Sant Gadge Baba Amravati University, Amravati

Part B

Syllabus Prescribed for <u>Second</u> Year PG Programme

Programme: M.Sc. PART-II (MICROBIOLOGY)

M.Sc. PART II (MICROBIOLOGY) EXAMINATION (Semester –III)
Examination scheme under CBCS for the subject MICROBIOLOGY

Sr. No.	Paper/ Code	Course	Theory					Practical	
			Max. Marks (Credits)	Min. Passing Marks (Mi. Grade Pt.)	Internal Assessment (Credits)	Min. Pass Marks (Min. Grade Pt.)	Theory + Internal Assessment Passing Marks (Grade Pt.)	Max. Marks (Credits)	Min. Marks (Min. Grade Point)
1	2	3	4	5	6	7	8	9	10
1.	PAPER-IX [DSC, 3MCB1-C] MOLECULAR BIOLOGY	DSC (3MCB1C)	80 (03)	40 (03)	20 (01)	08 (01)	40 (04)	-	-
2.	PAPER-I-AEC [AEC, 3MCB1-A] MOLECULAR BIOLOGY	AEC (3MCB1A)	(01)	-	-	-	-	25 Internal	10
3.	PAPER-X -DSC [DSC, 3MCB2] GENERAL VIROLOGY	DSC (3MCB2)	80 (04)	40 (04)	20 (01)	08 (01)	40 (04)	-	-
4.	PAPER-XI [DSE, 3MCB3] FERMENTATION TECHNOLOGY	DSE (3MCB3)	80 (04)	40 (04)	20 (01)	08 (01)	40 (04)	-	-
5.	PAPER-XII [DSC, 3MCB4] IMMUNOLOGY	DSC (3MCB4)	80 (04)	40 (04)	20 (01)	08 (01)	40 (04)	-	-
6.	PRACTICAL-V [LAB-V] FERMENTATION TECHNOLOGY	LAB-V	-	-	-	-	-	100 (03)	50 (04)
7.	PRACTICAL-V [LAB-VI] IMMUNOLOGY AND MEDICAL MICROBIOLOGY	LAB-VI	-	-	-	-	-	100 (03)	50 (04)
8.		Internship/ Field work/ Work Experience							
9.	PAPER-XII [DSC, 3MCB4] IMMUNOLOGY	Open elective/ GIC/Open skill/MOOC (This will be offered by the Department to the students of other discipline)	-	-	-	-	-	-	-
10.	Total	Total	320 (16)	-	80 (04)	-	-	225 (06)	-

Total Marks 625, Total minimum and maximum credits 26.

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
3MCB1-C	MOLECULAR BIOLOGY	3 periods per week

PAPER-IX
[DSC, 3MCB1-C]
MOLECULAR BIOLOGY
Number of periods per week: 3.
Number of Credits: 3.

After completion of this course students will be able to:
CO1: Understand DNA replication.
CO2: Understand the genetic recombination, genetics and molecular organization and gene mutation.
CO3: Follow transcription and translation of protein synthesis.
CO4: comprehend the Regulation of gene expression and Gene regulation in eukaryotes

Unit-II	**DNA Replication:** i) Enzymes of DNA replication in prokaryotes and eukaryotes, replication mechanisms in prokaryotes, eukaryotes, and phages. ii) DNA repair mechanism	12 periods
Unit-III	**a) Genetic recombination**: Mechanism of genetic recombination, Transformation, Transudation, Conjugation and Transposable elements **b) Genetics and Molecular organization**: Genes concept, genome, Multigene families, Pseudogenes, split genes, overlapping genes, genetic code **c) Gene mutation:** Insertion deletion, frame shift and suppressor mutation, chemical and physical agents	11 periods
Unit-IV	**Protein Synthesis:** a) **Transcription:** RNA polymerases in prokaryotes and eukaryotes, process of transcription, concept of promoters and promoters types, enhancers and silencers and other regulatory elements, post transcriptional processing of tRNA, mRNA and tRNA, transcripts. Post transcriptional modification, spliceosome assisted and self-splicing of RNA transcripts. RNA dependent synthesis of RNA and DNA. b) **Translation:** Protein synthesis, Translational process and control of translation, post-translational modification (covalent modification, phosphorylation, glycosylation, mythelation etc. protein targeting and degradation, nonribosomal polypeptic synthesis Processing of RNA.	11 periods
Unit-V	**Regulation of gene expression:** Gene regulation in prokaryotes - operon concepts (Lac operon and trp, arabinose operon), Negative & Positive Control, Sigma factor, Post translational regulation, etc. **Gene regulation in eukaryotes-** Regulation at transcriptional and translational level, by gene rearrangement	11 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
3MCB1-A	MOLECULAR BIOLOGY	1 period per week

PAPER-IX
[DSC, 3MCB1-A]
MOLECULAR BIOLOGY.

Number of tutorial per week: 1.
Number of Credits: 1.

After completion of this course students will be able to:
CO1: comprehend thoroughly the structure, importance and role of nucleic acids.

Unit-I	**Nucleic Acids :** Importance of nucleic acid in living systems, general composition of nucleic acids, purine and pyrimidine bases, tautomeric forms of bases, reactions of purines and pyrimidines, structure of nucleosides and nucleotides, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and Crick model for DNA. Different types of DNA and RNA	15 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
3MCB2	**VIROLOGY**	4 periods per week

PAPER-X -DSC
[DSC, 3MCB2]
GENERAL VIROLOGY
Number of periods per week: 4.
Number of Credits: 4.

