

Swami Vivekanand University, Sagar (M.P.)

As per model syllabus of U.G.C. New Delhi, drafted by
Central Board of Studies and Approved by Higher
Education and the Governor of M.P.



foKku I ædk;

Faculty of Science

Syllabus & Prescribed Books

Subject- Microbiology

M.Sc. Semester Examination

2016-18

I to IV Semester

dyl fpo

Loket foosdkuan fo' ofo | ky;] fl jkst k I kxj ¼e-i z½



COURSEWISE SCHEME

Ist SEMESTER

1. Course Code	: MSCMB	5. Total Practical	: 2
2. Course Name	: M.Sc. Microbiology	6. Total Practical Marks	: 100
3. Total Theory Subject	: 4	7. Total Marks	: 300
4. Total Theory Marks	: 200	8. Minimum Passing Percentage	: 36

Sub. Code	Subject Name	Theory										Practical		Total	
		Paper					CCE		Total Marks		Max.	Min.	Max.	Min.	
		1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.					
Compulsory															
MSCMB 101	General and Introductory Microbiology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 102	Immunology and Medical Microbiology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 103	Biostatistics and Computer Application	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 104	Tools and Techniques	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 105	Practical-I	0	0	0	0	0	0	0	0	0	50	18	50	18	
MSCMB 106	Practical-II	0	0	0	0	0	0	0	0	0	50	18	50	18	



M.Sc. FIRST SEMESTER

MICROBIOLOGY

PAPER I - General and Introductory Microbiology

- Unit I -** General account of prokaryotes: Origin & Classification of prokaryotes (numerical and molecular taxonomy)
- Unit II -** General characteristics, Occurrence of eubacteria (mycoplasma, rickettsiae, chlamydiae, spirochete, cyanobacteria and fungi) and archaeobacteria.
- Unit III-** Sterilization Preservation and Identification: Sterilization - Moist heat, Dry heat, Radiations, Chemical methods, Filtration. Preservation and biochemical identification of microorganisms using cytochemical & immunological methods.
- Unit IV-** Growth kinetics of bacteria, Nutrition-complex media, solid media, enrichment media, selective media, synthetic media. Types of culture-anaerobic culture, enrichment culture, pure culture, clonal culture, mixed culture, batch culture, continuous culture and synchronous culture. Growth measurement-Dry weight, optical measurement of cell mass, total cell count, biochemical and biomolecular measurement
- Unit V-** Viruses: General characteristics and structure of viruses, viral multiplication (Lytic and lysogenic), anti microbial agents, antibiotics and drug resistance, biological control.



M.Sc. FIRST SEMESTER

MICROBIOLOGY

PAPER II - IMMUNOLOGY AND MEDICAL MICROBIOLOGY

- Unit I -** Infection : Source of infection, vehicles of reservoir of infection, spread of infection. Types of infection, Predisposing factors, Host parasite relationship. Inflammation : Symptoms and mechanism, acute and chronic inflammation. History of immunology, growth of immunology as discipline.
- Unit II -** Immune Response : Innate immune mechanism, defence barriers. Adaptive or Acquired immune response. Anatomical organization of immune system: Primary lymphoid organs., secondary lymphoid organs. Cells of immune system: Mononuclear cells and granulocytes, antigen present in cells, T and B - lymphocytes and their subsets, Antigen and Hapten: Structure, properties and types Immunoglobulin, structure heterogeneity, types, subtypes and properties. Complement systems : Structure, component properties and function of complement, components. Biological consequence of complement activation. Antigen-Antibody reaction: Agglutination, precipitation, complement fixation, immunofluorescence assay (IFA), ELISA, RIA and Flow cytometry.
- Unit III-** Transplantation Immunology. Tumor Immunology Autoimmunity: Its mechanism and related disorders. Immunodeficiency diseases.
- Unit IV-** Major Histocompatibility Complex (MHC) and HLA Hypersensitivity: Definition and classification: IgE mediated hypersensitivity mechanism of mast cell degranulation. mediators of type 1 reactions and consequences.
Type 2 hypersensitivity - Antibody dependent cell mediated cytotoxicity (ADCC) and NK cell mediated cytotoxicity
Type 3 immune complex mediated and type 4 cell mediated or delayed type hypersensitivity, Cytokines and their role in immune responses. disease related to cytokines and their therapeutic uses
- Unit V-** Laboratory diagnosis of diseases caused by Bacteria Streptococcus Staphy...
..... Virus Herpes virus Rhinovirus.



