B. Sc. Microbiology

Program Objectives and Outcomes

Program Objectives:

• To enrich students with knowledge and understanding of the different disciplines of Microbiology such as medical Microbiology, immunology, biochemistry, fermentation technology, environmental Microbiology, genetics, agricultural and food Microbiology, Waste management.

• To make students learn advanced fields of microbiology such as Nanobiotechnology and Marine microbiology.

• To introduce the concepts of application and research in Microbiology and inculcate sense of scientific responsibilities.

• To help students build-up a progressive and successful career in Microbiology.

• To take a step ahead for the holistic development of students through activities like lectures from eminent personalities, Visits and various competitions.

• It makes the student's competent enough to use Microbiology knowledge and skills to analyze problems involving microbes and undertake remedial measures.

• In addition, students are to be trained to use this knowledge in day-today applications and get a glimpse of research.

• The students graduating in B.Sc. Microbiology degree must have thorough understanding the fundamentals of Microbiology as applicable to wide ranging contexts.

• They should have the appropriate skills of Microbiology so as to perform their duties as microbiologists.

• They must be able to analyze the problems related to Microbiology and come up with most suitable solutions.

• As Microbiology is an interdisciplinary subject the students might have to take inputs from other areas of expertise. So the students must develop the spirit of team work.

Program Specific Objectives:

The B.Sc. Microbiology Program will enable the students;

PSOB-1.To learn basic concepts of amazing world of Microorganisms, Techniques in Microbiology, basics of Bacteriology, Cultivation and growth of Micro-organisms.

PSOB-2. To understand concepts of Medical Microbiology, Epidemiology, Immunology,

Bacterial Physiology, Fermentation Technology, Bacterial Genetics, Air, Water and Soil Microbiology.

PSOB-3.To strengthen the fundamentals of various fields of Microbiology.

PSOB-4. To develop scientific aptitude and motivate students to take up higher studies like MSc microbiology and Research.

PSOB-5.To realize and appreciate the applicability of knowledge and Interdisciplinary approach in everyday life.

Program Specific Outcomes:

After successful completion of B.Sc. Microbiology Course, student will have:

PSOC-1.Understanding of Basic Concepts and Advanced knowledge of theory and practical courses in Microbiology.

PSOC-2.Subject knowledge to solve issues like bioremediation, Waste management and diagnostics.

PSOC-3.Competency in laboratory safety and in routine an specialized microbiological laboratory skills.

PSOC-4. Motivation to involve in research activities, including accurately reporting observations and analysis.

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T.Y.B.Sc. Microbiology

To be implemented from Academic Year 2023-24

(CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Medical Microbiology- I**
Course Code	21SBMB351
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	**Objectives**
1.	To Understand the human anatomy, pathogens and various diseases associated with organ systems.
2.	To Acquire knowledge of principles underlying establishment of bacterial pathogens in human body.
3.	To Comprehend of pathogenesis of specific pathogens causing microbial diseases.

Expected Course Specific Learning Outcome

Sr. No.	**Learning Outcome**
1.	Students will be introduced to the anatomy and physiology of the various organ systems of the human body.
2.	Students will study the various parasites and bacterial pathogens and their pathogenesis.
3.	Students will acquire basic knowledge of commonly occurring bacterial diseases with respect to their epidemiology, prevention, and treatment.

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	**Introduction to infectious diseases**	**16**
1	1. Introduction to infectious diseases of following human body systems:(Brief anatomy and Physiology, Diseases, Pathogens, common symptoms)	
	a. Respiratory system	3
	b. Gastrointestinal system and liver	3
	c. Urogenital system	3
	d. Central nervous system	3
2	Study of following groups of parasites (with respect to – Classification, Lifecycle, Morphological characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis (Serological diagnosis wherever applicable), Epidemiology, Prophylaxis and Chemotherapy):	
	a. Plasmodium	2
	b. Entamoeba	2
Credit II	Study of following groups of bacterial pathogens: (With respect to- Classification and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy):	**20**
	a. *Salmonella, Vibrio, E.coli, Proteus*	4
	b. *Streptococcus pneumoniae, Streptococcus pyogenes, Staphylococcus, Neisseria meningitidis and Neisseria gonorrhoeae*	5
	c. *Pseudomonas aeruginosa*	1
	d. *Treponema, Leptospira*	2
	e. *Clostridium tetani, Clostridium perfringens*	3
	f. *Mycobacterium tuberculosis and Mycobacterium leprae*	3
	g. Rickettsia	2

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MB 351 Medical Microbiology-I and MB 361 Medical Microbiology- II

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1. https://www.who.int/travel-advice/disease-information
2. https://Microbenotes.Com/Remdesivir/#Mechanism-Of-Action-Of-Remdesivir
3. Aspergillus https://www.cdc.gov/fungal/diseases/aspergillosis/index.html
4. Histoplasma capsulatum https://www.cdc.gov/fungal/diseases/histoplasmosis/
5. Cryptococcus neoformans www.cdc.gov/fungal/diseases/cryptococcosis-neoformans/

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To be implemented from Academic Year 2023-24

(CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Immunology- I**
Course Code	21SBMB352
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	**Objectives**
1.	To Understand immune system structure, composition, function and comparison of different types of immunity.
2.	To acquire knowledge about Organs of immune system, Innate immunity, Antigen and Immunoglobulins
3.	To know about Antigen- Antibody Interactions, Major Histocompatibility Complex, Transplantation and Immunity
4.	To acquaint with Hybridoma Technology and Monoclonal Antibodies

Expected Course Specific Learning Outcome

Sr. No.	**Learning Outcome**
1.	Students will be acquainted with the concepts Organs of immune system, Innate immunity, Antigen and Immunoglobulins
2.	Students will understand Antigen- Antibody Interactions, Major Histocompatibility Complex, Transplantation and Immunity
3.	Students will become aware about Hybridoma Technology and Monoclonal Antibodies

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	**Organs of immune system, Innate immunity, Antigen and Immunoglobulins**	**18**
1.	**Organs of immune system:** Primary lymphoid organs (Thymus and Bone Marrow): Thymus – structure and function, thymic education (positive and negative selection) Bone marrow –Structure and function Secondary lymphoid organs – structure and function of spleen and lymph node, mucous associated lymphoid tissue, lymphatic system and lymph circulation	**2** **2**
2.	**Innate immunity: Non-specific mechanisms of defense: Second line of defense:** a. Pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs) b. Cellular components: Phagocytic cells – PMNL, macrophages (reticulo- endothelial cell system) and dendritic cells c. Humoral components: complement, cytokinins, inflammatory mediators Non-specific mechanisms of defense Phagocytosis - oxygen dependent and independent systems Complement activation - Classical, Alternative and lectin pathway Inflammation - cardinal signs, mediators, vascular and cellular changes	 **1** **1** **5**
3.	**Antigen:** Factors affecting immunogenecity Antigenic determinants, haptens and Heterophilic antigens and cross-reactivity, Carrier, Adjuvants Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, Autoantigens, Isoantigens	 **1** **1** **1**

