

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY
THIRD YEAR B.Sc. (MICROBIOLOGY)
SEMESTER - V

SYLLABUS FOR T. Y. B. Sc.
Academic Year 2018-2019

**Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE 411004
Scheme of Course Structure (Faculty of Science)**

2018-2019

T. Y. B. Sc. - Microbiology

Semester	Course Code	Title	Paper No.	Credits	Exam (I + E)	Marks (50 + 50)	
V	MIC3501	Medical Microbiology	I	3	I + E	50+50	
	MIC3502	DNA Functioning & Transfer	II	3	I + E	50+50	
	MIC3503	Enzymology	III	3	I + E	50+50	
	MIC3504	Fundamentals of Immunology	IV	3	I + E	50+50	
	MIC3505	Principles of Fermentation Technology OR	V	3	I + E	50+50	
	MIC3506	Basic Waste Water Treatment		3	I + E	50+50	
	MIC3507	Agricultural Microbiology & Bionanotechnology OR	VI	3	I + E	50+50	
	MIC3508	Instrumentation in Biology		3	I + E	50+50	
	MIC3511	Microbiology Practical I	Practical - I	2	I + E	50+50	
	MIC3512	Microbiology Practical II	Practical - II	2	I + E	50+50	
	MIC3513	Microbiology Practical III	Practical - III	2	I + E	50+50	
	VI	MIC3601	Metabolic Activities of Microorganisms	I	3	I + E	50+50
		MIC3602	Immunological Processes	II	3	I + E	50+50
MIC3603		Large Scale Bioprocesses	III	3	I + E	50+50	
MIC3604		Food & Dairy Microbiology	IV	3	I + E	50+50	
MIC3605		Antimicrobial Therapy & Prevention OR	V	3	I + E	50+50	
MIC3606		Immunohaematology & Diagnostics		3	I + E	50+50	
MIC3607		Recombination & Gene Manipulation OR	VI	3	I + E	50+50	
MIC3608		Genetic engineering & Biotechnology		3	I + E	50+50	
MIC3611		Microbiology Practical - IV	Practical - IV	2	I + E	50+50	
MIC3612		Microbiology Practical - V	Practical - V	2	I + E	50+50	
MIC3613		Microbiology Practical - VI	Practical - VI	2	I + E	50+50	

T. Y. B. Sc. (MICRIBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - I
TITLE: MEDICAL MICROBIOLOGY
PAPER CODE: MIC3501

[CREDITS - 3]

Learning Objectives:

1. To understand different human body systems with the defence mechanisms and infectious diseases.
2. To understand the stepwise process involved in infection
3. To understand the mechanisms of bacterial resistance to human defences
4. To understand the epidemiological principles related to diseases.

	Title and Contents	No. of Lectures
Unit - I	<p>Physiology and anatomy of human body systems, defence mechanisms and representative bacterial, fungal and viral infectious diseases of the systems</p> <p>a. Skin: <i>Pseudomonas</i>, <i>Staphylococcus</i></p> <p>b. Respiratory System: <i>Streptococcus pneumoniae</i>, <i>Mycobacterium tuberculosis</i>, Influenza virus,</p> <p>c. Gastrointestinal Tract: <i>Compylobacter</i>, Hepatitis virus, <i>Entamoeba histolytica</i></p> <p>d. Central Nervous System: <i>Clostridium tetani</i>, Polio virus, Rabies virus</p> <p>e. Urogenital System: <i>Leptospira</i>, <i>Treponemapallidum</i>, <i>Candida</i></p>	16
Unit - II	<p>Determinants of Pathogenicity</p> <p>A stepwise process in infection:</p> <p>a. Adhesion, Colonization and invasion of host tissues with detailed accounts of virulence factors of pathogenic organisms</p> <p>b. Evasion mechanisms of pathogenic organisms</p> <p>c. Mechanisms of bacterial resistance to host cellular and humoral defences</p> <p>d. Toxigenesis: Exotoxins, enterotoxins and endotoxins, role in pathogenicity</p>	16
Unit - III	<p>Epidemiological Principles</p> <p>a. Definition, scope and applications</p> <p>b. Incidence and prevalence rates, mortality and morbidity rates</p> <p>c. Disease distribution based on time, place and person</p> <p>d. Case control and cohort studies - study design and application</p> <p>e. Epidemiology of infectious diseases:</p> <p>i. Sources and reservoirs of infection</p> <p>ii. Modes of transmission of infections</p> <p>iii. Prevention and treatment measures</p>	16

References:

1. Tortora, G. J., Funke, B. R., Case, C. L, 1992. Microbiology: An Introduction, 5th edition, Benjamin Pub. Co. NY.
2. Roitt, P. I.: Mims, C. J. Medical Microbiology.
3. Virulence mechanisms of bacterial pathogens, 2nd edition by Roth, Bolin, Brogden

Minion and Michael.

4. Davis B. D., DeBacco, 1990. Microbiology 4th edition, J. B. Lippincott Co. NY.
5. Dey, N. C. and Dey, T. K. 1988, Medical Bacteriology, 17th Edition, Allied Agency, Calcutta.
6. Ananthnarayana, R. and C. E., Jayaram Panikar, 1996. Text book of Microbiology, 5th edition, Orient Longman.
7. Park and Park, Preventive and Social Medicine. 2013, Publisher: Banarsidas Bhanot, Jabalpur.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - II
TITLE: DNA FUNCTIONING & TRANSFER IN BACTERIA
PAPER CODE: MIC3502

[CREDITS - 3]

Learning Objectives:

1. Understand the detailed mechanism of DNA replication in bacteria
2. Understand how damage to DNA is repaired in bacteria
3. Learn the history and discovery of genetic code
4. Understand the detailed mechanism of gene expression in bacteria
5. Understand the modes of recombination in bacteria
6. Understand how the natural modes of genetic recombination found in bacteria can be used for gene mapping