M.Sc. FIRST SEMESTER

MICROBIOLOGY

PAPER III - Biostatics and computer applications

Unit I - Measures of central tendency : mean, median and mode, concept of dispersion, variants, standard deviation, coefficient of variation, skewness and kurtosis, correlation and regression for two variables.

Unit II - Probability : Definition and uses of probability. Probability distributions: Normal, binomial, poisson for one variant.

Unit III- Sampling methods: Simple and random sampling with out replacement. Test of significance based on small samples : X^2 (Chi-square) test, t-test and F-test, analysis of variants : one-way and two-way classification.

Unit IV- Fundamentals of computers : DOS commands : MS excel as a mean to calculate mean, mode, median, standard deviation, regression and plot curve fitting.

Unit V- Bioinformatics : use of computers in analyzing biological data, Internet : Advantage and applications.



M.Sc. FIRST SEMESTER

MICROBIOLOGY

PAPER IV - Tools and Techniques

Unit I - Microscopy : Specimen preparation for microscopy, Microbmetry, simple microscopy, phase contrast microscopy, fluorescence and electron microscopy.

Unit II - Characterization of biological macromolecules: Buffers and measurement of pH, centrifugation: principles and applications.

Unit III- Chromatography techniques: Principled, paper chromatography, thin layer chromatography, column chromatography gas chromatography, affinity chromatography; gel filtration.

Unit IV- Electrophoresis: Principles, moving boundry, zone (paper, gel etc), immunoelectrophoresis, isoelectric focusing.

Unit V- Electromagnetic spectum, Beer Lamberts law, absorbance, transmittance, extinction co-efficient, UV-VIS spectrophotometry, nuclear magnetic resonance, electron paramagnetic resonance, circular dichorism, atomic absorption spectrophotometry, manometry, polarography, radioisotopes tracer techniques.



COURSEWISE SCHEME IInd SEMESTER

1. Course Code	: MSCMB	5. Total Practical	: 2
2. Course Name	: M.Sc. Microbiology	6. Total Practical Marks	: 100
3. Total Theory Subject	: 4	7. Total Marks	: 300
4. Total Theory Marks	: 200	8. Minimum Passing Percentage	: 36

Sub. Code	Subject Name	Theory									Practical		Total	
		Paper					CC E		Total Marks		Max.	Min.	Max.	Min.
1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.				
Compulsory														
MSCMB 201	Microbiology Genetics and Recombination Studies	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCMB 202	Molecular Biology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCMB 203	Bimolecular Biomolecules	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCMB 204	Biochemistry	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCMB 205	Practical-I	0	0	0	0	0	0	0	0	0	50	18	50	18
MSCMB 206	Practical-II	0	0	0	0	0	0	0	0	0	50	18	50	18



M.Sc. Microbiology Syllabus

Semester - II

Paper-I Microbial Genetics and Recombination
Studies

Paper-II Molecular biology

Paper-III Molecular Biology

Paper-IV Biochemistry

Practical-I

Practical - II



M.Sc. Microbiology Semester - II

M.Sc. II - Semester

Paper - I

Microbial Genetics & Recombination studies

- Unit-I:** DNA as genetic material, structure of DNA and RNA, DNA replication (conservative and semi conservative replication), DNA polymerases, Conformational flexibility of DNA, structure of chromosome of eukaryotes,
- Unit-II:** Genetic recombination in bacteria transformation, transduction and conjugation, Use of transformation, transduction and conjugation in genetic mapping, preparation of genetic maps.
- Unit-III:** Sequencing of nucleic acids (Sanger's and Maxam and Gilbert's Method) genetic recombination and its prospects.
- Unit-IV:** Mutation-molecular mechanism of mutation, forward and reverse mutation, transition, transversion, induced mutation : radiations and base analogs, mutation frequency, application of mutagenesis.
- Unit-V:** Repair mechanisms, SOS, repair, post-transcriptional repair and dark repair.



