin Heidelberg.

SANDIP UNIVERSITY

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: I**
Course: Cell and Molecular Biology **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	• Introduction and basic concepts of living cell, cellular system etc.

Objectives	
1	To introduce the fundamental concepts and processes of living organisms at cellular and molecular level.
2	To familiarize the students with the importance of cellular and molecular process for encouragement towards research and develop scientific thinking
3	To develop proficiency and technical skills of students.
4	To apply the knowledge cellular and molecular mechanism of biological system to address various problems
5	To develop research driven approach for better understanding of the applications of biological processes

Unit Number	Details	Hours
1	Structural organization Membrane and Communication of cell 1.1- Introduction, History and General organization of Prokaryotic cell- Mycoplasma, Viruses, Viroids and Bacteria (*E.coli*). 1.2 General organization of Eukaryotic cell (Plant cell) 1.3 Composition of cell membrane 1.4 Molecular models-Unit membrane, Daniely and Dowsoṅs Model, Fluid mosaic Model. 1.5 Functions of cell membrane 1.6General principles of cell signaling. 1.7 G-protein linked receptors. 1.8 Enzyme linked receptors. 1.9 Mitosis and Meiosis	**12 L**

2	Structural organization, functions of cell organelles and Cytoskeleton 2.1 Nucleus-Ultrastructure, Nuclear envelop, Pore complex 2.2 Mitochondria-Morphology, molecular structure, membranes, molecular organization, Biogenesis, DNA, Symbiotic hypothesis Termination codon, Genetic code. 2.3 Chloroplast-Morphology, Ultra structure, molecular organization of thylakoids, Biogenesis, DNA, Semi-autonomous nature. 2.4 Golgi complex- Morphology, cytochemistry 2.5 Endoplasmic reticulum-Morphology, Biogenesis, protein segregation	**12 L**
3	Structural organization, functions of cell organelles and: Cytoskeleton: 3.1Ribosomes-types, structure. 3.2Structure and functions of Lysosomes, Vacuoles, Peroxisomes. 3.3Microtubules-cillia, flagella, & centrioles. 3.4Intermediate filaments. 3.5Microfilaments and cell motility.	**12 L**
4	Deoxyribose Nucleic Acid 4.1 DNA-chemical composition, bases, sugar, phosphate, Nucleosides, Nucleotides, Polynucleotides, Bonding systems, Watson and Crick double helix model of DNA, Types-A, B, and Z DNA. 4.2 DNA Replication-Replicon, Replisome, Primosome, Replication fork, Origin of replication (OriC in *E. coli*) RNA-primer, Semidiscontinuos synthesis, Leading strand, Lagging strand, Okazaki fragments, prokaryotic and Eukaryotic enzymes involved in DNA- fragments, prokaryotic and Eukaryotic enzymes involved in DNA- replication, Unidirectional and bidirectional DNA- replication, 4.3-Replication in closed circular DNA- θ-mode, σ-mode and D-loop replication. 4.4-DNA-damages and Repair:-Damages-Dimer formations, mismatch pair, 4.6 Significance of DNA	**12 L**
5	Ribose Nucleic acid, Gene Regulation and Transposons 5.1-Structure and functions of tRNA, rRNA, mRNA 5.2-Transcription-Capping, elongation, and termination, Role of RNA-polymerases. 5.3-Processing of RNA- RNA-editing, splicing, polyadenylation 5.4 Constitutive and regulated genes, Positive and negative control, transcriptional control, translational control, and post-translational control 5.5 Gene regulation in Prokaryotes- Inducible operon-lac operon, Represible operon-trp operon.	**12 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will be able to describe fundamental processes of cell.

CO2	Student will be able to explain the cellular processes of biological system
CO3	Student will be able to understand the molecular mechanism involved in biological system.
CO4	Student will be able to apply the knowledge to solve problems related to biological sciences
CO5	Student will be able to understand gene regulation mechanism to address number of biological challenges

Resources	
Recommended Books	1. Strickberger. Genetics. 3rd Ed. 1990. Ed. 2. A. K. Sharma and A. Sharma. 1990. Chromosome techniques 3. P.K. Gupta. 1990. Genetics. 4. Principles & Methods in Plant Molecular Biology,Genetics&Biochemistry,Agrobios. Prathibha Devi 5. A. K. Sharma and A. Sharma. 1990. Chromosome techniques.
Reference Books	1. E.D.P. De Robertis and E. M. F. De Robertis. 1987. Cell and Molecular biology8th Ed(Indian Ed 2. G. M. Cooper. 1997. The Cell and Molecular approach. ASM Press. Ed. 3. Snustad and Simmons. 1997. Principles of Genetics. Ed. 4.Benjamin Lewis. 1999. Genes VII. 5. Daniel Hartl. 1994. Basic Genetics. Ed 6.Winter, Hicky and Fletcher. 1999. Instant notes in Genetics. Ed. 7.A.V.S.S. Sambamurthy. 1999. Genetics. 8.P.K. Gupta. 1990. Genetics. 9. Twyman. 1998. Advanced Molecular Biology. 10.Turner, Mclennon, Bates and White. 1999. Instant notes in MolecularBiology. 11.Primrose. 1999. Molecular Biotechnology. 12.Stansfield. 1996. Theory & Problems in Genetics. Schaum's Series. McGraw & Hill.