After completion of this course students will be able to:

CO1: Introduce to virology, understand general properties of viruses and Replication, perform viral assays etc.

CO2: understand virus-host interaction and signify the interferons and antiviral Agents

CO3: design and perform laboratory diagnosis of viral infections

CO4: follow the Structure, Pathogenesis, Laboratory Diagnosis & immunology of few viruses

Unit-I	**Fundamentals of Virology** **a) Introduction to Virology:** Historical aspects: nature of viruses; origin and evolution of viruses, terminology, differentiation with other microorganisms and Epidemiology. **b) General properties of Viruses:** Morphology, size, host specificity, viral structure, shape, Chemical properties, Susceptibility to physical and chemical agents **c) Nomenclature of viruses:** Baltimore classification. **d) Transmission of viruses:** Non-vector and vector mode of transmission of viruses.	12 periods
Unit-II	**Replication of Viruses:** **a)** Viral genomes **b)** Mechanism of virus attachment and entry into host cell **c)** Genome replication of viruses **d)** Transcription mechanism and posttranscriptional processing of viral mRNA **e)** Translation of viral mRNA **f)** Assembly, exit and maturation of progeny virions	12 periods
Unit-III	**Pathogenesis of viral infection:** a) Host and virus factor involved in pathogenesis. b) Stages of viral infection c) Host response to virus Infections: Interferon- Definition, types of interferons Types of inducer, induction of interferon, Mechanism of action of interferon	12 periods
Unit-IV	**Laboratory Diagnosis of Viral Infections:** **a)** Microscopy **b)** Cultivation of Viruses: Animal inoculation, Embryonated eggs and tissue-cultures (Human Embryonic Kidney cell culture, MKC, Human Amnion cell culture), Detection of virus growth in cell cultures **c)** Serological methods for detection of viruses. **d)** Detection of viral proteins and nucleic acids.	12 periods
Unit-V	**Control of virus** **a)** Antiviral drugs: classification, mechanism and clinical application **b)** Antiviral proteins and viral vaccines **c)** Photodynamic Inactivation of viruses **d)** Inactivation of viruses by chemical agents e) Interference of viral replication by intrinsic factors	12 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
3MCB3	FERMENTATION TECHNOLOGY	4 periods per week

PAPER-III
[DSE, MCB3]
FERMENTATION TECHNOLOGY
Number of periods per week: 4.
Number of Credits: 4.

Course learning outcomes (COs)
After completion of this course, students will be able to:
CO1: Design and classify the type of fermentors
CO2: Simplify the industrial production of antibiotics and anticancer drugs etc.
CO3: Categorize the food and beverage production.
CO4: Relate the food technology with microbiology
CO5: Demonstrate the biomass production for probiotics and probiotics

Unit-I	**Bioreactors:** Design and type of fermentors, unit operation and techniques, batch and continuous fermentations, evolution of bio-kinetics constants. Significance of bio-kinetic constants, Computer control of fermentation process.	12 periods
Unit-II	a) **Industrial production:** Penicillin, streptomycin, and tetracycline. b) **Anticancer drug:** interferons, anthracycline, L-apsparginas es. Biotechnological application for the production of rare biological molecules, antibiotics, vaccines, steroids, hormones and diagnostic kits	12 periods
Unit-III	**Food and beverage production.** a) Cottage & cheddar cheese, Yoghurt and *Dahi* b) Mycotoxin production c) Oriental food fermentations: 1) Koji 2) Soya Sauce 3) Miso, d) Single cell proteins, mycoproteins. e) Types of different alcoholic beverages and production of whisky.	12 periods
Unit-IV	**Food Technology:** a) Starter culture for food industries, b) Production and preservation of following fermented foods: i. Soya souse fermentation by moulds, ii. Fermented vegetables – Sauerkraut iii. Fermented Meat – Sausages iv. Production and application of Bakers Yeast v. Application of microbial enzymes in food industries. c) Food borne infection and intoxications, bacterial with examples of infective and toxic types: *Clostridium, Salmonella, Shigella, Staphylococcus, Compylobacter, Listeria.* **d) Quality assurance**: Microbiological quality of standard of food, Government regulatory practices and policies. FDA, EPA, HACCP, ISI.	12 periods
Unit-V	**A) Biomass Production :** **i) Bacterial biomass- production:** a) Bacillus megatherium	12 periods

	b) Acinebacter cerificans. **ii) Fungal biomass production:** Paecilomyces varioti by Pekilo process & Candida utilis from hydrocarbon. **B) Prebiotics and probiotics** a) Importance of probiotics b) Sources of Prebiotics c) Probiotics organisms d) Desirable characteristics e) Benefits of probiotics consumption	

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
3MCB4	IMMUNOLOGY	4 periods per week

PAPER-IV
[DSC, 3MCB4]
IMMUNOLOGY
Number of periods per week: 4.
Number of Credits: 4.

Course learning outcomes (COs)
After completion of this course, students will be able to:
CO1: Determine the role of basic immunology.
CO2: Formulate the relation between antigens and immunogenicity.
CO3: Illustrate the significance of clinical immunology.
CO4: Explain the hypersensitivity, conventional vaccines etc.
CO5: Design the immunobiotechnology & hybridoma technology.

