SYLLABUS

FOR

M.Sc. SEMESTER PATTERN IN

MICROBIOLOGY

GONDWANA UNIVERSITY

GADCHIROLI

INDIA

M.Sc. Microbiology III & IV Semester

SYLLABUS
FOR
M.Sc. SEMESTER PATTERN IN MICROBIOLOGY SUBJECT, GONDWANA UNIVERSITY, GADCHIROLI (M.S.) INDIA

SEMESTER – III (THEORY)

PAPER - I	MB3-T009	GENETICS AND MOLECULAR BIOLOGY (GMB)	80
PAPER - II	MB3-T010	RECOMBINANT DNA TECHNOLOGY (RDT)	80
PAPER - III	MB3-T011	BIOPROCESS TECHNOLOGY (BT)	80
PAPER - IV	MB3-T012	FOOD MICROBIOLOGY AND FOOD SAFETY (FMFS)	80
INTERNAL ASSESSMENT ON EACH THEORY PAPER			20

PRACTICALS

PRACTICAL - V	MB3-LAB5	PRACTICAL	80+20
PRACTICAL - VI	MB3-LAB6	PRACTICAL	80+20
SEMINAR	MB3-INT3		25

SEMESTER – IV (THEORY)

PAPER - I	MB4-T013	MEDICAL MICROBIOLOGY AND PARASITOLOGY (MMP)	80
PAPER - II	MB4-T014	VIROLOGY (VIR)	80
PAPER - III	MB4-T015	IMMUNOLOGY (IMM)	80
PAPER - IV	MB4-T016	BIOSTATISTICS AND BIOINFORMATICS (BBI)	80
INTERNAL ASSESSMENT ON EACH THEORY PAPER			20

PRACTICALS

PRACTICAL - VII	MB4-LAB7	PRACTICAL	80+20
PROJECT/DISSERTATION			80+20
SEMINAR	MB4-INT4		25

GONDWANA UNIVERSITY, GADCHIROLI
SEMESTER SYSTEM SYLLABUS
FOR M. Sc. Microbiology (Semester III & IV)
(With effect from Academic Session 2013-14)
Structure of M. Sc. Microbiology Syllabus, Semester System, Theory paper and Internal Assessment

Semester	Title of Paper	Work Hrs.	Marks
Semester III	Paper I: Genetics and Molecular Biology (GMB)	04	80
	Paper II: Recombinant DNA Technology (RDT)	04	80
	Paper III: Bioprocess Technology (BT)	04	80
	Paper IV: Food Microbiology and Food Safety (FMFS)	04	80
	Internal assessment on each theory paper		20
	Total	16	400
Semester IV	Paper I: Medical Microbiology and Parasitology (MMP)	04	80
	Paper II: Virology (VIR)	04	80
	Paper III: Immunology (IMM)	04	80
	Paper IV: Biostatistics and Bioinformatics (BBI)	04	80
	Internal assessment on each theory paper		20
	Total	16	400

GONDWANA UNIVERSITY, GADCHIROLI
SEMESTER SYSTEM SYLLABUS
FOR M. Sc. Microbiology (Semester III & IV)
(With effect from Academic Session 2013-14)
Structure of M. Sc. Microbiology Syllabus, Semester System, Practical & Seminar

Semester	Practical & Seminar	Work Hrs.	Marks
Semester III	Practical V	08	100
	Practical VI	08	100
	Seminar	02	25
	Total	18	225
Semester IV	Practical VII	08	100
	Project/Dissertation	08	100
	Seminar	02	25
	Total	18	225

