

SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science & Humanities



Structure, Teaching Scheme and Syllabus of

B. Sc. (Microbiology) Honours with Research

Sem-5 as per NEP-2020

Program Code: SC102

With effect from: 2023-24

Semester- 5

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Medical microbiology
Course Code:	15-MIM301-3C
Pre-requisite Course:	Basic knowledge of Medical microbiology

Course Objectives:

- To understand Host – Parasite relationship
- To understand Basics of Epidemiology
- To understand Vector-borne diseases
- To understand Systemic diseases of various system

Teaching and Examination Scheme:

Teaching Scheme(Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	HOST PARASITE RELATIONSHIP 1. Terms: Pathology, Infection, intoxication and disease, symptoms, sign, syndrome, Prophylaxis. 2. Normal flora of skin, oral cavity, Gastrointestinal tract, and other body regions, 3. Classifying Infectious disease on basis on occurrence severity and extent of host involvement. 4. Entry of pathogen into the host, Colonization and growth. 5. Toxins – Endotoxins and Exotoxins. 6. Nonspecific host defences – general, physical, chemical and biological barriers.	13	28%
2	EPIDEMIOLOGY. AND PROPHYLAXIS 1. Definition - pandemic, epidemic, endemic and sporadic, epizootics and zoonoses, Morbidity rate, Mortality rate: Immunization, vaccine, adjuvant, serum, antiserum, anamnesis, toxoids 2. Epidemiology Technique and Epidemiological Markers 3. Recognition of Epidemic, antigenic shift and drift, Herd Immunity. 4. Transmission of disease: Contact, vehicle and vector transmission. 5. Nosocomial infections. 6. Control of Epidemics. 7. Types of vaccines –whole organism vaccines, Inactivated, Purified macromolecules as vaccines, Recombinant vector vaccines, DNA vaccines, and multivalent subunit vaccines.	13	28%
3	Systemic diseases: 1. Diseases of Skin and Eyes, Bacterial, Viral (Chicken pox and Herpes) and Fungal 2. Diseases of Nervous System: Bacterial and Viral (Rabies and	19	44%

	Creutzfeldt-Jakob disease) 3. Diseases of Cardiovascular and Lymphatic System: Bacterial, Protozoal (Malaria) and Viral (Dengue fever). 4. Diseases of Respiratory System: Bacterial, Viral (Influenza and Common cold.) 5. Diseases of Digestive System: Bacterial, Viral (Hepatitis) and Protozoa (Amoebic dysentery.) 6. Diseases of Urinary and Reproductive System: Bacterial, Viral (Genital Herpes) and Fungal (Candidiasis)		
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List of Experiments:

1. Identification of unknown medically important bacteria from mixed population using identification keys:
 - a. Escherichia coli,
 - b. Enterobacter aerogenes,
 - c. Proteus vulgaris,
 - d. Salmonella group : S. typhi, S. paratyphi A, S. paratyphi B,
 - e. Shigella dysenteriae,
 - f. Pseudomonas aeruginosa.
2. Isolation, cultivation, identification and study of antibiotic sensitivity (Antibiogram) of Gram-negative/Gram Positive Bacteria.
3. Urine examination: Physical, chemical, microscopic.
4. Study of Malarial Parasite through permanent slide and diagram.
5. Visit to Pathological laboratory for understanding identification of various infectious disease.

Textbooks:

1. Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th ed). Benjamin Cummings N.Y
2. Prescott, L.M., Harley, J.P., Klein, D.A., (2002) Microbiology (5th ed McGraw Hill. International ed.

Reference Books:

1. Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th ed). Benjamin Cummings N.Y.
2. Prescott, L.M., Harley, J.P., Klein, D.A., (2002) Microbiology (5th ed McGraw Hill. International ed.
3. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
4. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
5. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
7. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

List of Open-Source Software/learning website:

<https://www.youtube.com/watch?v=TgtzgRhsXAg>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Define and enlist the terms used terms: used in host parasite relationship. And get basic understanding of normal flora of human body	1 Remember 2 Understand
CLO2	To get knowledge and understand the entry of pathogens and its mode of action .	1 Remember 2 Understand 3 Apply 4 Analyze
CLO3	Classify and compare the infectious disease on the basis of occurrence severity and extent of host involvement.	2 Understand 3 Apply 4 Analyze
CLO4	To understand the concept of epidemic and its control.	1 Remember 2 Understand 3 Apply 4 Analyze 5 Evaluate 6 Create
CLO5	To study the diseases caused by microbes (virus , bacteria, fungi, protozoa). Through theoretical and practical approach.	1 Remember 2 Understand 3 Apply 4 Analyze
CLO6	To study describe and compare types of vaccine which would help student to design prophylactic measures for infectious disease.	1 Remember 2 Understand 3 Apply 4 Analyze 5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcome s	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1			2	2	2	1	2		3			2	2		2		2
CLO2	2			1		2		1			2	2		1	1		3	1
CLO3			2		1	3	2		1			1	2					3
CLO4	1	2	2	2		3		1		2	1				1	2	2	2
CLO5					3	3	2	2				2		2			1	3
CLO6		2	3	1	3	2	1		1		1	2	1		2		3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Fundamental of Virus
Course Code:	15-MIM302-3C
Pre-requisite Course:	

Course Objectives:

- To study and understand general classification, cultivation, and enumeration of virus.
- To study the bacteriophage, plant virus and animal virus.
- To understand role of virus in cancer.
- To study virus like particles prions and viroid.