M.Sc. Microbiology Semester - II

M.Sc. II - Semester
Paper - II
Molecular Biology

- Unit-I :** Genetic code, central dogma, transcription, reverse transcriptase exo and endo nucleases, RNA polymerases, synthesis of RNA in eukaryotes and prokaryotes, operators, exon and intron post transcriptional processing of RNA.
- Unit-II :** Translation and protein in eukaryotes and prokaryotes, t-RNA synthetase, activation in amino-acids, inhibitors of protein synthesis.
- Unit-III :** Gene expression, regulation of gene expression, operon concept, catabolite activator protein (CAP, positive and negative control and gene expression in prokaryotes, Lac operon and Tryptophan operon, Britto - Davidson model of gene regulation.
- Unit-IV :** Extrachromosomal genetic material : overlapping genes Transposons and silent genes, evolutionary significance of Silent genes, ribonucleoprotein,
- Unit-V :** Basics of recombinant DNA technology - vectors used in, recombinant DNA technology (plasmids, phages, cosmids, phageids, BAC, Yac) Genomic & c DNA Library Applications of recombinant DNA technology.



M.Sc. Microbiology Semester - II

M.Sc. II - Semester
Paper - III
Biomolecules

- Unit-I:** Physical properties of water and hydrogen bonding, ionization of water, weak acids and weak bases, pH and pK relationships, buffers, hydrophobic interaction.
- Unit-II:** Amino acid: structure of amino acids, classification and properties of amino acids, Henderson and Hesselbach equation for ionization of amino acids.
- Unit-III:** Synthesis of peptide bond, primary, secondary, tertiary and quaternary structure of proteins, amino acid sequencing of proteins, probes for protein confirmation.
- Unit-IV:** Lipids: saturated and unsaturated fatty acids, biosynthesis of fatty acids, distribution and functions of lipids in microorganisms, structural details of phospholipids, sphingolipids, steroids, carotenoids.
- Unit-V:** Lipid metabolism: biosynthesis and degradation of lipids by alpha oxidation, beta-oxidation and w-oxidation,



M.Sc. Microbiology
Semester - II

M.Sc. II - Semester
Paper - IV
Biocheistry

- Unit-I:** Oxidation and reduction reactions, standard redox potential, law of thermodynamics, entropy, enthalpy and free energy of reaction.
- Unit-II:** Enzymes: classification, active sites, holoenzyme, coenzyme, cofactor, regulation of enzymes, eactivattion, covalent modification, feedback inhibition, factors contributing to the catalytic efficiency of enzyme (mode of catalysis),
- Unit-III:** Enzyme kinetics : Reaction rate and derivation of Michaelis-Menten equation, Michaelis-Menten kinetics, Lineweaver-Burk plot, inhibition kinetics, isozymes.
- Unit-IV:** Carbohydrates: classification, physical, optical and chemical properties, chemical structure and properties of starch, cellulose and glycogen.
- Unit-V:** Carbohydrate metabolism: Kreb's cycle and EMP pathway, WDH (phosphokinase) pathway, glyoxylate cycle, regulation of glycogenolysis, gluconeogenesis and glycogenesis.



BOOKS RECOMMENDED : FOR SEMESTER II :

1. Lehinger, A.L. - Principles of Biochemistry. CBS Publishers & Distributors, New Delhi.
2. Fundamentals of Biochemisry-Dr. A.C. Deb
3. A Textbook of iochemistry- A.v.S.S.Rao
4. Strickberger, M.W. - Genetics, Printice Hall of India Pvt. Ltd. New Delhi.
5. Genetics - P.K. Gupta
6. Molecular Genetics - R.M. Shukla

Note : Practicals as per syllabus and availablity of facilities at institution.



