

SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science and Humanities



Structure, Teaching Scheme and Syllabus of B.Sc. (Biotechnology) Honours with Research

Sem-5 as per NEP 2020

Program Code: SC101

With effect from: 2023-24

SEMESTER-5

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Animal Biotechnology
Course Code:	15-BIM301-3C
Pre-requisite Course:	Molecular Biology

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	Topic	Total Hours	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%

Text Books: 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>

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.

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	2 Understanding
CLO2	List the types of media, different types of substrates	1 Remembering
CLO3	Enabling students to understand types, advantages and disadvantages of stem cells, vaccines, etc.	2 Understanding,
CLO4	Understand organ culture and bioreactor	3 Applying, 2 Understanding
CLO5	Learn about transgenic animals and their applications	5,3, 4Evaluate, Applying, Analyze
CLO6	Discuss the mechanisms involved in IVF and Embryo transfer.	Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	3	3	2	2	1	3	1	2	3	3	1	2	3	1	1	3	1	3	2
CLO2	1	1	3	1	2	3	2	3	2	3	1	1	1	1	1	1	1	2	2
CLO3	3	2	1	2	2	3	2	3	2	3	1	1	1	1	1	1	2	3	3
CLO4	1	2	2	1	3	2	1	1	2	3	1	1	2	2	1	1	1	1	2
CLO5	1	2	3	2	3	3	2	2	3	3	2	2	1	1	1	1	1	2	3
CLO6	3	2	2	1	3	3	2	3	2	3	2	1	1	1	1	1	3	3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Human Anatomy
Course Code:	15-BIM302-3C
Pre-requisite Course:	Basic Biology

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	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%
3	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%

Text Books:

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>

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.

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	Plan 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 6 Create
CLO6	Write & design General features & functions of Excretory, Reproductive and Endocrine system	1 Remember 2 Understand 3 Apply 6 Create

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	1	1	2	1	3	3	2	2	3	2	2	1	1	1	1	1	1	2	1
CLO2	1	1	1	1	2	2	2	1	2	2	1	1	1	1	1	1	1	2	2
CLO3	1	1	1	1	2	3	2	3	3	1	1	2	2	2	1	1	1	1	2
CLO4	1	1	1	1	3	3	2	3	3	3	2	1	2	1	2	1	2	2	2
CLO5	1	1	1	1	2	3	1	1	3	3	1	1	1	1	1	1	1	2	2
CLO6	1	1	1	1	2	3	1	1	3	2	1	1	2	1	1	1	2	2	2

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Immunology
Course Code:	15-BIM303-3C
Pre-requisite Course:	Molecular Biology

Course Objectives:

- This course is designed to enable students to acquire understanding of the structure of immune system, its functions.
- This will enable the student to understand basics of various immunoreactions and immunodiagnostic techniques.
- It will also help in acquiring knowledge in the field of vaccine.

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	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 and Organs of immune system : Peripheral and Central Lymphoid System	15	33%

2	Antigen and Immunogen: Types of Antigen, Characteristics of Antigen (Foreignness, High molecular weight, Chemical complexity, Degradability) Antigenicity and Immunogenicity, Epitopes, MHC molecules, Haptens Immunogenic adjuvant. 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	15	33%
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	16	34%

Text Books: J Kuby (1991). Immunology freeman and company

Reference Books:

1. Immunology : by IM Roitt, J. Brostoff and DK Male (1993) BMP, London.
2. Todd R.F. 2001. Lecture notes on immunology.

List of Open Source Software/learning website:

https://www.youtube.com/watch?app=desktop&v=xdlvPk_2r-w

<https://www.youtube.com/watch?v=kpwTHDKQ-k4>

List of Experiments:

1. Preparation and Identification of different cell types in peripheral blood :
 - a. Total count of WBC
 - b. Total count of RBC
 - c. Differential Count of WBC.
2. Estimation of Blood Glucose by Glucose Oxidase method.
3. Estimation of Blood Urea by DAM method.
4. Determination of human blood groups: ABO and Rh system.
5. Determination of Clotting, Bleeding, Prothombin time of Blood.
6. Agglutination and Precipitation.
 - Blood grouping
 - Widal test (Slide Test)
 - VDRL Test
 - SRID test
 - Ouchterlony Double Diffusion test
 - HIV detection rapid test
 - Pregnancy detection rapid test.
7. Estimation Haemoglobin by Sahli's Method.