	Title and Contents	No. of Lectures
Unit - I	DNA replication, damage and repair A. DNA Replication <ol style="list-style-type: none"> i. Single replicon ii. Bidirectional movement of replication fork, Ori C iii. Prepriming and priming reaction iv. DNA polymerases, DNA synthesis of leading and lagging strand v. Okazaki fragments vi. Termination - Ter sequence and Tus protein vii. Eukaryotic DNA replication, multiple replicons, eukaryotic DNA polymerases, ARS in yeast, origin recognition complex (ORC) viii. Regulation of replication 	8
	B. DNA damage and repair <ol style="list-style-type: none"> i. DNA damage by hydrolysis, deamination, alkylation, oxidation and radiation ii. Mismatch repair iii. Base excision repair iv. Nucleotide excision repair v. Photoreactivation vi. Translesion DNA synthesis vii. Transcription couple repair viii. SOS response 	8
Unit - II	Gene Expression A. Introduction to central dogma	2
	B. Transcription <ol style="list-style-type: none"> i. Structure of promoter ii. Structure and role of RNA polymerases iii. Initiation, elongation and termination iv. Concept of operon 	4

	v. Lac operon & Arabinose operon	
	C. Genetic Code: Historical approach, deciphering the genetic code, code alignment, characteristics of genetic code, altered code in mitochondria, codon usage	4
	D. Translation: i. Structure & role of mRNA, tRNA and ribosomes in translation ii. Activation of tRNA iii. Initiation, elongation, translocation and termination of translation	6
Unit - III	Gene Transfer A. Transformation i. Development of competence in Gram positive and Gram negative bacteria ii. Process of transformation in Gram positive and Gram negative bacteria iii. Factors affecting transformation iv. Mapping of chromosome by co-transformation	5
	B. Conjugation i. Properties of F plasmid ii. F ⁺ , F ⁻ , Hfr and F' strains iii. Process of conjugation between F ⁺ and F ⁻ and Hfr and F ⁻ iv. Interrupted mating experiment	6
	C. Transduction i. Process of generalized transduction ii. Process of specialized transduction iii. Mapping by co-transduction	5

References:

1. Stricberger, M. W., 1985 Genetics, 3rd edition Macmillan Pub. Co. NY.
2. Stanier, R. Y., 1985, General Microbiology, 4th edition and 5th edition, MacMillan Pub. Co. NY.
3. Hayes, William, 1984, The Genetics of Bacterial and their Viruses, CBS Pub., New Delhi.
4. Peter J. Russell, iGenetics: A Molecular Approach, 3rd edition, Pearson
5. Russel, Peter, Essential Genetics, 2nd edition, Blackwell Science Pub.
6. Lewin Benjamin, 1994, Genes II, VII and VIII, Oxford University Press.
7. Watson. J. D., Molecular Biology of Gene.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - III
TITLE: ENZYMOLOGY
PAPER CODE: MIC3503

[CREDITS - 3]

Learning Objectives:

1. Learn about the structure and functioning of the enzyme active site and to understand the requirements of cofactors of enzyme action
2. Understand the principles of enzyme quantification and purification along with the methodology and infrastructural requirements
3. Learn about the applications of immobilized enzymes
4. Understand kinetics of enzymes and its mathematical expression

	Title and Contents	No. of Lectures
Unit - I	<p>Structure of enzyme active site and factors affecting active site:</p> <p>A. Active Form of the enzyme:</p> <ol style="list-style-type: none"> i. Structure of enzyme ii. Microenvironment at the active site and its amino acid representation iii. Methods to determine active site structure: Physical, Chemical and Biological <p>B. Enzyme cofactors:</p> <ol style="list-style-type: none"> i. Structure and biochemical function ii. Cofactors required for redox reactions: NAD⁺ / NADP⁺ (Coenzyme), FAD / Lipoic acid (Prosthetic group) iii. Cofactors for anabolic pathways: Amino acid Biosynthesis (Pyridoxine cofactors), Nucleic acid Biosynthesis (Folic acid) iv. Cofactors for catabolic / Amphibolic pathways: Coenzyme A (TCA), Biotin (Carboxylation pathways) v. Fat soluble cofactors: Vitamins A, D, E and K vi. Metal cofactors <p>C. Requirement of Optimum Physical parameters: pH, Temperature and water activity</p>	16
Unit - II	<p>Methods / Techniques in Enzymology</p> <p>A. Enzyme Assays:</p> <ol style="list-style-type: none"> i. Sampling and Continuous assays ii. Examples of Enzyme assays based on the following: <ol style="list-style-type: none"> a. Spectrophotometric methods b. Spectrofluometric methods c. Radioisotopic methods d. Coupled Enzyme assays (Luminescence based assays) <p>B. Principles and methods of Enzyme purification:</p> <ol style="list-style-type: none"> i. Methods of cell fractionation: 	16

	<p>Physical, Chemical and Biological</p> <p>ii. Methods of Enzyme concentration: Ultrafiltration, Dialysis, Salt and solvent precipitation, Adsorption</p> <p>iii. Methods of Enzyme purification: Principle, Materials used and Applications:</p> <p>a. Based on differences in molecular size (Density Gradient centrifugation, Gel filtration)</p> <p>b. Based on differences in charged properties (Ion exchange Chromatography, Gel Electrophoresis)</p> <p>c. Based on differences in solubility (Salt and Solvent Fractionation, Isoelectric focusing and Isoelectric Precipitation)</p> <p>d. Based on differences in ligand affinity and selective adsorption (Ligand chromatography)</p> <p>e. Characterization of enzymes using Criteria of purity: SDS-PAGE, Ultracentrifugation, Gel filtration</p> <p>C. Immobilization of enzymes:</p> <p>i. Concept and comparison to whole cell immobilization</p> <p>ii. Methods of Enzyme immobilization</p> <p>iii. Applications of Immobilized enzymes in Industry</p>	
<p>Unit - III</p>	<p>Enzyme kinetics and regulation:</p> <p>A. Regulation of Enzyme activity:</p> <p>i. Enzyme compartmentation at Cellular level</p> <p>ii. Feedback Inhibition</p> <p>iii. Feedback Repression</p> <p>iv. Allosteric enzymes</p> <p>v. Isoenzymes</p> <p>vi. Covalently modified regulatory enzymes</p> <p>vii. Proteolytic activation of Zymogens</p> <p>viii. Multienzyme complexes and Metabolons</p> <p>B. Enzyme Kinetics:</p> <p>i. Concept of Initial velocity</p> <p>ii. Michaelis Menten Equation for the initial velocity of single substrate enzyme catalyzed reaction.</p> <p>iii. Briggs and Haldane modification of the Michaelis Menten Equation for the initial velocity of single substrate enzyme catalyzed reaction.</p> <p>iv. Michaelis Menten plot</p>	<p>16</p>

	<ul style="list-style-type: none"> v. Significance of kinetic constants vi. Plotting Kinetic data using transformations of MM plot <ul style="list-style-type: none"> a. Lineweaver Burke plot b. Hanes plot c. Eadie Hofstee plot d. Eisenthal Cornish Bowden plot vii. Concept, Types of enzyme inhibitions and Derivation of the Michaelis Menten Equation for the initial velocity of single substrate enzyme catalyzed reaction in the presence of the inhibitors. viii. LB plots and Secondary plots for Enzyme catalyzed reactions in the presence of Enzyme inhibitors 	
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References:

1. Nelson D. L. and Cox M. M. (2002). *Lehninger's Principles of Biochemistry*, Mac Millan Worth Pub. Co., New Delhi.
2. Segel Irvin H. (1997). *Biochemical Calculations*. 2nd edition, John Wiley and Sons, New York.
3. Garrett, R. H. and Grisham, C. M. (2004) *Biochemistry*. 3rd edition, Brooks / Cole, Publishing Company, California.
4. Conn Eric, Stumpf Paul K., Bruening George, Doi Roy H., (1987) *Outlines of Biochemistry* 5th edition, John Wiley and Sons, New Delhi.
5. Palmer Trevor (2001). *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*, Horwood Pub. Co., Chinchester, England.
6. White David (2000). *Physiology and Biochemistry of Prokaryotes*. 2nd edition. Oxford University Press, New York.
7. David A. Hall & Krishna Rao (1999). *Photosynthesis (Studies in Biology)* 6th edition, Cambridge University Press, London.