4.	**Immunoglobulins:**	
	Characteristic of domain structure, functions of light and heavy chain domains and antigenic nature of immunoglobulin molecules	**2**
	Molecular basis of antibody diversity (kappa, lambda and heavy chain)	**2**
Credit II	**Antigen- Antibody Interactions, Major Histocompatibility Complex, Transplantation and Immunity and Hybridoma Technology and Monoclonal Antibodies**	**18**
1.	**Antigen- Antibody Interactions:**	
	Principles of interactions: Antibody affinity and avidity, ratio of antigen antibody, lattice hypothesis and two stage theory, antigen-antibody reaction kinetics (dialysis equilibrium experiment)	**2**
	Visualization of antigen antibody complexes:	
	Precipitation reactions: in fluid and in gel, immunoelectrophoresis	**1**
	Agglutination reactions: hemagglutination,bacterial agglutination, passive agglutination and agglutination-inhibition	**1**
	Immunofluorescence techniques: direct and indirect, fluorescence-activated cell sorting (FACS)	**2**
	Enzyme-linked immunosorbent assay (ELISA), biotin-avidin system and enzyme- linked immune absorbent spot (ELISpot) assay	**2**
	Radioimmunoassay RIA	**1**
2.	**Major Histocompatibility Complex:**	
	Structure of MHC in man and mouse	**1**
	Structure and functions of MHC class–I and class–II molecules	**1**
	MHC antigen typing (microcytotoxicity , mixed lymphocyte reaction and molecular typing)	**1**
3.	**Transplantation and Immunity:**	
	Types of Grafts, Allograft rejection mechanisms	**2**
	Prevention of allograft rejection Shelf-life determination	**1**
4.	**Hybridoma Technology and Monoclonal Antibodies:**	
	Preparation, HAT selection and propagation of hybridomas secreting	**2**

	monoclonal antibodies Applications of monoclonal antibodies	**1**

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T.Y.B.Sc. Microbiology
2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Enzymology
Course Code	21SBMB353
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr.No.	Objectives
1.	To understand methods of active site determination, role of enzymes and its cofactors in microbial physiology.
2.	To learn to perform enzyme assay, purification and quantification of enzymes activity, enzyme kinetics in terms of initial, final velocity, mathematical expression of enzyme kinetic parameters.
3.	To correlate regulation of metabolism at enzymatic levels and apply methodology for commercial applications of enzymes.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the methods of active site determination, role of enzymes and its cofactors in microbial physiology.
2.	Students will become aware about the concept enzyme assay, purification and quantification of enzymes activity, enzyme kinetics in terms of initial, final velocity and mathematical expression of enzyme kinetic parameters.
3.	Students will understand the significance of regulation of metabolism at enzymatic levels and apply methodology for commercial applications of enzymes.

Syllabus

Unit No.	Title with Contents	No. of Lectures
CreditI	**Enzymes:**	**18**
1	**Structure of enzymes**: a. Methods to determine amino acid residues at active site (Physical method e.g. x-ray crystallography and chemical methods such as trapping of ES complex, use of inhibitors, use of pseudo- substrate) b. Role of vitamins in metabolism: Occurrence, Structure and Biochemical functions of the following: i) Nicotinic Acid (Niacin) and the Pyrimidine nucleotides. ii) Riboflavin (Vitamin B2) and the Flavin nucleotides	 03 02
2	**Enzyme assays:** a. Principles of enzyme assays and calculation of enzyme unit, specific activity b. Enzymes assays with examples by: i. Spectrophotometric methods ii. Radioisotope assay	 01 02
3	**3. Principles and Methods of Enzyme purification:** a. Methods of cell fractionation b. Principles and methods of enzyme purification: i. Based on molecular size ii. Based on charge iii. Based on solubility differences iv. Based on specific binding property and selective adsorption c. Construction of enzyme purification chart	 02 02 02 02 01 01
Credit II	**Enzyme Kinetics, metabolic regulation and Immobilized Enzymes:**	**18**
1	**Enzyme Kinetics:** a. Concept of initial velocity b. Michaelis Menton equation for the initial velocity of single substrate enzyme catalyzed reaction. Brigg's Haldane modification of Michaelis Menton equation. Michaelis Menton plot, Lineweaver and Burk plot. Definition with significance of Km, Ks, Vmax.	 02 05

2	**Metabolic Regulations:** a. Enzyme compartmentalization at cellular level b. Allosteric enzymes c. Feedback mechanisms d. Covalently modified regulatory enzymes (Glycogen phosphorylase) e. Proteolytic activation of zymogens f. Isozymes - concept and examples g. Multienzyme complex e.g. Pyruvate dehydrogenase complex (PDH)	 01 01 02 01 01 01 01
3	**Immobilization of enzymes:** Concept, methods of immobilization and applications	 03

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2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Genetics
Course Code	21SBMB354
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand the central dogma of molecular biology.
2.	To know basic biological processes like replication, transcription and translation.
3.	To learn basic gene transfer and mapping techniques.
4.	To know basic recombination mechanisms at the molecular level

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	To exhibit a knowledge base in Genetics and Molecular Biology
2.	To understand the central dogma of Molecular Biology
3.	To construct genetic map of bacteria and fungi
4.	To get introduced to concept of recombination and bacteriophage Genetics

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	**DNA REPLICATION,CENTRAL DOGMA AND GENE EXPRESSION**	**18**
	1. Process of prokaryotic DNA replication a. Concept of Single replicon. b. Bidirectional movement of replication fork c. Ori C gene d. Pre-priming and Priming reactions. e. DNA polymerases, DNA synthesis of leading, lagging strand Okazaki fragments. f. Termination-Ter sequence, Tus protein	06
	2. Transcription a. Concept of central dogma b. Structure of promoter sequences. c. Structure and function of RNA polymerase. d. Steps of transcription: Initiation, Elongation and termination. e. Gene Regulation and Operon Concept (Eg-Lac Operon) f. Comparison of Prokaryotic and Eukaryotic transcription	06
	3.Translation a. Structure and role of m-RNA, t-RNA ,rRNA and Ribosome inTranslation. b. Role of Aminoacyl t-RNA synthetase in tRNA charging. c. Steps in translation: Initiation, elongation, translocation and termination of protein synthesis. d. Comparison of Prokaryotic and Eukaryotic translation	06
Credit II	**Gene transfer in bacteria and mapping techniques**	**18**
	1.Gene transfer by Transformation a. Discovery of Transformation b.Natural transformation Systems-*Streptococcus pneumonia* and *Haemophilus influenzae*. c.Factors affecting transformation process i.Competence development	4

	ii. Size of DNA iii. Concentration of DNA	
	2.Gene transfer by Conjugation **a.** Discovery of Conjugation b. Properties of F plasmid, F^+,F^-, Hfr and F′ strains c. Process of conjugation between $F^+$and F^-, Hfr and F^-	4
	3.Gene transfer by Transduction a. Discovery of Transduction b. Generalized transduction mediated by phage P22 c. Specialized transduction mediated by lambda phage.	4
	4.An introduction to Gene mapping a. Concept of genetic recombination and its significance. Different types of Recombination mechanisms. b. Recombination mapping: Map unit, recombination frequency, Recombination frequency percentage. c. Concept of Holliday model of Recombination, Role of Rec and Ruv proteins in homologous recombination. d. Mapping of genes by co-transformation e. Mapping of genes by co-transduction f. Mapping by interrupted mating experiment	6

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3. Guidelines and Handbook for Institutional Biosafety Committees (DBT, Govt. of India and BCIL):https://thsti.res.in/pdf/IBG.pdf
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http://www.informatics.jax.org/silver/chapters/7-1.shtml

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T.Y.B.Sc. Microbiology

To be implemented from Academic Year 2023-24

(CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Fermentation Technology– I**
Course Code	21SBMB355
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	**Objectives**
1.	To apply classical, advanced strain improvement and isolation techniques for fermentation processes.
2.	To optimize and sterilize media used in fermentation industry for commercially economical and efficient fermentations.
3.	To recover the product using suitable methods and ensuring quality of the finished product by quality assurance tests.
4.	To acquaint fermentation economics, process patentability, process validation.