SANDIP UNIVERSITY

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: I**

Course: Enzymes and Microbial Metabolism **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	1. Introduction and basic concepts of enzymes 2. Basic concept of microbial physiology

Objectives	
1	To impart the knowledge of microbial physiology and biochemistry that needed to develop the concepts and skills related to subject.
2	To understand and critically evaluate research that addresses physiological and biochemical processes of microbes.
3	To encourage application of the theories related to microbial metabolism for production of bio-products and to address current problems.
4	To impart the knowledge of enzymes, its kinetics, extraction and applications.
5	To develop an understanding of metabolic processes carried out in all kind of living systems

Unit Number	Details	Hours
1	**Enzyme Kinetics** Purifications of enzyme, purification chart, kinetics of single substrate enzyme catalyzed reaction. Kinetics of reversible inhibitions enzyme catalyzed reactions, King Altman approach to derive – two substrate enzyme catalyzed reactions, types of two substrate enzyme catalyzed reactions, concept of allosterism, positive and negative co-operatively, models of allosteric enzymes (Monod, Wyamann and Changuax model,Koshland, Nemethy and Filmer model), kinetics of allosteric enzyme, Hill plot, examples of allosteric enzymes and their significance in allosteric regulation	**12 L**
2	**Bio-energetic** Laws of thermodynamics, entropy, enthalpy, free energy, freeenergy and equilibrium constant, Gibbs free energy equation,determination of free	**12 L**

	energy of hydrolytic and biological oxidation reduction reactions, under standard and non-standardconditions, high energy compounds, coupled reactions,determination of feasibility of reactions, Atkinson's energy charge, phosphorylation potential and its significance	
3	**Membrane Transport** Aerobic and anaerobic respirationmitochondrial electron transport chain, structure and function of ATPase, generation and maintenance of proton motive force,oxidative phosphorylation, inhibitors and un-couplers of electrontransport chain and oxidative phosphorylation. Concept of anaerobic respiration, components of electrontransfer system and energy generation of bacteria where nitrate,sulfate and carbonate acts as terminal electron acceptors	**12 L**
4	**Nitrogen metabolism** Biochemistry of biological nitrogen fixation, properties of nitrogenase and its regulation, ammonia assimilation with respect to glutamine synthetase, glutamate dehydrogenase, glutamate synthetase, their properties and regulation,Biosynthesis of five families of amino acids and histidine, Biosynthesis of purine and pyrimidine bases **Photosynthesis** Structure of chloroplast, energy consideration in photosynthesis, light and dark reaction, electron carriers in photosynthesis, Organization of photosystem I and II, cyclic and non-cyclic flow of electrons, Z scheme, Hill reaction, photolysis of water, C_3, C_4 CAM plants, Photorespiration, Regulation of photosynthesis, Bacterial photosynthesis: scope, electron carriers, Photosynthetic reaction center, cyclic flow of electrons, bacterial photophosphorylation in various groups of phototrophic bacteria, electron donors other than water in anoxygenic photosynthetic bacteria	**12 L**
5	**Biosynthesis of carbohydrates in plants and bacteria** Calvin cycle and its regulation, Transport of solute acrosschloroplast membrane, Synthesis of starch and sucrose,Photorespiration, C_4 and CAM pathways, synthesis of celluloseand peptidoglycan, integration of carbohydrate metabolism inplant cell. **Lipid Biosynthesis** Synthesis of storage lipids: Fatty acids and triacylglycerols,Synthesis of membrane lipids: Glycerophospholipids, sphingolipids, sterols, Lipids as signal molecules such asphosphatidyl inositol, eicosanoids, Vitamins, A, D, K, and E,Dolichols.	**12 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will be able tounderstand the concepts of microbial physiology
CO2	Student will be able to understand the metabolic processes carried out in microorganisms
CO3	Student will be able to understand the role of enzymes in biological systems including microbial metabolism

CO4	Student will be able to study enzyme kinetics, extraction and purification methods of enzymes from biological systems
CO5	Student will be able to integrate the fundamental processes with their applications

Resources	
Recommended Books	1. Cox M. M., Nelson D. L., (2008) Lehninger Principles ofBiochemistry, Fifth edition, W. H. Frreman and CompanyNew York 2. Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry*. 3rdEd. Brooks/Cole, Publishing Company, California. 3. Hall D. D. and Rao K. K. (1996) *Photosynthesis* 5th Ed.,Cambridge University PressMandelstam Joel and McQuillen Kenneth (1976)*Biochemistry of Bacterial Growth*, Blackwell ScientificPublication London. 4. Michael T. Madigan, John M. Martinko, David A. Stahl,David P. Clark (2012) *Brock Biology of Microorganisms*,Thirteenth edition, Benjamin Cummings, San Francisco. 5. Moat Albert G. and Foster John W. (1988) *MicrobialPhysiology* 2nd Ed. John Wileyand Sons New York.
Reference Books	6. Nelson D. L. and Cox M. M. (2005) *Lehninger's Principles ofBiochemistry*, Fourth edition, W. H. Freeman & Co. NewYork. 7. Palmer Trevor (2001) *Enzymes: Biochemistry, Biotechnologyand Clinical chemistry*, Horwood Pub. Co. Chinchester,England. 8. White David (2000) *Physiology and Biochemistry ofProkaryotes.* 2nd Ed. Oxford University Press, New York.

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
0	0	4	2	-	-	-		50	-	50	100
Max. Time, End Semester Exam (Theory) - 2Hrs.											