T. Y. B.Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - IV
TITLE: FUNDAMENTALS OF IMMUNOLOGY
PAPER CODE: MIC3504

[CREDITS - 3]

Learning Objectives:

1. To understand the defence mechanisms of human body
2. To understand the cells and organs involved in Immune System
3. To understand the types of Antigens

	Title and Contents	No. of Lectures
Unit - I	Introduction to Immunology	3
	a. ImmUnity definition and three lines of defence mechanisms.	4
	b. Hematopoiesis and its kinetics: Erythrocytic, myelocytic, monocytic and lymphocytic lineages and differentiation process, lymphocyte types and subsets on time line.	7
	c. Organs of immune system <ol style="list-style-type: none"> i. Primary lymphoid organs (Thymus and Bursa): Thymus - structure, thymic education (positive and negative selection). ii. Secondary lymphoid organs: Structure and function of spleen and lymph node, mucous associated lymphoid tissue; response of secondary lymphoid organs to antigen, lymphatic system and lymph circulation. 	2
	d. Concept of Humoral immune response and Cell mediated immune response.	8
Unit - II	Antigen and Immunoglobulins	8
	a. Antigen <ol style="list-style-type: none"> i. Concepts and factors affecting immunogenicity and basis for specificity ii. Antigenic determinants, haptens and cross-reactivity, Carriers iii. Adjuvant: conventional and novel iv. Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, Autoantigens and Isoantigens. 	8
	b. Immunoglobulin <ol style="list-style-type: none"> i. Structure of basic Unit, chemical and biological properties, Isotypes of immunoglobulins ii. Characteristic of domain structure, functions of light and heavy chain domains, Antigenic nature of immunoglobulin molecules iii. Molecular basis of antibody diversity (kappa chain, lambda chain and heavy chain diversity) iv. Monoclonal antibodies: Hybridoma technology and production of monoclonal antibodies. Applications of monoclonal antibodies. 	6
Unit - III	Antigen antibody interactions	6

	a. Principles of interactions: Antibody affinity and avidity, ratio of antigen antibody, lattice hypothesis and two stage theory, antigen-antibody reaction kinetics (dialysis equilibrium experiment)	
	b. Immunodiagnostic methods: Pros and Cons, sensitivity and specificity: i. Precipitation reactions: in fluid and in gel, Immunelectrophoresis ii. Agglutination reactions: hemagglutination, bacterial agglutination, passive agglutination and agglutination-inhibition iii. Immunofluorescence techniques: direct and indirect, FACS iv. ELISA, biotin-avidin system, ELISPOT assay	10

References:

1. Janeway Charles A., Paul Travers, Mark Walport, Mark Shlomchik. Immunobiology Interactive, 2005. Garland Science Publishing, USA.
2. Kindt T. J., Goldsby R. A., Osborne B. A., 2007, Kuby Immunology 6th edition, W. H. Freeman and Co., New York.
3. Pathak S. S. and Palan V. (1997). Immunology - Essential and Fundamental, Pareen Publications, Bombay.
4. Roitt Evan, Brostoff J. Male D. (1993). Immunology 6th edition, Mosby and Co., London.
5. Roitt I. M. (1988). Essentials of Immunology, ELBS, London.
6. Roitt M. (1984). Essentials of Immunology, P. G. Publishers Pvt. Ltd., New Delhi.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - V
TITLE: PRINCIPLES OF FERMENTATION TECHNOLOGY
PAPER CODE: MIC3505

[CREDITS -3]

Learning Objectives:

1. The types of fermentation process
2. The optimization of fermentation parameters
3. Downstream process of fermentation
4. The quality assurance tests.

	Title and Contents	No. of Lectures
Unit - I	A. Introduction to solid state fermentation and submerged fermentation B. Media optimization <ol style="list-style-type: none"> i. Classical Approach - one factor at a time ii. Full factorial design iii. Plackett Burman Design iv. Response surface methodology (RSM) C. Scale up and scale down <ol style="list-style-type: none"> i. Objective of scale up ii. Levels of fermentation (Laboratory, pilot plant and production levels) iii. Criteria of scale up for critical parameters (aeration, agitation, broth rheology and sterilization) iv. Scale down 	3 8 5
Unit - II	A. Principles and methods of downstream processing <ol style="list-style-type: none"> i. Concentration: Cell disruption, Filtration, Centrifugation ii. Purification: Liquid liquid extraction, distillation, Ion exchange chromatography, Drying iii. Formulation B. Contribution of various expense heads to a fermentation process (Recurring and non-recurring expenditure) citing any suitable example Quality Assurance of fermentation product	12 4
Unit - III	A. Detection and quantification of the product by physicochemical, biological and enzymatic methods. <ol style="list-style-type: none"> i. Sterility testing ii. Pyrogen testing - Endotoxin detection iii. Ames test and modified Ames test iv. Toxicity testing v. Shelf life determination B. Introduction to intellectual property rights	12 4

References:

1. Principles of fermentation technology: P. F. Stanbury A. Whittaker, Pregmon Press.
2. Casida L. E. (1984) Industrial Microbiology, Wiley Easterbs, New Delhi.
3. A. H. Patel. (1985) Industrial Microbiology, Macmillan India Ltd.
4. Indian Pharmacopeia Latest edition.
5. Reed G., Ed. Prescott and Dunn's Industrial Microbiology.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - V
TITLE: BASIC WASTE WATER TREATMENT
PAPER CODE: MIC3506

[CREDITS - 3]

Learning Objectives:

1. To learn characterization of waste.
2. To learn biological methods of waste treatment.
3. To learn recent methods of new treatment.
4. To learn effluent treatment in a specific industry.