Expected Course Specific Learning Outcome

Sr. No.	**Learning Outcome**
1.	Students will be acquainted with the concepts of strain improvement, Sterilization & optimization of Media and Scale-up & Scale-down of fermentation
2.	Students will understand the Significance Downstream processing and Quality assurance of fermentation products
3.	Students will become aware about the Fermentation economics, IPR and SOPs

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	**Upstream processes of fermentations**	**18**
1.	**Strain Improvement:**	
	Objectives of strain improvement	**1**
	Methods for strain improvement:	**2**
	Types of mutants used in strain improvement (altered cell permeability mutants, auxotrophs, analogue resistant mutants, revertants)	
	Selection of different types of mutants (replica plate method, filtration enrichment, penicillin enrichment method, gradient plate technique)	**2**
2.	**Media optimization**	
	Objectives of media optimization	**1**
	Methods of media optimization:	**1**
	Classical approach – One factor at a time, Full factorial design	**2**
	Plackett and Burman Design (with example)	
	Response Surface Methodology (RSM)	**1**
3.	**Sterilization of Media:**	
	Methods of sterilization	**1**
	Batch sterilization and Continuous sterilization (direct and indirect methods)	**1**
	Concept and derivation of Del factor	**1**
	Filter sterilization of liquid media	**1**
4.	**Scale-up and Scale-down:**	
	Objectives of scale-up	**1**
	Levels of fermentation (laboratory, pilot-plant and production level – flow sheet to explain scale up)	**1**
	Criteria of scale-up for critical parameters: Scale-up window	**1**
	Scale-down	**1**

Credit II	**Downstream processing and Quality assurance of fermentation products**	**18**
5.	**Downstream processing of fermentation products: (method, principle, types, examples of fermentations, factors affecting, merits and demerits at large scale operation)**	
	Cell disruption methods	**1**
	Filtration	**1**
	Centrifugation	**1**
	Liquid-liquid extraction	**1**
	Distillation	**1**
	Ion-exchange chromatography	**1**
6.	**Quality assurance of fermentation products (as per IP, USP)**	
	Methods of detection and Quantification of the fermentation product: physicochemical, biological and enzymatic methods	**2**
	Bioburden test	**1**
	Microbial limit test	**1**
	Sterility testing (direct inoculation method, membrane filtration method)	**1**
	Pyrogen testing: Endotoxin detection (LAL test)	**1**
	Ames test and modified Ames test	**1**
	Toxicity testing (Acute toxicity)	**1**
	Shelf-life determination	**1**
7.	**Fermentation economics, IPR and SOPs**	
	Contribution of various expense heads to a process (Recurring and nonrecurring expenditures) citing any suitable example.	**1**
	Introduction to Intellectual Property Rights – Types of IPR (Patenting in fermentation industry)	**1**
	Concept of validation (significance of SOPs)	**1**

References: MB 355 Fermentation Technology- I

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Agricultural Microbiology
Course Code	21SBMB356
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand plant growth improvement with respect to disease resistance, environment tolerance.
2.	To correlate stages of plant disease development, epidemiology, symptom based classification, control methods
3.	To understand the importance of microorganisms in sustainable agriculture, biotechnological application of bio films, edible vaccines
4.	To correlate Soil Micro biome and Role of microorganisms in soil health
5.	To determine the use of Microorganisms as tools in plant genetic engineering

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of plant disease resistance
2.	Students will become aware about the role of Microbiologist in Epidemiology of plant diseases
3.	Students will understand the Significance of biotechnological applications of microorganisms in the field of agriculture.

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	**Plant Pathology**	**18**
1	Plant growth improvement and Stages in development of a disease a. Plant growth improvement with respect to disease resistance b.Stages in development of a disease: Infection, invasion, colonization, dissemination of pathogens	03
2	Classification of disease based on symptoms (with one example of the following): Canker, Downy mildew, Mosaic	03
3	Plant disease epidemiology : i.Concepts of monocyclic, polycyclic and polyetic diseases with one example of each ii. Disease triangle iii. Forecasting of plant diseases	06
4	Methods of plant disease control i. Eradication ii.Chemical control iii.Biological control (employing bacterial and fungal cultures) iv. Integrated pest management v. Genetic engineering for disease resistant plants	06
Credit II	**Microorganisms in sustainable Agriculture and tools in plant genetic engineering**	**18**
1	Microorganisms in sustainable Agriculture Soil Micro biome (plant Micro biome): Concept, Composition, functioning and methods to study plant Micro biome Conservation of soil health: Role of microorganisms in soil health	3

2	Phytonutrient availability by soil microorganisms Mechanism of diazotrophy, Phosphate solubilization, Potassium mobilization, micronutrient availability	2
3	Biofilm in plant surfaces, Biofilm formation; Biofilm in Phyllosphere and rhizosphere, Examples of plant- microbe interactions in biofilms, Biotechnological applications of plant biofilms	3
4	Microorganisms in plant genetic engineering: a. Concept of GM crops (Transgenic crops) w.r.t. to edible vaccines, insecticide resistance, herbicide resistance, improved varieties, new variants, disease resistance	5
5	Tools and techniques: i Technology of BT resistant crops ii. Concept of edible vaccines iii.Technique of use of plant viruses in genetic engineering iv. RNAi Technology and antisense RNA technology in disease resistant plant varieties	5

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Semester V Practical Course-I

Diagnostic Microbiology and Immunology

[2 Credits; 78 Lectures] [1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures] 78 L distributed as 60 L for performing practicals and 18 L for internal evaluation 12 Practicals x 5 lectures = 60 Lectures

Course/ Paper Title	**Diagnostic Microbiology and Immunology**
Course Code	21SBMB357
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To introduce concept of Physical, Chemical and Microscopic examination of Clinical samples
2.	To make students understand and train them for Isolation and identification of pathogens from Clinical samples
3.	To train the students in Immunology techniques like Agglutination tests
4.	To make them understand importance of White blood cell differential count from peripheral blood in immunology

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn about the Physical, Chemical and Microscopic examination of Clinical samples
2.	Students will learn Isolation and identification of pathogens from Clinical samples
3.	Students will learn Immunology techniques like Agglutination tests
4.	Students will understand the importance of White blood cell differential count from peripheral blood in immunology

Sr.No.	Practical	No. of Practicals
Clinical microbiology: (7 practical) (for identification use of keys as well as Bergey's Manual is recommended)-		
1	Physical, Chemical and Microscopic examination of Clinical samples – Urine. Isolation, identification of following pathogens *E. coli / Klebsiella species;*	2 1
2	Physical and Microscopic examination of Clinical samples – Pus. Isolation, identification of following pathogens *Pseudomonas spp. / Staphylococcus spp.*	1 1
3	Physical, Chemical and Microscopic examination of Clinical samples – Stool. Isolation, identification of following pathogens *Salmonella spp./Proteus ;*	1 1
Immunology: (5 Practicals)		
4	**Agglutination tests:** Widal test (Slide test and Tube Test) andRapid Plasma Reagin (RPR) test	2
5	Agglutination Inhibition (Pregnancy test)	1
6	White blood cell differential count from peripheral blood	2
	TOTAL	**12**

