"Education for Knowledge, Science and Culture" -

- Dr Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Empowered Autonomous),

Department of Biotechnology

Syllabus For

Master of Science in Biotechnology Part – I

(Semester I and II)

(Syllabus to be implemented from July, 2023 onwards as Per NEP 2020)

For M.Sc- Biotechnology Part - I

BIOTECHNOLOGY to be implemented from June2023

1. TITLE: Biotechnology

2. YEAR OF IMPLEMENTATION:- As per NEP 2020 Guidelines Syllabus will be implemented from June, 2023 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to Postgraduate students at first year of two years of M.Sc. degree course. Students learn Biotechnology as a separate subject from M.Sc. I. The goal of the syllabus is to make the study of Biotechnology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER:

1) To make the students knowledgeable with respect to the subject and it's practicable Applicability.

2) To promote understanding of basic and advanced concepts in Biotechnology.

3) To expose the students to various emerging areas of Biotechnology.

4) To prepare students for further studies, helping in their bright career in the subject.

5) To expose the students to different processes used in industries and in research field.

6) To prepare the students to accept the challenges in life sciences.

7) To develop skills required in various industries, research labs and in the field of human health.

5. DURATION

• The course shall be two year full time course.

6. PATTERN:-

Pattern of theory and Practical Examination will be Semester wise.

7. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

3) OTHER FEATURES:

(A) LIBRARY:

Reference and Text Books, Journals and Periodicals, Reference Books. – List Attached

(B) LABORATORY SAFETY EQUIPMENT:

1) Fire extinguisher

2) First aid kit

3) Fumigation chamber

4) Stabilized power supply

5) Insulated wiring for electric supply.

6) Good valves & regulators for gas supply.

7) Operational manuals for instruments.

8) Emergency exits.

Teaching and Evaluation Scheme

M. Sc. I Biotechnology (Sem. I & II) From Academic Year: 2023 – 2024

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	CA	CIE	PR	Marks	
Semester-I										
1	DSC-I	DSC21MBT11	Biological Chemistry	4	-	80	20	-	100	4
2	DSC-II	DSC21MBT12	Microbial technology	4	-	80	20	-	100	4
3	DSE-I A	DSE21MBT11	Environmental Biotechnology and Ecology	4	-	80	20	-	100	4
	DSE-II B	DSE21MBT12	Genetics and Basic Cell Biology							
4	RMD-I	RMD21MBT11	Research Methodology	4	-	80	20	-	100	4
5	DSC-PR-I	DSC21MBT19	Techniques in Biological Chemistry and Microbial Technology	-	4		-	100	100	4
6	MIN-PR-II	MIN21MBT19	Techniques in Environmental Biotechnology and cell Biology	-	2		-	50	50	2
				16	**06**	**320**	**80**	**150**	**550**	**22**
Semester-II										
1	DSC-III	DSC21MBT21	Molecular Biology	4	-	80	20	-	100	4
2	DSC-IV	DSC21MBT22	Enzyme Technology	4	-	80	20	-	100	4
3	DSE-II A	DSE21MBT21	Virology	4	-	80	20	-	100	4
	DSE-II B	DSE21MBT22	Immunology							
4	DSC-PR-III	DSC21MBT29	Techniques in Molecular Biology and Enzyme Technology	-	4	-	-	100	100	4
5	MIN-PR-IV	MIN21MBT29	Techniques in Immunology and Virology	-	2	-	-	50	50	2
6	OJT-I	OJT21MBT21	On Job Training		04	-	-	-	100	4
				12	**10**	**240**	**60**	**150**	**550**	**22**
	Total (Sem. I & II)			**28**	**16**	**640**	**160**	**300**	**1100**	**44**

Department of Biotechnology, Vivekanand College, Kolhapur (Autonomous)
Credit Frameworks for M.Sc. Programs as per NEP to be implemented in 2023-24 (Approved by BoS Biotechnology)
M.Sc. Biotechnology

Year	Level	Semester	Major		Research Methodology (4)	(OJT)/ (FP)	Research Project: (RP)	Cumulative Credit	Degree
			Mandatory Paper with credits	Elective paper credits (Choose any one)					
I	6.0	I	**BTM-I (4)** Biochemistry **BTM-II (4)** Microbiology **PR I – A (4)** Techniques in Biochemistry And Microbiology **PR I – B (2)** Techniques in Environmental biotechnology and Cell Biology	**BTE-I A (4)** Environmental Biotechnology and Ecology **or** **BTE-I B (4)** Genetics and Cell Biology	**RM (Research Methodology in Biotechnology) -I (4)**	---	---	22	**PG Diploma in Biotechnology (After 3yr B.Sc. Degree) Note: All the practicals for M.Sc.-I and II will be discipline specific i.e. Biotechnology oriented**
		II	**BTM-IV (4)** Molecular biology **BTM-V(4)** Enzyme Technology **PR II - A (4)** Techniques in Molecular biology and Enzyme technology **PR II - B (2)** Techniques in Immunology and Virology	**BTE-III A (4)** Virology **or** **BTE-III B (4)** Immunology	---	**OJT/FP (4)**	---	22	
Cumulative Credit for PG Diploma			**28**	**8**	**4**	**4**	---	**44**	
Exit option: PG Diploma (40-44 Credits) after Three Year UG Degree									
II	6.5	III	**DSC-V (4)** Advances in Gene technology **DSC-VI (4)** Bioprocess Engineering **DSC-VII (4)** Plant Biotechnology **PR III – A (2)** Techniques in Gene technology	**DSE-III A (4)** Developmental Biology **or** **DSE-III B (4)** Clinical Research and Database Management	---	---	**RPR (research Project) – I (4)**	22	**PG Degree After 3-Yr UG Or PG Degree after 4-Yr UG Note: All the practicals/Project will be discipline specific i.e. Biotechnology oriented**
		IV	**DSC-VIII (4)** Cellular Biology **DSC-IX (4)** Animal Biotechnology **DSC-X (4)** Bioinformatics	**DSE-IV A (4)** Bioethics, Bio safety and IPR **Or** **DSE-IV B (4)** Stem Cell Technology	---	---	**RPR (research Project) – II (6)**	22	
Cumulative Credit for 1 Year PG Degree			**28**	**8**	**4**	**4**	**10**	**44**	
Cumulative Credit for 2 Year PG Degree			**54**	**16**	**4**	**4**	**10**	**88**	
2 Years-4 Sem. PG Degree (88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (44 credits) after Four Year UG Degree									