COURSEWISE SCHEME IIIrd SEMESTER

1. Course Code	: MSCMB	5. Total Practical	: 2
2. Course Name	: M.Sc. Microbiology	6. Total Practical Marks	: 100
3. Total Theory Subject	: 4	7. Total Marks	: 300
4. Total Theory Marks	: 200	8. Minimum Passing Percentage	: 36

Sub. Code	Subject Name	Theory										Practical		Total	
		Paper					CCE		Total Marks		Max.	Min.	Max.	Min.	
1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.					Max.
Compulsory															
MSCMB 301	Bacteriology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 302	Virology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 303	Mycology & Parasitology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 304	Food and Industrial Microbiology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 305	Practical-I	0	0	0	0	0	0	0	0	0	50	18	50	18	
MSCMB 306	Practical-II	0	0	0	0	0	0	0	0	0	50	18	50	18	



MSc IIIrd SEMESTER MICROBIOLOGY

PAPER-I

BACTERIOLOGY

UNIT-I

1. Classification of microorganism: Haeckel's three kingdom concept.
2. Whitakers five kingdom concept : three domain concept of Carl woese.
3. Basis of microbial classification.

UNIT-II

1. Morphology and ultra structure of bacteria: cell wall of eubacteria.
2. Cell membrane: structure, composition and properties.
3. Antigenic properties, structure and function of capsule flagella cilia and Pilli.

UNIT-III

1. Bacterial nutrition: comman nutritional requirements, growth factor.
2. Transport of nutrients across the bacterial membrane.
3. Mode of nutrition: autotrophy and heterotrophy.

UNIT- IV

1. Cultivation of bacteria: aerobic and anaerobic.
2. Measurement of growth and factors affecting growth.
3. Growth of bacteria under extreme condition: thermophillus, halophillus.

UNIT-V

1. Physical control of micro organism: heat, filtration and radiation.
2. Chemical control of micro organism: halogens, phenols and phenolic compouncts, heavy metals, alcohols, ethylene oxide, aldehydes and hydrogen peroxide.
3. Sterilization by soaps, detergents and dyes.



MSc IIIrd SEMESTER MICROBIOLOGY

PAPER-II

VIROLOGY

UNIT: I

1. General morphology and ultra structure of viruses.
2. Viral genome: their types and structure.
3. Viral related agents: viroids and prions.

UNIT: II

1. Cultivation of viruses in embryonated eggs, experimental animals and cell culture: primary and secondary cell cultures, suspension cell cultures and monolayer cell cultures.
2. Various methods of virus detection: Haemagglutination, haemagglutination inhibition, complement fixation, IFA, ELISA, RIA.
3. Purification of viruses.

UNIT: III

1. Plant viruses: Recent advances in classification of plant viruses.
2. Life cycles and other details of TMV and cauliflower mosaic virus, potato virus x.
3. General idea about cyanophages.

UNIT: IV

1. Bacteriophage: classification, morphology and ultra structure.
2. One step growth curve (latent period, eclipse period and burst size).
3. Life cycle: lytic and lysogenic cycle of bacteriophages.

Unit: V

1. Animal viruses: classification and nomenclature.
2. Life cycles of DNA viruses: Herpes.
3. Life cycles of RNA viruses: AIDS and Oncogenic viruses
4. Viral vaccines



MSc IIIrd SEMESTER MICROBIOLOGY
Paper III
MYCOLOGY & PARASITOLOGY

UNIT-I

1. General features classification & nomenclature of fungi.
2. Structure reproduction vegetative, asexual and sexual structure of fungi,
3. Ecology of soil fungi cultivation of fungi, molds & their associate with other organism lichen, mycorrhiza, fungi as parasites of insects.

UNIT-II

1. Mycoses, classification of pathogenic fungi.
2. Isolation and identification of dermatophytes and keratinophilic fungi.
3. Immunology of dermatophytes, dimorphic fungi.

UNIT-III

1. The causative agent, source, pathogenicity & lab. diagnosis of the following: Candidiasis,
2. Cryptococcosis, Aspergillosis,
3. Histoplasmosis, Rhinosporidiosis, sporotrichosis

UNIT-IV

1. General characteristics immunity, occurrence, classification reproduction of protozoa.
2. protozoan diseases: Malaria, Amoebiasis, Leishmaniasis,
3. Sources, transmission, Laboratory diagnosis, prevention & control. Of above parasitic diseases

UNIT-V

1. General features, immunity and classification of helminthes.
2. Morphology and disease caused by Roundworms, Hookworms,
3. Host parasite interaction: its role in disease like Cancer and AIDS.