References: MB 357: Diagnostic Microbiology and Immunology

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T.Y.B.Sc. Microbiology
2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Practical: Practicals based on Enzymology, Genetics and Molecular Biology
Course Code	21SBMB358
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To make students aware about the principle and working of colorimeter and spectrophotometer along with estimation of biological molecules.
2.	To make students aware about basics of Enzymology along with production, assay and precipitation of Amylase.
3.	To make them understand basic chromatography techniques with an example of Paper Chromatography.
4.	To introduce basic techniques in Molecular Biology like plasmid DNA isolation, estimation and purity determination

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn the principle and working of colorimeter and spectrophotometer along with estimation of biological molecules.
2.	Students will learn basics of Enzymology along with production, assay and precipitation of Amylase.
3.	Students will be acquainted with concept, principle and basic chromatography techniques with an example of Paper Chromatography
4.	Students will understand principle and methodology of plasmid DNA isolation, estimation and purity determination

Syllabus

Expt. No.	Topics	No. of Practicals
1	Determination of absorption spectra and molar extinction co-efficient of two different dyes (by colorimetry /spectrophotometry)	1
2	Estimation of reducing sugar from natural sources by DNSA method	1
3	Estimation of proteins from natural sources by Folin Lowry method	1
4	Lab scale production of amylase using isolates	1
5	Assay of Amylase Enzyme	1
6	Precipitation of amylase from fermentation broth by salt & Determination of specific activity of crude and purified amylase	1
7	Separation and Identification of amino acids from the mixture by paper chromatography.	1
8	Isolation of Plasmid DNA from Bacteria	1
9	Estimation of DNA by Diphenylamine method.	1
10	Determination of purity of DNA preparation and its quantification. Estimation of DNA by UV spectrophotometric methods at 260 nms. Purity checks of DNA by 260 / 280 ratio.	1
11	Bacterial Artificial transformation & Competence development in *E coli* using Calcium Chloride method.	1
12	Bacterial Conjugation (Demonstration)	1
	TOTAL	**12**

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Practical: Based on Industrial and Agricultural Microbiology
Course Code	21SBMB359
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr.No.	Objectives
1.	To make students aware about operation of laboratory scale fermenter
2.	To make them understand importance of sterility checking of injectables
3.	To introduce concept of bioassay by different methods
4.	To make them understand importance of microorganisms in plant pathology and agriculture

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn about the use of laboratory scale fermenter
2.	Students will learn to check sterility of injectables and get acquainted with different types of methods used for bioassay
3.	Students will learn isolation and identification of plant pathogens
4.	Students will understand importance of microorganisms with respect to soil fertility and plant growth

Syllabus

Expt. No.	Topics	No. of Practicals
1	Media preparation and sterilization of laboratory scale fermenter	**1**
2	Sterility Testing of pharmaceuticals (non-biocidal injectables)	**1**
3	Minimum inhibitory concentration and minimum bactericidal concentration of antibacterial compounds (MIC and MBC)	**2**
4	Antibiotic and growth factor assay (agar gel diffusion technique)	**2**
5	Isolation and identification of *Xanthomonas* spp. from citrus canker	**1**
6	Isolation of *Aspergillus niger* from black rot of onion	**1**
7	Collection of plant disease specimens and study of symptoms/ Project based on digital record of plant diseases (Group Activity)	**1**
8	Isolation of PGPR with phosphate solubilisation potential	**1**
9	Validation of commercial formulations of bioinoculants based on BIS standards,	**1**
10	Pot studies to check effect of bioinoculants on plant growth	**1**
	TOTAL	**12**

References:

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2. USA Clinical Laboratory Standards Institute(CLSI) Guidelines 2021 on https://clsi.org/

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Skilled Base Elective MB 3510 Marine Microbiology

2 Credit Course: 1.5 credit

theory+0.5 credit Practical

Course/ Paper Title	Marine Microbiology
Course Code	21SBMB3510
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To train students in the field of Marine Microbiology
2.	To acquire advances in the knowledge of marine microbes and marine ecology
3.	To comprehend the role of marine microbes in bioremediation
4.	To comprehend the role of marine microbes in bioprospecting.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	The awareness of unseen and unexplored niche of marine ecosystem of microbes will be created in students
2.	Students will acquire advances in the knowledge of marine microbes and marine ecology.
3.	This course will help students to get new career opportunities in Marine Microbiology field.

Syllabus

Unit No	Title with Contents	No. of Lectures
1.5 Credit	**Theory Total Lectures: 21**	**21**
1	**1. Marine ecology and sampling** a. Marine Habitats – estuaries, mangroves, coral reefs, salt marshes, coastal ecosystems, deep sea, hydrothermal vents, Polar habitat – Arctic, Antarctica, Southern Ocean b. Physiology of marine microorganisms – metabolic diversity, marine loop, marine snow(Composition and formation), Role of marine microorganisms in biogeochemical cycles c. Sampling methods– water sampling (Niskin sampler) and sediment sampling (Types of Grab sampler and core), Culturing methods of marine microorganisms – VBNC, biofilm, mats from vents and estuarine sample.	3 4 4
2	**2. Marine microbes, role in bioremediation and bioprospecting** a. Extremophilic microorganisms – econiches, different types with examples and significance b. Archaea –biodiversity, stress response, adaptation and significance c. Marine mycology – econiche, types of marine fungi and significance d. Bioremediation – Role of marine microorganisms in bioremediation of heavy metals, hydrocarbon pollutants – tar ball and oil spills	 2 3 2 3
0.5 Credit	**Skilled Based Elective 21SBMB 3510:** **Marine Microbiology Practical** **Total Lectures: 15 Practical 03 x 05 lectures=15 lectures**	
1	Physico-chemical analysis of sea water	01
2	Isolation of marine bacteria/ fungi from different econiches coastal waters/ sediments	01
3	Isolation of extremophilic bacteria – halophiles, thermophiles, acidophiles, alkalophiles, psychrophiles, osmophiles (any two of these)	01

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Dairy Microbiology
Course Code	21SBMB3511
Semester	V
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand prospects of dairying at commercial marketing.
2.	To acquire skills of processing of milk and dairy products
3.	To assess quality control in dairy industry.
4.	To comprehend production of dairy products of commercial significance with emphasis to local and global market demand.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will understand prospects of dairying at commercial marketing.
2.	Students will acquire skills of processing of milk and dairy products.
3.	Students will be able to assess quality control in dairy industry.
4.	Students will be able to comprehend production of dairy products of commercial significance with emphasis to local and global market demand.