Unit-I	**Basic Immunology**- Anatomic organization of the immune system cell types and organs. Effect of mechanisms involved in specific and nonspecific immune mechanisms. characters. Immune Response- primary, Secondary, Immunological memory.	12 periods
Unit-II	**Antigens, and Immunogenicity**, variation in antigenic Antibody and Immunoglobulins- Structure and functions of IgG, IgA, IgM, IgD, & Ig E., Antigen-Antibody reactions.	12 periods
Unit-III	**Clinical Immunology** - Complement system; classic and alternate pathways and functions,. Cell medicated immuncity. Immunological tolerance and Immunosuppression. Tumors Immunological. Autoimmunity and Autoimmune diseases,	12 periods
Unit-IV	A) Hypersensitivity, Immune deficiency diseases, MHC class Molecules. B) Conventional vaccines, peptide vaccine, subunit vaccine, genetically engineered vaccines, production and application of lymphokines. Antibody diversity, Immunogenetics.	12 periods
Unit-V	**Immunobiotechnology & Hybridoma Technology:** Immuni zation of animals, isolation of stimulated spleen cells, myeoloma cell lines used as fusion partners, fusion method, detection and application of monoclonal antibodies,	12 periods

Sant Gadge Baba Amravati University, Amravati

Syllabus Prescribed for Second Year PG Programme

Programme: M.Sc. (Microbiology)

Semester III

Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
LAB-V	Applied Microbiology	6 periods per week

PRACTICAL-V
[LAB-V]
Applied Microbiology
Number of periods per week: 6.
Number of Credits: 3.

Course learning outcomes (COs)
After completion of this course students will be able to:
CO1: Isolate antibiotic producing microbes
CO2: Develop techniques for preparation of fermented foods
CO3: Demonstrate media for SSF
CO4: Perform the assays of amino acids and vitamins
CO5: Produced tissue culture plant for biotechnological utility

A. Applied Microbiology

1.	Isolation of antibiotic producing organism from soil.
2.	Microbiological assay of antibiotics and purification by ion-exchange resin.
3.	Determination of kla for fermenter.
4.	Preparation of yoghurt, koji, cheese. Idli
5.	Preparation of Flavor and aroma.
6.	Solid state fermentation of some product.
7.	Microbiological assay of amino acids.
8.	Microbiological assay of vitamins.

B. Plant Tissue Culture

9.	Preparation of media for plant cell culture.
10.	Callus from explants.
11.	Haploid cell culture.
12.	Proto-plast culture.
13.	Educational tour and submission of report.

Code of the Course/Subject	Title of the Course/Subject (Laboratory/Practical/practicum/hands-on/Activity)	(No. of Periods/Week)
LAB-VI	IMMUNOLOGY AND CLINICAL MICROBIOLOGY	6 periods per week

PRACTICAL-VI
[LAB-VI]
IMMUNOLOGY AND CLINICAL MICROBIOLOGY
Number of periods per week: 6.
Number of Credits: 3.

Course learning outcomes (COs)
After completion of this course, students will be able to:
CO1: Isolate pathogens from clinical samples
CO2: Perform Isolation and identification of following pathogenic bacteria
CO3: Evaluate serological testing and perform diagnostic immunology
CO4: Prepare monoclonal antibodies
CO5: Develop techniques for hematology, parasitology etc.

1.	Diagnostic methods for isolation and Identification of pathogenic microorganisms from the following specimens: (a) Blood (b) Urine (c) Cerebrospinal fluid (d) Throat (Swabs) (e) Sputum (f) faeces (g) Pus and wound (infection) fluid.
2.	**Isolation and identification of following pathogenic bacteria:** (a) Staphylococcus aureus (b) Streptococcus pyogenic (c) Streptococcus pneumonia (d) Salmonella typhi and paratyphi A.B.C. (e) Shigella Species (f) Escherichia coli (g) Proteus vulgaris (h) Pseudomonas aeruginosa (i) Vibrio cholera (j) Mycobacterium tuberculosis (k) Clostridium titanic
3.	**Serology:** a) VDRL Test b) RPR test c) Kahn test d) Widal test e) C-Reactive protein f) Anti streptomycin-o g) R.A. Factor h) ELISA test i) Surface visual B-96 test (ELISA) j) Latex agglutination test (pregnancy test)
4.	**Diagnostic Immunology:** a) Double diffusion methods of ouchterolony b) immunoelectrophoresis c) Quantitative determination of plasma protein by immunoeletrop horesis. d) Single radial immunodiffusion. e) Estimation of antigen-antibody response by immunodiffusion technique. f) Estimation of antigen- antibody response by immunoelectropho resis.
5.	**Preparation of monoclonal antibodies.**
6.	**Hematology:** a) Estimation of HB, b) PCV c) Blood cell counts W.B.C. & R.B.C. d) ESR e) blood smear examination f) bleeding time g) clotting time h) prothrombin time i) prothrombine determination j) Lab. diagnosis of leukaeminias.
7.	**Study of medical Parasitology:**

	a) E. histolytica b) Trypanosomes c) Leishmania and d) Plasmodium
8.	**Stool Examination for:** a) Ova, cysts of intestinal parasite blood cell and pus cells b) Occult blood, c) Characteristics of the stool in amoebic and bacillary dysentery.
9.	**Antibiotic and chemotherapeutic agents:** a) Antibiotic sensitivity test. b) Assay of antibiotic level in the body fluids.
10.	**Routine examination of urine.**
11.	**Student seminar and submission of report.**