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 .	2 Understanding
CLO2	List the types of Immunity.	1 Remembering
CLO3	Understand various Immunoreactions and its application	2 Understanding,
CLO4	Learn basic techniques to identify and interpret disease state and drug effect.	3 Applying, 2 Understanding
CLO5	Compare primary and secondary immune system. Evaluate antibody structure.	5, 4 Evaluate, , Analyze
CLO6	The awareness of the immune system will help them for further work in the field of vaccine production.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	1	1	1	1	2	3	2	1	3	1	1	1	1	1	1	1	1	2	2
CLO2	1	1	1	1	1	3	2	1	1	1	1	1	1	1	1	1	2	2	2
CLO3	1	1	2	1	2	2	1	1	3	1	2	1	1	1	1	1	1	2	3
CLO4	2	3	3	2	3	3	2	2	3	3	2	2	1	1	1	1	1	2	2
CLO5	2	2	3	2	3	3	1	3	3	3	2	1	1	2	1	1	2	2	2
CLO6	1	1	3	2	3	3	2	3	2	3	2	2	2	1	2	1	1	2	2

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Microbiology Applied to Medical
Course Code:	15-MIE301-3C

Pre-requisite Course:

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	Topic	Total Hours	Weightage (%)
1	HOST PARASITE RELATIONSHIP Terms: Pathology, Infection, intoxication and disease, symptoms, sign, syndrome, Prophylaxis. Normal flora of skin, oral cavity, Gastrointestinal tract, and other body regions, Classifying Infectious disease on basis on occurrence severity and extent of host involvement. Normal flora of skin, oral cavity, Gastrointestinal tract, and other body regions, Entry of pathogen into the host, Colonization and growth. Toxins – Endotoxins and Exotoxins. Nonspecific host defences – general, physical, chemical and biological barriers.	13	28

2	EPIDEMIOLOGY. AND PROPHYLAXIS Definition - pandemic, epidemic, endemic and sporadic, epizootics and zoonoses , Morbidity rate, Mortality rate: Immunization, vaccine, adjuvant, serum, antiserum, anamnesis, toxoids Epidemiology Technique and Epidemiological Markers Recognition of Epidemic, antigenic shift and drift, Herd Immunity. Transmission of disease: Contact, vehicle and vector transmission. Nosocomial infections. Control of Epidemics. 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 : Diseases of Skin and Eyes, Bacterial, Viral (Chicken pox and Herpes.)and Fungal Diseases of Nervous System: Bacterial and Viral (Rabies and Creutzfeldt Jakob disease) Diseases of Cardiovascular and Lymphatic System: Bacterial, Protozoal (Malaria) and Viral(Dengue fever). Diseases of Respiratory System: Bacterial, Viral (Influenza and Common cold.) Diseases of Digestive System: Bacterial, Viral (Hepatitis) and Protozoal (Amoebic dysentery.) Diseases of Urinary and Reproductive System: Bacterial, Viral (Genital Herpes) and Fungal (Candidiasis.)	19	44

Text 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. DA., (2002) Microbiology (5th edY McGraw Hiil. 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. DA., (2002) Microbiology (5th edY McGraw Hiil. 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

List of Open Source Software/learning website:

- <https://www.youtube.com/watch?v=TgtzgRhsXAg>
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/248

List of Experiments:

1. Identification of unknown medically important bacteria from mixed population using identification keys:
 - a. *Escherichia coli*,
 - b. *Enterobacteraerogenes*,

- c. *Proteus vulgaris*,
d. *Salmonella group* : *S. typhi*, *S. paratyphi A*, *S. paratyphi B*,
e. *Shigelladysenteriae*,
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.