Objectives	
1	To acquire proficiency in identification of microorganisms using Bergey's manual
2	To train the students in advance microbial techniques.
3	To impart the knowledge of analytical methods in biological sciences

Sr. No.	Description
1	Isolation of the following types of bacteria from natural samples. Identification of the bacteria to at least the Genus level using the Bergey's Manuals: The identification key must be designed for each isolated and identified bacterium.
2	Isolation of the following types of fungi from natural samples. Identification of the fungi. Molds (Saprophytic); Yeasts The identification key must be designed for each isolated and identified fungus.
3	Isolation and identification of any one type of cyanobacterium from a natural sample. The identification key must be designed for each isolated and identified cyanobacterium.
4	Preparation of buffers.
5	Chromatography: separation of sugar and amino acids by paper and thin layer chromatography.
6	Colorimetry and spectrophotometry: Estimation of sugar and total carbohydrates, estimation of protein by lowry. Bradford and UV spectrophotometry.
7	Electrophoresis: Agarose gel electrophoresis,
8	Electrophoresis: SDS PAGE of proteins.

Term Work:

Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on attendance, good laboratory practice (GPL), timely completion, journal/record book, oral/viva, respectively. It should be assessed by course teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The regular attendance of the students during semester for practical course will be monitored and marks will be given accordingly (10 Marks).
2	Good Laboratory Practices (10 Marks)
3	Timely Completion (10 Marks)
4	Journal / Record Book (10 Marks)
5	Oral / Viva (10 Marks)
Practical/Oral/Presentation:	
Practical/Oral/Presentation shall be conducted and assessed jointly by at least a pair of examiners appointed as internal and external examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.	

Notes	
1	One experiment from the regular practical syllabus will be conducted (40 Marks).
2	Oral/Viva-voce (10 Marks).

School of Science

First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: I**

Course: Cell and Molecular Biology and Enzyme & Microbial Metabolism Laboratory II **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
0	0	4	2	-	-	-		50	-	50	100

Max. Time, End Semester Exam (Theory) - 2Hrs.	

Objectives	
1	To understand various cell activities using microscopic techniques.
2	To create the general understanding among students related to production of bio-products.
3	To give the overview for development of scientific methods of screening, characterizing microbes and their use in production of microbial products.

Sr. No.	Description
1	Studying the stages mitosis in growing tip of onion root cells
2	Demonstration of mounting of embryos (frog and fruit fly) at various developmental stages on permanent slides
3	Isolation and characterization of bacterial pigment
4	Isolation and estimation of chromosomal DNA of bacteria
5	Isolation and characterization of (as nitrogen fixers) Rhizobium or *Azospirillum*
6	Detection of siderophore production by *Azospirillum* and *Pseudomonas*
7	Production and extraction of bacterial enzyme. Purification of enzyme by ammonium sulphate precipitation and dialysis.
8	Isolation and characterization of biodegradable bacteria

Term Work:

Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on Attendance, Good Laboratory Practice (GLP), Timely Completion, Journal/Record book and Oral. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The regular attendance of the students during semester for practical course will be monitored and marks will be given accordingly (10 Marks).
2	Good Laboratory Practices (10 Marks)
3	Timely Completion (10 Marks)
4	Journal / Record Book (10 Marks)
5	Oral / Viva (10 Marks)

Practical/Oral/Presentation:

Practical/Oral/Presentation shall be conducted and assessed jointly by at least a pair of examiners appointed as internal and external examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	One experiment from the regular practical syllabus will be conducted (40 Marks).
2	Oral/Viva-voce (10 Marks).

School of Science

FirstYear M.Sc Microbiology (Part Time)

Year: First Year **Semester: II**

Course: Pharmaceutical science **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.											

Prerequisite	• Introductory concepts ofpharmaceutical science

Objectives	
1	To provide students with requisite knowledge, technical and scientific skills for appropriate development of therapeutic drugs.
2	To inculcate professionalism that will form the basis for integrated and multi-disciplinary approach to pharmaceutical and cosmeceuticals.
3	To ensure that the students are demonstrated with the importance and significance of research in advancing clinical studies.
4	To understand the guidelines and principles of various regulatory bodies.
5	To expand knowledge on chemotherapeutic agents

Unit Number	Details	Hours
1	**Drug Discovery** 1.1.Historical perspective 1.2.Modern methods of drug discovery. 1.3.Conventional Process Bioprospecting (Medicinal Chemistry) –Extraction and purification principles, Purification and characterization of bioactive molecules from natural sources 1.4.Rational Drug Design – Principle (Structure activity relationship) and Tools (applications of High Through Put Screening, Combinatorial synthesis, Pharmacogenomics)	**12 L**
2	**Clinical development** 2.1.Preclinical development: Toxicity testing – acute, sub-acute and chronic toxicity 2.2.Clinical development:Clinical trials–(Aims, Objectives, Conduct): I, II, III and IV	**12 L**