MASTER OF SCIENCE (MICROBIOLOGY)
TWO YEAR (FOUR SEMESTERS) DEGREE COURSE

Sr. No	Semester	Paper	Course code	Title of paper	Teaching scheme			Examination scheme							
					T (hr)	P (hr)	Total Periods / week	Dur. Of paper (Hrs.)		Max. Marks		Min. Pass Marks		Total Marks / Credits	
								T	P	External Mark	Internal Mark	T	P	T	P
1	**III**	**I**	MB3-T009	Genetics and Molecular Biology	4		4	3		80	20	32		**100/4**	
2	**III**	II	MB3-T010	Recombinant DNA Technology	4		4	3		80	20	32		**100/4**	
3	**III**	III	MB3-T011	Bioprocess Technology	4		4	3		80	20	32		**100/4**	
4	**III**	IV	MB3-T012	Food Microbiology and Food Safety	4		4	3		80	20	32		**100/4**	
5	**III**		MB3-LAB5	Practical		8	8		8*	80	20		40		**100/4**
6	**III**		MB3-LAB6	Practical		8	8		8*	80	20		40		**100/4**
7	**III**		MB3-INT3	Seminar	2		2			25			10	25./1	
8				**Total**	**18**	**16**	**34**			**505**	**120**			525	200
9	IV	**I**	MB4-T013	Medical Microbiology and Parasitology	4		4	3		80	20	32		**100/4**	
10	IV	II	MB4-T014	Virology	4		4	3		80	20	32		**100/4**	
11	IV	III	MB4-T015	Immunology	4		4	3		80	20	32		**100/4**	
12	IV	IV	MB4-T016	Biostatistics and Bioinformatics	4		4	3		80	20	32		**100/4**	
13	IV		MB4-LAB7	Practical		8	8		8*	80	20		40		**100/4**
14	IV			Dissertation/Project		8	8		8*	80	20		40		**100/4**
15	IV		MB4-INT4	Seminar	2		2			25			10	25./1	
16				**Total**	**18**	**16**	**34**			**505**	**120**			525	200

Note: T= Theory; P= Practical/lab, * = If required, for two days.
Minimum marks for passing 40 out of 100 in each Theory paper
Minimum marks for passing 40 out of 100 in each Practical/Lab and Project work and minimum of 10 out of 25 in the internal (seminar) examination of that semester.
Internal Assessment on each theory paper 20 marks.

MASTER OF SCIENCE (MICROBIOLOGY)

TWO YEAR (FOUR SEMESTERS) DEGREE COURSE

A) Pattern of Question Paper

1. Four units in each paper.
2. One question on each unit.
3. Fifth question on all units.
4. Maximum marks of each paper 80
5. Internal assessment on each theory paper 20 marks
6. Projects shall be evaluated by internal and external examiners. 50% marks of project shall be given by internal and external examiners each.
7. Duration of question paper is 3 hours.
8. Practical/lab examination of 100 marks. Distribution of marks shall be 20 internal and 80 external.

General Instructions/Directions.

Each paper is supposed to cover minimum 60 clock hours of teaching and 240 clock hours per semester for all the four papers.

Each Question paper shall have five questions with equal marks/credits.

There will be four long questions one question from each unit. A long question can be subdivided into two short questions.

Fifth question shall comprise of four very short question one question of each unit.

There shall be internal choice from each unit on first four question and fifth question is compulsory

Practical examination shall be of minimum 12 hours and may spread over two days,

There shall be at least one major and two minor experiments in the practical examination

Minimum passing marks are per the marks/credit annexure.

Every student shall be required to participate in educational/industrial tour atleast once during PG course.

SEMESTER III

Paper- I
Genetics and Molecular Biology (GMB)

MB3-T009

Unit -I: Replication, Repair and Recombination

General concept of Genes, Genome, Recon, Cistron, muton, overlapping genes, genes within genes.

Replication—i) Initiation, priming in prokaryotes and eukaryotes, ii) Elongation of DNA chain, holoenzyme, processivity of replication, sub units of DNA pol-III,iii)Termination of replication in prokaryotes and eukaryotes iv) DNA repair:-BER,NER and Photoreactivation.

Unit -II: Gene Expression

Genetic code-Basic features

Transcription:- i) Comparative study of prokaryotic and eukaryotic transcription ii)Promoter classes I,II,III,-35 and -10 sequences, iii)RNA Polymerase, iv) Interaction of RNA polymerase with promoter. Initiation of RNA synthesis and promoter escape, v) Elongation of RNA chain. Enhancers and silencers, general and specific factors, vi)Termination of transcription—Extrinsic and intrinsic.

Post-transcriptional events:- mRNA, rRNA and tRNA processing through splicing mechanism, trans splicing , RNA editing, post transcriptional control of gene expression, RNA interference, catalytic RNA and anti-sense RNA.

Translation—Initiation, elongation and termination, mechanisms, Post translational modifications. chapperons.