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 Remembering 2 Understanding
CLO2	To get knowledge and understand the entry of pathogens and its mode of action .	1 Remembering 2 Understanding 3 Applying 4 Analyze
CLO3	Classify the infectious disease on the basis of occurrence severity and extent of host involvement.	2 Understanding 3 Applying 4 Analyze
CLO4	To understand the concept of epidemic and its control	1 Remembering 2 Understanding 3 Applying 4 Analyze 5 Evaluate 6 Create
CLO5	To study the diseases caused by microbes (virus , bacteria, fungi, protozoa)	1 Remembering 2 Understanding 3 Applying
CLO6	To study describe and compare types of vaccine which would help student to design prophylactic measures for infectious disease.	1 Remembering 2 Understanding 3 Applying 4 Analyze 5 Evaluate 6 Create

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	1			2	2	2	1	2		3			2	2		2	1	2	2
CLO2	2			1		2		1			2	2		1	1		1	1	1
CLO3			2		1	3	2		1			1	2				2	2	2
CLO4	1	2	2	2		3		1		2	1				1	2	1	3	2
CLO5					3	3	2	2				2		2			2	2	2
CLO6		2	3	1	3	2	1		1		1	2	1		2		1	2	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Virology
Course Code:	15-MIE302-3C
Pre-requisite Course:	

Course Objectives:

- It includes general classification, cultivation, and enumeration of virus.
- The bacteriophage, plant virus and animal virus must be studied.
- The Course also provides the information about role of virus in cancer
- It also discusses about the 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	Topic	Total Hours	Weightage (%)
1	• 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%

2	• 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%
3	• Classification of Animal Viruses • 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	15	33%

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, paramyxo 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.

Text Books:

1. Principles of Microbiology by Prescott (2020).
2. Microbiology by R.M. Atlas (1996).

Reference Books:

1. Madigan MT, and Martinko J M (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education
3. Microbiology Powar and Dagainawala

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 structure	1 Remember 2 Understand
CLO2	Basically, understand the factors responsible for pathogenicity of virus	2 Understand 3 Apply
CLO3	Apply and explore the area of cultivation and enumeration of virus	3 Apply
CLO4	Analyze various types and effects caused by virus in plants animal and bacteria	4 Analyze
CLO5	Think critically about	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	2 Understand 6 Create

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1																			
CLO2		2		1	2	1			3	2									
CLO3						3			1										
CLO4	1				2	2			1										
CLO5	1	3		3			3			3	2								
CLO6	1	3		4	2	3			2	2									

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Haematology
Course Code:	15-SEC307-3C
Pre-requisite Course:	

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	Topic	Total Hours	Weightage (%)
1	Blood parts: Plasma and serum, Red blood cells, White blood cells, Platelets 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	15	50%
2	Anticoagulants Blood Coagulation Collection: venous blood & capillary blood , Storage and transfusion of blood Blood grouping Minor and Major cross matching Blood Transfusion Reactions Erythroblastosis Foetalis	15	50%

Text Books:

Mirza Sara Beg (2022) The Text Book of Hematology & Blood Banking, 1st Edition, Dviip Publication.

Reference Books:

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

List of Open Source Software/learning website:

- https://www.youtube.com/watch?v=0hBTK8_B7xA
- https://www.youtube.com/watch?v=VG_Y_KqXcVYQ
- <https://www.nhs.uk/how-you-can-help/get-involved/download-digital-materials/blood-donation-videos/>
- <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 be able to understand the components of Blood.	2 Understanding
CLO2	List out different types of blood cells.	1 Remembering
CLO3	Understanding the mechanism of ESR.	2 Understanding
CLO4	Learn basic techniques to identify and interpret red blood indices.	3 Applying, 2 Understanding
CLO5	Learn about leucocytes, evaluate diseases associated with them, identify and compare the increase and decrease of WBC in the body.	5,3, 4 Evaluate, Applying, Analyze
CLO6	Acquire fundamentals and translate the knowledge that will enable them to understand different blood grouping tests for transfusion.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	3	2	2	1	2	2	1	2	1	1	2	2	3	2	2	1	2	2	2
CLO2	3	1	3	1	1	2	1	1	3	1	1	1	3	1	2	2	2	3	2
CLO3	3	1	2	2	1	3	2	1	1	2	2	1	2	2	1	1	2	3	1
CLO4	2	2	2	2	1	3	1	2	1	2	1	2	2	1	2	2	3	2	3
CLO5	2	1	1	1	3	3	1	1	2	1	2	1	2	2	2	1	3	3	3
CLO6	1	2	3	1	3	3	1	1	1	2	1	1	2	1	2	2	3	1	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC104
Course Name:	Bioethics
Course Code:	15-SEC308-3C
Pre-requisite Course:	

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

Course Contents:

Unit	Topic	Total Hours	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%

Text Book: 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_mlAAX8BBD1
- <https://www.youtube.com/watch?v=X98-TJRMZRk&pp=ygUzc3VidHJhY3Rpb24gYW5kIG11bHRpcGxpY2F0aW9uIGJ5IHZlZGljIG1hdGhlcW0aWNz>

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.	2 Understanding
CLO2	List out different principles of bioethics.	1 Remembering
CLO3	Understanding the mechanism of business ethics.	2 Understanding
CLO4	Learn basic techniques to biosafety and levels of it concerned with India.	3 Applying, 2 Understanding
CLO5	Learn about laboratory biosafety, evaluate diseases associated with them, identify and compare the levels of biosafety.	5,3, 4 Evaluate, , Applying, Analyze
CLO6	Acquire fundamentals and translate the knowledge that will enable them to understand handling of recombinant organism at Industrial Level.	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO 1	PSO2	PSO3
CLO1	2					3					2					3	2	2	2
CLO2		1			2		1			3		1			2		2	3	2
CLO3			3					2					2			2	2	3	1
CLO4		2					2					2					3	2	3
CLO5					2					2					2		3	3	3
CLO6	1					1					1					2	3	1	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Basic Course in Biomedical Research
Course Code:	15-MIE301-3O
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	Conceptualizing a research study Introduction to health research Formulating research question, hypothesis and objectives Literature review Epidemiological considerations in designing a research study Measures of disease frequency Descriptive study designs Analytical study designs Experimental study designs Validity of epidemiological studies Qualitative research methods: An overview	15	34%
2	Bio-statistical considerations in designing a research study Measurement of study variables Sampling methods Calculating sample size and power Planning a research study Selection of study population Study plan and project management Designing data collection tools Principles of data collection Data management Overview of data analysis	15	33%

3	Ethical issues in conducting a research study Ethical framework for health research Conducting clinical trials Writing a research protocol Preparing a concept paper for research projects Elements of a protocol for research studies Publication ethics, Manuscript Writing (non-graded), Grant Proposal Writing (non-graded)	15	33%
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List of Experiments:

1. Designing a Study Protocol:

- Data Collection Methods: Developing methods for collecting data (e.g., questionnaires, interviews, lab experiments).
- Sampling Methods: Selecting a representative sample from the population of interest.
- Ethical Considerations: Addressing ethical issues related to research, such as informed consent and confidentiality.

2. Conducting a Literature Review:

- Information Management:
Managing and organizing the literature review, potentially using software like Zotero or Mendeley.
- Critical Evaluation:
Analyzing and evaluating the validity and reliability of the research articles.

3. Data Analysis:

- Data Cleaning and Preparation:
Preparing the data for analysis, including cleaning inconsistencies and missing values.
- Statistical Analysis:
Using statistical software (e.g., SPSS, R) to analyze the data and test hypotheses.
- Interpretation of Results:
Interpreting the statistical findings and drawing conclusions based on the data.