Syllabus

Skilled Based Elective MB 3511 Dairy Microbiology Theory Total Lectures: 21

Unit No	Title with Contents	No. of Lectures
Credit 1.5	**1.Definition, types, microflora and pathogens:** i. Definition of milk, Composition and physicochemical properties of Milk of different animals. Difference between colostrum and milk. ii. Types of milk: whole, toned, double toned, homogenized, and skimmed milk, dehydrated milk iii. Microflora associated with milk and its importance. iv. Sources of contamination of raw milk and relative importance in influencing quality of milk during production, collection, transportation, and storage, milk borne diseases.	**8**
	2.Processing Techniques and naturally occurring preservatives i. Bacteriological aspects of processing techniques like bactofugation,thermisation, pasteurization (in detail process is expected), sterilization and boiling. ii. Naturally occurring preservative systems in milk like LP system, immunoglobulins, Lysozyme, Lactoferrin etc.	4
	3.Spoilage of Milk i. Spoilage of Milk ii. Succession of microorganisms in milk leading to spoilage iii. Stormy fermentation, ropiness, sweet curdling iv. Colour and flavour defects v. Preservation of Milk and Milk products by physical (irradiation) and Chemical agents, food grade bio preservatives (GRAS), Bacteriocins of LAB	5
	4.Microbiological aspects of quality control and quality assurance in production of milk and milk products. i. Good Manufacturing Practices, ii. Sanitary standard operating procedures, iii. Total quality management and application of HACCP program in dairy industry. iv. Safety concern of biofilm formation on equipment surfaces and	4

	their control measures	

Skilled Based Elective MB 3511
Dairy Microbiology Practical

Total Lectures: 15 Total Practical 05 x 05 lectures=15 Lectures

Unit No	Title with Contents	No. of Practicals
Credit 0.5	**1. Microbiological analysis of milk:** Enumeration of bacteria. (Standard Plate Count (SPC) and Direct Microscopic Count) – raw milk and pasteurized milk	**1**
	2. Microbiological quality control tests for milk: i. Dye reduction tests (MBRT) ii. Mastitis test iii. Phosphatase test	1
	3. Microbiological quality of indigenous dairy products: i. Khoa ii. Kulfi iii. Shrikhand iv. Paneer v. Curd/ Buttermilk	1

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T.Y.B.Sc. Microbiology

To be implemented from Academic Year 2023-24

(CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Medical Microbiology II
Course Code	21SBMB361
Semester	**VI**
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	Gain Knowledge principles of chemotherapy of microbial diseases and development of drug resistance among pathogens and strategies to mitigate.
2.	To Acquire knowledge of principles underlying establishment of fungal and viral pathogens in human body.
3.	Students will acquire basic knowledge of commonly occurring fungal and viral diseases with respect to their epidemiology, prevention, and treatment.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be introduced to the basic principles of chemotherapy and drug resistance.
2.	Students will study the mode of action of different classes of antibiotics and their use in treatment of diseases.

3.	Students will acquire basic knowledge of commonly occurring fungal and viral diseases with respect to their epidemiology, prevention, and treatment.

Syllabus

Sr. No.	Topic	No. of Lectures
Credit 1	**Chemotherapy**	**18**
	1. Routes of drug administration.	1
	2. Mode of action of antimicrobial agents on:	
	a. Bacteria:	
	i. Cell wall: Beta lactams:1st to 6th Generation- e.g. Meropenem, Imipenem, Piperacillin, Tazobactam	2
	ii. Cell membrane: Polymyxin	1
	iii. Protein synthesis: Streptomycin, Tetracycline	1
	iv. Nucleic acids: Fluroquinolones, Rifamycin	1
	v. Enzyme inhibitors: Trimethoprim, Sulfamethoxazole	1
	b. Fungi: Griseofulvin, Amphotericin B, Anidulafungin, Voriconazole	2
	c. Viruses: Acyclovir, Oseltamivir, Remdesivir	2
	d. Protozoa: Metronidazole, Chloroquine	1
	3. Mechanisms of drug resistance on:	
	a. Genetic basis:	3
	i. Mutations in gene(s)	
	ii. Acquisition of foreign DNA coding for resistance determinants through horizontal gene transfer.	
	b. Mechanisms of drug resistance by:	3
	i. Limiting uptake of a drug.	
	ii. Modification of a drug target.	
	iii. Inactivation of a drug.	
	iv. Active efflux of a drug.	
Credit 2	**Human and Animal Viruses and Fungal Pathogens**	**18**

	Introduction to cultivation of viruses	2
	Study of following groups of viral pathogens:	
	a. Human viruses (with respect to – Virion, Characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis including serological diagnosis, Epidemiology, Prophylaxis and Chemotherapy):	
	i. Respiratory Viruses: Influenza Virus, Corona Virus	2
	ii. Haemorrhagic Virus: Dengue	2
	iii. Hepatic Virus: Hepatitis A Virus	1
	iv. Gastrointestinal Virus: Rotavirus	1
	v. Cutaneous Viruses: Human papillomavirus	1
	vi. Neurological Viruses: Japanese Encephalitis Virus	1
	b. Animal Viruses: FMD Virus and Rinderpest Virus	2
	Study of following groups of yeast and fungal pathogens (With respect to – Morphological and cultural characteristics, Classification, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Prophylaxis and Chemotherapy)	
	a. *Aspergillus* species (Pathogenic)	1
	b. Cryptococcus neoformans	1
	c. Histoplasma capsulatum	1
	d. Candida	1
	e. Dermatophytoses	2

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2. https://Microbenotes.Com/Remdesivir/#Mechanism-Of-Action-Of-Remdesivir
3. Aspergillus https://www.cdc.gov/fungal/diseases/aspergillosis/index.html
4. Histoplasma capsulatum https://www.cdc.gov/fungal/diseases/histoplasmosis/
5. Cryptococcus neoformans www.cdc.gov/fungal/diseases/cryptococcosis-neoformans/

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T.Y.B.Sc. Microbiology

To be implemented from Academic Year 2023-24

(CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Immunology- II
Course Code	21SBMB362
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To Acquire knowledge about antigens, Recognition of pathogens; antigen processing and presentation; Immunity to infection.
2.	To Understand abnormal working of Immune system in hypersensitivity,
3.	To know about Autoimmunity and immune tolerance
4.	To acquaint with auto immune diseases and immunopathology

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the concepts of antigens, Recognition of pathogens; antigen processing and presentation; Immunity to infection
2.	Students will understand abnormal working of Immune system in hypersensitivity
3.	Students will become aware about Autoimmunity, Auto-immune diseases and immune tolerance

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	**Cytokines, Adaptive / Acquired Immunity**	**18**
1.	**Cytokines:**	
	Concept-Cytokines, lymphokines, monokines, interleukins, chemokines, interferons and tumor necrosis factor	**1**
	Properties, Attributes and biological functions of cytokines	**2**
2.	**2. Adaptive / Acquired Immunity (Third line of defense):**	
	A. Humoral Immune Response	
	i. Primary and secondary response kinetics, significance in vaccination programs	**2**
	ii. Role of cytokines in activation and differentiation of B-cells	**1**
	B. Cell Mediated Immune Response	
	Activation and differentiation of T cells, role of cytokines in activation	**2**
	Antigen processing and presentation (Major Histocompatibility class I and class II restriction pathways), cell-cell interactions and adhesion molecules, response to super-antigens	**5**
	Mechanism of Cytotoxic T lymphocytes (CTL) mediated cytotoxicity, Antibody- dependent cellular cytotoxicity (ADCC)	**3**
	Significance of Cell Mediated Immune Response (CMI)	
	Immune response against tumors and foreign transplanted cells	**1**
Credit II	**Hypersensitivity, Autoimmunity, Autoimmune diseases**	**18**
1.	**Hypersensitivity**	
	General principles of different types of hypersensitivity reactions	**1**
	Gell and Coomb's classification of hypersensitivity – mechanism with examples for type I (Immediate), II, III and IV (delayed)	**6**
2.	**Autoimmunity and Autoimmune diseases:**	
	Immunological tolerance – Central and peripheral tolerance	**2**
	Types of autoimmune diseases	**1**

	Factors contributing development of autoimmune diseases	**1**
	Immunopathological mechanisms, Diagnosis and treatment of autoimmune diseases: Myasthenia gravis and Rheumatoid arthritis	**6**
	Therapeutic immunosuppression for autoimmunity	**1**

References: MB 362- Immunology-II

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T.Y.B. Sc Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Metabolism
Course Code	21SBMB363
Semester	**VI**
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To learn mechanisms of transport of solutes across the membrane.
2.	To get acquainted with mechanism of biosynthesis and degradation of Biomolecules.
3.	To comprehend basic concept of Bacterial photosynthesis

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the different mechanisms of transport of solutes across the membrane.
2.	Students will learn mechanism of biosynthesis and degradation of biomolecules.
3.	Students will understand basic concept of Bacterial photosynthesis.