Teaching and Examination Scheme:

Teaching Scheme(Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	• Early Development of Virology • General Properties of Viruses • The Cultivation of Viruses • Virus Purification and Assays • The Structure of Viruses -Virion Size, General Structural Properties, Helical Capsids, Icosahedral Capsids, Nucleic Acids, Viral Envelopes and Enzymes, Viruses with Capsids of Complex Symmetry • Principles of Virus Taxonomy • Prevention & control of viral diseases Antiviral compounds and their mode of action, Interferon and their mode of action, General • Principles of viral vaccination. • Study the critical and recent knowledge about application of antiviral drug and viral vaccination through assignments and group discussion.	15	34%
2	• Classification of Bacteriophages • Reproduction of Double-Stranded DNA Phages: The Lytic Cycle, The One-Step Growth Experiment, Adsorption to the Host Cell and Penetration, Synthesis of Phage Nucleic Acids and Proteins, The Assembly of Phage Particles, Release of Phage Particles • Reproduction of Single-Stranded DNA Phages • Reproduction of RNA Phages • Temperate Bacteriophages and Lysogeny • Study the critical and recent knowledge about application of bacteriophages through assignments and group discussion.	15	33%
3	• Classification of Animal Viruses	15	33%

	• Reproduction of Animal Viruses- Adsorption of Virions, Penetration and Uncoating, Replication and Transcription in DNA Viruses, Replication and Transcription in RNA Viruses, Synthesis and Assembly of Virus Capsids, Virion Release • Cytocidal Infections and Cell Damage • Persistent, Latent, and Slow Virus Infections • Viruses and Cancer: Introduction to oncogenic viruses • Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes • Plant Viruses- Virion Morphology, Plant Virus Taxonomy, Plant Virus • Reproduction, Transmission of Plant Viruses • Viruses of Fungi and Algae • Insect Viruses • Viroids and Prions		
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List of Experiments:

1. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample.
2. Study of the structure of important animal viruses (rhabdo, influenza, paramyx hepatitis B and retroviruses) using Pictures and Diagram.
3. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs
4. Study of the structure of important bacterial viruses (ϕ X 174, T4, λ) using Pictures and Diagram
5. Demonstration Theoretically of isolation and propagation of animal viruses by chick embryo technique
6. Study of cytopathic effects of viruses using photographs.
7. Perform local lesion technique for assaying plant viruses.

Textbooks:

- Principles of Microbiology by Prescott (2020).

Reference Books:

- Microbiology by R.M. Atlas (1996)
- Madigan MT, and Martinko J M (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
- Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education
- Microbiology Powar and Dagainawala
- 1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
- Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
- Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
- Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
- Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
- Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
- Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
- Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
- Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

List of Open-Source Software/learning website:

- <https://nptel.ac.in/courses/102103039>
- <https://edurev.in/p/60230/NPTEL--Biotechnology--General-Virology->

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn virus classification and its general structure	1 Remember 2 Understand
CLO2	To study bacteriophage, its types of characteristics and growth. Study the recent application of bacteriophages through assignments and group discussions.	1 Remember 2 Understand 3 Apply
CLO3	Apply and explore the area of cultivation and enumeration of virus. Also to study viruses of fungi, algae and insect.	1 Remember 2 Understand 3 Apply
CLO4	Basically, understand the factors responsible for pathogenicity of virus. Analyse various types and effects caused by virus in plants animal and bacteria.	2 Understand 3 Apply 4 Analyze
CLO5	To study and think critically about Antiviral drug mechanisms and viral vaccine. Through classroom teaching, assignments and group discussion.	1 Remember 2 Understand 3 Apply 5 Evaluate
CLO6	The student would understand the process and mechanism of cancer and various disease caused by virus so that a treatment process can be designed.	1 Remember 2 Understand 3 Apply 4 Analyze 5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1																	3	1
CLO2		2		1	2	1			3	2							2	3
CLO3						3			1								1	2
CLO4	1				2	2			1								2	3
CLO5	1	3		3			3			3	2						2	3
CLO6	1	3		4	2	3			2	2							3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Fundamentals of Immunology
Course Code:	15-MIM303-3C
Pre-requisite Course:	Basics of Immunology

Course Objectives:

- To understand basic mechanism of Immunity
- To understand about Antigens & Antibody
- To understand Design of Vaccines
- To understand various Antigen-antibody Interactions

Teaching and Examination Scheme:

Teaching Scheme(Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	Immunity and Immune response: Introduction and Historical perspective, Immunity: Types: Innate and Acquired Immunity, Active and Passive Immunity, Natural and Artificial Immunity, Cell Mediated and Humoral Immunity, Herd Immunity Innate immunity: Skin & Mucosal Barrier, Physiological Barrier, Phagocytic Barrier, Inflammatory Barrier. Complement Fixation – Classical, Alternative and lectin Pathway Acquired Immunity: Primary and Secondary Immune Response, Clonal Selection Theory Cells, Tissue and Organs of immune system : Peripheral and Central Lymphoid System, Lymphoid and Myeloid Cells, Lymphatic System, Cytokine and their role in immunity.	13	28%
2	Antigen and Immunogen: Types of Antigen, Characteristics of Antigen (Foreignness, High molecular weight, Chemical complexity, Degradability) Antigenicity and Immunogenicity, Epitopes, Epitopes recognized by B- Cells and T-cells, isoantigen. Homologous and heterologous antigens, Super antigens and Cell Associated Differentiation Antigens CD's, ABO & Rh antigens MHC molecules, Haptens Immunogenic adjuvant. Cross Reactivity Antibody structure and functions. Structural features and biological properties of IgG, IgM, IgA, IgD & IgE. T-Cell & B-Cell generation:- Generation (Maturation), Activation, Proliferation and differentiation	19	44%

3	Immunoreactions and immunization Antigen-antibody Interactions Types(Precipitation reactions, Agglutination reaction, CFT, Neutralization, Serotyping, Flow cytometry, Immunoblot technique, Immunochromatographic techniques, IFT, RIA, ELISA) and Mechanism (Lattice Hypothesis) Prophylactic Immunization: Principles of vaccination, Types of Vaccines, Schedule of Vaccination, Hazards of Vaccination. Basic introduction and critical thinking on some uses antibody like abzymes, and targeted drug therapy.	13	28%
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List of Practical

1. Preparation and Identification of different cell types in peripheral blood:
 - i. Total count of WBC
 - ii. Total count of RBC
 - iii. Differential Count of WBC.
2. Estimation of Blood Urea by DAM method.
3. Estimation of Blood Glucose by GOD/POD method.
3. Determination of human blood groups: ABO and Rh system.
4. Estimation Haemoglobin by Sahli's Method.
5. Study of Agglutination reaction and Precipitation reactions:
 - i. Widal Slide test
 - ii. Dreyer's technique, ii) Double dilution technique.
 - iii. Ouchterlony Double Diffusion test
 - iv. HIV detection rapid test
 - v. SRID
6. Visit to pathological laboratory of studying various antigen antibody reactions.

Textbooks:

1. Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th ed). Benjamin Cummings N.Y
2. Prescott, L.M., Harley, J.P., Klein. DA., (2002) Microbiology (5th edY McGraw Hill. International ed..

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1. Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th ed). Benjamin Cummings N.Y.
2. Prescott, L.M., Harley, J.P., Klein. DA., (2002) Microbiology (5th edY McGraw Hill. International ed.
3. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
4. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
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List of Open-Source Software/learning website:

<https://www.youtube.com/watch?v=TgtzgRhsXAg>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the development of the knowledge of structure and function of Immune system.	1 Remember 2 Understand
CLO2	List the types of Immunity.	1 Remember
CLO3	Understand various Immunoreactions and its applications.	2 Understand 3 Apply
CLO4	Learn basic techniques to identify and interpret disease state and drug effect.	2 Understand 3 Apply
CLO5	Compare primary and secondary immune system. Evaluate and compare antibody structure.	4 Analyze 5 Evaluate
CLO6	The awareness of the immune system and its components and practical experiments will help them for further work in the field.	4 Analyze 5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1			2	1	2	1	2		3			2	1		1		2
CLO2	2			1		2		1			1	2		1	1		3	1
CLO3			2		1	3	2		1			1	2					3
CLO4	1	2	1	2		2		1		2	1				1	2	2	2
CLO5					2	1	2	2				2		2			1	3
CLO6		2	3	1	3	2	1		1		1	2	1		2		3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Biotechnology applied to Animal
Course Code:	15-BIE301-3C
Pre-requisite Course:	

Course Objectives:

- This course is helps to acquire Basic knowledge of animal cell culture laboratory requirements.
- It will also help in enriched with the knowledge of tissue culture technique, cell lines, preservation of cells.
- It will also provide knowledge of organ culturing, stem cell biology, IVF and Embryo Technology.
- It will also aid in getting knowledge of transgenic animals and its applications.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	• Introduction – History and scope of Animal Cell Culture • Various types of substrates used for Adhesive and Non-adhesive Animal Cell • Media – Different types of media (serum based as well as Non-serum based), role and importance of various components used in the media • Reproduction of cells – various methods of tissue disaggregation, primary culture, subculture, secondary culture, cell line – Finite, contact inhibition and continuous • Conservation of cell line – Cryopreservation • Bioreactor, various types and its importance	15	34%
2	• Organ culture, different approaches and importance • Stem Cells – Introduction, various types of stem cells and its applications • Vaccines, different types of vaccines • Antibody, Types of antibody, production of monoclonal antibody • IVF, Embryo technology – Introduction, embryo transfer and applications	15	33%

3	Transgenic Animals • Animal Cloning – Dolly sheep • Various strategies of transgenesis • Studying human disease using transgenic mice • Meat and organ development using transgenic pig • Production of Therapeutic protein, milk, wool using transgenic cattle, sheep and goat	15	33%
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List of Experiments:

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization.
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution.
4. Preparation of Minimal Essential Growth medium.