Part B

Syllabus Prescribed for <u>Second</u> Year PG Programme

Programme: M.Sc. PART II (MICROBIOLOGY)

M.Sc. PART II (MICROBIOLOGY) EXAMINATION (Semester –IV)
Examination scheme under CBCS for the subject MICROBIOLOGY

Sr. No.	Paper/ Code	Course	Theory					Practical	
			Max. Marks (Credits)	Min. Passing Marks (Mi. Grade Pt.)	Internal Assessment (Credits)	Min. Pass Marks (Min. Grade Pt.)	Theory + Internal Assessment Passing Marks (Grade Pt.)	Max. Marks (Credits)	Min. Marks (Min. Grade Point)
1	2	3	4	5	6	7	8	9	10
1.	PAPER-XIII [DSC, 4MCB1-C] BIOTECHNOLOGY.	DSC (4MCB1C)	80 (03)	40 (03)	20 (01)	08 (01)	40 (04)	-	-
2.	PAPER-XIV - AEC [DSC, 4MCB1-A] BIOTECHNOLOGY	AEC (4MCB2A)	(01)	-	-	-	-	25 Internal	10
3.	PAPER-XIV- DSC [AEC, 4MCB2] CLINICAL VIROLOGY	DSC (4MCB2)	80 (04)	40 (04)	20 (01)	08 (01)	40 (04)	-	-
4.	PAPER-XV [DSC, 4MCB3] MICROBIAL TECHNOLOGY	DSC (4MCB3)	80 (04)	40 (04)	20 (01)	08 (01)	40 (04)	-	-
5.	PAPER-XVI [DSC, 4MCB4] MEDICAL MICROBIOLOGY and/ or 2GIC-X (Student of Microbiology will take at other departments)	DSC/ DSE (4MCB4) and/ or 2GIC-X (Student of Microbiology will take at other departments)	80 (04) and/ or 80 (04)	40 (04) and/ or 40 (04)	20 (01) and/ or 20 (01)	08 (01) and/ or 08 (01)	40 (04) and/ or 40 (04)	-	-
6.	PRACTICAL-VII [LAB-VII] APPLIED MICROBIOLOGY AND BIOTECHNOLOGY RECOMBINANT DNA TECHNOLOGY	LAB-VII	-	-	-	-	-	100 (03)	50 (04)
7.	PROJECT [PROJECT]	PROJECT	-	-	-	-	-	100 (03)	50 (04)
8.		Internship/ Field work/ Work Experience							
9.	PAPER-XVI [DSC, 4MCB4] MEDICAL MICROBIOLOGY	GIC/Open skill/MOOC (This will be offered by the Department to the students of other discipline depending upon availability of space, time and expertise)	80 (04)	40 (04)	20 (01)	08 (01)	40 (04)	-	-
10.	Total	Total	320 (16) or and 80 (04)	-	80 (04) or and 20 (01)	-	-	225 (06)	-

Total Marks 625 or 725, Total minimum credits 26, maximum credits 31.

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
4MCB1	BIOTECHNOLOGY	4 periods per week

PAPER-XIII
[DSC, 4MCB1-C]
BIOTECHNOLOGY.
Number of periods per week: 4.
Number of Credits: 4.

Course learning outcomes (COs)
After completion of this course, students will be able to:
CO1: Use the methods of Genetic Engineering
CO2: Apply the genes cloning in prokaryotes & eukaryotes.
CO3: Comprehend the cloning strategies.
CO4: summarize the various concepts of bioinformatics.
CO4: familiarize with the Plant Biotechnology.

Unit-I	**Genetic Engineering** a) **Enzymes used in recombinant DNA technology:** Endonucleases, ligases, Enzymes to modify DNA molecules. b) **Vectors:** Plasmids, plant vector, bacteriophages, cosmids, phagmides, animal viruses, plants viruses, special vectors.	12 periods
Unit-II	**Genes cloning in prokaryotes & Eukaryotes:** Isolation of gene, Methods of gene transfer, Selection and screening of recombinant DNA, nucleic acid hybridization and clot curves, southern, northern and western blotting techniques, dot and slot blots, colony hybridization.	12 periods
Unit-III	**Cloning strategies**: **a)** Cloning from m-RNA and genomic DNA, synthesis of gene, gene probes, gene banks, gene libraries, mapping of gene, DNA sequencing, RFLP, DNA finger printing, site direct mutagenesis. **b)** Polymerase chain reaction & gene amplification.	12 periods
Unit-IV	**Plant Biotechnology:** a) Culture media and plant cell culture b) Tissue culture, micropropogation and somaclonal variation c) Production and use of haploid cell culture d) Protoplast culture, regeneration and somatic hybridization e) Gene transfer method in plants, transgenic plants and animals.	12 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
4MCB1-A	BIOTECHNOLOGY	1 Tutorial per week

PAPER-XIII [AEC, 4MCB1-A]
BIOTECHNOLOGY
Number of tutorial per week: 1.
Number of Credits: 1.

Course learning outcomes (COs)
After completion of this course, student will be able to:
CO1: apply the biotechnology in various fields.