	Title and Contents	No. of Lectures
Unit - I	Overview of the methods of effluent treatment i. Classification and characterization of waste ii. Principles and mechanisms of waste treatment iii. Biological methods of liquid waste treatment iv. Biological methods of solid waste management v. e waste management	16
Unit - II	Advanced methods of waste water treatment i. Rotating biological contactors ii. Membrane biological reactors iii. Moving bed bioreactor iv. SAFF	16
Unit - III	Effluent treatment processes in different industries. i. Dairy ii. Paper and pulp iii. Pharmaceutical iv. Textile	16

References:

1. Tehobanoglous G. and F. L. Burton (1991) Wastewater Engineering Treatment, Disposal and Reuse, 3rd edition.
2. Metcalf and Eddy (Eds.) Tata McGraw Hill Publishing Co. Ltd., New Delhi.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - VI
TITLE: AGRICULTURAL MICROBIOLOGY AND BIONANOTECHNOLOGY
PAPER CODE: MIC3507

[CREDITS - 3]

Learning Objectives:

1. To understand the important developments in soil and agricultural microbiology and its scope.
2. To become aware about the testing methods routinely used for testing soil, food and air quality.
3. To understand various applications of microbiology in nanotechnology.

	Title and Contents	No. of Lectures
Unit - I	Agriculture Microbiology A. Plant growth improvement with respect to i. Disease resistance ii. Environmental tolerance	2
	B. Methods of plant disease control i. Chemical control ii. Eradication iii. Biological control (employing bacterial and fungal cultures) iv. Integrated pest management v. Development of insect resistant plants (BT crops) vi. Applications of viral proteins in controlling plant viral diseases vii. Antisense RNA technology in plant disease control viii. RNA interference (RNAi) in controlling plant pathogens ix. Mycoviruses acting against fungal plant pathogens	9
	C. Soil health improvement i. Phosphate solubilization ii. Potassium mobilization iii. Iron chelation	3
Unit - II	Testing methods i. Soil Quality ii. Food Quality iii. Air Quality (Environmental samples) iv. Bureau of Indian Standards (BIS)	11
Unit - III	Microbiology to Nanotechnology A. Needs, Historical perspectives, Introduction to nanotechnology, Opportunities and challenges of nanotechnology.	3
	B. Structural and functional principles of nanotechnology	1
	C. Nanotechnology: Nanoparticles synthesis by	4

	plants, bacteria and yeast	
D.	Various terminologies used in nanotechnology	1
E.	Characteristics and applications of quantum dots and fullerenes, Magnetic nanoparticles	1
F.	Applications of nanotechnology i. <i>In-vitro</i> diagnosis. ii. Medical applications of nanoparticles and nanosystems. iii. Nano drug delivery. iv. Micelles for drug delivery. v. Conventional drug delivery and targeted drug delivery. vi. Delivery profile. vii. Role of nanotechnology in Cancer treatment. viii. Nano biosensors and biochips	9

References:

1. David S. Ingram, N. F. Robertson (1999). Plant Disease. 1st Edn.: Collins George Nicholas Agrios (2005). Plant Pathology. 5th Edn. Academic Press Inc.
2. Matthew Dickinson, (2003). Molecular Plant Pathology. Garland Publishing Inc.
3. N. S. Subba Rao. (1995). Soil Microorganisms and Plant Growth. 3rd Edn. Science Pub Inc.
4. Christof M. Niemeyer and Chad A. Mirkin (2006). Nanobiotechnology, John Wiley & Sons.
5. Daniel L. Feldheim and Colby A. Foss, Jr. (2002). Metal Nanoparticles Synthesis, Characterization and Applications, Marcel Dekker, Inc.
6. Mahendra Rai and Nelson Duran (2011). Metal Nanoparticles in the Microbiology, Springer Verlag Berlin Heidelberg.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
MICROBIOLOGY PAPER - VI
TITLE: INSTRUMENTATION IN BIOLOGY
PAPER CODE: MIC3508

[CREDITS - 3]

Learning Objectives:

1. To understand the important instrumentation techniques
2. To understand applications various instruments
3. To understand the routinely used techniques in industry and research

	Title and Contents	No. of Lectures
Unit - I	Introduction to Bio-molecular Separation and Detection (with respect to Principle, working, types and applications)	
	A. pH meter and Colorimeter	2
	B. Centrifugation Basic principle, instrumentation, types of centrifugation (Preparative and Analytical), Sedimentation Coefficient, Rate-Zonal centrifugation) Ultracentrifuge	4
	C. Chromatography Principle, paper, thin layer, gel filtration, ion exchange, affinity chromatography, chromatography, High-performance liquid chromatography	7
	D. Radioactive labeling & counting, Autoradiography	3
Unit - II	Characterization of biomolecules	
	A. Basics of spectroscopy: Simple theory of the absorption of light by molecules, Lambert Beer's law, deviation from Lambert Beer's law, instrumentation for measuring the absorbance of visible light, Factors affecting the absorption properties of a chromophore.	4
	B. UV visible spectroscopy: Introduction, basic principle, instrumentation and applications.	1
	C. Infra Red (IR) spectroscopy: Introduction, basic principle, factors affecting IR group frequencies, instrumentation and applications.	2
	D. Nuclear magnetic resonance spectroscopy (NMR): Basic principles, elementary ideas and instrumentation chemical shifts, spin-spin coupling, instrumentation and applications.	2
	E. Mass Spectroscopy: Introduction, basic principles, instrumentation, uses and applications	2
	F. Fourier-transform infrared spectroscopy: Introduction, basic principles, instrumentation, uses and applications.	2
G. X-ray powder diffraction (XRD):	1	

	Introduction, basic principles, instrumentation, applications.	
	H. Gas Chromatography: Introduction, basic principles, instrumentation, uses and applications.	2
Unit - III	Advanced techniques in microscopy A. Sample preparation for electron microscopy B. Bright field microscopy, Phase contrast microscopy, Florescence microscopy, Bright-field microscopy, Dark -field microscopy, Phase-contrast microscopy, Fluorescent microscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), scanning tunneling microscope (STM), Atomic force microscopy (AFM), scanning probe microscope (SPM)	16
References:		
<ol style="list-style-type: none"> 1. Instrumental Methods of Analysis. 6th Edition by H. H. Willard, L. L. Merritt Jr. and others. 1986. CBS Publishers and Distributors. 2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G. and Anand, S. Himalaya Publishing House, Mumbai. 3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B. L. and Wilson, K. 4. Spectroscopy. Volume 1. Edited by B. B. Straughan and S. Walker. Chapman and Hall Ltd. 5. Chromatography: Concepts and Contrasts - 1988 by James Miller. John Wiley and Sons.Inc., New York. 6. Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A. Sewell. 		