MSc IIIrd SEMESTER MICROBIOLOGY

PAPER-IV

FOOD AND INDUSTRIAL MICROBIOLOGY

- UNIT-I** Introduction of food microbiology: food spoilage, purification & decay microbial spoilage of various types of food: fish, meat, eggs, fruits and vegetables.
- UNIT-II** Harmful effects of bacteria moulds and bacterial toxins & mycotoxins, diseases caused by spoiled food: bacterial diseases: staphylococcal; salmonella and clostridium, causative foods of mycotoxicosis. methods of their control.
- UNIT- III** Beneficial effect of bacteria wine, beer, and fermented fruit juices. Microbiology of milk and milk products, source of micro organisms in milk their and classification microbiological examination of milk and milk products, standard plate count, microscopic count, reductase test.
- UNIT-IV** Principle of preservation , various methods of preservation of food products : low temperature, refrigeration & freezing cool & dry storage, canning of food, high temperature (dehydration & smoking). irradiation: principle, chemical preservation: acids, fungicidal such as sodium benzoate, propionates, acetates, sorbic acid etc
- UNIT-V** Industrial uses of bacteria, fungi and actinomycetes. microbial production of citricino acids, vitamins. Fermentation technology: its principle continuous cultivation of micro organisms, growth parameters and automation control.



COURSEWISE SCHEME IVth SEMESTER

1. Course Code	: MSCMB	6. Total Practical Marks	: 100
2. Course Name	: M.Sc. Microbiology	7. Project Marks	: 50
3. Total Theory Subject	: 4	8. Total Marks	: 350
4. Total Theory Marks	: 200	9. Minimum Passing Percentage	: 36
5. Total Practical	: 2		

Sub. Code	Subject Name	Theory										Practical		Total	
		Paper					CCE		Total Marks		Max.	Min.	Max.	Min.	
1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.					Max.
Compulsory															
MSCMB 401	Microbial Physiology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 402	Microbial Metabolism	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 403	Environmental Microbiology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 404	Microbial Interactions and Biotechnology	42	0	0	42	15	8	3	50	18	0	0	50	18	
MSCMB 405	Practical-I	0	0	0	0	0	0	0	0	0	50	18	50	18	
MSCMB 406	Practical-II	0	0	0	0	0	0	0	0	0	50	18	50	18	
MSCMB 407	Project Work	0	0	0	0	0	0	0	50	18	0	0	50	18	



M.Sc. Microbiology
Semester -IV
Paper -I Microbial Physiology

- Unit-I** Chemical potential of water, Diffusion, Ficke's law, quantitative estimation, Donnan equilibrium, factors affecting the diffusion, osmosis, osmotic pressure of electrolytes and non electrolytes.
- Unit-II** Passive and active transport, criteria of carrier mediated active transport, group translocation.
- Unit-III** Photosynthesis: oxygenic and non-oxygenic photosynthetic prokaryotes and non cyclic electron transport, photophosphorylation.
- Unit-IV** Calvin cycle, photorespiration, effect of light, temperature, pH and CO₂ on photosynthetic yield.
- Unit-V** Ecological role of methanogens sulfur reducing bacteria and pathway of sulfate utilization, acetogenesis and hydrogen production.

BOOKS RECOMMENDED:

1. The Physiology and Biochemistry of Prokaryotes by David White - Oxford University Press.
2. Microbial Physiology (III Edition) by Ian W Dawes and Ian W Sutherland - Blackwell Scientific Publication.
3. Microbial physiology by S.Ram Reddy & S.M Reddy -Scientific publishers (India).
4. General Microbiology (V Edition) by Roger Y.Stanier and John L. Ingram- M. Macmillan Education Ltd.
5. Microbial Physiology and metabolism by Daniel R. Caldwell - Wm. C. Press Publishers



M.Sc. Microbiology
Semester -IV
Paper -II Microbial Metabolism

- Unit -I** Respiration: Electron transport chain and proton pump, electron carriers, Chemical coupling, chemiosmotic theory, role of coupling factors.
- Unit-II** Use of proton pump in doing useful work, Oxidative phosphorylation (ATPsynthesis), substrate level phosphorylation, inhibitors of oxidative phosphorylation.
- Unit -III** Biological nitrogen fixation: free living and symbiotic nitrogen fixing prokaryotes, nitrogenase complex and its components, Mechanism of biological nitrogen fixation, genetic regulation of nitrogen fixation, inhibition of nitrogenase by oxygen.
- Unit -IV** Nitrogen metabolism: nitrate assimilation pathways in prokaryotes, transamination and deamination reactions.
- Unit -V** Methylophils, pathway of methanooxidation, property of methane monooxygenase, methanogens, process of methanogenesis.