Unit-V	**Application of Biotechnology:** a) Application in agriculture, plants and animal improvement. b) Enzyme biotechnology c) Protein engineering, immunotoxins and drug designing d) Metabolic engineering for over production of metabolites. e) Use of microbes in industry and agriculture f) Application to medical sciences, gene therapy, genetic counseling, diagnosis of diseases and phenomenon of ageing. g) Control of environmental pollution, recovery of minerals and restoration of degraded lands	15 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
4MCB2	CLINICAL VIROLOGY	4 periods per week

PAPER-XIV [DSC, 4MCB2]
CLINICAL VIROLOGY
Number of periods per week: 4.
Number of Credits: 4.

Course learning outcomes (cos)
After completion of this course, students will be able to:
CO1: Comprehend the in Plant Viruses.
CO2: Discuss the Bacterial Viruses.
CO3: Distinguish the Oncogenic Viruses (Tumor Viruses) and AIDS viruses.
CO4: Categorize Viroids and Prions.

Unit-I	**Plant Viruses:** **a) Plant Viruses:** Classification, life cycle and replication of tobacco mosaic virus (TMV), PVY, CMV, TSWV, CaMV **b) Viroids and Prions.**	12 periods
Unit-II	**Bacterial Viruses:** Life cycle, Structure and replication of following RNA and DNA phages: Ox174 phage, T4 phage; Lambda phage, MS2, Mu phage, M13phage, Cynophages, Mycoviruses.	12 periods
Unit-III	**DNA viruses:** **Structure, Pathogenesis, Laboratory Diagnosis & immunology of DNA-viruses:** Pox viruses, Herpes Simplex virus, Adenovirus, Hepatitis viruses	12 periods
Unit-IV	**RNA viruses:** **Structure, Pathogenesis, Laboratory Diagnosis & immunology of RNA-viruses:** Orthomyxoviruses, Paramyxoviruses, Rubella, Picorna viruses, Rabdo viruses	12 periods
Unit-V	**Emerging viruses:** **a) Non-Vector borne:** Human Immunodeficiency virus, Corona virus, Influenza virus **b) Vector borne:** Dengue, Chikungunya, Zika Virus, Ebola Virus. **c) Oncogenic viruses:** DNA and RNA oncogenic viruses.	12 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
4MCB3	MICROBIAL TECHNOLOGY	4 periods per week

PAPER-XV [DSC, 4MCB3]
MICROBIAL TECHNOLOGY
Number of periods per week: 4.
Number of Credits: 4.

Course learning outcomes (COs)
After completion of this course, student will be able to:
CO1: Categorize the in depth upstream and downstream processes in fermentation.
CO2: Distinguish the Modern trends in Microbial Productions.
CO3: Distinguish the Enzyme biotechnology.
CO4: Comprehend Fuel Biotechnology.
CO5: Apply Biofertilizers and Biopesticides in agriculture.

Unit-I	Isolation and screening of microorganisms, maintains of isolates/ strains, Inoculum developments, sterilization, strain improvement, process development, Downstream processing, In situ recovery of products. General scale up procedure Solid-state fermentations, Manufacturing cost estimation, Principal and general consideration in down stream processing.	12 periods
Unit-II	a) **Fermentation of acids:** Aspartic acid, L glutamic acid and Gluconic acid. **b) Modern trends in Microbial Productions:** Bioplastic (PHB, PHA) Biopolymer (Dextran, alginates, xanthan, Pullulan) **Fermentation Of enzymes and Amino acids:** Amylase, Protease. Riboflavin, cyanocobalamine,	12 periods
Unit-III	**Enzyme biotechnology:** Immobilization of enzymes - (glucose - isomerase) Methods, bioreactors and application in industry. Enzyme electro catalysis. Biosensors- Bioelectodes, Optrons, Immunological biosensors.	12 periods
Unit-IV	**Fuel Biotechnology**: Biofuels, Energy crops, Biogas, Bioethanol, Biobutanol, Biodiesel, Biohygrogen.	12 periods
Unit-V	**Biofertilizers and Biopesticides.** a) Basic concept: PSM, N2 Fixer, S-solubilizers etc, Ksolubilizers b) Biomass production c) Formulation (Carrier based, dried, liquid, and mixed inoculum) d) Application methods e) Inoculation quantity concept. f) Biopesticides: Bacterial, fungal, viral etc. g) Biocontrol mechanism, h) Preparation and application of Biopesticides	12 periods

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
4MCB4	MEDICAL MICROBIOLOGY	4 periods per week

PAPER-XVI [DSC, 4MCB4]
MEDICAL MICROBIOLOGY
Number of periods per week: 4.
Number of Credits: 4.

Course learning outcomes (COs)
After completion of this course, students will be able to:
CO1: categorize the Pathogenic bacteria, fungi and laboratory diagnosis.
CO2: analyze the Parasites and their laboratory diagnosis.
CO3: distinguish the extremophiles and apply those for socio-economic benefits.
CO4: apply Clinical Microbiology for human health.
CO5: perform waste water treatment.