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - V
TITLE: MICROBIOLOGY PRACTICAL- I
PAPER CODE: MIC3511

[CREDITS - 2]

Sr. No.	List of Practicals	No. of Practicals
1.	Isolation and identification of Lactic culture up to genus level	1
2.	Antifungal activity of Lactic acid bacteria	1
3.	Laboratory scale fermentation, estimation, product recovery and yield calculation of ethanol / organic acid (any one)	4
4.	MIC and MBC of antibacterial compounds	2
5.	Quality Assurance Tests: a. Antibiotic and growth factor assay (agar gel diffusion technique) b. Sterility testing of non-biocidal injectables	2

T.Y. B.Sc. (MICROBIOLOGY) SEMESTER -V
PAPER TITLE: MICROBIOLOGY PRACTICAL -II
PAPER CODE: MIC3512

[CREDITS - 2]

Sr. No.	List of Practicals	No. of Practicals
1.	Determination of λ max of biological compounds	1
2.	Determination of Molar Extinction coefficient of biological compounds	1
3.	Preparation of Buffers: calculations using the Hendersen - Hasselbach Equation	1
4.	Blood Biochemistry I: determination of Blood sugar, Serum Proteins and Albumin content	1
5.	Blood Biochemistry II: determination of Serum Urea, BUN and Serum Cholesterol content	1
6.	Preparation of SDR for reducing sugars using DNSA protocol	1
7.	Preparation of SDR for proteins using Folin Lowry protocol	1
8.	Screening and Isolation of Amylase producers from soil samples	1
9.	Amylase concentration using salt/solvent precipitation	1
10.	Amylase assay and establishment of purification chart	1

T. Y. B. Sc. (MICRIBIOLOGY) SEMESTER - V
TITLE: MICROBIOLOGY PRACTICAL -III
PAPER CODE: MIC3513

[CREDITS - 2]

Sr. No.	List of Practicals	No. of Practicals
1.	Physical, Chemical and Microscopic examination of clinical sample - urine	1
2.	Antibiotic sensitivity testing of the isolates (for Gram negative and Gram positive)	1
3.	Epidemiological survey: Development of hypothesis, Data collection, organization, statistical analysis, graphical representation using computers and interpretation, preparation of report	2
4.	Demonstration of egg inoculation technique	1
5.	Isolation, Identification of pathogens from clinical samples like Urine, Stool, Pus (for identification use of keys as well as Bergey's Manual is recommended)	5

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY
THIRD YEAR B.Sc. (MICROBIOLOGY)
SEMESTER - VI

SYLLABUS FOR T.Y. B.Sc.
Academic Year 2018-2019

T.Y. B.Sc. (MICROBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER I
PAPER TITLE: METABOLIC ACTIVITIES OF MICROORGANISMS
PAPER CODE: MIC3601

[CREDITS -3]

Learning Objectives:

1. To understand membranes structure its flexible nature and impact on membrane specificity and structure.
2. To understand the significance and regulation over the Interconnectivity of catabolism and anabolism of macromolecules.
3. To understand the fundamental concepts of thermodynamics and their applications in biological systems.

	Title and Contents	No. of Lectures
Unit - I	<p>Role of Membrane structure and function in metabolism</p> <p>A. Membrane Structure and Specificity</p> <ol style="list-style-type: none"> i. Concept of polar and nonpolar biomolecules with examples, membrane potential and its significance ii. Structure of lipid bilayer and the Fluid Mosaic model components: Glycerophospholipids, Sterols and Proteins iii. Differences in membranes of subcellular compartments and the plasma membranes of animal and plant cells <p>B. Membrane Transport</p> <ol style="list-style-type: none"> i. Concepts, laws governing, mathematical expressions and Examples for Diffusion, Osmosis, Passive Transport, active transport and facilitated transport ii. Characteristics and Types of facilitated transport systems iii. Primary active transport with examples iv. Secondary active Transport with examples v. Examples for multiple transport mechanisms for a single solute: Group translocation, Na Glucose symporter and GLUTS vi. Ionophores Mechanism of action and their applications vii. Liposomes and their applications in targeted drug delivery viii. Transport of gases, water and large molecules 	16
Unit - II	<p>Biosynthesis and Degradation of Biomolecules through metabolic pathways</p> <p>A. Biosynthesis: Concept of polymerization</p> <ol style="list-style-type: none"> i. Polysaccharides: Starch, Glycogen and Peptidoglycan ii. Lipids: Fatty acids, Triacylglycerols and phospholipids 	16

	<ul style="list-style-type: none"> iii. Nucleic acids iv. Proteins <p>B. Degradation of Macromolecules</p> <ul style="list-style-type: none"> i. Polysaccharides: Starch, Cellulose and Glycogen ii. Lipids: Beta Oxidation of fatty acids iii. Proteins: Proteolytic digestion in the GIT and the Protein Urea cycle <p>C. Photosynthesis in Bacteria</p> <ul style="list-style-type: none"> i. Concept of bacterial photosynthesis: Habitats and examples of photosynthetic bacteria, Photosynthetic apparatus, Oxygenic and anoxygenic mechanisms ii. Synthesis of reserve food material through photosynthesis iii. Cyclic and Non-cyclic photophosphorylation and conservation of energy 	
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Unit - III	<p>Bioenergetics</p> <p>A. Fundamentals Concepts</p> <ul style="list-style-type: none"> i. Laws of Thermodynamics, Bioenergetics, free energy considerations in biological systems ii. Concept of enthalpy, entropy and free energy, activation energy, feasibility of reactions, coupled reactions <p>B. High energy compounds</p> <ul style="list-style-type: none"> i. Hierarchy amongst high energy compounds ii. Common high energy compounds used in biological systems: Reasoning, structure and utilization. Pyrophosphates, enolic phosphates, Thioesters, Guanidium phosphate iii. Phosphorylation potential and Atkinson's Energy charge <p>C. Energy conservation</p> <ul style="list-style-type: none"> i. Mitochondrial Electron Transport Chain: Components, organization and arrangement in the inner mitochondrial membrane ii. Structure and function of ATP synthase iii. Inhibitors and uncouplers of ETC and oxidative phosphorylation iv. Energetics of Mitochondrial Electron transport 	16
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References:

1. Nelson D. L. and Cox M. M. (2002). *Lehninger's Principles of Biochemistry*, Mac Millan Worth Pub. Co., New Delhi.
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6. White David (2000). *Physiology and Biochemistry of Prokaryotes*. 2nd Ed. Oxford University Press, New York.
7. David A. Hall & Krishna Rao (1999). *Photosynthesis (Studies in Biology)* 6th Edition, Cambridge University Press, London.

T. Y. B.Sc. (MICROBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER - II
TITLE: IMMUNOLOGICAL PROCESSES
PAPER CODE: MIC3602

[CREDITS -3]

Learning Objectives:

1. To understand the natural defence mechanisms of human body.
2. To understand the regulation of immune system.
3. To understand the role of immunology in clinical diagnosis.