*** **Abbreviations:** DSC-Discipline specific core, DSE- Discipline specific Elective, , PR- practical Yr.: Year; Sem.: Semester; OJT: On Job Training: Internship/ Apprenticeship; FP: Field projects; RM: Research Methodology; Research Project: RP; Cumulative Credits: Cum. Cr. **Research Methodology will be common for one section and second section related to subject.**

Program outcomes for M.Sc Biotechnology for 2023-2024

PO1 Gain and apply fundamental practical and theoretical knowledge of all the disciplines in life sciences with emphasis on Biotechnology.
PO2 Earn a Master's Degree with specialization in Biotechnology.
PO3 graduates will be able to understand the need and impact of Biotechnological solutions on environment and societal context keeping in view need for sustainable solution.
PO4 graduates will be able to demonstrate scientific methodology and industrial management when dealing with pharmaceutical industries in Biotechnology.
PO5 To give an insight in developing skills and knowledge in changing Biotechnological environment globally.

Subject Offered	Course Outcome paper wise for M.Sc-I Biotechnology for 2023-24
DSC21MBT11 Biological Chemistry	At the end of this course students will be able to: CO 1. Understand the concept of origin of Life CO2. Demonstrate the Importance of Carbohydrates. CO 3. Perceive knowledge about Proteins. CO 4. Illustrate the importance of lipids.
DSC21MBT12 Microbial technology	At the end of this course students will be able to: CO1.To describe the micro biome and microbial diversity.. CO2. To study Characteristics and Salient features of major groups of Bacteria. CO 3. Outline line Microbial growth kinetics. CO 4. Appreciate the relation between microbes and environment..
DSE21MBT11 Environmental Biotechnology and Ecology	At the end of this course students will be able to: CO 1. Classify and manage different waste generated. CO2. Discover microorganisms useful in biodegradation of hazardous substances. CO 3. To study renewable and non-renewable natural resources CO 4. To learn different concept of evolution.
DSE21MBT12 Genetics and Basic Cell Biology	At the end of this course students will be able to: CO 1. Learn the concept of Genetics CO2. Understand the mechanism of transfer of characters. CO 3. Classify different characters & functions of cellular organelles. CO 4.Elaborate the process Cellular Transport.
RMD21MBT11 Research Methodology	At the end of this course students will be able to: CO 1. To understand the different types of research work. . CO2. To present the research work scientifically CO 3. To acquaint with latest good laboratory practices and instrumentation required for research. CO 4.study different technique in sample analysis.
DSC21MBT19 Techniques in Biological Chemistry and Microbial Technology	CO 1. To understand the different types of estimation of Biological compounds. . CO2. To study the Biochemistry of Biomolecules. CO 3. To acquaint with latest good laboratory practices in Microbiology CO 4. To understand the Microbial techniques.
MIN21MBT19 Techniques in Environmental Biotechnology and cell Biology	CO1 To study water pollution and its quality. CO2 To outline the importance all abiotic factor. CO3.To study haploid and diploid cell division CO4 To study the structure of Mitochondria and Cholroplast.

Semester I

Subject Code-DSC21MBT11 Biological chemistry (Credit 04)

Topic	Units	Lectures 60
	Unit-I	
1	**Chemical Basis of Life:-** Chemical Basis of Life- Urey-Miller Experiment, abiotic formation of amino acids, oligomers, Water- Properties of Water, Ionization and hydrophobicity , emergent properties of biomolecules in water. Biological importance of water**.** Solvation properties of water**.** Hydrophobic attraction of water, Concept of Biomolecules, Macromolecules and their monomeric subunits.	**10**
	Unit-II	
2	**Carbohydrates: -** Sterochemical relations of aldoses and ketoses. Ring formation in monosaccharide. α and β anomers Biological importance of Carbohydrates, classification with examples, monosaccharide, disaccharides- Maltose, Lactose, Sucrose. Oligo saccharides, polysaccharides with specific refrence to Starch, Glycogen. Cellulose,Concept of reducing and non reducing sugars, Glycoconjugates - Glycoproteins, Glycolipids. **Metabolism of Carbohydrates:-** Glycolysis, TCA cycle, Gluconeogenesis, Glycogenesis, Glycolgenolysis (reactions, energetics, Significance regulation at Enzymatic , hormonal level), Oxidative phoshphorylation, components of ETC, F_1 -F_0 ATP synthase Complex, Chemiosomotic hypothesis, inhibitors/uncouples of ETC.	**18**
	Unit-III	
3	**Amino acids:-** Introduction Biological importance, classification based in R group with examples, essential and non- essential amino acids, Zwitter ion& I pH ,concept of pka, H-H equation , Peptide bond formation Urea cycle. **Proteins:-** Biological significance of Proteins, Protein classification based on composition (Simple, Conjugate, Derived with examples), reactions of protein sequencing Dansyl chloride, Dabsyl chloride, Sangers reagent, Edman's reagent), Structural level organization of Proteins- Primary, Ramchandran Plot, Secondary(Types-α-helix and β-pleated sheet), super secondary motifs, forces stabilizing tertiary structure with reference to Mb, Quaternary structure- Hemoglobin Structure of Ribozyme.	**18**
	Unit IV	
4	**Lipids- Biological importance of Lipids, Classification of Lipids** – Simple, compound, derived, Types of fatty acids, saturated ,unsaturated at least 4 examples, types of waxes, Cholesterol, Lipoprotein- LDL,VLDL,HDL, Chylomicrones, Liposomes, micelle formation , chemical properties of lipids- Saponification value, Iodine value, Acid Value. **Metabolism of Lipids:-** β- oxidation of fatty acid- palmitic acid, Biosynthesis of fatty acid –palmitic acid , regulation of fatty acid metabolism.	**14**

References:

1. Biochemistry text book by LubertStryer
2. Biochemistry and Molecular Biology of Plants
3. Buchannan B, Gruiseem W, Jones R, ASPP, Maryland; First Edition 2000
4. Plant Biochemistry -Hans-Walter Heldt; 2006 Edition
5. Plant Biochemistry and Molecular Biology -Lea PJ, Leegood RC;
   Second Edition 1999John Wiley & Sons
6. Plant Physiology -Taiz L and Zeiger E; Fourth Edition 2006, Sinauer Associates, INC