	2.3.Drug development: ADME and ADR 2.4.Role of FDA in drugdevelopment (INDA, NDA)	
3	**Basic Pharmaceutical concepts** 3.1.Quality- Definition and application 3.2. QC, QA and regulatory factors 3.3. ISO- principles 3.4. Sanitary practices in drugs and cosmetic manufacturing	**12 L**
4	**Quality Assurance and Validation in Pharmaceutical Industry** 4.1.GMP and Good GLP in pharmaceutical Industry 4.2. Quality assurance and quality management -ISO, WHO and US certification. 4.3. Regulatory authorities and its role Pharmacopeia (IP, UK, US), Animal ethics committee (CPCSEA). 4.4.Delivery systems – formulations, targeted drug delivery, Sustained release drugs Drug distribution in body, bio-availability and pharmacokinetic studies	**12 L**
5	**Development of antimicrobial agents** 5.1.Screening and development strategies for new antimicrobial agents and 5.2. Mode of action of antimicrobial agents 5.3.Bioassay of antibacterial agents in liquid media and in agar media using standard guidelines-e.g. (NCCLS)/(CLSI) 5.4.Laboratory methods to assess activity of antimicrobial combinations (antagonism, synergism and additive effect)	**12 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will get adequate attention for study of pharmaceutical science in this academic program.
CO2	Student will develop requisite knowledge, technical and scientific skills for appropriate formulation of therapeutic drugs to address the needs of industry.
CO3	Student will acquire knowledge on preparatory pharmacy and professional way of preparing various cosmetic products.
CO4	Student will be aware of importance and significance of research in advancing clinical studies.
CO5	Student will understand the regulations and ethics and its appropriate application.

	Resources
Recommended Books	1. Hillisch A and Hilgenfeld R (2009) Modern Methods of drug discovery. Springer International Edition. 2. Philip A, Taylor and Francis (2006) Cosmetic Microbiology practical approach.2nd Ed. 3. Kokate C. K., Purohit A. P., Gokhale A. B. (2000) Pharmacology, 4th Ed., Nirali Prakashan. 4. Walsh Gary, (2003), Biopharmaceuticals Biochemistry and Biotechnology,

	2nd Ed., John Wiley & Sons Ltd, England 26. Vyas S. P and Dixit V. R. (2002), Pharmaceutical Biotechnology, CBS Publishers and Distributors, New Delhi 5. Chatwal G. P. (2003) Biopharmasceutics and Pharmacokinetics, Himalaya Publishing House, Mumbai. 6. Chorghade Mukund S., (2006), Drug discovery and development Volume I: Drug discovery, Wiley-Interscience, John Wiley and Sons Inc. USA.
Reference Books	1. Denyer S p, Hodges N A and Gorman S P (2005) Hugo and Russell's Pharmaceutical Microbiology. Blackwell Publishing. 2. Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press. 3. Altreuter D., and D S. Clark, (1999), Combinatorial Biocatalysis: Taking the Lead from Nature, Curr. Opin. Biotechnol. 10, 130. 4. Dale Maureen M, John C. Foreman and Tai-Pang D. Fan, (1004), Text book of Immunopathology, 3rd Ed., Blackwell Scientific Publication, London 5. Gale E. F., Cundliffe E., Reynolds P. E., Richmond M. H. and Waring M. J., (1972), The molecular basis of antibiotic action, John Wiley and Sons, London 6. Goldstein A., Aronow L., and Kalman S. M. (1969) Principles of Drug Action, The Basis of Pharmacology, Harper international edition New York. 7. Lorian.V., (1986), Antibiotics in laboratory medicine, 2nd Ed, Williams & Wilkins Publication. 8. Mannfred A. Holliger,(2008), Introduction to pharmacology, 3rd Ed., CRC Press 38 9. National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). Performance standards for antimicrobial susceptibility testing; 12th information supplement (M100-S1). Villanova, PA; NCCLS: 2002 10. Osol Arther (1975) Remington's Pharmaceutical Sciences, 15th Ed., Mack Pub. Co., Pennsylvania.

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: II**

Course: Quantitative Biology and Validation/Qualification of equipments and processes **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	• Introduction and basic concepts of biostatistics

Objectives	
1	To inculcate statistical techniques to study living organisms.
2	To ensure that the students can analyze and measure the bio-statistical challenges.
3	Toacquire knowledge and underlying principles of complex biological behavior in terms of physical and mathematical models.
4	To understand the central theme of validation and qualification of processes and equipment.
5	To orient students towards the importance of biostatistics tools in biological research.

Unit Number	Details	Hours
1	**Introduction to Statistics** 1.1.Measures of central tendency – mean, mode, median and their properties 1.2.Measures of dispersion – variance, standard deviation, coefficient of variance 1.3.Symmetry and skewness, measures of skewness, kurtosis 1.4.Sampling and sampling distributions – concept of sample and population	**12 L**
2	**Correlation and regression** 2.1. Concept of correlation, positive correlation, negative correlation 2.2.Graphical method of studying types and correlation – Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's rank correlation coefficient 2.3. Regression – Equations of regression line using least square method,Regression estimate and its standard error 2.4. Probability theory and testing	**12 L**
3	**Analysis of variance** 3.1. Analysis of variance table (ANOVA) 3.2. Standard error	**12 L**

	3.3. Critical difference for pairs of treatments 3.4. Tukey's test for pair wise comparison of treatments	
4	**Modeling in Biology** 4.1. Population models: Exponential, logistic and chemostat models 4.2. Models in population genetics, models based on Hardy-Weinberg equation 4.3. Introduction to the concept of stochastic models and epidemiological model 4.4. Concept and applications of databases and internet	**12 L**
5	**Validation and Qualification of process and Equipments** 5.1. Stages of qualification: Process Design, Process Qualification Continued Process Verification **5.2. Types of Process Validation**: Prospective Validation, Retrospective Validation, Concurrent Validation, Revalidation. 5.3 Validation Protocol:- Qualification Life Cycle, Change control **5.4. Elements Of** equipments **Validation**: Design Qualification (DQ), Installation Qualification (IQ), Operational Qualification (OQ), Performance Qualification (PQ)	**12 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will get adequate attention for study of Quantitative Biology and Qualification in this academic program.
CO2	Student will develop an understanding of the central concepts of modern statistical theory and their probabilistic foundation.
CO3	Students will efficiently learn to participate in data coordination and management, statistical analysis and reporting of study results in the field of Biology.
CO4	Student will acquire knowledge of appropriate selection of method and its interpretation for model designing.
CO5	Student will understand standard validation methodology and participate in efficient validation and qualification of processes and Equipments.

