SYLLABUS

FOR

M.Sc. SEMESTER PATTERN IN

MICROBIOLOGY

GONDWANA UNIVERSITY

GADCHIROLI

INDIA

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

SEMESTER – I (THEORY)

			MARKS
PAPER - I	MB1-T001	MICROBIAL DIVERSITY AND EVOLUTION (MDE)	100
PAPER - II	MB1-T002	MICROBIAL PHYSIOLOGY AND METABOLISM (MPM)	100
PAPER - III	MB1-T003	ENZYMOLOGY AND TECHNIQUES (ET)	100
PAPER - IV	MB1-T004	MICROBIAL ECOLOGY (ME)	100

PRACTICALS

PRACTICAL - I	MB1-LAB1	100
PRACTICAL - II	MB1-LAB2	100
SEMINAR	MB1-INT1	25

SEMESTER – II (THEORY)

			MARKS
PAPER - I	MB2-T005	ADVANCE TECHNIQUES IN MICROBIOLOGY (ATM)	100
PAPER - II	MB2-T006	MEMBRANE STRUCTURE AND SIGNAL TRANSDUCTION (MSST)	100
PAPER - III	MB2-T007	MICROBIAL METHODS FOR ENVIRONMENT MANAGEMENT (MMEM)	100
PAPER - IV	MB2-T008	MICROBIAL METABOLITES (MMT)	100

PRACTICALS

PRACTICAL - III	MB2-LAB3	100
PRACTICAL - IV	MB2-LAB4	100
SEMINAR	MB2-INT2	25

Distribution of Marks for M. Sc. Microbiology (Semester Pattern)

Semester	Theory (T) papers & practicals(P) & marks/Seminar(S)/Project	Credit	Total Mark/credit	Grand Total Mark & Credit
I	T-4 x 100= 400 P-2 x 100= 200 S-1 x 25= 25	4 x 4= 16 2 x 4= 08 1 x 1= 01	625/25	2500 marks 100 credits
II	T-4 x 100= 400 P-2 x 100= 200 S-1 x 25= 25	4 x 4= 16 2 x 4= 08 1 x 1= 01	625/25	
III	T-4 x 100= 400 P-2 x 100= 200 S-1 x 25= 25	4 x 4= 16 2 x 4= 08 1 x 1= 01	625/25	
IV	T-4 x 100= 400 P-2 x 100= 200 S-1 x 25= 25	4 x 4= 16 2 x 4= 08 1 x 1= 01	625/25	

GONDWANA UNIVERSITY, GADCHIROLI

SEMESTER SYSTEM SYLLABUS

FOR M. Sc. Microbiology (Semester I & II)

(With effect from Academic Session 2012-13)

Structure of M. Sc. Microbiology Syllabus, Semester System, Theory

Semester	Title of Paper	Work Hrs.	Marks
Semester I	Paper I: Microbial Diversity and Evolution (MDE)	04	100
	Paper II: Microbial Physiology and Metabolism (MPM)	04	100
	Paper III: Enzymology and Techniques (ET)	04	100
	Paper VI: Microbial Ecology (ME)	04	100
	Total	**16**	**400**
Semester II	Paper I: Advance Techniques in Microbiology (ATM)	04	100
	Paper II: Membrane Structure and Signal Transduction (MSST)	04	100
	Paper III: Microbial Methods for Environment Management (MMEM)	04	100
	Paper VI: Microbial Metabolites (MMT)	04	100
	Total	**16**	**400**

GONDWANA UNIVERSITY, GADCHIROLI

SEMESTER SYSTEM SYLLABUS

FOR M. Sc. Microbiology (Semester I & II)

(With effect from Academic Session 2012-13)

Structure of M. Sc. Microbiology Syllabus, Semester System, Practical & Seminar

Semester	Practical & Seminar	Work Hrs.	Marks
Semester I	Practical I	08	100
	Practical II	08	100
	Seminar I	02	25
	Total	**18**	**225**
Semester II	Practical III	08	100
	Practical IV	08	100
	Seminar I	02	25
	Total	**18**	**225**