Text Books:

1. Elements of Biotechnology: P.K. Gupta

Reference Books:

1. Molecular biotechnology : Bernard, R. Glick and Pasternak.
2. Jan Freshney. R .Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (6th Ed.) Wiley & Sons. 2010.
3. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
4. Biotechnology: U. Satyanarayana

List of Open Source Software/learning website:

<https://www.youtube.com/watch?v=HNOcQKwW5ks>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Discuss the basics of cell tissue culture, mechanism of reproduction of cells, conservation of cells	1 Remember 2 Understand
CLO2	List the types of media, different types of substrates	1 Remember
CLO3	Enabling students to understand types, advantages and disadvantages of stem cells, vaccines, etc.	1 Remember 2 Understand 3Apply
CLO4	Understand organ culture and bioreactor	2 Understand 3 Apply 4 Analyze
CLO5	Learn about transgenic animals and their applications	1 Remember 2 Understand 3Apply 5 Evaluate
CLO6	Discuss the mechanisms involved in IVF and Embryo transfer.	1 Remember 2 Understand 3Apply 4 Analyse 5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	3	3	2	2	1	3	1	2	3	3	1	2	3	1	1	3		
CLO2	1	1	3	1	2	3	2	3	2	3	1	1	1	1	1	1		
CLO3	3	2	1	2	2	3	2	3	2	3	1	1	1	1	1	1		
CLO4	1	2	2	1	3	2	1	1	2	3	1	1	2	2	1	1		
CLO5	1	2	3	2	3	3	2	2	3	3	2	2	1	1	1	1		
CLO6	3	2	2	1	3	3	2	3	2	3	2	1	1	1	1	1		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Basic Course in Biomedical Research
Course Code:	15-BIE301-3O
Pre-requisite Course:	

Course Objectives:

- The primary objective of this course is to equip students with the foundational knowledge and practical skills required to conceptualize, design, and implement high-quality health research studies.
- The course equips students with essential skills to design and conduct health research through training in epidemiology, biostatistics, ethics, and research methodology.
- The course develops students' skills in research writing, grant proposals, and ethical standards to support effective contributions to health research and evidence-based practice.

Teaching and Examination Scheme:

Teaching Scheme(Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	Developing a biomedical research concept: Overview of health-related research, Crafting research questions, hypotheses, and study objectives and Reviewing existing literature Epidemiological principles in study design: Understanding how to measure disease occurrence, Types of descriptive research designs Types of analytical research designs Types of experimental research designs Assessing the validity of epidemiological research Introduction to qualitative research methods	15	34%
2	Biostatistical factors to consider when designing a research study: Defining and measuring study variables, Techniques for selecting samples, Estimating required sample size and statistical power. Planning and organizing a research project: Choosing the target population for the study, Creating a study blueprint and managing the project, Developing instruments for data collection, Key principles for gathering data, Organizing and handling collected data and data analysis	15	33%
3	Addressing ethical concerns in research: Ethical guidelines and principles in health research, Implementing clinical trials, Developing a research protocol, creating a concept note for research proposals Key components of a research study protocol: Ethics in publishing, writing research manuscripts (non-evaluative), and drafting grant proposals (non-evaluative)	15	33%

List of Experiments:

1. Developing a Research Protocol:

1. Defining the Research Question: Clearly articulate the central question the study seeks to answer.

2. **Reviewing Existing Literature:** Examine current studies to pinpoint knowledge gaps and areas needing further investigation.
3. **Selecting a Study Design:** Decide on the most suitable research design (such as observational or experimental) based on the question and resources.
4. **Planning Data Collection:** Outline methods for gathering data, including tools like surveys, interviews, or laboratory tests.
5. **Choosing a Sampling Strategy:** Identify a sample that accurately represents the population under study.
6. **Addressing Ethical Issues:** Ensure ethical standards are met, including informed consent and maintaining confidentiality.

2. Performing a Literature Review:

1. **Searching Scholarly Databases:** Use academic databases (e.g., PubMed, Scopus, Web of Science) to locate relevant studies.
2. **Organizing Information:** Keep track of sources and notes using reference management tools like Zotero or Mendeley.
3. **Critically Assessing Studies:** Evaluate the reliability and credibility of the literature.
4. **Summarizing and Integrating Findings:** Combine insights from various sources to highlight trends, themes, and research conclusions.

3. Analysing Data:

1. **Preparing the Dataset:** Clean and format the data to ensure it's ready for analysis, addressing issues like missing values.
2. **Conducting Statistical Tests:** Apply statistical methods using tools like SPSS or R to explore the data and test your hypotheses.
3. **Drawing Conclusions:** Analyze the statistical results and derive meaningful conclusions.
4. **Visualizing the Data:** Use graphs, charts, and tables to present findings clearly and effectively.

4. Sample Practical Assignment:

- A group of students may be given a research problem (e.g., assessing a new drug's effectiveness) and asked to create a full research plan, conduct a literature review, and analyze sample data to answer the question.