Subject Code: - DSC21MBT12 Microbiology (Credit 04)

Topic No.	Topics	Lectures 60
	Unit-I	
1	**Beginning of Microbiology**, milestones in the development of microbiology, spontaneous generation, Microbial Ecosystem, Microbial world, Branches of Microbiology, Application of microbiology**.** **Microbial evolution and Taxonomy**, systematics and taxonomy: Evolution of earth's earliest life forms, primitive organisms, their metabolic strategies and their molecular coding, New approaches to bacterial taxonomy, nomenclature, Bergey's manual, Ribotyping. Modern trends in Prokaryotic Taxonomy – Polyphasic, Polygenic, Numerical taxonomy.	**15**
	Unit-II	
2	**Characteristics and Salient features of major groups of Bacteria** Occurrence, shape and arrangement of bacterial cells, structure of bacterial cell – cell wall (Gram positive or Gram negative), capsule, plasma membrane, cytoplasm, ribosome, nucleoid, mesosomes, plasmids, flagella, pili (fimbriae), inclusion bodies, cell division and endospore formation. Characteristics of major groups of bacteria, Archaebacteria – general characteristics and classification; Eubacteria, Actinomycetes – general characteristics and classification, economic importance. Cyanobacteria – general characteristics and classification – ultra-structure, reproduction and economic importance. Mycoplasma, Rickettsia, Chlamydia, Photosynthetic bacteria and bioluminescent bacteria.	**15**
	Unit-III	
3	**Microbial Growth** Reproductive strategies, Bacterial Cell Cycle, Influence of environmental factors on growth, Microbial growth in Natural environmental, Laboratory culture of cellular Microbes, Growth curve, Measurement of Microbial population, Continuous culture of microorganism	**15**
	Unit IV	
4	**Microbial Ecology and Symbiosis** **Methods in Microbial Ecology-**Culturing techniques, Assessing Microbial diversity, Assessing Microbial Community Activity **Microorganism in Marine and Freshwater Ecosystems-**Water as microbial Habitat. **Microorganism in Terrestrial Ecosystems-** Soil as Microbial Habitat, Microbes- Plants Interaction The Subsurface Biosphere, Microbes in soil Environment. **Microbial interaction** Introduction, Mutualism- microorganism-insects mutualism, sulphide based mutualism, The rumen ecosystem. Co operation, Commensalism, predation, Parasitism, Ammensalism, Competition, Human Microbes interaction.	**15**

Reference

1. Microbiology-Pelzer, Chan, Krieg Tata McGraw Hill Publications
2. Microbiology-Concepts and applications by Paul A. Ketchum, Wiley
3. Fundamentals of Microbiology –Furbisher, Saunders & Toppan Publications
4. General Microbiology –C.B. Powar, H.F. Daginawala, Himalayan Publishing House
5. Medical Bacteriology, 14th edition, (1988), Dey, N.C and Dey, TK., Allied Agency, India
6. Prescott's Microbiology Ninth Edition.

Environmental Biotechnology and Ecology
Subject Code- DSE21MBT11 (Credit 04)

Topic No.	Topics	Lectures 60
	Environmental Biotechnology	
	Unit –I	
1	**Introduction to environment: pollution and its types;** Air pollution: Primary and secondary pollutant, **Global Warming, Ozone hole** Water pollution: Introduction, causes, Hardness and its types BOD, COD, waste water treatment Soil pollution and its types and control **Environmental Toxicology** Definition, classification and concept, Pesticide Toxicity – Classification (Organic and Inorganic), Mode of action of toxicants (Metals, organophosphates, carbamates and mutagens), Bioconcentration, Bioaccumulation, Biomagnifications.	**15**
	Unit –II	
2	**Bioremediation Techniques** -Definition, Principle, Insitu and Exsitu Bioremediation, Bioremediation of waste waters (MSW, BSW and ISW), Activated Sludge Process, Lagoons, Oxidation ponds, Trickling filter. **Solid Waste Treatment [Plastics and Aromatics], Slurry Phase Treatment, Agricultural Bioremediation-** Microbial Composting, Biogas, Land Farming and pest Control**, Bioremediation of Industrial wastes, Xenobiotics, Bioaugmentation and Biofiltration.**	**15**
	Ecology	
	Unit –I	
3	**Ecosystem-** Concept, structure, function**. Productivity-** Kinds of productivity**. Food chain-** types of food chain, food web, concept of tropic level. **Ecological pyramids-** concepts and types. **Energy flow in ecosystem –**concept of energy, unit of energy, **Biogeochemical cycle:** Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorus cycle Concept - Habitat and Niche	**15**
4	**Population Ecology-** Introduction, population characteristics, Natality, Mortality, survivor ship curves, age structure, age pyramid**. Population growth-** Exponential and logistic, r and k strategists. **Evolution: -** Theories of evolution-Lamarckism, Darwinism, Modern synthetic theory and Mutational theory**.** Evidences of evolution and Adaptive radiation and Adaptive conversation. Concept of species and speciation. **Hardy-Weinberg law and Equation.**	**15**

References: Environmental Biotechnology

1. Environmental Biotechnology by S. K. Agarwal
2. Biodegradation & Bioremediation (1999), Martin Alexander, Academic press.
3. General Microbiology, Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R., McMillan Publications, 1989.
4. Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis Horwood Ltd., 1987.
5. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol.4, Gulf Publications Co. London, 1989.
6. Bioremediation engineering; design and application 1995 John. T. cookson, Jr. Mc Graw Hill, Inc.
7. Environmental Biotechnology by A.K. Chatterjee 8. Environmental Biotechnology by S.N.Jogdand Himalaya Publishing.