Syllabus

Sr.No.	Topic	No. of Lectures
Credit I	**Membrane transport and Bioenergetics**	**18**
1	**Membrane transport mechanisms:** i. Passive transport - Diffusion, Osmosis, Facilitated transport ii. Active transport - Active transport systems in bacteria iii. Group translocation of sugars in bacteria iv. Ionophores: Mechanism and examples	06
2	**Bioenergetics:** i. Laws of thermodynamics- first and second law ii. Concepts of free energy, entropy, high energy compounds: Pyrophosphate, enolic phosphates, acyl phosphates, thioester compounds, and guanidinium compounds iii. Mitochondrial electron transport chain: components, arrangement of different components in the inner membrane, structure and function of ATP synthatase, inhibitors and uncouplers of ETC and oxidative phosphorylation, energetics of mitochondrial electron transport chain	 01 04 07
Credit II	**Metabolic pathways and Bacterial Photosynthesis**	**18**
1	**Biosynthesis and Degradation:** a. Chemistry, concept of polymerization of macromolecules: Polysaccharides. (Starch, and peptidoglycan) and Lipids (Fatty acids, triglycerides and phospholipids) b. Degradation of macromolecules – Polysaccharides (starch), Lipids (fatty acids oxidation e.g. β oxidation), Proteins (urea cycle)	 06 06
2	**Bacterial Photosynthesis:** i. Examples of photosynthetic bacteria ii. Photosynthetic apparatus iii. Oxygenic and Anoxygenic mechanisms iv. Calvin cycle and its regulation	06

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Bacterial Genetics and Molecular Biology
Course Code	21SBMB364
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To get introduced to concept of recombination and bacteriophage Genetics
2.	To demonstrate the knowledge of common and advanced laboratory practices in Molecular Biology
3.	To exhibit a knowledge base in Genetics and Molecular Biology.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	To exhibit a knowledge base in Genetics and Molecular Biology
2.	To understand the concept of cloning in bacteria
3.	To construct genetic map of bacteria and fungi by mapping techniques
4.	To get introduced to concept of recombination and bacteriophage Genetics
5.	To demonstrate the knowledge of common and advanced laboratory practices in Molecular Biology

Syllabus

Unit No	Title with Contents	No. of Lectures
Credit I	**Genetic Recombination and Bacteriophage Genetics.**	**18**
	1.Gene linkage and crossing over a.Mendel'slaws b.Eukaryotic Cell cycle, Mitosis, Meiosis c.Genetic mapping by Tetrad analysis in *N.crassa* (Numerical d.Calculations using PD, TT and NPD) e.Genetic Mapping by Parasexual cycle in *A. nidulans*	08
	2.Bacteriophage Genetics a. Concept of Virulent and temperate phages, Lytic and lysogenic cycles (T-series / Lamda phages) b. Concept and formation of a plaque, Plaque assay and concept of one step growth curve. c.Bacteriophage mutants: Plaque morphology (r type), Hostrange and Conditional lethal mutants (Ts and Am) d.Concept of Genetic Complementation and Cis-trans test of genetic function.(Intergenic- rII locus of T4 phage, Mechanism of Intragenic complementation.) e.Latest applications of Bacteriophages.	10
Credit II	**DNA repair mechanisms and RDT**	**18**
	3.DNA damage and Repair mechanisms a. DNA damage by hydrolysis, deamination, alkylation, oxidation and Radiation (X rays and UV rays) b. DNA repair by Photo reactivation c. DNA repair by Mismatch repair mechanism d. DNA repair by Excision repair mechanisms (BER/NER)	04

	4.Recombinant DNA Technology-Tool sand basics of recombinant DNA technology a. Introduction to recombinant DNA technology-Concept, Principle and Applications. b.Restriction enzymes: Concept, Nomenclature, properties and types with specific examples (Eco R1, SmaI, PstI). c.Vectors: Features of an ideal vector i.Plasmids:pBR322 ii.Bacteriophage vectors: Lambda iii.Cosmids iv.High capacity vectors: YACs, BACs Concept of Expression vectors d.Joining of DNA molecules- DNA Ligases (*E. coli* and T4 phage), Use of Linker / Adaptor / Homopolymer tailing e. Methods to transfer recombinant DNA into bacterial host cells (Physical – Electroporation, Gene gun, Chemical –$CaCl_2$ mediated, liposome mediated) f.Methods of screening recombinants using selectable markers and Blue-White screening	10
	5.Molecular techniques used in RDT- Principle, applications and methodology a. Isolation and purification of genomic DNA. b.Agarose gel electrophoresis c.Southern, Northern and Western blotting. d.PCR	4

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T.Y.B.Sc. Microbiology

To be implemented from Academic Year 2023-24

(CBCS – Autonomy 21 Pattern)

Course/ Paper Title	**Fermentation Technology– II**
Course Code	21SBMB365
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	**Objectives**
1.	To impart technical understanding of commercial fermentations.
2.	To apply classical, advanced strain improvement and isolation techniques for fermentation processes.
3.	To acquaint fermentation economics, process patentability, process validation.
4.	To comprehend the large-scale productions of commercially significant fermentation products of classical and recent significance.

Expected Course Specific Learning Outcome

Sr. No.	**Learning Outcome**
1.	Students will be acquainted with the concepts of Solid state and Submerged state fermentations and large-scale fermentations
2.	Students will become aware about the Fermentation of Large-scale production of enzymes, steroids, biomass-based products, milk products, vaccines, immune sera

Syllabus

Unit No.	Title with Contents	No. of Lectures
Credit I	**Solid state and Submerged state fermentations and large scale fermentations**	**18**
1.	**Introduction to Solid State Fermentation and Submerged Fermentation:** Process, production strains, media, fermenter design, fermentation conditions, applications, merits and demerits	**1**
2.	**Large scale production of (process with flow sheet, nature of the product, production pathway, applications, production strains, media, fermentation process, parameters, product recovery)** **a. Primary Metabolites:** i. Vitamins (B12 and B2) ii. Amino acids - Glutamic acid, Lysine iii. Organic acids (Citric acid, Vinegar) **b. Secondary metabolites:** i. Bioethanol Alcoholic Beverages - Beer (Lagering, Maturation, Types of beer) Wine (Aging, Malo-lactic acid fermentation, types of wine, wine defects, comparison of white and red wine) Antibiotics [Penicillin (natural and semi synthetic) and Streptomycin]	 **3** **3** **4** **1** **3** **3**
Credit II	**Large scale production of enzymes, steroids, biomass-based products, milk products, vaccines, immune sera and Modern trends in microbial production**	**18**
1.	**Enzymes** Amylase Esterases Proteases	 **2** **2** **2**