Reference Books:

1. **Introduction to Health Research** World Health Organization. (2001). Health research methodology: A guide for training in research methods (2nd ed.). WHO Regional Office for the Western Pacific.[Link: <https://apps.who.int/iris/handle/10665/206929>]
2. **Literature Review** :Aveyard, H. (2019). Doing a literature review in health and social care: A practical guide (4th ed.). Open University Press.
3. **Kerzner, H. (2013). Project management: A systems approach to planning, scheduling, and controlling (11th ed.). Wiley.**

List of Open-Source Software/learning website:

1. **World Health Organization. Health research methodology: a guide for training in research methods.** Manila: WHO Regional Office for the Western Pacific; 2001: p. 1-10. <https://apps.who.int/iris/handle/10665/206929>
2. **Bonita R, Beaglehole R, Kjellstrom T. Basic epidemiology. 2nd ed. Geneva: World Health Organization; 2006: p. 15-23.**
http://apps.who.int/iris/bitstream/10665/43541/1/9241547073_eng.pdf
Coggon D, Rose G, Barker DJP. Epidemiology for the uninitiated. 4th ed. London: BMJ publishing Group; 1997. <https://www.bmj.com/about-bmj/resources-readers/publications/epidemiology-uninitiated>
Campbell MJ, Swinscow TDV.
3. **Statistics at square one. 9th ed. BMJ Publishing Group; 1997. <https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one>**

4. Hudelson PM. Qualitative research for health programmes. Geneva: World Health Organisation; 2004. https://apps.who.int/iris/bitstream/handle/10665/62315/WHO_MNH_PSF_94.3.pdf?sequence=1

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn, understand and formulate a research question, hypothesis, and objectives based on biological or life science problems.	1 Remembering 2 Understanding 3 Applying 6 Create
CLO2	Apply principles of epidemiology and biostatistics to design studies relevant to life science research.	3 Applying 4 Analyze
CLO3	Design a structured research plan including sample selection, variable measurement, and data collection tools.	6 Create
CLO4	Evaluate ethical considerations and ensure scientific validity in life science research studies.	2 Understanding 5 Evaluate
CLO5	Analyze biological data using appropriate statistical tools and interpret results in the context of life sciences.	3 Applying 4 Analyze
CLO6	Create scientifically sound research protocols, manuscripts, and grant proposals relevant to life sciences.	5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2	3			3	3			1	2					1		3	3
CLO2	2	3			3	3			2	3					2		3	3
CLO3	3	3	2		3	3	2		2	3					2		3	3
CLO4	3	2			3	3			2	3					2		3	3
CLO5	3	2			3	3	2		2	3					2		3	3
CLO6	3	3	3		3	3	2		3	3					1		3	2

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Anatomy and Physiology of Humans
Course Code:	15-BIE302-3C
Pre-requisite Course:	

Course Objectives:

- To understand Different systems of Human body like Skeletal and Muscular system
- To understand Digestive (Alimentary) and Respiratory system
- To understand Circulatory, Nervous system
- To understand Excretory, Reproductive and Endocrine system

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	-	25	100

Subject Contents:

Unit	Topic	Total Hours	Weightage (%)
1	Introduction Different systems of Human body, Cell- Structure & function; Body Tissue their functions, Common anatomical terms (Anterior/Ventral, lateral, medial, median, posterior/dorsal etc.), Anatomical Position & Planes (Supine, prone, recumbent, lithotomy) planes- coronal, sagittal. Skeletal system Bones: Number, Type and Classification. Joints: Type and Classification. Muscular system Types of muscular tissue. Property and function of muscular tissue. Muscle metabolism	12	27%

2	Digestive (Alimentary) system General features and functions of organs involved in digestive system. Composition of gastric juice, pancreatic juice, bile and digestion of food by different Enzymes, Absorption and Defecation. Respiratory system General features of different parts of the respiratory system. Functions played by different parts of respiratory system. Circulatory system Systemic circulation of blood. Structural and functional features of heart. Lymphatic & reticuloendothelial system.	18	45%
3	Nervous system Classification of nervous system. Structure & function of parts of brain. Structure & function of spinal cord. Excretory and Reproductive systems General features & functions of excretory system. Parts of male reproductive system and their functions. Parts of female reproductive system and their functions. Endocrine system Definition of endocrine gland. Different endocrine glands and hormones secreted by them. Major actions hormones secreted by endocrine system.	15	33%

List of Experiments:

- 1.To study the skeletal & muscular system.
- 2.To study microscopic examinations of tissues
- 3.To Study Digestive System
- 4.To study cardiovascular System
- 5.To study respiratory system
6. To study the lymphatic system.
7. To study the excretory and reproductive system.

Textbooks:

1. Human Anatomy (3- Vol) B.D. Chaurasia. 1995 .3rd Edn. CBS. New Delhi.
2. General Anatomy 3rd Ed ,2015 (2015), Vishram Shing Elsevier Publication

Reference Books:

1. Handbook of Christen Medical Association, India (CMAI) Medical Laboratory Technology- Robert H. Carman. 2nd edⁿ. CMAI, New Delhi.
2. Human Physiology (Vol. I, IV) C.C. Chatterjee 1992. 11th Edⁿ. Medical Allied Agencies, Calcutta.
3. Human Anatomy (3- Vol) B.D. Chaurasia. 1995 .3rd Edⁿ. CBS. New Delhi.
4. Cunningham's Manual of Practical Anatomy (3- Vol) Cunningham 1986 15th ELBS Oxford University.
5. Tortora and Derrickson. Principles of Anatomy and Physiology. John Wiley & Sons, Inc.
6. Srinageswari K. and Sharma R. Practical workbook of Human Physiology. Jaypee Publishers, New Delhi.
7. Goyal R. K. Elements of Human Anatomy Physiology & Health Education. B. S. Shah Publishers.