References: Ecology

1. Fundamentals of ecology ; E.P Odum.
2. Concept of ecology ; Dash.
3. Enviornmental Biology,Verma & Agarwal
4. Enviornmental Science., Saigo, Canninhham
5. General ecology., H.D.Kumar

Subject Code:-DSE21MBT12 Genetics and Basic Cell Biology (Credit=04)

Topic No.	Topics	Lectures 60
	Genetics	
	Unit –I	
1	**Genetics of bacteria and Bacteriophage** Concept of a gene in pre-DNA era; mapping of genes in bacterial and phage chromosomes by classical genetic crosses; fine structure analysis of a gene; genetic complementation and other genetic crosses using phenotypic markers; phenotype to genotype connectivity prior to DNA-based understanding of gene. **Genetics of Yeast** Meiotic crosses, tetrad analyses, non-Mendelian and Mendelian ratios, gene conversion, models of genetic recombination, yeast mating type switch; dominant and recessive genes/mutations, suppressor or modifier screens, complementation groups, transposon mutagenesis, synthetic lethality, genetic epistasis	**15**
	Unit –II	
2	**Genetics as a model of higher eukaryotes** Monohybrid & dihybrid crosses, back-crosses, test-crosses, analyses of autosomal and sex linkages, screening of mutations based on phenotypes and mapping the same, hypomorphy, genetic mosaics, genetic epistasis in context of developmental mechanism. **Population genetics** Introduction to the elements of population genetics: genetic variation, genetic drift, neutral evolution; mutation selection, balancing selection, Fishers theorem. **Plant genetics** Laws of segregation in plant crosses, inbreeding, selfing, heterosis, maintenance of genetic purity, gene pyramiding.	**15**
	Basic Cell Biology	
	Unit –I	
3	**Cell Structure** – Discovery of Cell, Cell theory - Definition, discovery, three assumptions of cell theory, exceptions, organismal theory, protoplasm theory, **Organization of Prokaryotic cell, Organization of Eukaryotic cell** (plant and animal cell), **Ultra structure & functions of cell organelles** Mitochondria, Chloroplast, E.R., Golgi apparatus ,Lysosome, Peroxisome, Ribosomes. **Cell membrane** –components, Molecular models of cell membrane-Unit membrane model, Protein, crystal model, fluid mosaic model, Types of membrane transport, Passive transport-simple diffusion, facilitated diffusion, osmosis.	**15**
4	**Nucleus** -Introduction, morphology, occurrence, shape, size, number, position Ultra structure of nucleus-Nuclear membrane, nucleoplasm, nucleopore complex, nucleus.	**15**

	Chromosome structure - introduction, General features of **Prokaryotic chromosome**. General features of **Eukaryotic chromosome.** **Cytoskeleton assembly -** Introduction, Cytoskeleton elements, Microtubules- occurrence, structure, chemical composition, microtubule associated proteins, functions, Microfilaments- occurrence, structure, chemical composition, functions, Intermediate filaments(IF) - occurrence, structure, chemical composition, types of IF, functions Organization of cilia and flagella	

References: Genetics

1. Hartl, D. L., & Jones, E. W. (1998). *Genetics: Principles and Analysis*. Sudbury, MA: Jones and Bartlett.
2. Pierce, B. A. (2005). *Genetics: a Conceptual Approach*. New York: W.H. Freeman.
3. Tamarin, R. H., & Leavitt, R. W. (1991). *Principles of Genetics*. Dubuque, IA: Wm. C. Brown.
4. Smith, J. M. (1998). *Evolutionary Genetics*. Oxford: Oxford University Press.
5. Strickberger “Genetics”
6. Freifelder “Genetics”
7. Stanier “General Microbiology”
8. P. K. Gupta “Genetics”
9. C. Sarin “Genetics”
10. Larry Snyder Wendy Champness “Molecular Genetics of Bacteria”

References:- Basic Cell Biology

1) Molecular biology of cell-Albert
2) Molecular biology & cell biology – Loddish etal
3) Cell biology –De Robertis
4) Cell biology-Genetics, molecular biology-P.S. Warma & Agarwal
5) Genes Lewin
6) Cell biology –Geral karp
7) Practical biochemistry – Keith, Wilson and Walker
8) Cell Biology- C.B.Pawar

Subject Code: RMD14CHE11: Research Methodology in Biotechnology (Credit 04)

Topic No.	Topics	Lectures 60
	Unit –I	
1	**Fundamentals of Research Methodology** • Meaning, Objective, Motivation and Types of Research • Research Approach • Significance of Research, Research Methods, research and Scientific Methods • Criteria of Good Research, Research Process and steps involved • Hypothesis: Meaning, functions and types of hypothesis; Null/Alternative hypothesis • Literature Survey, Source of information, Review • Ethical issues and intellectual property rights. • Publication Process, Selection of Journal, Citation index, Impact factor, H-index, Journal Cite score, Google scholar index, Research gate, Academia, etc	15
	Unit –II	
2	**Interpretation and Report Writing** • Meaning of Interpretation, Why Interpretation? Technique of interpretation, Precaution in Interpretation • Significance of Report Writing, Different Steps in Writing Report, Layout of the Report, Types of Report. • Mechanics Writing a research report: Writing preliminaries, Main body of research, reference and bibliography • Precaution for Writing Research Reports • Meaning and Importance of workshop, Seminar, Conference, Symposium etc in research • Plagiarism-Concept and Significance of Plagiarism. • Writing tools: Grammerly, Answer the public, Copyscape, Chatgpt, ginger. • Referencing and citation tools: Endnote, Mendeley, Jabref, Zotero.	15
	Unit –III	
3	**Research Methodology in Biotechnology** • **Ultraviolet-visible absorption spectroscopy**: Principle, Instrumentation and application. • **Fluorescence spectrophotometry**: Principle, Instrumentation and application. • Other types (IR, NMR, ESR and MASS) of spectrophotometry: Basic principle and application. • Elimentary idea about X-ray crystallography, API- Electrospray and MALDI TOF.	15

	• **Chromatographic techniques**: Principles of chromatography (Adsorption and Partition chromatography), Planar chromatography (Paper and Thin- layer chromatography), • **Column chromatography** (Gas chromatography, Gel exclusion/permeation chromatography and FPLC, Ion-exchange chromatography, Affinity chromatography, HPLC).	
	Unit –IV	
4	• **Electrophoretic techniques:** General principles, support media, electrophoresis of proteins (SDS-PAGE, native gels, gradient gels, isoelectric focusing gels and two dimensional gels), electrophoresis of nucleic acids (Agarose, pulse-field and sequencing gels). • **Radioisotope techniques**: Nature of radioactivity, isotopes in biochemistry, measurement of radioactivity (carbon dating, Geiger-Muller counting and liquid scintillation counting), autoradiography.	**15**

Reference Books:

1. Kumar R., Research Methodology - A Step-By-Step Guide for Beginners, Pearson Education, Delhi (2006).

2. Montgomery, D. C., Design & Analysis of Experiments, 5th Ed., Wiley India (2007).

3. Kothari, C. R., Research Methodology-Methods and Techniques, 2nd Ed., New Age
International, New Delhi.

4. Ram Ahuja, “Research Methods”, (2001), Rawat Publications, New Delhi.

5. Cooper D., Schindler P., Business research methods”, (2003) Tata Mc-Graw Hill, New Delhi

Practical Code- DSC21MBT19 **Total 04 Credits**

Techniques in Biological Chemistry & Microbiology Technology

Techniques in Biological Chemistry 02 Credits		
Sr No.	**Name of Practical**	**Type**
1	Estimation of Total Flavonoids Content by $AlCl_3$ Method	**Major**
2	Estimation of concentration of amino acid by formal tiration	**Major**
3	Determination of Acid base titration curve and measurement of pka value of Amino acid.	**Major**
4	To prepare an Acetic-Na Acetate buffer and validate the Henderson-Hasselbalch equation.	Minor
5	Estimation of Protein Bradford Method using suitable standard Protein.	**Major**
6	Estimation of Total Sugar by Anthrone Method using suitable standard sugar.	**Major**
7.	Estimation of Reducing Sugar by DNSA Method.	Minor
8.	Estimation of Urea by DAM Method	**Major**
9.	Estimation of Protein by Lowry's method using suitable standard Protein.	Minor
10.	Estimation of Total Sugar by Phenol H_2SO_4 method using suitable standard sugar.	Minor
11.	To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer-Lambert's Law.	Minor
12.	Separation of amino acids by thin layer chromatography.	Minor
13.	Estimation of Cholesterol by Iron Reagent	Minor
Techniques in Microbiology Technology 02 Credits		
1	Isolation of Symbiotic Nitrogen fixing bacteria from root nodules of leguminous plant.	**Major**
2	Study of Growth curve of bacteria.	Minor
3	Isolation of E. Coli from sewage water sample with the help of EMB agar medium and its biochemical characterization using Bergey's Manual.	**Major**
4	Test of Motility of bacteria by Hanging drop Technique and Agar Stabbing Method.	Minor
5	Enrichment and Isolation of Antibiotic Producers	Minor
6	Enrichment and Isolation of Thermophilic Bacteria	Minor
7	Determination of phenol co-efficient of antimicrobial agents.	**Major**
8	Determination of Minimum Inhibitory Concentration (MIC)	Minor
9	Isolation of *Actinomycetes.*	**Major**
10	Study of diauxic growth of Bacteria	Minor
11	Isolation of Phosphate Solubilizing Bacteria by Soil extract ager/PK medium.	**Major**
12	Isolation of Lactic Acid bacteria from commercial Probiotic sample NRCL/MRS Agar.	**Major**

Practical Code- MIN21MBT19 **Total 04 Credits**

Techniques in Environmental Biotechnology & Cell Biology

Techniques in Environmental Biotechnology and Cell Biology 02 Credits		
Sr No.	**Name of Practical**	**Type**
1	Determination of BOD of Domestic Waste.	**Major**
2	Determination of COD from industrial effluents sample.	**Major**
3	Determination of Total, Permanent and Temporary Hardness of water sample.	**Major**
4	Bacteriological examination of Water -Quantitative MPN	Minor
5	Detection and isolation of industrially important microorganisms – lipase producers/oil degraders.	Minor
6	Total Plate count of Soil manure.	Minor
7	Isolation of Mitochondria.	**Major**
8	Isolation of Chloroplast.	**Major**
9	Isolation of Nucleus.	**Major**
10	Mitosis	Minor
11	Meiosis	Minor
12	Micrometry	Minor

List of minimum equipment's-for Biotechnology-Entire

1) Hot air oven - 1

2) Incubator - 1

3) Autoclave - 1

4) Refrigerator - 1

5) Students microscopes(oil immersion) - 10 nos. for one batch

6) Digital balance - 2

7) pH meter - 1

8) Centrifuge - 1

9) Colorimeter - 1

10) Distilled Water Plant - 1

11) Laminar air flow cabinet - 1

12) Colony counter - 1

13) Water bath - 1

14) Arrangements for gas supply and fitting of two burners per table.

15) One working table of 6' x 2½' for two students.

16) One separate sterilization room attach to the laboratory (10' x 15')

17) At least one wash basin for a group of five students

18) One separate instrument room attached to lab (10' x 15')

19) One laboratory for one batch including working tables (6' x 2½') per two students for one batch

20) Store room (10' x 15')

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note: - At least 80% Practical's should be covered in practical examination.

Nature of Question Paper (Theory)

Instructions

1. **A Total of Five questions are to be answered from the Paper**
2. Answers to all the Five Questions are to be written in the same answer book
3. **Question 1 is Compulsory.**
4. **Answer any Two Questions from Section-I (Q.2 to Q.4) and any Two questions from Section-II (Q.5 To Q. 7)**
5. Figures to the right indicate full Marks.

Time: 3 Hrs **Total Marks: 80**

Q. 1. Fill In the Blanks. (16 Marks)

SECTION –I

Q.2 (Attempt Any One Long answer Out of Two) (16 Marks)

Q.3 Discuss in Brief (Any Two out of Three)) (16 Marks)

Q.4 Write Short Notes on (Any Four Out of Six) (16 Marks)

SECTION-II

Q.5 (Attempt Any One Long answer Out of Two) (16 Marks)

Q.6 Discuss in Brief (Any Two out of Three)) (16 Marks)

Q.7 Write Short Notes on (Any Four Out of Six) (16 Marks)

Scheme of marking (Theory)

Semester	Core Course	Marks	Evaluation	Standard of passing
I.	Theory	80	semester wise	40% (16 M)

Scheme of marking (CIE - Continuous Internal Evaluation)

Semester	Core Course	Marks	Evaluation	Standard of passing
I.	Theory	20	semester wise	40% (08 M)

For Continuous Internal Evaluation/Examination - 20 Marks- Oral/Seminar/Fill In Blanks/ Short Notes

Nature of Question Paper (Practical)

Techniques Biological Biochemistry and Microbial Technology

Instructions

1. **A Total of eight questions are to be answered from the Paper**
2. **Answers to all the Five Questions are to be written in the different answer paper**
3. **Figures to the right indicate full Marks.**

Time: 3 Hrs **Total Marks: 100**

Section-I (Biological Biochemistry)