Unit -III: Gene Regulation

Operon concept

Lac operon, *Arabino* and *trp* operon

Chromatin remodeling and mRNA and protein degradation control

Regulation of translation—Autogenous control of r-proteins, PhageT_4 Proteins, p32 translational regulation

Unit -IV: Gene Recombinations

Gene recombinations -Preliminary concept

Recombinations in microbes—transformation, conjugation and transduction

Gene mapping in bacteria by –transformation, conjugation and transduction

Mapping bacteriophage gene by recombination analysis, deletion mapping and complementation.

Transposons:- Bacterial P elements and retroposons

SEMESTER III

Paper- II
Recombinant DNA Technology (RDT)

MB3-T010

Unit I: Techniques and Enzymes in Genetic Recombination

Core techniques and enzymes in genetic recombination: restriction endonucleases,type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleses, their activity, DNA ligase: properties and specificity, SI nuclease, BAL-31nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase, its activity and mode of action, chemical synthesis of DNA, restriction digestion, ligation and transformation.

Unit II: Cloning Vectors

Basic strategy of cloning-vectors (lambda gt10, gt11Bacteriophage, lambda replacement vectors, phage P1 vector, BACs, YACs, DNA cloning with single stranded DNA vectors, (M13 vectors), Cosmids, plasmid as a vector for gene cloning, phasmids and other advanced vectors, specialist purpose vectors for amplification and for expression (pETvector, pBAD vector), cloning and selection of individual gene, gene libraries: cDNA and genomic libraries, concept of library construction, differences and ideal examples of each library

Unit III: Specialised Cloning Strategies

Expression vectors, promoter probe vectors, vectors for library construction-artificial chromosome, recombinant DNA technology with reference to cloning and production of interferon and insulin, Miscellaneous applications of genetically engineered microorganisms (GEMS)/ genetically modified organisms (GMOs)

Unit IV: PCR and DNA Sequencing Method

PCR- principle and procedure, optimization of PCR, Designing of primers, identification of PCR products, variation in basic PCR- inverse, asymmetrical, multiplex, hot start, ligation mediated, RT, real-time quantitative PCR, DD PCR and immune PCR, applications of PCR

DNA sequencing method-dideoxy and chemical method, sequence assembly, automated sequencing, genome sequencing and physical mapping of genomes

SEMESTER III

Paper- III

Bioprocess Technology (BT)
MB3-T011

Unit -I: General Principles of Fermentation

Fermentations and Types- Definition of fermentation, industrial fermentations, classification of industrial fermentations based on different criteria

Concept of batch and continuous fermentation, mode of conduct of continuous fermentation and its type. Examples of growth associated and non growth associated fermentations.

Bioreactors- i) materials used in construction of fermentors, ii) design and parts of batch fermentor, their functions, iii) Geometry of fermentor , propellers, aerators their types, iv) types of bioreactors –plug flow reactors, CSTR, loop reactors, air-lift, fedbatch, fluidized bed reactors, rotary disc reactors, solid-state fermentors.

Process optimization—Mass and heat transfer, Kl_a, factors affecting oxygen transfer-rotational speed, rheology, liquid density, oxygen transfer rate , oxygen requirement, Newton number, Reynold number, Power number, mean resistance time, substrate utilization rate, oxygen snag, yield coefficient.

Fermentation Kinetics—Growth kinetics and Monods model, specific growth rate , growth limiting substrates , growth yield and kinetics of product formation.

Immobilized systems ,kinetics of immobilized reactors.

Unit -II: Down Stream Processing and Scale Up

Basic principles of scale up working parameters, geometric constants, Pi-relations.

Productivity , power requirements.

Downstream processing- i) Bioseperation—filtration, types of filters, membrane filters , centrifugation , sedimentation, flocculation. ii) Purification--- solvent extraction- concurrent & countercurrent extractors with examples. Distillation—single stage and fractional iii) Chromatographic techniques—ion exchange, affinity, gel filtration ,adsorption chromatography, principles and applications with examples. iv) Concentration , crystallization, reverse osmosis, ultrafiltration with one example each. v) Drying- techniques and process with example, Storage and packaging.

Unit -III : Industrial Fermentations

Biofuels—Ethanol from different sources such as saccharine, cellulosic, starchy waste by using *Saccharomyces cerevisiae* & *Zymomonas mobilis*, r-DNA technology for ethanol production. Methane production.