Resources	
Recommended Books	1. Cochran W.G. – Sampling Techniques,Wiley eastern Ltd, New Delhi. 3. Feller W. – Introduction to probability theory and its applications, Asia Publishing House, Mumbai. 2. Statistical Methods – Snedecor G.W. and Cochran W.G. Affiliated East-West Press Pvt. Ltd.1989 3. Irfan Ali Khan and Atiya Khanum, Fundamentals of Biostatistics. 2nd Ed. Ukaaz Publications, Hydrabad. 4. Haefner James W. (1996) Modeling Biological Systems : Principles and Applications, Kluwer Academic Publications 5. Virmani T and Pathak K. Validation: An Essentiality in the Pharmacy. Pharminfo.net. 5:22-24 (2007). 6. Dashora K, Singh D and Saraf S. Validation - the Essential Quality Assurance Tool for Pharma Industries. pharminfo.net. 3: 45-47 (2005). 7. Lingnau J. Optimization and Validation of Manufacturing Processes. Drug Dev. Ind. Pharm. 15: 1029-1046 (1989).

Reference Books	1. Goon, Gupta and Dasgupta – Fundamentals of statistics, World Press, Kolkata. 2. Gupta S.P.- Statistical methods, Sultanchand & Sons. 3. Lindgren B.W.- Statistical Theory, Macmillan Publishing Co. Inc. 4. Montgomery D.C. – Design and analysis of experiments, John Wiley & Sons. 5. Mood A.M., Graybill F. and Bose D.C.- Introduction to the theory of statistics, McGraw Hill Publishing Co. 6. Murthy M.N. – Sampling methods, Indian Statistical Institute, Kolkata. 7. Wayne Daniel (2007) Biostatistics A foundation for Analysis in the health sciences, Edition 7, Wiley- India edition. 8. Agalloco J. Validation: an unconventional review and reinvention. PDA J. Pharm. Sci. Tech. 49:175–179 (1995). 9. Aleem H, Zhao Y, Lord S, McCarthy T and Sharratt P. Pharmaceutical process validation: an overview. J. Proc. Mech. Eng. 217: 141-151 (2003). 10. Chitlange S. S, Pawar A. S, Pawar H. I, Bhujbal S. S. and Kulkarni A. A. Validation. pharmainfo.net/reviews/validation. 4: 318-320 (2006). 11. Nash R. A. and Wachter A. H. Pharmaceutical Process Validation an International Third Edition. Revised and Expanded, Marcel Dekkar, Inc., New York, 2003; 129:760-792.

SANDIP UNIVERSITY

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: II**
Course: Medical Microbiology and Virology **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	• Introduction and basic concepts pathogens like bacteria, fungi, protozoa and viruses

Objectives	
1	To impart the knowledge of microorganisms of medical importance.
2	To familiarize students with various etiological agents responsible for global infections.
3	To understand fundamentals of virulence processes of pathogenic microorganisms
4	To develop students ability to solve the challenges and expand the scope in research related to clinical microbiology.
5	To develop research driven approach for treatment and prevention of infectious diseases

Unit Number	Details	Hours
1	**Basics in Medical microbiology:** Infectious diseases overview, Medically important microbes. Microbial diseases - sources, route of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections. Concept of Multidrug resistant bacteria.	**10 L**
2	**Diagnosis of microbial diseases:** Collection, transport and preliminary processing of clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases. Modern methods of microbial diagnosis.	**6L**
3	**Bacteriology**: Characteristics, classification, pathogenesis, pathology, diagnosis, treatment, prevention and control of diseases caused by bacteria of clinical importance -	**12 L**

	Staphylococci, Streptococci, Bacillus, Clostridium, Corynebacterium, Escherichia, Salmonella, Shigella, Klebsiella, Proteus, Vibrio, Pseudomonas, Mycobacteria, Spirochaetes, Rickettsia.	
4	**Mycology and Parasitology:** 1. Mycology - Human mycotic infections caused by Dermatophytes, Histoplasma, Cryptococcus, Candida, opportunistic mycoses. Mycotoxins. 2. Parasitology - Medical importance of Entamoeba, Giardia, Plasmodium, Taenia, Ascaris, Wucherhiria. Laboratory techniques in parasitology	**12 L**
5	**Virology:** 1. Classification and Morphology of Viruses Virus classification schemes of ICTV / ICNV. Morphology and ultra-structure of viruses. Virus related agents, viroids and prions. 2. Viral Multiplication 3. Cultivation and assay of viruses Cultivation of viruses using embryonated eggs, experimental animals and cell cultures (Cell-lines, cell strains and transgenic systems). Assay of viruses – Physical and Chemical methods (Electron Microscopy and Protein and Nucleic acids studies.), Infectivity Assays (Plaque and end-point) Genetic analysis of viruses by classical genetic methods.	**12**
6	**Pathogenesis of Viruses and their control:** Host and virus factors involved in pathogenesis, patterns of infection, pathogenesis of animal viruses, Adenovirus, Herpes virus, Hepatitis virus, Picorna virus, Poxvirus and Orthomyxovirus, pathogenesis of plant [TMV] and insect viruses [NPV]. Host cell transformation by viruses and oncogenesis of DNA and RNA viruses. Control of Viruses: Control of viral infections through vaccines, interferons and chemotherapeutic agents. Structure, genomic organization, pathogenesis and control of Human-immunodeficiency virus.	**8 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will get adequate knowledge of the etiological agents of medical importance such as bacteria, viruses, parasites etc.
CO2	Student will develop an understanding of the role of microbes as a potential pathogen and progression of disease.
CO3	Students will efficiently learn the process of detection, treatment and controlof pathogenic microbes
CO4	Student will acquire comprehensive theoretical knowledge of medical microbiology and virology which includes mode of transmission, disease causation and diagnosis of pathogen of major significance to public health.
CO5	Student will develop an approach to analyze and solve the clinical problems.