2.	**Microbial transformation of steroids**	**2**
3.	**Biomass based products:** i. Yeast: Baker's and Distiller's yeast ii Probiotics: Lactobacillus sporogenes	 **2** **2**
4.	**Milk products:** Cheese (Processed, soft, semi-hard, hard ripened types- bacterial and mold)	 **2**
5.	**Vaccines:** Tetanus – Tetanus toxoid (TT) Rabies – HDCC, Chick embryo cell line, Vero cell line as per Serum Institute	 **1** **1**
6.	**Immune sera:** Anti-tetanus serum (ATS) Anti-rabies serum (ARS)	 **1** **1**

References: MB 365 Fermentation Technology- II

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Large scale production of tetanus vaccine:

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T.Y.B. Sc. Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Food Microbiology
Course Code	21SBMB366
Semester	**VI**
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To Identify and classify types of microorganisms in food processing and compare their Characteristics and behavior
2.	To learn food classification based on their perishability, intrinsic and extrinsic factors affecting the growth of microbes in foods, role of microorganisms in food fermentation.
3.	To acquire knowledge about food spoilage, food borne diseases, predisposition and preventive and control measures

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will be acquainted with the different types of microorganisms in food processing with respect to their classification and role.
2.	Students will learn classification of foods and different parameters affecting food spoilage.
3.	Students will understand the importance of food borne diseases and their control measures.

Syllabus

Sr.No.	Topic	No. of Lectures
Credit I	**Introduction to properties of food and spoilage of food**	**18**
1	Classification of food- Perishable, non-perishable, and stable	1
	i. Definition of food	1
	ii.Sensory or organoleptic factors- appearance factors- size, shape, color, gloss, consistency, wholeness	1
	iii. Textural factors-texture changes	1
	iv. Flavor factors (taste, smell, mouthfeel, temperature)	1
2	Factors affecting Microbial growth in food	
	i. Intrinsic factors- pH, water activity, O-R potential, nutrient content, biological structure of food, inhibitory substances in food. ii.Extrinsic factors-Temperature of storage, Relative humidity, concentration of gases	6
	i. Sources of food spoilage microorganisms ii. Contamination and spoilage of perishable foods- a. Vegetables and fruits b. Meat and meat products c. sea foods d. Egg and poultry products. e. spoilage of canned foods	1 7
Credit II	**Food Preservation and food in relation to disease**	**18**
1	Principles of food preservation a. Importance of TDP, TDT, D, F, Z values b. Use of low and high temperature for food preservation. c. Use of chemicals and antibiotics in food preservation, d. Canning e. Dehydration f. Use of radiation g. Tetra pack technology	10

	h. Food grade bio preservatives	
2	Microbial food poisoning and food infection a. Food poisoning -*Clostridium botulinum, Aspergillus flavus* b. Food infection-*Salmonella* typhimurium, *Vibrio parahaemolyticus*	4
3	Concept of Prebiotic and Probiotic and fermented food- a. Definition, Health effects, Quality assurance, Safety, side effects and risk. b. Potential applications of Prebiotic, Probiotic and fermented food	4

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2023-24 (CBCS – Autonomy 21 Pattern)

Semester VI Practical Course-I

DSEC-MB – 367: Diagnostic Microbiology and Immunology

[2 Credits; 78 Lectures] [1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures] 78 L distributed as 60 L for performing practicals and 18 L for internal evaluation 12 Practicals x 5 lectures = 60 Lectures

Course/ Paper Title	**Diagnostic Microbiology and Immunology**
Course Code	21SBMB367
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	**Objectives**
1.	To study the commonly occurring parasitic pathogens
2.	To make students understand Isolation and identification of fungal pathogens from Clinical samples
3.	To make them understand importance of multi drug resistance and antibiotic sensitivity
4.	To make them understand Immunohematology techniques like Cross-matching
5	To train the students in Immuno chromatography
6	To train the students in Immunology techniques like Immunoprecipitation
7	To make them understand the application of Demonstrations of: a. Serum protein separation by electrophoresis

	ELISA (Antigen/ Antibody detection)
8	**Visit** to Immunological and immune-hematological Laboratory and preparation of visit report

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn about the commonly occurring parasitic pathogens
2.	Students will learn Isolation and identification of fungal pathogens from Clinical samples
3.	Students will learn Immunology techniques like Agglutination tests
4.	Students will understand the importance of White blood cell differential count from peripheral blood in immunology

Sr.No.	Practical	No. of Practicals
Clinical microbiology (5 practical)		
1	Study of permanent slides of following microbial pathogens: a. *Entamoeba histolytica* b. *Giardia* c. *Plasmodium spp.* d. *d. Dermatophytes*	1
2	Isolation and identification of following yeast and fungal pathogens:*Candida albicans* Slide Culture Technique	1 1
3	Antibiotic sensitivity testing of the bacterial pathogens (for Gram negative and Gram Positive pathogens)	1
4	Demonstration of Bacterial identification by Vitek System	1
Immunology (7 Practicals)		
4	**Immunohematology:** Cross-matching (Major and Minor) and Coomb's test (Direct and Indirect)	2

5	**Immunochromatographic test:** a.The qualitative differential detection of IgM and IgG antibodies to dengue virus in Human serum /Plasma b. Qualitative detection of Rheumatoid factor (RA factor)	2
6	**Immunoprecipitation:** Double diffusion (Ouchterlony) technique	1
7	**Demonstrations of:** b. Serum protein separation by electrophoresis c. ELISA (Antigen/ Antibody detection)	1
8	**Visit** to Immunological and immune-haematological Laboratory and preparation of visit report	1
	TOTAL	**12**

References: MB 367: Diagnostic Microbiology and Immunology

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T.Y.B.Sc. Microbiology
2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Practical: Practicals based on Metabolism, Genetics and Molecular Biology
Course Code	21SBMB368
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To make students aware about the clinical aspects of biochemistry.
2.	To make students aware about concept and preparation of buffers, qualitative and quantitative biochemical techniques.
3.	To make them understand basic concept of genomic DNA isolation and its detection.
4.	To introduce basic techniques in phage biology.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn the estimation of anlysts from clinical samples by biochemical techniques.
2.	Students will learn basic concept, calculations and preparation of buffers along with qualitative and quantitative biochemical techniques.
3.	Students will be acquainted with concept, principle and methodology of genomic DNA isolation and its detection using agarose gel electrophoresis.
4.	Students will understand isolation and enumeration of bacteriophages from natural sources.