APPENDIX A

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	I	I	MB1-T001	Microbial Diversity And Evolution(MDE)	4		4	3		100		40		100/4	
2	I	II	MB1-T002	Microbial Physiology And Metabolism (MPM)	4		4	3		100		40		100/4	
3	I	III	MB1-T003	Enzymology and Techniques (ET)	4		4	3		100		40		100/4	
4	I	IV	MB1-T004	Microbial Ecology (ME)	4		4	3		100		40		100/4	
5	I		MB1-LAB1	Laboratory Exercise 1		8	8		8*	80	20		40		100/4
6	I		MB1-LAB2	Laboratory Exercise 2		8	8		8*	80	20		40		100/4
7	I		MB1-INT1	Seminar	2		2			25			10	25/1	
8				**Total**	**18**	**16**	**34**			**585**	**40**			**425/ 17**	**200/ 8**
9	II	I	MB2-T005	Advance Techniques in Microbiology (ATM)	4		4	3		100		40		100/4	
10	II	II	MB2-T006	Membrane structure and Signal Transduction (MSST)	4		4	3		100		40		100/4	
11	II	III	MB3-T007	Microbial Methods for Environment Management (MMEM)	4		4	3		100		40		100/4	
12	II	IV	MB2-T008	Microbial Metabolites (MMT)	4		4	3		100		40		100/4	
13	II		MB2-LAB3	Laboratory Exercise 3		8	8		8*	80	20		40		100/4
14	II		MB2-LAB4	Laboratory Exercise 4		8	8		8*	80	20		40		100/4
15	II		MB2-INT2	Seminar	2		2			25			10	25/1	
16				**Total**	**18**	**16**	**34**			**585**	**40**			**425/ 17**	**200/ 8**

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.

APPENDIX B

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 100
5. Projects shall be evaluated by internal and external examiners. 50% marks of project shall be given by internal and external examiners each.
6. Duration of question paper is 3 hours.
7. 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.

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-I

Paper-I
Microbial Diversity and Evolution (MDE)
MB1- T001

UNIT-I: - Microbial Evolution and Systematic

Evolution of Earth and early life forms.
Primitive life forms:-RNA world, molecular coding, energy and carbon metabolism, origin of Eukaryotes, endosymbiosis.
Methods for determining evolutionary relationships:-Evolutionary chronometers,Ribosomal RNA sequencing, signature sequences, phyllogenetic probes, microbial community analysis.
Derivation of Microbial Phyllogeny:- characteristics of domain of life, classical taxonomy, chemotaxonomy, bacterial speciation.

UNIT-II: -Microbial Diversity: Archea

General Metabolism and Autotrophy in archea
Phylum Euryarchaeota:-Halophilic archaea, methanogens, thermoplasma.
Phylum Crenarchaeota:-Energy metabolism, Thermoproteales, sulfolobales, desulfolobales.
Phyllum Nanoarchaeota:- Nanoarchaeum.
Heat stable biomolecules and extremophiles, Evolutionary significance of hyperthermophiles.

UNIT-III :-Microbial Diversity: Bacteria

Phylum Proteobacteria:-Free living N2 fixing bacteria,purple phototrophic bacteria nitrifying bacteria, sulphur and iron oxidizing bacteria, sulphate and sulphur reducing bacteria.
Phylum prochlorophytes and cyanobacteria,
Phylum:Planctomyces,
Phylum;Verrucomicrobia.

UNIT-IV :- Microbial Diversity.
Phylum: Cytophaga, Phylum: Green Sulfur Bacteria. Phylum: Deinococci.
Phylum: Green non –sulfur bacteria.
Phylum: Branching Hyperthermophiles, Thermotoga and Aquifex.
Phylum:Nitrospira and Deferribacter.

PAPER II

Microbial Physiology And Metabolism (MPM)

MB1-T002

UNIT-I BIOENERGETICS

Basic concept of bioenergetics and metabolism.

Carbohydrate metabolism: glycolysis and its regulation, Feeder pathway of glycolysis and carbohydrate–homo and hetero lactic fermentation. Glycogenesis, Glycogenolysis. Gluconeogenesis ; pathways and regulation, Pentose phosphate pathway, kreb's cycle and glyoxalate pathway.

Substrate level phosphorylation and oxidative phosphorylation, electron transfer reaction in mitochondria, electron carriers and multienzyme complex I to IV.

ATP synthesis: chemiosmotic theory, shuttle system, regulation of oxidative phosphorylation and uncouplers, inhibitors of oxidative phosphorylation.

UNIT-II PHOTOSYNTHESIS AND LIPID METABOLISM

Photosynthesis: structure of chloroplast, light reaction and dark reaction; Kelvin cycle, C3 and C4 pathway.

Mechanism of energy generation in cyanobacteria, green bacteria and purple sulphur bacteria and chemolithotrops.

Lipid metabolism digestion absorption; oxidation of unsaturated fatty acid and odd chain fatty acid, ketone bodies.

Lipid biosynthesis: biosynthesis of fatty acids, triacylglycerol and phospholipids and regulation of fatty acid metabolism.

UNIT-III PROTEIN AND NUCLEIC ACID METABOLISM

Amino acid metabolism: biosynthetic families of amino acids, Breakdown of amino acids into six common intermediates and urea cycle and regulation of amino acid metabolism.