	Title and Contents	No. of Lectures
Unit - I	<p>Innate defence mechanisms</p> <ol style="list-style-type: none"> i. Humoral components: Defensins, pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs), complement, kinins, acute phase reactants ii. Cellular components: Phagocytic cells - PMNL, macrophages (reticulo-endothelial cell system) and dendritic cells iii. Functions: Phagocytosis (oxygen dependent and independent systems), Complement activation (Classical, Alternative and lectin pathway), Coagulation system, Inflammation (cardinal signs, mediators, vascular and cellular changes, role of Toll-like receptors) iv. Cytokines: Types, General characters and role in immune activation - Interferons, Interleukins and TNFs 	16
Unit - II	<p>Activation of immune response</p> <ol style="list-style-type: none"> A. Major Histocompatibility Complex: <ol style="list-style-type: none"> i. Structure of MHC in man and mouse ii. Structure and functions of MHC class-I and class-II molecules iii. Polymorphism of MHC molecules B. Humoral Immune response: Primary and secondary response kinetics, significance in vaccination programs C. Antigen Processing and presentation: Antigen processing and presentation (MHC class I and class II restriction pathways), cell-cell interactions and adhesion molecules, response to super-antigens D. Cell mediated Immune response: <ol style="list-style-type: none"> i. Activation and differentiation of T cells ii. Mechanism of CTL mediated cytotoxicity, ADCC iii. Significance of CMI 	16

Unit - III	Clinical Immunology A. Transplantation: i. Types of Grafts ii. Allograft rejection mechanisms iii. Prevention of allograft rejection; Immunosuppression iv. HLA typing B. Hypersensitivity: i. Immediate and delayed type of hypersensitivity ii. Gell and Coombs classification of hypersensitivity: mechanism with examples for type I, II, III and IV C. Autoimmunity: i. Autoimmunity - Types, Immunopathological mechanisms, Theories of origin of autoimmunity, ii. Pathophysiology (mechanism of symptom generation) of Myasthenia gravis and Rheumatoid arthritis iii. Therapeutic immunosuppression for autoimmunity	16
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2. Kindt T. J., Goldsby R. A., Osborne B. A., 2007, Kuby Immunology 6th edition, W. H. Freeman and Co., New York.
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T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER - III
TITLE: LARGE SCALE BIOPROCESSES
PAPER CODE: MIC3603

[CREDITS - 3]

Learning Objectives:

1. To understand the types of fermentation.
2. To understand the optimization of fermentation parameters.
3. To understand downstream process of fermentation.

	Title and Contents	No. of Lectures
Unit - I	Microbial production of organic acid, solvents and beverages i. Organic acid: Citric acid, Acetic acid ii. Solvents: Ethanol, acetone butanol iii. Beverages: Beer and wine	16
Unit - II	Microbial production of therapeutic agents i. Streptomycin ,cephalosporin ii. Vaccines, polio, tetanus iii. Steroids: Microbial transformation with an example of any one steroid in detail iv. Production and application of monoclonal antibody	16
Unit - III	Microbial production of enzymes, amino acids and vitamins i. Amylase and esterase (use of immobilized cells and enzymes) ii. Amino acids: Lysine, glutamic acid iii. Vitamins: Cyanocobalamine, Riboflavin iv. Immobilization of enzymes and whole cells	16

References:

1. Principles of fermentation technology: P. F. Stanbury A. Whittaker, Pregmon Press.
2. Casida L. E. (1984). Industrial Microbiology, Wley Easterbs, New Delhi.
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T.Y. B.Sc. (MICROBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER - IV
PAPER TITLE: FOOD AND DAIRY MICROBIOLOGY
PAPER CODE: MIC3604

[CREDITS - 3]

Learning Objectives:

1. To understand the important developments in food microbiology and its scope.
2. To know about pathogenic, non-pathogenic and useful microorganisms in the food industry.
3. To become aware about the testing methods routinely used for testing food quality.
4. To understand the students about common causes of food spoilage.

	Title and Contents	No. of Lectures
Unit - I	<p>A. Introduction to Food Microbiology Food as a substrate for microorganisms - Microorganisms important in food microbiology. Classification of Foods based on stability: Perishable, Semi-perishable & stable.</p> <p>B. Food Spoilage</p> <ol style="list-style-type: none"> i. Chemical and physical properties of food affecting microbial growth ii. Sources of food spoilage causing micro - organisms iii. Spoilage of Meat and Poultry products, Bread, Fruits and Vegetables, Eggs, Sea foods and Canned foods. <p>C. Food preservation</p> <ol style="list-style-type: none"> i. Principles of food preservation ii. Thermal destruction of bacteria - use of low temperature and high temperature. iii. Determination of TDP, TDT, D, F, and Z values iv. Use of chemicals and antibiotics in food preservation v. Canning vi. Dehydration vii. Use of radiations viii. Food additives. <p>D. Food borne infections and intoxications</p> <ol style="list-style-type: none"> i. Bacterial, non -bacterial - Food borne disease outbreaks ii. Laboratory testing - preventing measures <p>E. Food sanitation and regulation, plant sanitation, Employee's health standards, quality control and HACCP</p>	23

<p>Unit - II</p>	<p>Dairy Microbiology</p> <p>A. Dairy Development in India Role of National Dairy Development Board (NDDB), National Dairy Research Institute (NDRI), Military dairy farm, Indian Dairy Corporation (IDC), Dairy Co-operatives, Milk Grid, Operation Flood</p> <p>B. Milk Chemistry and Constituents</p> <ol style="list-style-type: none"> i. Definition and Composition of milk ii. Types of Milk (skimmed, toned and homogenized). iii. Concept of clean milk iv. Factors affecting quality and quantity of milk. v. Nutritive value of milk vi. Physico-Chemical properties of milk <p>C. Microbiology of milk</p> <ol style="list-style-type: none"> i. Common micro-organisms found in milk ii. Fermentation and spoilage of milk iii. Milk borne diseases <p>D. Methods of Pasteurization Principle of Pasteurization - LTH, HTST, UHT</p>	<p>13</p>
<p>Unit - III</p>	<p>A. Recent Advances and Quality Control</p> <ol style="list-style-type: none"> a. Fermented foods <ol style="list-style-type: none"> i. Definition and Types ii. Significance of fermented foods (probiotic characteristics of lactic acid bacteria) Probiotics and functional foods <p>B. Applications of genetically modified microorganisms</p> <ol style="list-style-type: none"> a. Starter cultures b. Genetically modified foods <ol style="list-style-type: none"> i. Food grade Bio-preservatives ii. Recombinant Dairy enzymes and Proteins <p>C. Food Adulteration Definition, classification of adulterants, list of foods commonly adulterated, harmful effects of adulterants and methods of detecting adulterants.</p>	<p>12</p>
<p>References:</p> <ol style="list-style-type: none"> 1. Banwart G. J. (1989). Basic Food Microbiology, 2nd Edn. Chapman and Hall, International Thompson Publishing. 2. Clarence Henry Eckles, Willes Barnes Combs, Harold Macy (1943). Milk and milk products, 4th Ed. McGraw-Hill Book Company, Incorporated. 3. James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern Food Microbiology, 7th Edn. Springer Science & Business. 4. Sukumar De (2001). Outlines of Dairy Technology. 1st Ed. Oxford University Press, Delhi. 5. William C. Frazier, Dennis C. Westhoff, N. M. Vanitha (2013). Food Microbiology, 5th Edn. McGraw-Hill Education, India. 		