Resources	
Recommended Books	1. Textbook of Medical Microbiology. C.P. Baveja. 4th edition 2. Davis and Dulbacco Medical Microbiology Gibbs. Bernard D, Renato Dulbecco & others. Davis. 3rd edition 3. Textbook of Medical Laboratory Technology. Praful B. Godkar, Darshan P. Godkar. 2014 4. Bailey and scott's diagnostic microbiology. Patricia M. Tille. 2014 5. Koneman's Color Atlas and Textbook of Diagnostic Microbiology. Gary W. Procop (Author), Elmer W. Koneman. 2006 6. General virology. Luria S. E. et.al.1978 7. Field's Virology, 5th Ed. Lippincott Williams & Wilkins. Martin, Bernard Roizman, Stephen E. Straus.2007 8. A Practical Guide to Clinical Virology. 2ndEd. Edited by, John Wiley & Sons, Ltd. Haaheim L. R., J. R. Pattison and R. J. Whitley.2002 9. Principles of Virology: Molecular Biology, Pathogenesis, and Control. Flint S. J., V. R. Racaniello, L. W. Enquist, V. R.Rancaniello, A. M. Skalka. 2003. 10. Basic Virology, Blackwell Publishing. Edward K. Wagner, Martinez J. Hewlett. 2004
Reference Books	**Virology:** 1. Medical Virology 10 Th Edition by Morag C and Tim bury M C 1994. Churchil Livingstone, London. 2. Introduction to Modern Virology 4th Edition by Dimmock N J, Primrose S. B. 1994. Blackwell Scientific Publications. Oxford. 3. Virology 3 rd Edition by Conrat H.F., Kimball P.C. and Levy J.A. 1994. Prentice Hall, Englewood Cliff, New Jersey. 4. Molecular Biology, Pathogenesis and Control by S.J. Flint and others. ASM Press, Washington, D.C. 5. Applied Virology. 1984. Edited by EdonardKurstak. Academic Press Inc. **MedicalMicrobiology** 1. Unsworth K. E. and David W. Holden, (2000), Identification and analysis of bacterial virulence genes in vivo, Phil. Trans. R. Soc. London B. 355, 613-622 2. Woods D. E., (2002), The use of animal infection models to study the pathogenesis of melioidosis and glanders, Trends Microbiol, 10(11):483-5 3. Eduardo A. G.roisman and Howard Ochman, (1994), How to become a pathogen, Trends in Microbiology, 2(8):289-294 4. Carpenter Philip L., (1975), Saunders International Edition - Immunology and Serology, W. B. Saunders and Co., London 5. Schlessinger David, Editor, Mechanism of Microbial Virulence, in Microbiology –

	1979, American Society for Microbiology, Washington D. C., 79-230 6. Schlessinger David, Editor, Biochemical Genetics of Pathogenecity, in Microbiology – 1979, American Society for Microbiology, Washington D. C., 79- 230 7. Mark J. Pallen1 & Brendan W. Wren, (2007), Bacterial pathogenomics, Nature Rev. 449|18: 835-842 8. Hughes Eric A. and Jorge E. Galan, (2002), Immune Response to Salmonella: Location, Location, Location?, Immunity, 16: 325–328 9. Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore. 10. Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and Mc Cartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone. 11. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992) Medical Microbiology. 14th edition. ELBS with Churchill Livingstone. 12. Topley & Wilsons's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III Bacterial Diseases, Edward Arnold, London.

SANDIP UNIVERSITY

School of Science

First Year M.Sc Microbiology (Part Time)

Elective subject (DE1)

Year: First Year **Semester: II**

Course: Research methodology, IPR, Environmental Protection Act. **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	3. Introduction and basic concepts of research, environmental awareness

Objectives	
1	To develop understanding of the basic framework of research process.
2	To develop an understanding of various research designs and techniques.
3	To identify various sources of information for literature review and data collection.
4	To introduce fundamental aspects of Intellectual property Rights to students which is needed in development and management of innovative projects in bio-industries.To develop an understanding of the ethical dimensions of conducting applied research.
5	To gain adequate knowledge on the components of scholarly writing and evaluate its quality.