Antibiotics—production of Streptomycin, Chloramphenicol, Cephalosporine

Biopreservatives – *L.sakei* , polyhydroxyalkanotes,

Biopolymers- Dextrans, xanthan

Steroid transformations

Unit -IV: Industrial Production of Enzymes, Acids and Growth Factors

Amylases—Deep tank and solid state fermentation and applications

Glucose oxidase – production and applications

Lactic acid from whey and its applications, vinegar

Vit-B_{12}

Riboflavin

Gibberlins

Carotenoides

SEMESTER III

Paper- IV

Food Microbiology and Food Safety (FMFS)

MB3-T012

Unit -I: Food Spoilage

Introduction to food spoilage
Factors affecting food spoilage in general.
Spoilage of vegetables and fruits -factors and effects.
Spoilage of meat and meat products-factors and effects.
Spoilage of poultry products-factors and effects.
Spoilage of canned foods- meat and milk products- factors and effects.

Unit -II: Food Safety and Quality Assurance

Food infections and intoxications-
i)*Clostridium ii) B.cereus iii) Salmonella and Shigella iv) Staphyllococcus, v)Listeria, vi)Mycotoxins*
Foods involved, sources of these in food and pathological effects
Quality Assurance
i) Microbiological quality and standards of food
ii) Food safety in food service establishments and other food areas—premises, equipments and utensils, storage, sanitary facilities, cleaning agents, disinfectants and sanitizers , health status of food handlers , waste disposal
Food Standards and Regulations in India and abroad--
i) PFA ii) Food Safety and Standards Act in brief iii) BIS, iv) CODEX Allimantarius v) Risk analysis and HACCP in detail.

Unit -III: Food Processing and Preservation

Thermal processing—i) Cooking ii) Blanching iii) Commercial sterilization
Drying or dehydration---Theory and principles of drying
Drying techniques—i) Solar drying ii) Atmospheric drying iii) vacuum drying—tray dryers, tunnel dryers, belt dryers iv) drum dryers
Microwave drying, irradiation
Chemical and naturally occurring antimicrobials.
Biosensors in food industry.

Unit -IV: Food Fermentations

Fermented vegetables—Saurkraut and Pickles
Fermented fish
Fermented meat--Sausages
Curd and Shrikhand,
Probiotic foods- Youghurt, Applications of probiotic food as nutraceuticals
GM Foods

PRACTICAL –I

MB3-LAB5

LABORATORY EXERCISE 5

1) Isolation of Genomic DNA from Bacteria.
2) Agarose Gel Electrophoresis.
3) Isolation of Plasmid DNA.
4) Restriction Digestion of λ DNA.
5) Amplification of DNA by PCR.
6) Gene Cloning: - Cloning of GFP Gene
7) Southern Hybridization (Demonstration).
8) RFLP Analysis.
9) Detection of gene transfer by transformation in *E.coli.*
10) Detection of gene transfer by conjugation in *E.coli.*
11) Demonstration of transduction.
12) SDS- PAGE and protein separation.
13) Demonstration of UV induced mutagenesis in E.coli.
14) Testing of chemicals for mutagenesis by Ame's test.

Minimum **seven** experiments must be performed in the semester.

PRACTICAL –II

MB3-LAB6

LABORATORY EXERCISE 6

1) Determination of microbial kinetics for an inhibitory substrate in a fed batch.
2) Determination of Oxygen Transfer Rate (OTR) in submerged fermentation.
3) Determination of Specific Growth Rate and Growth yield ($Y_{x/s}$) of biomass production by yeast.
4) Product yield for Ethanol production.
5) Production of microbial products in Bioreactors
   a. Amylase and Protease production
   b. Assay of Amylase and Protease
6) Microbiological assays Vit.B_{12}/VitB_2 .
7) Microbial production of Dextran and assay by spectrophotometric / Viscometric methods.
8) Saurcraut fermentation.
9) Extraction of Aflatoxin by TLC.
10) Determination of microbial quality of packed foods by BIS methods
11) Proximate Analysis of foods.
12) Determination of TDP and TDT.
13) Extraction of carotenoides and spectrophotometric assays.
14) Production & assay of Penicillin.

Minimum **seven** experiments must be performed in the semester.