**T. Y. B. Sc (MICRIBIOLOGY) SEMESTER-VI
MICROBIOLOGY PAPER-V
TITLE: ANTIMICROBIAL THERAPY AND PREVENTION
PAPER CODE: MIC3605**

[CREDIT-3]

Learning Objectives:

1. To understand the desirable properties of chemotherapeutic agents
2. To understand different bacterial drug targets for chemotherapeutic agents
3. To understand mode of action of different drugs
4. To understand different preventive methods to infections
5. To understand mechanisms of bacterial resistance to antibiotics

	Title and Contents	No. of lectures
UNIT - I	<p>Chemotherapy I</p> <p>A. Introduction to Chemotherapy: Desirable parameters of chemotherapeutic agent (Selective toxicity, Bioavailability of Drug, LD-50 value, routes of drug administration, MIC, MBC)</p> <p>B. Drug targets in bacteria with examples of established drugs:</p> <ol style="list-style-type: none"> i. Cell wall biosynthesis: Cycloserine, Bacitracin, Carbapenems ii. Cell membrane functions: PolymyxinB, Monensin iii. Protein synthesis: Streptomycin, Tetracycline iv. Nucleic acid synthesis: Nalidixic acid, Rifampicin v. Enzyme inhibitors: Trimethoprim, Sulfa drugs 	16
UNIT - II	<p>Chemotherapy II</p> <p>A. Mode of action of antimicrobial agents on:</p> <ol style="list-style-type: none"> i. Fungi: Griseofulvin, Nystatin, AmphotericinB, Anidulafungin, Voriconazole ii. Viruses: Acyclovir, Zidovudine, Oseltamivir iii. Protozoa: Metronidazole, Mepacrine <p>B. Resistance to antibiotics:</p> <ol style="list-style-type: none"> i. Genetic basis of resistance ii. Biochemical mechanisms of resistance iii. Development of antibiotic resistance (e.g. ESBL, VRE, MRSA) iv. Antibiotic misuse 	16
UNIT - III	<p>Prevention</p> <ol style="list-style-type: none"> i. Vaccines and antisera, Developing vaccines ii. Immunization schedules: principles, schedules in developing and developed countries iii. Introduction to Clinical research: Definition, types and scope of clinical research, good clinical practices, careers in clinical research iv. Ethics in clinical research: Ethical theories and foundations, Integrity and misconduct in clinical research 	16

References:

1. Chakraborty, P., 2003. A textbook of Microbiology, 2nd Edition New Central Book Agency, India.

2. Medical Microbiology edited by Samuel Baron. Fourth edition. (University of Texas, Medical Branch of Galvesion)
3. Sherris, John C., Medical Microbiology: An Introduction to infectious diseases. Elsevier Publication, 2nd edition.
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6. Dey, N. C. and Dey, T. K. 1988. Medical Bacteriology, Allied Agency, Calcutta, 17th edition.
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T. Y. B. Sc. (MICRIBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER - V
TITLE: IMMUNOHEMATOLOGY AND DIAGNOSTICS
PAPER CODE: MIC3606

[CREDITS - 3]

Learning Objectives:

1. To understand the different blood group systems in human beings
2. To understand types of antibodies
3. To understand different methods for antisera preparation
4. To understand applications of blood grouping
5. To understand routine laboratory procedures in blood bank

	Title and Contents	No. of lectures
UNIT - I	Principles of Immunohematology i. Blood group antigens ii. Biochemistry of blood group antigens iii. Human Blood group systems - ABO, Rh system of blood grouping iv. Other blood group systems v. Types of antibodies: Natural antibodies and Immune antibodies vi. Methods for antisera preparation	16
UNIT - II	Applications of blood grouping i. Blood transfusion process ii. Transfusion reactions iii. Hemolytic disease of the newborn iv. Clinical significance of blood transfusion v. Crime investigation vi. Paternity determination vii. Evolution of blood group systems	16
UNIT - III	Routine laboratory procedures in blood bank i. Preparation for blood collection ii. Blood transportation after collection iii. Storage of blood iv. Preparation and use of blood components v. ABO blood grouping vi. Coombs test and cross matching vii. Detection of ESR and hematocrit values viii. Calculations of red blood cells	16

References:

1. Chakraborty, P., 2003. A textbook of Microbiology, 2nd Edition New Central Book Agency, India.
2. Medical Microbiology edited by Samuel Baron. Fourth edition. (University of Texas, Medical Branch of Galvesion)
3. Sherris, John C., Medical Microbiology: An Introduction to infectious diseases, Elsevier Publication, 2nd edition.
4. R. S. Satoskar, S. D. Bhandarkar, 2007. Pharmacology and Pharmacotherapeutics, Popular Prakashan, 20th edition.
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T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER - VI
TITLE: RECOMBINATION AND GENE MANIPULATION
PAPER CODE: MIC3607

[CREDITS - 3]

Learning Objectives:

1. To understand the proteins involved in the natural recombination in bacteria
2. To understand phage genetics and its mutants
3. To understand the basics of gene manipulation and the techniques involved

	Title and Contents	No. of Lectures
UNIT - I	<p>A. Recombination and Mapping</p> <ol style="list-style-type: none"> i. Recombination ii. Proteins involved in recombination: RecA, B, C, D, Ruv A, B, C iii. Models for homologous recombination: The Holliday model, Double strand break repair model iv. Homologous and site specific recombination <p>B. Phage mutants & genetic complementation</p> <ol style="list-style-type: none"> i. Bacteriophage mutants: Plaque morphology, host range mutants, conditional lethal mutants ii. Deletion mapping using bacteriophage deletion mutants (Benzer's spot tests) iii. Genetic Complementation: <ol style="list-style-type: none"> a. Cis-Trans test of genetic function b. Intercistronic (rII locus of phage) c. Intracistronic (β galactosidase) 	16
UNIT - II	<p>Gene Manipulation</p> <ol style="list-style-type: none"> A. Guidelines for gene manipulation B. Generation of recombinant DNA <ol style="list-style-type: none"> i. Enzymes required for cutting and joining the DNA molecules: Restriction endonucleases and DNA ligase ii. Vectors: Plasmids, cosmids, phagemids iii. Methods to transfer recombinant DNA into host, screening of rDNA iv. Concept of genomic and cDNA libraries v. Concept of clone and probe 	16
UNIT - III	<p>Techniques used in recombinant DNA technology with one example of application</p> <ol style="list-style-type: none"> i. Isolation and purification of genomic DNA ii. Isolation of RNA iii. Agarose gel electrophoresis iv. Blotting: Northern, Southern and Western v. Concept of PCR vi. DNA sequencing - Maxam Gilbert and Sangers 	16

	method, automated sequencing, shotgun sequencing	
vii.	Databank entries & annotation	