List of Open Source Software/learning website/ e-Resources:

<https://www.youtube.com/watch?v=XtHucs6VDYU>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Explain and classify Different systems of Human body, Cell- Structure & function	1 Remember 2 Understand 3 Apply
CLO2	Describe Type and Classification of Skeletal system	1 Remember 2 Understand 4 Analyze
CLO3	Explain various Types, Property and function of Muscular system	1 Remember 2 Understand 3 Apply
CLO4	Explain General features, functions and disease of Digestive (Alimentary) and Respiratory system	1 Remember 2 Understand 3 Apply 5 Evaluate
CLO5	Structure, function and disease of Circulatory and Nervous system	1 Remember 2 Understand 3 Apply
CLO6	Write & design General features & functions of Excretory, Reproductive and Endocrine system	1 Remember 2 Understand 3 Apply

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	1	1	2	1	3	3	2	2	3	2	2	1	1	1	1	1		
CLO2	1	1	1	1	2	2	2	1	2	2	1	1	1	1	1	1		
CLO3	1	1	1	1	2	3	2	3	3	1	1	2	2	2	1	1		
CLO4	1	1	1	1	3	3	2	3	3	3	2	1	2	1	2	1		
CLO5	1	1	1	1	2	3	1	1	3	3	1	1	1	1	1	1		
CLO6	1	1	1	1	2	3	1	1	3	2	1	1	2	1	1	1		

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Structural Biology
Course Code:	15-BIE302-3O
Pre-requisite Course:	

Course Objectives:

- Understand the structure, function, and characterization of biological macromolecules and major advancements in molecular biology.
- Learn key structural biology techniques (X-ray crystallography, NMR, cryo-EM) and data analysis methods.
- Gain skills in molecular visualization, molecular dynamics simulations, and protein engineering.
- Explore principles and applications of structure-based drug discovery and computational screening.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	--	2	4	50	25	--	25	100

Subject Contents:

Unit	Content	Lectures	Weightage
1	Introduction: Flow of the history of biological inventions, basic Biological Macromolecules of life, i.e., Protein, Nucleic Acid, Carbohydrates & Lipid/Fat, and a comparison between polymers and "3C" secrets of covalent bond, nucleic acid, DNA sequencing, PCR innovation, gene sequencing to genome sequencing, introduction to NGS and its different platforms, arrival of Post Genomic Era, the effect of HGP, and experimental three-dimensional structure determination techniques. Protein: Amino acids and their properties, Protein Chemistry, Chirality, Peptide bond, and Levels of protein structures, Dihedral angles, Peptide bond, and Ramachandran Plot, Super Secondary Structures, Motif, Domains, Non-covalent interactions, Folding of Protein, Thermodynamics, and Kinetics of protein folding, Characterization of Proteins. Introduction to Structural Biology Techniques: cellular organization, resolution structure determining technique with their ranges of the resolution, Spectroscopy Techniques Overview: Introduction to spectroscopic techniques used in protein studies. Types of Spectroscopy: UV-Visible and Circular Dichroism (CD) spectroscopy. Fluorescence spectroscopy including applications of Green Fluorescent Protein (GFP). Infrared (IR) and Raman spectroscopy for protein analysis.	15	34%

	Raman microscopy and Raman crystallography for structural studies. Microscopy Introduction: Basics of microscopy relevant to structural biology. Cryo-Electron Microscopy (Cryo-EM): Instrumentation and data collection. Data analysis and advancements in Cryo-EM. Role in protein structure determination and deposition to PDB.		
2	X-ray Crystallography Production of X-ray and its properties, unit cell, symmetry, and lattice, the geometry of the crystal system, Crystal Symmetry, Instrumentation in X-ray Crystallography, Data collection, and processing Data Analysis: Interpretation of diffraction patterns through indexing and application of Bragg's Law and Laue equations. Fundamental Concepts: Relationship between Laue equation and Bragg's Law; lattice transformation principles. Geometrical Models: Ewald sphere construction, Laue conditions for diffraction. Scattering and Structure Determination: Structure factors, atomic scattering factor, and anomalous dispersion. Phase Problem: Introduction and mathematical expression using Fourier transformation. Solving Phase Problem: Patterson function, heavy atom methods, isomorphous replacement, anomalous dispersion techniques. Structure Refinement and Deposition: Refinement techniques including simulated annealing. Structure validation and deposition in the Protein Data Bank (PDB), and usage of validation suites. NMR Spectroscopy Introduction: Basic principles of Nuclear Magnetic Resonance and instrumentation. Sample Preparation: Considerations and chemical shift phenomena. Spectral Interpretation: Factors affecting 1D and 2D NMR spectra. Advanced NMR: 2D and 3D NMR applications in protein structure elucidation.	15	33%
3	Molecular Visualization Historical Context: Evolution of molecular visualization techniques for biological macromolecules. Structure File Formats: Overview of common structural data files such as .pdb, .mmCIF, and .mtz. Visualization Tools: Introduction and demonstration of COOT for model building and validation. 3D molecular visualization using PyMOL, including a hands-on demonstration. Molecular Dynamics (MD) Simulation Purpose: Importance of MD simulations in understanding molecular behavior. Simulation Workflow: Constructing an accurate atomistic model. Algorithms powering simulation processes. Core Concepts : Topology and parameter files, components of a force field. Solvation models, solvent types, and Periodic Boundary Conditions. Central simulation box, phase space, and ensemble theory. Energy Considerations: Energy minimization techniques, potential energy surfaces (PES)., Methods for performing and assessing energy minimization .MD Simulation Steps: Detailed process from model building to analysis.	15	33%