Q. 1. Major. (20 Marks)

Q.2 Minor (15 Marks)

Q.3 Viva voce (10 Marks)

Q.4 Journal (05 Marks)

Section-II (Microbial Technology)

Q. 5. Major. (20 Marks)

Q.6 Minor (15 Marks)

Q.7 Viva voce (10 Marks)

Q.8 Journal (05 Marks)

Total: 100 Marks

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Nature of Question Paper (Practical)

Techniques in Environmental Biotechnology and Cell Biology

Instructions

1. **A Total of Four questions are to be answered from the Paper**
2. **Answers to all the Five Questions are to be written in the different answer paper**
3. **Figures to the right indicate full Marks.**

Time: 3 Hrs **Total Marks: 50**

Section-I (Biological Biochemistry)

Q. 1. Major. (20 Marks)

Q.2 Minor (15 Marks)

Q.3 Viva voce (10 Marks)

Q.4 Journal (05 Marks)

Total: 50 Marks

Scheme of marking (practical)

Semester	Marks	Evaluation	Standard of passing
I	100	Semester	40% (40 M)
I	50	Semester	40% (20 M)

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Semester II

Subject Code- DSC21MBT21 Molecular Biology (Credit 04)

Topic	Units	Lectures 60
	Unit-I	
1	**Experimental Evidences for DNA as a genetic material:-** Griffith's Exp., Avery, Macleod, McCarty Exp., Blender Exp., RNA As a genetic material Gierer and Schram expt. **Properties and Function of DNA:-** Tm, Cot Curve, Purity of DNA, Acid- Base Nature, Buoyant Density Concept of Gene, Unit of Gene (Cistron, Recon, and Muton), Fine Structure of gene, One gene One Polypeptide Hypothesis, interrupted gene. **Organization of genome:-**Viral (Lambda, T4), Bacteria (E. *coli*), Eukaryote, Typical Structure of chromosome (Euchromatin & Heterochromatin), Packaging of DNA (Nucleosome, Solenoid Model).	**15**
	Unit-II	
2	**Nucleic Acid biosynthesis:-** De novo synthesis of Purine and Pyrimidine ring, Salvage Pathway, Feedback inhibition. **DNA Replication-** Semi conservative model of replication (M.S Expt.). Direction of replication (Unidirectional and Bidirectional). **Prokaryotic and eukaryotic replication-** Enzymes involved in replication, initiation, elongation and termination. Rolling circle model and telomere replication. **DNA Damage:-** Mutation and its Types, Chemical damage of DNA by: Base Analogue, 5 Bromo uracil, 2Amino purine, Nitrous Acid, Nitrosoguanidine, Methly sulphonate, EMS, Intercalating Agent (EtBr), DNA damage by UV Radation **DNA Repair:** - Photo reactivation Repair of pyrimidine dimers, Direct repair, Excision repair (Nucleotide and Base), Mismatch repair, SOS repair, Recombination repair, Repair of double strand DNA break.	**15**
	Unit-III	
3	**Transcription in prokaryote and Eukaryote** Mechanism of transcription-Enzyme involved, initiation, elongation and termination. Inhibitors of transcription, Post transcriptional modification, Transcriptional control by hormones. **Genetic Code** Properties of genetic code. Assignment of codons with Unknown sequences a) Polyuridylic b) Acid Copolymers method. Assignment of codons with known sequences a) Binding technique b) Repetitive seq. technique. Wobble Hypothesis, Variation in genetic code.	**15**

	Unit IV	
4	**Translation in prokaryote and Eukaryote** Structure and role of ribosome in translation, Amino acid t-RNA complex formation, Initiation, Elongation, termination of translation Inhibitors of translation. Post- translation modifications (Protein folding, Removal of Leader sequences, Phosphorylation, Glycosylation). **Regulation of gene expression in prokaryote and eukaryote.** Regulation of gene expression in prokaryote a) Lac operon b) Tryptophan operon c) Arabinose operon. **Regulation of gene expression at transcriptional and translation level.**	**15**

References:

1) Molecular biology by Watson
2) Genetics by Strickberger
3) Molecular Biology - Glickpastornack
4) Molecular biology - Geralad Carph
5) Gene by Levin
6) Genome by T.A. Brown
7) Molecular biology by Lodish
8) Biochemistry by Nelsdon and Cox
9) Biochemistry by Lubert Stryer

Subject Code: - DSC21MBT22 Enzyme Technology (Credit 04)

Topic No.	Topics	Lectures 60
	Unit-I	
1	General introduction and historical background, Definition, Properties of Enzymes Nomenclature and IUB classification of enzyme. Chemical nature of enzyme, Activation Energy and Transition state hypothesis, BiSubstrate reaction catalyzing enzymes, ,Coenzymes and cofactors , Prosthetic groups. Active site (Lock and Key and Induced fit hypothesis), Isozymes(Lactate dehydrogenase),Abzymes, Synzyme, Ribozymes Metallozymes, Metal activated enzymes- Examples Allosteric enzyme- properties and Sequential and Symmetry model of allosteric enzymeS- examples , Aspartate transcarbomylase ,Phosphofructokinase I	**15**
	Unit-II	
2	Enzyme activity- factors affecting enzyme activity like Temperature, pH, Activator 2,Inhibitors, Substrate concentration and enzyme concentration. Units of enzyme activity Enzyme catalysis- Factors affecting enzyme catalysis like Proximity orientation, Strain and distortion ,Acid base catalysis- Explain with refrence to example Keto to Enol conversion tautomerism,, RNase , Covalent catalysis- Explain with refrence to example Decarboxylation to Acetoacetate to Acetone via Schiff base formation , Chymotrypsin . Metal ion catalysis- Carbonic unhydrase Enzyme kinetics- steady state kinetics, Michaelis –Menten equation, Significance of Km and Vmax. Concept of Turn over number Determination of Km by-1.Lineweaver Burk plot, 2. Eadie-Hofstee plot, 3. Hanes-Woolf plot, Eisenthal&Cornish plot	**15**
	Unit-III	
3	Enzyme regulation Zymogen activation, Inhibition – Reversible inhibition Example and Kinetics of 1. Competitive inhibition, 2. Non-competitive 3. Un-competitive, Irreversible inhibition. Feedback inhibition, Allosteric inhibition- ATcase, Cholesterol esterasase Purification of enzyme- Introduction, Why isolate enzymes? Objectives and strategy in enzyme purification. Choice of sources, Methods of homogenization , methods of separation, Parameters to check success of purification procedure , Examples of purification procedure(RNA polymerase purification from *E.coli* and chymotrypsin)	**15**