References:

1. Strickberger, M. W., 1985 Genetics, 3rd Edition Macmillan Pub. Co., NY.
2. Stanier, R. Y., 1985, General Microbiology, 4th Edition, and 5th edition, MacMillan Pub. Co., NY.
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6. Primrose, S. B. and Old. Principles of Gene Manipulation.
7. Dale, J. W., Schantz, M. V., Plant, N., 2012, From Genes to Genomes: Concepts and Applications of DNA technology, 3rd edition, Wiley-Blackwell Pub., UK.
8. Brown T. A., 2010, Gene Cloning and DNA Analysis, 6th edition, Wiley-Blackwell Pub., UK.
9. Brown T. A., 2002, Genomes, 2nd edition, Bios Scientific Publishers Ltd.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - VI
MICROBIOLOGY PAPER - VI
TITLE: GENETIC ENGINEERING & BIOTECHNOLOGY
PAPER CODE: MIC3608

[CREDITS - 3]

Learning Objectives:

1. To understand the application of recombinant DNA technology.
2. To understand the techniques used for analysis of gene expression.
3. To understand the basics of transgenics and its applications.

	Title and Contents	No. of Lectures
UNIT - I	<p>PCR, Genomic & cDNA libraries</p> <p>A. PCR</p> <ol style="list-style-type: none"> i. PCR reaction ii. PCR in practice - Optimization of PCR reaction, Primer design, Analysis of PCR products, contamination iii. Cloning PCR products iv. Long range PCR v. Reverse transcription PCR vi. Quantitative and Real time PCR vii. Applications of PCR <p>B. Genomic and cDNA libraries</p> <ol style="list-style-type: none"> i. Genomic libraries: Growing and storing libraries ii. cDNA libraries iii. Screening libraries: with gene probes, with antibodies 	16
UNIT - II	<p>Analysis of Gene Expression</p> <ol style="list-style-type: none"> A. Analysing transcription: Northern blots, Reverse transcription PCR, <i>In situ</i> hybridization B. Methods for studying promoter: Locating the promoter, Reporter genes C. Regulatory elements and DNA binding proteins: Yeast one-hybrid assays, DNase I footprinting, Gel retardation assays, Chromatin immunoprecipitation (ChIP) D. Translational analysis: Western blots, Immunocytochemistry, Immunohistochemistry E. Next Generation Sequencing (NGS): Pyrosequencing, SOLiD sequencing, Bridge Amplification sequencing 	16

UNIT - III	Modifying organisms: Transgenics A. Transgenesis & cloning - Common species used for transgenesis B. Animal transgenesis - basic methods, direct injection, retroviral vectors, embryonic stem cell technology, gene knockouts, gene knock down technology, gene knock in technology C. Plant transgenesis - Introducing foreign gene, Gene subtraction D. Advantages, disadvantages & applications of transgenic animals and plants	16
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References:

1. Primrose, S. B. and Old. Principles of Gene Manipulation
2. Dale, J. W., Schantz, M. V., Plant, N., 2012, From Genes to Genomes: Concepts and Applications of DNA technology 3rd Ed, Wiley-Blackwell Pub, UK
3. Brown T. A., 2010, Gene Cloning & DNA Analysis, 6th edition, Wiley-Blackwell Pub., UK.
4. Brown T. A., 2002, Genomes, 2nd edition, Bios Scientific Publishers Ltd.

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER -VI
TITLE: MICROBIOLOGY PRACTICAL IV
PAPER CODE: MIC3611

[CREDITS - 2]

Sr. No.	List of Practicals	No. of Practicals
1.	Microbial Testing of Food and Dairy Products a. Phosphatase test b. MBRT test c. Test for detection of Mastitis d. Standard Plate Count (for milk / milk product / food products e.g. milk powder, confectionary products) e. Direct Microscopic Count	5
2.	Detection of Adulterants in food products	1
3.	Dye removal from wastes by dead microbial biomass	1
4.	Enrichment, Isolation, Preparation and Application of Bioinoculants (e.g. <i>Azo-Rhizo</i> / Blue Green Algae (Cyanobacteria), Phosphate Solubilizer - any one)	1
5.	Biosynthesis of nanoparticles	1
6.	Calibration of pH meter	1

T. Y. B. Sc. (MICROBIOLOGY) SEMESTER - VI
TITLE: MICROBIOLOGY PRACTICAL- V
PAPER CODE: MIC3612

[CREDITS - 2]

Sr. No.	List of Practicals	No. of Practicals
1.	Isolation of bacteriophage using <i>E coli</i> as bacterial host	1
2.	Enumeration of bacteriophages using agar overlay method	1
3.	Isolation of genomic DNA by Marmur's method	1
4.	Detection and quantitation of DNA using Diphenylamine method	1
5.	UV spectroscopy to determine purity of DNA	1
6.	Agarose gel electrophoresis	1
7.	Preparation of competent cells of <i>E coli</i>	1
8.	Transformation of <i>E coli</i>	1
9.	Screening of recombinant cells	1
10.	Visit to a research institute and preparation of visit report	1

T. Y. B. SC (MICRIBIOLOGY) SEMESTER - VI
TITLE: MICROBIOLOGY PRACTICAL- VI
PAPER CODE: MIC3613

[CREDITS - 2]

Sr. No.	List of Practicals	No. of practicals
1.	Estimation of hemoglobin (Cyan-methemoglobin method) and Counting of RBCs	1
2.	ESR, PCV determination and Calculation of hematological indices	1
3.	Counting of WBCs using counting chamber	1
4.	White blood cell differential count from peripheral blood	1
5.	Visit to blood bank and preparation of visit report	1
6.	Blood group typing for ABO and Rh systems	1
7.	Cross-matching and Widal test	1
8.	Coomb's test	1
9.	Immunoprecipitation: Double diffusion (Ouchterlony) technique	1
10.	Demonstrations of RPR test and ELISA (Antigen / Antibody detection)	1