Books Recommended :-

1. The Physiology and Biochemistry of Prokaryotes by David White-
Oxford University Press.
2. Microbial Physiology (III Edition) by Albert G.Moat and John W.
Foster - John Wiley & Sons.
3. General Microbiology (V Edition) by Roger Y.Stanier and John L.
Ingram-M. Macmillan Education Ltd.
4. Microbial physiology by S.Ram Reddy & S.M Reddy- Scientific
publishers (India).
5. Cell Physiology Source Book (II Edition) by Nicholas Sperelakis-
Academic press
6. Bacterial Metabolism (II Edition) by H.W. Doelle-Elsevier.



M.Sc. Microbiology
Semester -IV
Paper-III Environmental Microbiology

- Unit-I** Types of radiations: ionizing and non-ionizing, action of radiation, phenotypic and genotypic changes in the microbes after exposure to radiation, hazards of radiation and precaution from radiation hazards.
- Unit-II** Radioactive isotopes, preparation, labeling, detection and measurement of radioactivity, kinetics of radioactive disintegration.
- Unit -III** Microbiology of domestic and wastewater, DO, COD and BOD, treatment of effluents by biological means, waste stabilization ponds, composting, various approaches of studying pollution- heavy metal pollution, eutrophication, and biofertilizers.
- Unit-IV** Nutrient cycle like C, N, P, S, interactions among different microbial populations.
- Unit -V** Microbial degradation of cellulose, lignin and xenobiotics like pesticides and synthesis of polymers and recalcitrants.

BOOKS RECOMMENDED

1. Microbial Ecology Fundamentals and Applications (IV Edition) by Atlas/Bartha — Imprint of Addition Wesley Longman, Inc.
2. Environment and Pollution (An Ecological Approach) (III Edition) by R.S Ambasht & P.K Ambasht — CBS Publishers & Distributors, New Delhi
3. Practical Biochemistry Principles & Techniques (V Edition) by Keith Wilson & John Walker-Cambridge University Press.
4. Water & Waste Water Technology (II Edition) by Mark J. Hammer-Prentice Hall.



M.Sc. Microbiology
Semester -IV
Paper -IV

Microbial Interactions and Biotechnology

- Unit-I** Soil water and air environment, green house effect, thermal stratification in atmosphere.
- Unit-II** Microbial associations: symbiosis, commensalisms antagonism, mycorrhizal association, leaching of ores by microorganisms, dispersal of spores in air.
- Unit-III** Genetic engineering: recombinant DNA technology, gene cloning, selection of phage as vector, preparation of recombinants.
- Unit -IV** Southern, northern and western blotting, analysis of orientation and amplification of recombinant (PCR), prospects of genetic engineering.
- Unit-V** Fermentation industries , Selection of industrial microorganism Fermentation medium, Aeration , pH , Temperature , Batch and Continuous processes, Immobilised enzymes, Recovery methods , Quality control of industrial products, Production of human proteins, Vaccines and vitamins (B2,B12 and C)

BOOKS RECOMMENDED

1. Microbial Ecology Fundamentals and Applications (IV Edition) by Atlas/Bartha — Imprint of Addison Wesley Longman, Inc.
2. Practical Biochemistry Principles & Techniques (V Edition) by Keith Wilson & John Walker — Cambridge University Press.
3. Molecular Biotechnology Principles & Applications of Recombinant DNA) by Bernand R. Click & Jack J. Pasternek - Panima Publishing Corporation.

Note:-Practicals I & II will be based on Theory Paper I, II, III and IV.



Swami Vivekanand University, Sagar (M.P.)