	Applications: Real-world uses of molecular dynamics in research and drug development. Protein Engineering Overview: Definition and scope of protein engineering—what it is, how it is done, and its areas of application. Rational Design: Logical approaches to modifying proteins based on structural insights. Example of successful rational protein design, with a focus on de novo design. Directed Evolution: Mimicking natural selection to engineer proteins. Achievements, current challenges, and future directions in the field. Structure-Based Drug Discovery Introduction: Fundamentals of using structural information to guide drug development. Rational Drug Design: Strategy and principles behind structure-guided drug discovery. Virtual Screening: Molecular docking and virtual screening techniques. Challenges, progress, and future outlook. Drug-Likeness and Toxicity: Criteria for selecting small molecules as drug candidates., In silico modeling of ADMETox (Absorption, Distribution, Metabolism, Excretion, and Toxicity). Case Study and Summary: Real-life example highlighting the application of (Structure-Based Drug Discovery)SBDD.		
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List of Experiments:

1. X-ray Crystallography: Uses X-rays to study the 3D structure of crystallized proteins.
2. Nuclear Magnetic Resonance (NMR) Spectroscopy:
3. Determines the 3D structure of molecules, especially proteins, in solution.
4. Cryo-Electron Microscopy (cryo-EM): A technique that uses electron beams to visualize biological samples at near-atomic resolution.
5. Small-Angle X-ray Scattering (SAXS): Provides information about the overall shape and size of macromolecules in solution.
6. Integrative Structural Biology: Combines information from multiple techniques to build a comprehensive picture of biomolecular ensembles.
7. Practical Applications: Drug Design:
8. Structural information is crucial for designing drugs that target specific proteins involved in diseases.
9. Protein Engineering: Modifying protein structures to improve their function or stability, for example, in therapeutic applications.
10. Understanding Biological Processes: Structural studies help researchers understand how proteins and other biomolecules interact to carry out their functions.
11. Developing new therapies: Structural biology provides insights into the molecular mechanisms of diseases, which can lead to the development of novel therapies.
12. Further Exploration: EMBO practical course on integrative structural biology:
13. This course covers various techniques and explores how to integrate experimental and computational methods.
14. Integrative structural biology course at the European Molecular Biology Laboratory (EMBL):
15. This course offers hands-on training in techniques like X-ray crystallography, cryo-EM, and SAXS

Reference Books:

1. Carl Ivar Branden and John Tooze., "Introduction to Protein Structure" 2nd 2001 Edition, Taylor and Francis
2. Voet, D. and Voet, J. G., "Biochemistry" 3rd edition, John Wiley and Sons.
3. Introduction to Protein Architecture: The Structural Biology of Proteins, 2001 Arthur M. Lesk, Oxford University Press; 1st edition
4. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co
5. Creighton. T.E., Proteins, Structure and Molecular Properties, 2nd Edition, 1993 W.H. Freeman and Co
6. McPherson, A. "Introduction to Macromolecular Crystallography", 2nd 2009 edition, Wiley-Blackwell.
7. Drenth, J., "Principles of Protein X-Ray Crystallography", 3rd edition, 2007 Springer.
8. Rhodes, G., "Crystallography Made Crystal Clear", 3rd edition, Academic Press

List of Open-Source Software/learning website:

https://onlinecourses.nptel.ac.in/noc21_bt14/preview

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Learn and explain the structure and functions of key biological macromolecules and summarize major milestones in molecular biology.	1 Remember 2 Understand
CLO2	Describe and differentiate key structural biology techniques such as X-ray crystallography, NMR, and cryo-EM.	2 Understand 3 Apply
CLO3	Interpret data generated from structural biology experiments and solve basic problems related to macromolecular structures.	3 Apply 4 Analyze
CLO4	Use molecular visualization software to model and analyze biological macromolecules.	3 Apply 4 Analyze
CLO5	Demonstrate basic understanding of molecular dynamics simulations and their applications in studying biomolecules.	2 Understand 3 Apply
CLO6	Discuss the principles of protein engineering and structure-based drug discovery and their significance in life sciences.	2 Understand 5 Evaluate

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1		2	2		1	2				1	1						1	
CLO2		2	3			3				1	2						1	
CLO3		2	3		3	3				1							1	2
CLO4	2	3	3			3				2								2
CLO5	3	2	2		3	3				2	2						2	2
CLO6	3	3	3			3				2	2						2	2

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Haematology
Course Code:	15-SEC307-3C
Pre-requisite Course:	Basics of Hematology

Course Objectives:

- The course is designed to acquire basic knowledge of Blood components.
- This will enable the student to understand basics of blood transfusion.
- This course is designed to enable students in understanding the basics and applications of Blood grouping.