Unit Number	Details	Hours
1	**Research Methodology** Introduction Meaning of Research Objectives of Research Types of Research Research Methodology: Philosophical Perspective Defining the Research Problem Data Collection Method Sampling Fundamentals Role of Computer in Research Structure of Questionnaire Ethical consideration in research	**12 L**
2	**Intellectual Property Rights**	

	Introduction to IPR History of IPR in India Overview of Laws related to Intellectual Property Rights in India Types of Intellectual property – Patents, Trademarks, Copyrights and related rights; Traditional vs. Novelty; Importance of intellectual property rights in biology and environmental sciences; GATT and WTO and IPR provisions under TRIPS; Madrid agreement; Hague agreement; WIPO treaties; Budapest treaty; Indian Patent Act (1970)	**12 L**
3	**Patents:** Definition, patentable and non-patentable inventions; types of patent application – Ordinary, Conventional, PCT, Divisional, and Patent of addition; Concept of Prior Art; Patent databases, Patent infringement – meaning, scope, litigation Patenting of biological materials, international co operation, obligations with patent applications, implication of patenting, current issues, hybridoma technology etc. Patenting of higher plants and animals, transgenic organisms and isolated genes, patenting of genes and DNA sequences, plant breeder's right and farmers rights.	**12 L**
4	**Introduction to bioethics:** Definition, History of bioethics. Ethics in Bio-medical research. Guidelines-ICMR, Institutional Ethics Committees, Institutional Review Board, Ethics-SOPs Ethical issues based on methodology of clinical Research. The ethics of clinical research in developing countries.	**12 L**
5	**Introduction to National Environmental Laws:** Environmental Law and the Indian Constitution Other Laws and Environment (IPC, Cr.PC, Torts) Environment Protection Act, 1986 Sustainable Development and Environment- Nagoya protocol related to microbes Introduction to Environmental Impact Assessment	**12 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will get adequate attention for study ofResearch methodology
CO2	Student will acquire knowledge and understanding of data analysis and interpretation in relation to the research process
CO3	Students will develop an approach to carry out scientific research
CO4	Learner will understand the fundamentals and application of Intellectual property rights

	related to biological sciences
CO5	It will help to stimulate environmental consciousness for sustainability and environmental protection.

Resources	
Recommended Books	1. Research Methodology : Methods And Techniques (Multi Colour Edition) by C.R. Kothari and Gaurav Garg 2. Ponkhshe S. (1988) Management of Intellectual Property, Bhate and Ponkhshe Prakasham, Pune 3.Economics and Environment – Good Steie 4. Environmental Planning, Policies & Programmes in India – K.D. Saxena 5. Land – Use and Environment – S.M. Mujtava
Reference Books	1.Ratledge C and Kristiansen B eds. (2001) Basic Biotechnology 2nd Ed. Cambridge Univ. Press. Cambridge 2. Ecology And Environment Paperback – 2011by P D Sharma 3. Environmental Impact Assessment – John Glasson 4. Methods of Environmental Impact Assessment – Morris & Therivel 5. Environmental Impact Assessment – L.W. Canter 6. Chemical Principles of Environmental Pollution – Alloway & Ayers 7. Industrial Environment – Assessment and Strategy – S.K. Aggarwal 8. Introduction to Environmental Engineering and Science – Gilbert Masters 9. Handbook of Environmental Assessment, (Vol.-I & II) – Judith Petts 10. Environmental Administration and Law- Paras Diwan.

SANDIP UNIVERSITY

School of Science

First Year M.Sc Microbiology (Part Time)

Elective subject (DE1)

Year: First Year **Semester: II**

Course: Principles of Genetics **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
4	0	-	4	15	20	15		-	50	-	100
Max. Time, End Semester Exam (Theory) - 3Hrs.											

Prerequisite	1. Introduction and basic concepts of Genes, nucleic acid, chromosomes etc.

Objectives	
1	To impart the knowledge of genetic and its advances.
2	To increase the understanding of all biological phenomena and related concepts.
3	To understand functions of classical genetics including Mendelian laws and their significance in genetic diseases.
4	To introduce students to the genetic related problems
5	To create the base for advanced genetics

Unit Number	Details	Hours
1	**History of Genetics:** • Definition and scope of Genetics. • Pre-mendelian genetic concepts- Pre-formation, Epigenesis, Pangenesis, Inheritance of acquired characters, Germplasm theory. • Heredity and Environment; Genotype and Phenotype; Heredity and Variation. • Clones, Purelines and Inbred lines. • Norms of reaction and Phenocopies.	**12 L**
2	**Mendelian Genetics** **a. Law of segregation:** • Monohybrid cross, back cross and test cross. • Dominance and Recessive ness, • Co-dominance and Incomplete dominance. • Genetic problems related **b. Law of Independent Assortment:** • Dihybrid cross in Pea plant and *Drosophila*, • Back cross and test cross. • Genetic problems related.	**12 L**
3	**Multiple alleles:**• Definition, Eye color in Drosophila, Blood groups and Rh factor in Human. • Genetic diseases: eg.Autosomal, X linked and Y linked. Eugenics, Genetic counselling	**12 L**
	Gene interactions: • Deviations from Mendelism:	

4	➢ Inter allelic- • Complementry gene interaction (9:7) Ex. *Lathyrus odoratus* • Supplementry gene interaction (9:3:4) Ex. Grain color in Maize. • Epistasis: - Dominant –Ex. Fruit color in *Cucurbita pepo.* • Epistasis:- Recessive –Ex. Coat color in Mice. ➢ Inter allelic Non Epistatic: Ex. Comb pattern in Fowl.	**12 L**
5	**Sex Linkage:** Meiotic behavior of chromosome and non- disjunction. • Bridges theories of non-disjunction. • Sex linkage in *Drosophila*. **Sex determination:** . • Chromosomal theory of sex determination-XX-XY, XX-XO, ZZ-ZW; Genic balance theory of Bridges, Y chromosome in sex determination in *Melandrium.*• Environment and sex determination. • Hormonal control of sex determination (free martin). • Gynandromorphs / Intersexes, Super sexes in *Drosophila.*• Sex differentiation and Dosage compensation (*Drosophila* and Man).	**12 L**
	Total	**60**