Syllabus

Expt. No.	Topics	No. of Practicals
1	Clinical Biochemistry - Estimations of i) Blood sugar ii) Blood urea iii) Serum cholesterol iv) Serum proteins	4
2	Preparation of buffers	1
3	Estimation of total carbohydrates from natural sources by Phenol Sulphuric acid method.	1
4	Spot tests for Proteins	1
5	Spot tests for Carbohydrates	1
6	Isolation and Enumeration of Bacteriophages (Principle , Methodology and Calculations of phage titer in PFU's/ml)	2
7	Isolation of Genomic DNA from bacteria and Agarose Gel Electrophoresis for DNA detection. (Demonstration)	2
	TOTAL	**12**

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2023-24 (CBCS – Autonomy 21 Pattern)

Course/ Paper Title	Practical: Based on Industrial and Food Microbiology
Course Code	21SBMB369
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr.No.	Objectives
1.	To make students aware about laboratory scale production of ethanol
2.	To make them understand about alcohol and sugar tolerance for yeast
3.	To introduce concept of probiotic micro flora
4.	To make them learn importance of microorganisms in food spoilage and use of heat in controlling microbial growth

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will learn about production of ethanol at laboratory scale
2.	Students will learn to isolate probiotic micro flora and food spoilage causing organisms
3.	Students will be acquainted with significance of high temperature in controlling food spoilage
4.	Students will understand HACCP guidelines and importance of sanitary status of eatery

Syllabus

Expt. No.	Topics	No. of Practicals
1	Laboratory Scale production of the fermentation products: a. Ethanol (fermentation, recovery by simple distillation, estimation of end product by CAN method and fermentation efficiency)	**2**
2	Study of alcohol and sugar tolerance for yeast	**1**
3	Production and detection of amylase by shake flask or solid substrate cultivation / Bread making	**1**
4	Isolation and identification of probiotic micro flora from natural sources or any commercial formulation.	**2**
5	Isolation of microorganisms causing spoilage of vegetables/fruits/bread/sweets	**1**
6	Determination of TDP value	**1**
7	Determination of TDT value	**1**
8	Determination of D value	**1**
9	HACCP guidelines for food industry (activity based)	**1**
10	Evaluation and validation of sanitary status of an eatery i. Examination of micro flora from table surface ii. Utensils	**1**
	TOTAL	**12**

References:

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T.Y.B.Sc. Microbiology

2023-24 (CBCS – Autonomy 21

Pattern)

Skilled Base Elective MB 3610 Waste Management

2 Credit Course: 1.5 credit theory+0.5

credit Practical

Course/ Paper Title	Waste Management
Course Code	21SBMB3610
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand waste management and it practicable applicability.
2.	To assess the magnitude and influence of hazardous content of waste, pollution of water and waste water treatment technologies
3.	To impart the understanding of kinetics of biological systems used in waste treatment
4.	To learn the standards of waste management and competent authorities involved at National and international level.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	The awareness of waste management and it practicable applicability will be created in students

2.	Students will acquire knowledge of magnitude and influence of hazardous content of waste, pollution of water and waste water treatment technologies
3.	This course will help students to understand kinetics of biological systems used in waste treatment
4.	Students will learn the standards of waste management and competent authorities involved at National and international level.

Syllabus

Unit No	Title with Contents	No. of Lectures
1.5 Credit	**Theory Total Lectures: 21**	**21**
1	**A. Liquid Waste Management** **1. Principles of Wastewater Treatment** i. The need for treatment of wastewater ii. General characteristics of liquid waste - pH, Colour Turbidity, Odor, Electrical conductivity, COD, BOD, Total Solids, Total Dissolved Solids, Total Suspended Solids, Total Volatile Solids, Chlorides, Sulphates, Oil and Grease. **2. Microbiology of Wastewater** Role of microorganisms in wastewater treatment i. Aerobic and Anaerobic digestion models; attached / anchored and suspended growth. ii. Removal of pathogenic microbes, indicator microbes, enumeration of different types of microbes **3. Unit operations in wastewater treatment plant** i. Collection system - Methods of collection, conservancy systems, water carriage system, sewerage system. ii. Screen chamber, Grit chamber, Oil and grease removal iii. Stabilization pond, Aerated lagoon	4 4 4

	iv. Activated sludge process, Trickling filter v. Rotating biological contactors, anaerobic digestion processes, fluidized bed reactor.	
2	**B. Solid Waste Management and hazardous waste** **1.** Characterization of solid wastes: Dairy and e-waste **2.** Biomedical waste: Definition, Types, Processing **3.** Solid biodegradable waste processing: Composting, Vermicomposting, Biogas production **4.** Post-processing by-products of municipal solid waste treatment: leachate refused-derived fuel (RDF)	 2 2 2 3
0.5 Credit	**Skilled Based Elective MB 3610 Waste Management Practical** **Total Lectures: 15 Practical 03 x 05 lectures=15 lectures**	
1	**1.** Determination of Solids in wastewater: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids	1
2	**2.** Determination of Dissolved Oxygen, BOD and COD of waste water (before and after treatment) (MPCB Standards)	1
3	**3.** Preparation of Project report based on a case study (Hotel/ Industry-Dairy,Food processing) Study of the source, generation rates and characteristics of hazardous wastes and their regulation, handling, treatment, and disposal. Special emphasis is placed on process design of waste handling, treatment and disposal systems.	1

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NAAC accredited 'A' Grade

T.Y.B. Sc Microbiology

2023-24 (CBCS – Autonomy 21 Pattern)

Semester VI

Skilled Base Elective MB 3611 Nano-biotechnology

2 Credit Course: 1.5 credit theory+0.5 credit Practical

Theory-21 L; Practical-15L

Course/ Paper Title	Nanobiotechnology
Course Code	21SBMB3611
Semester	VI
No. of Credits	2

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To study fundamentals of nanobiotechnology
2.	To train students in biogenic synthesis and characterization of Nanoparticles.
3.	To obtain understanding of various biomedical applications of nanoparticles and nanomaterials.
4.	To understand design, development and application of Nanomaterials

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will get complete understanding of basic concepts in Nanobiotechnology

2.	Students will get theoretical knowledge about design, development and application of Nanoparticles and Nanomaterials.
3.	Students will get practical training inbiogenic synthesis and characterization of Nanoparticles. These skills will help them to apply for job opportunities in Nanobiotechnology field

Syllabus

Sr.No.	**Topic**	**No. of Lectures**
1.5 Credit I		**21**
1	**1. Introduction to Nano-biotechnology:** a. Introduction to nanoscale, nanomaterials, nanoscience and nanotechnology b. Nanoscalebioassemblies -Liposomes, viruses, DNA, polysaccharides and proteins (Proteinnanotubes, nanofibers, peptide nanoparticles). c. Biomedical applications of bioassemblies - Cell targeting, drug delivery, bioimaging and vaccine development. **2. Microbial mediated metallic nanoparticles synthesis:** a. Gold nanoparticles (AuNPs) b. Silver nanoparticles (AgNPs) c. Au-Ag alloy nanoparticles d. Oxide nanoparticles e. Magnetic nanoparticles f. Non-magnetic oxide nanoparticles g. Sulfide nanoparticles etc. **3. Characterization techniques for nanomaterials:** UV-visual spectroscopy, Fourier transform infrared (FTIR), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Scanning	6 5 6

	electron microscopy (SEM), Transmission electron microscopy (TEM) and dynamic light scattering (DLS). **4. Applications of nanoparticles:** Antibacterial agent, drug delivery, biosensor, animal industry and nanotechnology in wastewater treatment	4
0.5 Credit	**Skilled Based Elective 21SBMB 3611 Nano-biotechnology:** **Total Lectures: 15 Practical 03 x 05 lectures=15 lectures**	**15**
1	**1.** Microbial synthesis of metallic nanoparticle synthesis (any two)	1
2	**2.** Detection and Characterization of metallic nanoparticles in colloidal solutions by: a. UV-Spectrophotometer b. FTIR analysis	1
3	**3.** Application of nanoparticles- checking antimicrobial activities against the microbial synthesized metallic nanoparticles (any two)	1

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