Unit-I	**Host –Pathogen interaction:** a) General terminologies- Infection, invasion, ptahogens, pathogenicity, virulence, toxigenecity, opportunistic infection, nosocomial infection. b) Source and reservoir of infection c) Mode of transmission of infection d) Pathophysiological effect of Lipopolysaccharide e) Mechanism of pathogenicity f) Laboratory investigation of infection- types of specimens, microscopy, types of media, molecular techniques, Different techniques of typing, serological techniques	12 periods
Unit-II	**Pathogenic bacteria and laboratory diagnosis:** a) Gram Positive Pathogenic bacteria: *Staphylococci, Streptococci including pneumococci, Mycobacterium tuberculosis* and *M. leprea,Clostridium tetani,Coryneybacteria.* b) Gram Negative Pathogenic bacteria: *Escherichia, Klebsiella, Proteus, Salmonella, Shigella, Pseudomonas, Vibrio,Treponema*	12 periods
Unit-III	**Pathogenic fungi and their laboratory diagnosis:** a) Characteristic and classification of Fungi b) Pathogenic fungi and their laboratory diagnosis: *Candida albican, Cryptococcus neoformans, Blastomyces dermatitidis* and *Histoplasma capsulatum*. *Dermatophytes*	12 periods
Unit-IV	**Parasites and their laboratory diagnosis:** a) Protozoa: *Entamoeba histolytica, Leishmania donovani, Plasmodia species, Trypanosoma spp* b) *Helminths: Taenia saginata, Taenia solium, Echinococcus granulosus* c) *Nematods: Ascaris lumbricoides, Wuchereria bancrofti,Enterobius vermicularis*	12 periods
Unit-V	**Clinical Microbiology:** a) UTI, PUO, STD, Hospital acquired infections b) antimicrobial therapy, antibiotic resistance and its mechanism,	12 periods

	antimicrobial sensitivity testing c) Hospital waste management d) Prophylactic immunization	

Code of the Course/Subject	**Title of the Course/Subject**	**(Total Number of Periods)**
LAB-VII	APPLIED MICROBIOLOGY AND BIOTECHNOLOGY	6 periods per week

PRACTICAL-VII [LAB-VII]
APPLIED MICROBIOLOGY AND BIOTECHNOLOGY
Number of periods per week: 6.
Number of Credits: 3.

Course learning outcomes (cos)
After completion of this course, students will be able to:
Co1: Isolate the genomic DNA.
Co2: Demonstrate the DNA fingerprinting.
Co3: Differentiate between southern blotting and northern blotting.
Co4: Examine and estimate whole blood DNA extraction.
Co5: Enrich and recombinant DNA technology

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RECOMBINANT DNA TECHNOLOGY

1.	Agarose gel Electrophoresis
2.	Restriction Digestion of DNA
3.	DNA Ligation
4.	DNA Molecular size Determination
5.	DNA Fingerprinting
6.	Southern hybridization
7.	Restriction Mapping
8.	In vitro Transcription
9.	Southern Blotting
10.	Northern Blotting
11.	Plasmid preparation
12.	Genomic DNA isolation
13.	Gene Cloning
14.	Bacterial Gene expression
15.	Bacterial Transformation
16.	Bacterial Conjugation
17.	Bacterial Transduction
18.	Whole Blood DNA extraction
19.	Educational tour and submission of report.

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
Project	Project work	6 periods per week

Project Work-
Examination of Project work:
1. The examination should be held at the centres of practical examination.
2. There shall be panel of examiners including Head of the department and the Supervisor of the Student.
3. There should be at least 2 to 3 external examiners for a batch of up to 10 Students or 3 to 5 external examiners for a bach of more than 10 Students.
4. The Students should submit the project reporty within 20 days after the last/final theory paper in University examination.
5. The date of Viva-voce examination on project work should be within the 30 days after the completion of theory examination

Distribution of marks in Project work examination:

1. Evaluation of Project 40 marks, 2. Viva--voce 40 marks, (Jointely by internal and external examiners)
3. Internal Assessment 20 marks Total : 100 marks

Books recommended for complete programme of M.Sc. (Microbiology) New CBCS:

1. Biophysical Chemistry - Upadhyay&Nath (Himalaya Pub.)
2. Practical Biochemistry - Plummer (TMH Pub.)
3. Principal of Biochemistry - Lehninger (CBS Pub.)
4. Practical Biochemistry - Jayraman (Wiley Estern Pub.)
5. Physical Biochemistry - Morrison (Oxford)
6. Enzyme - Dixon &. Webb
7. Fundamentals of Enzymology - Lewis (Oxford)
8. Bacterial metabolism - A.H. Rose
9. Biochemistry - West & Toad
10. Out line of Biochemistry - Corn & Stump. (Wiley Eastern Pub.)
11. Soil Microbiology - Alexander (Wiley Eastern Pub.)
12. Genes VIII - Lewin (Oxford)
13. Element of Biotechnology - P.K. Gupta. (Rastogi Pub.)
14. Fundamentals of Biotechnology - Purohit&Mathur (Agro Bot. Pub.)
15. Essentials of molecular biology - Freifelder D. (Narosa Pub.)
16. A textbook of biotechnology - Duby (S. Chand Pub.)
17. Molecular Biology - Freifelder D. (Narosa Pub.)
18. Microbial Genetics - Freifelder D. (Narosa Pub.)
19. Text Book of Molecular Biology - Shastry& Other (Macmillan)
20. Hand Book of Tissue Culture (ICAR Pub.)
21. A textbook of Biotechnology - H.D. Kumar (E.W. pub.)
22. Basic Biotechnology Rev. Iganacimuthu (TMH Pub.)
23. Plant viruses - Mandahar (S. Chand & Co.)
24. Microbiology Lewis. (Harper)
25. Microbiology - Fundamentals & Application - Purohit. (Agro Botanical Pub.)
26. Industrial Microbiology - Casida (Wiley Eastern pub.)
27. Press Scott and Dunn's Industrial Microbiology.
28. Microbiology - Anantnarayan&Panikar (Orient Longman)
29. A text book of Microbiology, — P. Chakraborty (Central Pub.)
30. Medical Microbiology - Ichhapunani& Bhatia (J.P. Brothers)
31. Essential of Medical Mycology - Evans & Genitals (Churchill and Livingston)
32. Genetics by Strickbeger (Prentice Hall)
33. A short textbook of recombinant DNA technology Watson. (Black Well)
34. Molecular Biotechnology - Prime Rose - (Black Well.)
35. Immunology by Shetty - (Wiley Eastern Pub.)
36. Molecular biology of genes. Watson - (Begamin Cumming)
37. Recombinant DNA technology - Rodriguez (Begamin Cumming)
38. Advances in molecular genetics. Puhlar. (Begamin Cumming)
39. Molecular cloning - A lab manual. (Cold spring harbor lab pub.)
40. Concept of molecular biology - Rastogi (Wiley Eastern Pub.)
41. Genetic Engineering - SandhyMitra (Macmillan)
42. Elementary Microbiology Vol. I Vol. II (Fundamental of microbiology and microbial world) Ed. by. H.A. Modi. (AktaPrakashan)
43. Applied microbiology. Ed. by H.A. Modi. (AktaPrakashan)
44. Environmental Microbiology. Ed. by H.A. Modi (AktaPrakashan)

45. Fundamentals of Dairy Microbiology by J.B. Prajapati (AktaPrakashan) 46. Bio-Fertilizer.By Vyas&Modi (AktaPrakashan) 47.Biochemistry.By D. Das (Academic Pub.) 48. Biophysics & Biophysical Chemistry. By D. Das.(Academic Pub.)
49. Modern Immunology. By A. Das Gupta (Jaypee Pub.)
50. A textbook of microbiology by P. Chakraborty (New Central Book Agency)
51. Principal of gene manipulation by Old & Prim Rose (black well pub.)
52. Agricultural microbiology by Rangaswami&Bagyaraj (PHI)
53. An introduction to recombinant DNA by A.E.H. Emery (ELBS)
54. Concepts in Biotechnology by D. Bakasubramuniam and other (University Press.)
55. Introduction to genetics Engineering by D.S.T Nicholl (Cambridge)
56. Genetics by P.K. Gupta (Rastogi Pub.) 57. Genetics by SandhyaMitra (TMH)
58. Applied plant biotechnology by Iganacimuthu (TMH)
59. Immunodiagonostics S.C. Rastogi (Wiley Eastern Pub.)
60. Immunology by Roitt. (Black well)
61. A textbook of Microbiology. R.C.Dubey and D.K.Maheshewari.(S.Chand& Company) 62.Genetics - A.V.S.S. Sambamurty (Narosa Pub.)
63. Concept of Molecular Biology. P.S.Varma& V.K. Agrawal. (S.Chand& Company)
64. General Microbiology S.B. Sullia and S. Shantharam. (Oxford & IBH)
65. Modern Concept of Biotechnology. H.D.Kumar (Vikas Pub.)
66. Fundamentals of Enzymology - Price and Steven (Oxford Sci.Pub.)
67. Gene VII - Lewis (Oxford Science Publication)
68. Molecular Cell Biology, Berk, Lipursky, Baltimore, Darnell and Matsuduira (W.H. Freeman and Company)
69. Biotechnology - Rhem and Reead
70. Standard method s of Biochemical analysis - S.R. Thimmaiah (Kalyani Publisher).
71. Laboratory Manual of Bacterial Genetics - Institute of Microbial Technology - Chandigarh.
72. A textbook of Industrial Microbiology - WulfCrueger and AnnekieseCruger (Panima Publishing Corporation)
73 An Introduction to electrophoresis - K. Anbalgan (The Electrophoresis Institute, Salem Dist.S. India.)
74. Waste water microbiology - GabrianBitton (John Wiley & Sons)
75. Environmental Microbiology - Ralph Mitchell (John Wiley and Sons).
76. Microbial Biotechnology - Fundamentals of applied Microbiology - Alexander N. Glazer, and Hiroshi Nikoidu (W.H. Freeman and Company)
77. Gene structure and expression - John D. Hawkins (Cambridge University Press)
78. Biotechnology - John G. Smith, (Cambridge University Press)
79. Plant Biotechnology - S. Ignacimuthu S.J. (Oxford and IBH, New Delhi)
80. Advanced molecular biology - R.M.Twyman (Viva book Pvt.Ltd.)
81. Introductiory Microbiology - J.Heritage, E.G.V. Evans and R.A.Killington (Cambridge University Press)
82. General Microbiology - Schiegel (Cambridge University Press)
83. Gene Structure - Hawkins (Cambridge University Press)
84. Modern Concepts of Biotechnology - H.D.Kumar, (Vikas Publishing Pvt.Ltd.)
85. A textbook of Microbiology - R.C.Dubey and D.K.Maheshewari (S.Chand& Company) 86. Biotechnology - Applications and Research - Edited by Paul Cheremisinoff and Robert Ouellete (TechnomicPub.Co.Inc.)
87. Basic and Clinical Immunology - Daniel Stites, Abba Terr&TristramParslow (Prentice Hall International INC)