	Immobilization of enzyme- concept, Properties of immobilized enzyme, properties of matrix, Disadvantages of immobilization, methods of immobilization – Physical adsorption, Covalent bonding, Cross linking, encapsulation, entrapment. Applications of immobilized enzymes,	
	Unit IV	
4	Biosensors- Definition and Features of biosensor , Components of Biosensor Types of Biosensor-1. Clorimetric Biosensors 2. Potentiometric Biosensor example Glucose Biosensor 3. Amperometric Biosensor 4. Optical Biosensor 5. Pleizo – electric Biosensors 6. Immunosensors Application of Enzymes- Industrial enzymes – Thermophile enzymes amylases, lipases, Proteolytic enzymes. Clinical enzymes – enzymes as thrombolytic agent's anti-inflammatory agents. Streptokinase, Asparginase, Transaminases(AST,ALT), Cholinesterase, Phosphatase, Designer enzymes nature and use, Enzyme structure activity with respect to drug discoveries. Enzyme in Food Processing Industry	**15**

Reference

1. Fundamentals of Enzymology-Nicholas Price and Lewis Steven
2. Enzyme- Palmer
3. Enzyme Dixon and Webb
4. Enzyme Technology- S. Shammugam and T. Satishkumar
5. Enzymes and Enzyme Technology- Anil kumar and Sarika Garg
6. Enzyme structure and Mechanism- Albnert Olson
7. Enzyme technology- Pandey Ashok et.al
8. Enzyme in Food technology- Mohamad Kuddus Springer

Subject Code- DSE21MBT21 Virology (Credit 04)

Topic No.	Topics	Lectures 60
	Unit –I	
1	**History**: History, origin and evolution of viruses, pioneers of Virology and properties of viruses. Nomenclature and classification of viruses: Criteria used for naming and classification, Current ICTV classification of viruses of bacteria, plants and animals and humans. Morphology and properties of viruses: Physical- morphology and structure, sedimentation, electrophoretic mobility, buoyant density; Biochemical-chemical composition, nucleic acids, proteins, enzymes, lipids, carbohydrates, polyamines, cations, virus stability; Biological- Host range, inclusion bodies and transmission. Transmission of viruses: Non-vector and vector mode of transmission of viruses.	**15**
	Unit –II	
2	Laboratory Bio-safety: Principles of bio-safety, biosafety levels, containment facilities, maintenance and handling of laboratory animals and requirements of virology laboratory. Isolation, cultivation and maintenance of viruses: Isolation and cultivation of plant and animal viruses (experimental plants and tissue culture, experimental animals, embryonated eggs, organ cultures, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines). Purification of viruses: Extraction of viruses from tissues, clarification, and concentration of viruses in clarified extracts by physical and chemical methods, further purification of viruses by rate zonal / equilibrium density gradient centrifugation, Criteria of virus purity, Quantitation and preservation of purified virus preparations.	**15**
	Unit –III	
3	Assay of viruses: Infectivity assay methods (plaque, pock, end point, local / systemic assay of plant viruses), physical (EM), serological (HA, HI, immunofluorescence, ELISA) and molecular (viral protein and nucleic acid based) approaches. Replication: Introduction to virus replication, steps involved in virus replication and general strategies. Management of viruses: Cultural practices, Sanitation, control of vectors, vaccines, antiviral drugs and chemotherapy	**15**
	Unit –IV	
4	Bacteriophages: Biology of major RNA (MS2, Qβ) and DNA (T4, lambda, Øx174, M13) bacteriophages, replication of M13, T4 and lambda phages; biology of cyanophages. Algal and fungal viruses: Biology of viruses of Phycodnaviridae, Partitiviridae andTotiviridae. Biology of sub-viral agents: Satellite viruses, sat-RNAs, DI particles, viroids, virusoids and prions.	**15**

References:

1. Evidence-Based Diagnosis: An Introduction to Clinical Epidemiology 2nd Edition, by Thomas B. Newman, Michael A. Kohn (2020).2 edition, Publisher: Cambridge University Press
2. Virusphere: From Common Colds to Ebola Epidemics--Why We Need the Viruses That Plague Us (2020). 1st edition, Frank Ryan (Author), Publisher: Prometheus.

3. Guide to Clinical and Diagnostic Virology (2019), (ASM Books) 1st Edition, by ReetiKhare, Publisher: ASM Press.

4. Virology (2019), P. Saravanan.

5. Recent Advances in Animal Virology (2019) 1st Edition, Kindle Edition, by Yashpal Singh Malik, Raj Kumar Singh, Mahendra Pal Yadav, 471 pages, Publisher: Springer

6. Virology (2017) Ren Warom, Titan Books.

7. Virus: An Illustrated Guide to 101 Incredible Microbes (2016), 1st Edition (ASM Books) Fourth Edition, by Marilyn J. Roossinck, Carl Zimmer,Publisher: Princeton University Press.

8. A Planet of Viruses: (2015) 2nd ed, by Carl Zimmer (2015) University of Chicago Press.

9. Schaechter's Mechanisms of Microbial Disease (2012).Fifth, North American Edition, by N. Cary Engleberg MD, Terence Dermody , Victor DiRitaPublisher: LWW; Fifth, North American edition

10. Introduction to Modern Virology. (2001). 5th ed. Dimmock et al., Blackwell Sci. Publ.

11. Plant Virology. (2001). 4th edi. By R. Hull. Academic Press.

12. Fundamental Virology, 4th ed. (2001). D.M. Knipe and P.M. Howley.

13. Principles of Virology: (2000). by S.J. Flint et al., ASM Press.

14. Basic Virology, (1999). By Waginer and Hewelett, Black Well Science Publ.

15. Veterinary Virology. 3rd ed. (1999). Murphy et al., Academic Press.

16. Principles of Molecular Virology. (1997). 2nded. A. Cann. Academic Press.

17. Medical Virology. (1994). 4th edition. D.O. White and F.J. Fenner. Academic Press. Plant Virology. (2001). 4thed. By R. Hull. Academic Press.