Teaching and Examination Scheme:

Teaching Scheme(Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	-	-	2	25	25	--	-	50

Subject Contents:

Unit	Content	Lectures	Weightage
1	Blood parts: Plasma and serum, red blood cells, White blood cells, Platelets, Anticoagulants Haemoglobinometry Red blood cell count Red cell indices Blood film preparation and staining Red blood cell morphology in health and disease Erythrocyte sedimentation rate (ESR) Total white blood cell count White blood cell differential count and white blood cell morphology	18	60 %
2	Blood Transfusion & Transfusion Reactions • Collection, Storage and transfusion of blood • Blood grouping • Minor and Major cross matching • Erythroblastosis fetalis	15	40 %

Text books:

1. Mirza Sara Beg (2022) The Text Book of Hematology & Blood Banking, 1st Edition, Dviip Publication.
2. Textbook of Medical Laboratory Technology by Praful B. Godkar

Reference Books:

1. Baker, F., Silvertown, R.R. Pallister C.T. (1998) Baker and Silvertown's Introduction to Medical Laboratory Technology. (7th edn.) Butterworths. Heinemann. Oxford. UK

List of Open-Source Software/learning website:

1. <https://www.youtube.com/watch?v=dvEk5PxZ9Ko>
2. https://www.youtube.com/watch?v=0hBTK8_B7xA
3. https://www.youtube.com/watch?v=VG_Y_KqXcVYQ
4. <https://www.nhs.uk/how-you-can-help/get-involved/download-digital-materials/blood-donation-videos/>
5. <https://www.bbguy.org/education/videos/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Student will able to understand the components of Blood.	2 Understand
CLO2	List out different types of blood cells.	2 Understand 3 Apply 4 Analyze
CLO3	Understanding the mechanism of ESR.	1 Remember 2 Understand
CLO4	Learn basic techniques to identify and interpret red blood indices.	1 Remember 2 Understand 3 Apply 4 Analyze
CLO5	Learn about leucocytes, evaluate diseases associated with them, identify and compare the increase and decrease of WBC in the body.	3 Apply 4 Analyze 5 Evaluate
CLO6	Acquire fundamentals and translate the knowledge that will enable them to understand different blood grouping tests for transfusion.	4 Analyze 5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2	2					2				2							
CLO2	3	3	2	2		3			2				2			2		
CLO3	2	2	3	3			2			1	2	2			2		2	
CLO4	2				3			2								3		
CLO5	2						2		1					2				
CLO6						3		1		2		1						3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Microbiology
Program Code:	SC102
Course Name:	Bioethics
Course Code:	15-SEC308-3C
Pre-requisite Course:	Basics of Microbiology

Course Objectives:

- The course details on the social responsibility of the researchers and the bioethics.
- Students will also be learning biosafety guidelines with special emphasis on individuals, institutions and the society

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	--	--	2	25	25	--	--	50

Subject Contents:

Unit	Content	Lectures	Weightage
1	Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private, funding, development divide. Introduction to bioethics: Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.	15	50%
2	Biosafety: Definition of bio-safety, Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and world with special emphasis on Indian concerns. Biosafety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions (Indian context).	15	50%

Textbooks:

1. B.D. Singh. Biotechnology expanding horizons.

Reference Books:

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804, 9781555811808.
2. H.K.Das. Text book of biotechnology 3rd edition.
3. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.

List of Open-Source Software/learning website:

- https://www.youtube.com/watch?v=eyLsbv8E4Kg&list=PLVLoWQFkZbhUFSIAjbWPVv_mlAAX8BB D1
- <https://www.youtube.com/watch?v=X98-TJRMZRk&pp=ygUzc3VidHJhY3Rpb24gYW5kIG11bHRpcGxpY2F0aW9uIGJ5IHZlZGllIG1hdGh1bWF0aWNz>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Student will be able to understand the public acceptance issues.	1 Remember 2 Understand
CLO2	List out different principles of bioethics.	1 Remember
CLO3	Understanding the mechanism of business ethics.	2 Understand 3 Apply
CLO4	Learn basic techniques to biosafety and levels of it concerned with India.	1 Remember 2 Understand 3 Apply
CLO5	Learn about laboratory biosafety, evaluate diseases associated with them, identify and compare the levels of biosafety.	1 Remember 2 Understand 4 Analyze 5 Evaluate
CLO6	Acquire fundamentals and translate the knowledge that will enable them to understand handling of recombinant organism at Industrial Level.	5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)																Program Specific Outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2
CLO1	2					3					2					3		
CLO2		1			2		1			3		1			2			
CLO3			3					2					2			2		
CLO4		2					2					2						
CLO5					2					2					2			
CLO6	1					1					1					2		

3: High, 2: Medium, 1: Low