Course Outcome	
Students should able to	
CO1	Student will be able to know the fundamentals of life.
CO2	Student will acquire knowledge about the organizational and functional aspects of living cell and organelles
CO3	Students will be able to learn the classical genetics and transmission of genetic traits from generation to generation
CO4	Learner will be able to develop understanding to create the base for advanced genetics
CO5	It will help to stimulate the innovative ideas ofresearch for curing genetic related problem like genetic diseases

Resources	
Recommended Books	1. Principle of Genetics by Robert H. Tamarin, Tata-McGraw Hill, Seventh Edition (2002). 2. Genetics, Princilpes and Analysis by Daniel Hart and E.W. Jones. 4th Edition 1998; Jones and Bartlett Publication. 3. Genetics by M.W. Strickbergar. McMillan Publication, New York.
Reference Books	1. Essentials of Human Genetics by S.M. Bhatnagar etal (1999) IV edition. Orient Longman. 2. Human Genetics : Concepts and Applications by Lewis R (2001) McGrawHi; Boston. 3. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Sounders Company, London.

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: II**

Course: Pharmaceutical science ; Quantitative Biology and Validation/ Qualification of equipment and processes Laboratory III **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
0	0	4	2	-	-	-		50	-	50	100
Max. Time, End Semester Exam (Theory) - 2Hrs.											

Objectives	
1	To understand and abide to the standard regulatory protocol for microbiological analysis of pharmaceutical products.
2	To acquire hands on cosmetic product formulation, preservation and shelf life study.
3	To enhance the application skills of quantitative biology.

Sr. No.	Description
1	Antimicrobial effectiveness testing (as per FDA)
2	Microbial examination of non sterile products
3	Sterility testing of pharmaceutical product
4	Antibiotic potency assay
5	Preparation of cosmetic product and its shelf life study.
6	Efficacy testing of preservative
7	Bioburden Estimation for Medical Device
8	Problems to study normal distribution.
9	Application of Students t-test for biological problems.
10	Performance of chi-square test.

11	Conductance of ANOVA test.
12	Application of internet for bio-statistical analysis.
13	Validation and calibration of autoclave
14	Validation and calibration of Laminar air flow.
15	Validation and calibration of Incubator
16	Pharmaceutical industrial visit

Term Work:
Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on attendance, good laboratory practice (GPL), timely completion, journal/record book, oral/viva, respectively. It should be assessed by course teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The regular attendance of the students during semester for practical course will be monitored and marks will be given accordingly (10 Marks).
2	Good Laboratory Practices (10 Marks)
3	Timely Completion (10 Marks)
4	Journal / Record Book (10 Marks)
5	Oral / Viva (10 Marks)
Practical/Oral/Presentation:	
Practical/Oral/Presentation shall be conducted and assessed jointly by at least a pair of examiners appointed as internal and external examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.	

Notes	
1	One experiment from the regular practical syllabus will be conducted (40 Marks).
2	Oral/Viva-voce (10 Marks).

School of Science
First Year M.Sc Microbiology (Part Time)

Year: First Year **Semester: II**

Course: Virology and Medical Microbiology and Research methodology, IPR, Environmental Protection Act. Laboratory IV **Course Code:**

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA)					End Semester Examination		Total
L	**T**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**		**Lab**	**Theory**	**Lab**	
0	0	4	2	-	-	-		50	-	50	100
Max. Time, End Semester Exam (Theory) - 2Hrs.											

Objectives	
1	To understand the process involved in isolation and identification of pathogenic agents
2	To explore the various techniques in medical microbiology
3	To develop hands on skill for handling and processing of pathogenic microorganisms
4	To develop scientific writing and communication skill of students

Sr. No.	Description
1	Egg inoculation and cultivation of animal virus in embryonated egg.
2	Isolation and identification of pathogenic microorganisms from clinical specimens (urine, pus, sputum, stool, blood)
3	Antibiotic susceptibility testing of pathogenic bacteria
4	Germ tube test for detection of Candida spp.
5	Slide culture method and staining of fungal strains
6	Acid fast staining
7	Study of phagocytosis using bacterial/yeast cells.

8	Microscopic observation of intestinal parasitic agents
9	Visit to Industry/ research organization/ Hospital/ pathology lab
10	Scientific communication: Title and abstract for a given text.
11	Choosing and indexing key words from a given paper
12	Manuscript writing for research article
13	Writing a newspaper report / popular article of a latest research paper.
14	Preparation of display material (such as scientific posters)
15	Writing a pedagogical (academic) article on a scientific theme
16	To study format for patent filing

Term Work:
Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on Attendance, Good Laboratory Practice (GLP), Timely Completion, Journal/Record book and Oral. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	The regular attendance of the students during semester for practical course will be monitored and marks will be given accordingly (10 Marks).
2	Good Laboratory Practices (10 Marks)
3	Timely Completion (10 Marks)
4	Journal / Record Book (10 Marks)
5	Oral / Viva (10 Marks)

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by at least a pair of examiners appointed as internal and external examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	One experiment from the regular practical syllabus will be conducted (40 Marks).

2	Oral/Viva-voce (10 Marks).