18. Field's Virology Vol 1 and 2. B.N. Fields, D.M. Knipe, P.M. Howley, R.M. Chanock, J.L.Melnick, T.P. Monath, B. Roizman, and S.E. Straus, eds.), (2007) 3rd Edition. Lippincott-Raven,Philadelphia, PA.

19. Principles of Molecular Virology. (1997). 2nded. A. Cann. Academic Press. 20. Virology: (1994). 3rded. Frankel Conrat et al, Prentice Hall.

Subject Code:- DSE21MBT22 **Immunology (Credit=04)**

Topic No.	Topics	Lectures 60
	Unit –I	
1	**Immune system and Immune response**: Innate and acquired immunity, structure and functions of immune cells- NK cells, Macrophages, B cells T cells and subtypes, dendritic cells, neutrophils, basophils, eosinophils, and mast cells. Humoral and cell mediated immunity-components and significance. Organs of the immune system- Structural organization and functions of primary and secondary lymphoid organs. **Antigens and antibodies**: Structure and properties of antigens- iso- and allo-antigens, antigen specificity, haptens and adjuvants. Immunoglobulins- Structure, properties, types and subtypes. Affinity and avidity, class switching. Generation of immunological diversity- antibodies and TCR.	**15**
	Unit –II	
2	**Antigen recognition and Response**: Activation & Maturation T cell receptor – structure and diversity.MHC – types, structure, distribution, self- restriction. T and B cell activation. Maturation of lymphocytes – positive and negative selection, process of maturation. Antigen processing and presentation – cytosolic and endosomal pathways.T cell and NK cell – mediated lysis of cells, ADCC. Complement system – components, cascades.Cytokines – classification, properties and role as immunomodulators.	**15**
	Unit –III	
3	**Immunological tolerance-** types and mechanisms. Role of T regulatory cells in immunological tolerance and prevention of autoimmunity **Hypersensitivity reactions** : hypersensitivity reactions- types (I, II, III, and IV). **Autoimmunity**: Autoimmune diseases- Systemic lupus erythematosus, Multiple sclerosis, Myasthenia gravis, Rheumatoid arthritis Treatment of autoimmune disorders.	**15**
	Unit - IV	
4	**Antigen-antibody interactions** - Precipitation, agglutination and complement mediated immune reactions Advanced immunological techniques: RIA, ELISA, Westernblotting, ELISPOT assay, immune fluorescence microscopy,flow cytometry and immunoelectron microscopy; surfaceplasmon resonance. **Vaccinology:-** Active and passive immunization; live, killed, attenuated vaccines, subunit vaccines; recombinant vector vaccine , DNA vaccines, conjugate vaccines.	**15**

References:

1. Basic and Clinical Immunology by Stites Daniel P., Stobo John D., Frudenberg H.H., Wells J.V.
2. Biotechnology Application and Research by P. N. Cheremisinoff and R. P. Ouellette
3. Essential Immunology by Roitt Ivan M.
4. Fundamentals of Immunology 2nd ed. by Myrrik Quentin N. and Weiser Russell S.
5. Immunobiotechnology by Mahadev Sharma and Nirmal Tripathi
6. Immunology by I Kannan
7. Immunology 3rd ed. by Roitt I. M., Brostoff J., Male D. K.
8. Immunology 5th ed. by R. A. Goldsby, T. J. Kindt, B. A. Osborne, J. Kuby
9. Immunology II by Bellanti Joseph A.
10. Medical Immunology 9th ed. by Daniel P. Stites, Abba I Terr, Tristram G. Parslow.
11. Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.
12. Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.
13. Fundamentals of immunology 4th ed., Paul 1999, Lippencott Raven.

Practical DSC-PR-III - DSC21MBT29 Total 04 Credits

Techniques in Molecular Biology & Enzyme Technology

Techniques in Molecular Biology 02 Credits		
Sr No.	**Name of Practical**	**Type**
1	Eukaryotic DNA Isolation from Plant Material.	Major
2	Eukaryotic DNA isolation from Animal Material.	Major
3	Purification of DNA by silica membrane (solution based).	Major
4	Plasmid isolation from Bacteria.	Minor
5	Isolation of RNA from plant.	Major
6	SDS-PAGE for separation of protein using CCB.	Major
7	Genomic DNA isolation from bacteria.	Minor
8	Restriction digestion of DNA.	Minor
9	Silica Gel Extraction by spin column method.	Minor
10	Plasmid isolation by spin column method.	Minor
Techniques in Enzyme Technology 02 Credits		
1	Amylase Assay	Major
2	Isolation of α-Amylase from Germinating Seed.	Major
3	Study the effect of Substrate concentration on α-Amylase	Major
4	Effect of Temperature on α-Amylase	Minor
5	Effect of pH on α-Amylase	Minor
6	Isolation of β-Amylase from Sweet potato	Major
7	Effect of Activator on β-Amylase	Minor
8	Effect of Inhibitor on β-Amylase	Minor
9	Immobilization of Invertase	Minor
10	Study the effect of substrate Concentration on Invertase	Major
11	Purification of Protein/Enzyme By Ammonium Sulphate Precipitation	Minor
12	Study of enzyme activity of Nitrate reductase from plant	Major

Practical MIN-PR-IV Code: MIN21MBT29
Techniques in Immunology and Virology (02 Credits)

Techniques in Immunology		
Sr No.	**Name of Practical**	**Type**
1	Serum separation from blood and salting out of IgG by ammonium sulphate fractionation.	Major
2	RPR card test for syplilis,	Major
3	Demonstration of agglutination reaction: Slide haemagglutination (Blood grouping).	Major
4	Demonstration of precipitation reaction: Ouchterlony double diffusion, Single radial immunodiffusion.	Major
5	Determination of antigen concentration by Rocket electrophoresis	Minor
6	Enzyme linked immunosorbant assay (ELISA).	Minor
7	Qualitative detection of Rheumatoid factor in human serum	Minor
8	ASO test (For diagnosis of streptococcal infections)	Minor
Virology		
9	Demonstration of animal viruses' inoculation by chick embryo technique.	Minor
10	Isolation of bacteriophages from water/sewage sample using double agar layer technique.	Major
11	Enumeration of bacteriophages from water/sewage sample by plaque forming unit method. (PFU).	Major
12	Total DNA extraction from virus infected plant,	Major
13	Use of bioinformatics for viral genome analysis,	Minor