88. A Text Book of Biochemistry with Clinical correlation - Edited by Thomas Devlin (John Wiley and Sons, INC).
89. Microbiology Laboratory - Fundamentals and Application, George Wistreich (Prentice Hall)
90. Microbiology - A Laboratory Manual - James Cappucino and Natalic Sherman (The Benjamin / Cummings Pub.Co.Inc.)
91. Foundations in Microbiology - Kathleen Talaro& Arthur Talaro (Wm.C. Brown Publishers)
92. Principles of Microbiology - Ronald Atlus Mosby.
93. Fundamentals of Microbiology - Alcamo (Benjamin / Cummings Pub.Co.Inc.)
94. Sale and Molecular Biology - Concepts and experiments - Gerald Karp (John Wiley and Sons, INC).
95. Cellular and Molecular Immunology - Abul Abbas, Andrew Lichman& Jordan Pober (W.B.Saunders Co.)
96. Biochemistry-Zubay (WmC.Brown Publishers)
97. Life-An Introduction to Biology - Beck, Liem& Simpson (Harper Collins Publishers)
98. Genetics - A.V.S.S. Sambamurthy (Narosa Publication)
99. Water Pollution - V.P.Kudesia, (PragatiPrakashan Meerut)
100. Physicochemical Examination of Water, Sewage and Industrial waste - N. Maniwasakam (PragatiPrakashan, Meerut)
101. Textbook of Biochemistry - O.P.Agrawal, G.R.Agrawal (Goel Publishing House, Meerut)
102. Textbook of Medical Mycology - JagdishChander (Interprint, New Delhi)
103. An introduction to Plant tissue and Cell culture - N.C.Kumar (Emkay Publication Delhi) 104. Short Protocols in Molecular Biology - Edited by Ausubel, Brent, Kingston, Moore, Seidman, Smith and Struhl (John Wiley and Sons)
105. Molecular Cell Biology - Dernell, Lodish and Baltimore, (Scientific American Books) 106. Technological Applications of Biocatalysts - Published on behalf of Open University and University of Greenwich (ButterworthHeinemann).
107. Microbiology-Principle and Explorations - J.G.Black (John Wiley and Sons)
108. Techniques for engineering Genes - Published on behalf of Open University and University of Greenwich (Butterworth-Heinemann).
109. Biotechnological Innovations in Energy and Environmental management - Published on behalf of Open University and University of Greenwich (Butterworth-Heinemann).
110. Medical Microbiology - Mims, Playfair, Roitt, Wakelin and Williams (Mosby)
111. Principles of Enzymology for the Food Sciences (John Whitaker, Marcel Dekker, Inc.)
112. Biostatistics - A Foundation for analysis in Health Sciences - W.D.Daniels, John wiley and Sons.
113. Basic Statistics - C, Dunn
114. How Computers Works - Ron White, Techmedia.
115. How the Internet works - Preston Gralla, Techmedia.
116. Bioinformatics - 1998 - Baxevanis
117. Bioinformatics - 2000 – Haggins & Taylor OUP.
118. Fundamentals Biostatistics- Sadguru Prakash, Emkay Publication, New Delhi.
119. Bioinformatics for Beginners - Dr.K.Mani & N. Vijayraj (KalaiKathirAchchagani Pub. Coimbatore)

120. Instant Notes - Bioinformatics - West head, Parish and Twyman (Viva Publication) New Delhi.
121. Schaum's Outlines - Biochemistry, Kuchel& Ralston (TMH Edition)
122. Schaum's outlines - Microbiology (TMH Edition)
123. Schaum's outlines - Molecular and cell Biology (TMH Edition)
124. Principles of Genetics - R.H.Tamarin (TMH Edition)
125. Biotechnology DNA - Protein A Laboratory project in molecular Biology. Thiel, Bissen& Lyons (TMH Edition)
126. General Enzymology, Kulkarni and Deshpande, Himalaya Publishing House.
127. Modern Approaches to Soil and Agriculture and Environmental Microbiology, Shiva Aithal and Nikhilesh Kulkarni, Himalaya Publishing House.
128. Amol Nagrale and Pooja Mankar (Editor: Deshpande, A.R., Patil, Y. and Shrivastava R.) Applied Microbiology and Biotechnology Practical handbook Published by My rays book publication centre, powered by International Journal of Microbial Science
129. Mayur Thakre , Deepika Jain and Priyanka Jangid (Editor: Dr. V. D. Nanoty, Dr. A. R. Deshpande, Dr. R. R. Pachori) MSc II Semester III practical VI (Immunology and Medical Microbiology) Practical handbook Published by My rays book publication centre, powered by International Journal of Microbial Science.
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133. Dr. Anand Pande, Ms.Abhilash Deshmukh,Dr.Swati Zodpe,Dr.Harish Malpani and Dr. Dipika Jain MSc I Semester I practical I (Soil Microbiology) Practical handbook Published by My rays book publication centre, powered by International Journal of Microbial Science.
134. A textbook of Comprehensive Virology- Dr. N. S. Kulkarni, Dr. Shiva Aithal, Dr. R. D. Joshi published by Himalaya Publishing House