4. Example of a Practical Project:

- A student group could be assigned a research question (e.g., the effectiveness of a new drug) and required to design a study protocol, conduct a literature review, and analyze hypothetical data to answer their research 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>

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Enlist and explain conceptual research study.	1 Remember 2 Understand
CLO2	Discuss causes of epidemiology and their study.	1 Remember 2 Understand
CLO3	Learn various biostatistics and apply it for research.	2 Understand 3 Apply
CLO4	Acquire knowledge of planning of experiments and apply in research study.	1 Remember 2 Understand 3 Apply
CLO5	Understand the concept and advantages of ethics of research.	1 Remember 2 Understand 4 Analyze
CLO6	Understanding the concept and formation of protocol of research elements.	5 Evaluate 6 Create

Mapping of CLO s with POs & PSOs

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1	2	3			3	3			1	2					1		1	3	2
CLO2	2	3			3	3			2	3					2		1	2	2
CLO3	3	3	2		3	3	2		2	3					2		2	3	3
CLO4	3	2			3	3			2	3					2		1	1	2
CLO5	3	2			3	3	2		2	3					2		1	2	3
CLO6	3	3	3		3	3	2		3	3					1		3	3	3

3: High, 2: Medium, 1: Low

Branch Name:	B.Sc. Biotechnology
Program Code:	SC101
Course Name:	Structural Biology
Course Code:	15-MIE302-3O
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	• 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, Kinetics of protein folding, Characterization of Proteins. • Introduction to Structural Biology Techniques: cellular organization, resolution structure determining technique with their ranges of the resolution, the success of X-ray crystallography from single molecule to a crystal, X-ray Crystallography, Crystallization in X-ray Crystallography, Crystal mounting in X-ray Crystallography. • 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	15	34%
2	• X-ray Crystallography: Data Analysis of X-ray Crystallography - Diffraction Patterns, Indexing, Bragg's Law, Laue equation. Phase problem - Phase Problem, Patterson Function, How to solve phase	15	33%

	problem, Heavy atom replacement methods, Isomorphous replacement, atomic model deposition as well as different PDB validation suites. • NMR: Introduction to NMR, basic Principles of NMR and Instrumentation, NMR Sample Preparation and Chemical Shift related concepts, Factors effecting NMR Spectra (1D & 2D), 2D & 3D NMR Spectroscopy focusing on protein structure. • Spectroscopy: Introduction to Spectroscopy, UV-Vis and CD spectroscopy, Fluorescence Spectroscopy and Green Fluorescence Protein (GFP), Infrared & Raman Spectroscopy for protein, Raman Spectroscopy, Raman Microscopy and Raman Crystallography for studying protein. • Microscopy: Introduction to Microscopy, Functioning details of Cryo-Electron Microscopy (Cryo-EM), Cryo-Electron Microscopy: Data Collection and Analysis, A concise story of advancement Cryo-EM, Protein Data Bank.		
3	• Protein Engineering: What, How & Which of Protein Engineering, How to make logical Protein Engineering: Process of Rational design, a success story of Rational Protein designing: Focusing on De Novo Process. • Molecular Visualizations: History of Molecular Visualizations of Biological Macromolecules, Description of structure-related files (.pdb, .mmCIF, .mtz, etc.), Demonstration of COOT, 3D visualization using Pymol, Demonstration of Pymol. • Structure-Based Drug Discovery: Introduction to Structure-Based Drug Discovery (SBDD), Rational Drug Discovery, Docking Based Virtual Screening: Progress, Challenges and Future perspective, What makes a small molecule an ideal drug: Developing in silico ADMETox Model, Structure-Based Drug Discovery: Case study and Conclusion	15	33%

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:

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	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3
CLO1		2	2		1	2				1	1						1	3	2
CLO2		2	3			3				1	2						1	2	2
CLO3		2	3		3	3				1							2	3	3
CLO4	2	3	3			3				2							1	1	2
CLO5	3	2	2		3	3				2	2						1	2	3
CLO6	3	3	3			3				2	2						3	3	3

3: High, 2: Medium, 1: Low