Nucleotide metabolism; biosynthesis of purines and pyrimidines nucleotide by de novo and salvage pathways, Degradation of purines and pyrimidines nucleotides.

UNIT-IV NITROGEN METABOLISM

Nitrification, denitrification and pathways of nitrate and ammonia assimilation. Nitrogen cycle, Assimilation of nitrogen: denitrogen fixation- free living and symbiotic, diazotrophic organisms.

Biochemistry of nitrogen fixation: nitrogenase complex, function of nitrogenase, regulation of nitrogenase by oxygen and combined nitrogen sources, Genetics of nitrogen fixation; nif genes and their regulation.

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Paper-III
Enzymology and Techniques (ET)
MB1-T003

UNIT-I: - Enzymes kinetics

Overview of Michaelis-Menten equation and its transformation, Evaluation of kinetic parameters, Kinetics of bisubstrate reaction, multistep reactions, kinetics of enzyme inhibition, Classification of enzymes

UNIT-II: - Catalytic mechanisms

Concept of active site, determination of active site, acid –base catalysis, covalent catalysis, metal ion cofactors, proximity and orientation effects, preferential binding.

Active site determination and mechanism of ribonuclease, lysozyme, Active site determination and mechanism of serine protease.

UNIT-III: - Regulation of Enzyme activity

Allosterism, Kinetic analysis of allosteric enzymes

Covalent Modification, Feed -back inhibition

Membrane bound enzymes, isoenzymes and marker enzymes-LDH,multienzyme complex with mechanism

Constituitive and inducible enzymes.

UNIT-IV: - Techniques

Enzyme isolation and purification- Importance of purification, methods of purification and fractionation, crieteria of purity

Protein**:** ligand binding studies: association and dissociation constants, co-operative ligand binding MWC or concerted model, sequential model.

Enzyme biosensors: General concept, glucose biosensor. Industrial applications of enzymes. Immobilized enzymes, Protein engineering.

SEMESTER-I
Paper-IV
Microbial Ecology (ME)

UNIT-I: - Microbial Ecosystems

Population, guilds, communities, homeostatis, Environment and microenvironment.
Biofilms. Terrestrial environment, deep surface microbiology. Fresh water environment, lake and river microbiology. Marine Microbiology and Hydrothermal vents.

UNIT-II: - Diversity, stability and succession

Diversity indices, dominance indices, information statistics indices, Shannon index, Brillouin Index, Rank abundance diagrams, community similarity analysis, Jaccard Coefficient, Sorensen coefficient, cluster analysis. Community stability, stability hypothesis, Intermediate-disturbance hypothesis.
Meaning of succession: Tolerance and inhibition patterns of succession, theories of succession.

UNIT-III: - Ecology and Genetics

Genetic structure of population:- Genotype frequency, allele frequencies.
Hardy-Weinberg Law: - Assumptions, predictions, derivation, extension and natural selection.
Measuring genetic variation at protein level, measuring genetic variation at DNA level.
Factors effecting gene frequencies**:-**Mutation, Random genetic drift, migration, Hardy-Weinberg natural selection, Assortative mating, Inbreeding.

UNIT-IV: - Interactions and Ecosystem Management

Microbial Interactions: Competetion and coexistence, Gause hypothesis, syntrophy, commensalism and Mutualism, predation, parasitism, and antagonism, Interaction with plants and animals.
Concept of sustainable development: microbial technology and sustainable development.
Management and improvement of waste land/barren land.
Oil spills, damage and management petroleum and oil shore management.

PRACTICAL-I
MB1-LAB1
LABORATORY EXERSICE 1

1) Detection of enzyme activity of lipase, Urease, invertase, protease, Tween 80 hydrolysis.
2) Determination of kinetic constant of amylase:-Amylase activity,Vmax.Km.
3) Effect of pH and temperature on amylase activity.
4) Effect of inhibitors on amylase activity.
5) Estimation of protein:
6) Production, isolation and purification of enzyme and determination of fold purification(any one enzyme)
7) Estimation of sucrose in presence of glucose.
8) UV absorption of proteins, DNA and RNA.
9) Estimation of L-leucine by colourimetric method.
10) Determination of pka of an amino acid.

Minimum seven experiments must be performed in the semester.

PRACTICAL-II
MB1-LAB2
LABORATORY EXERCISE 2

1) Isolation and microscopic examination of Myxobacteria,Thiobacteria and Ferrobacteria.
2) Isolation of microflora from different ecological nitches such as freshwater,mangroves,salt pan bed,hot water spring, acid –zone soil,rhizosphere etc.(any two nitches)
3) Demonstration microbial Interactions:-competition, syntrophy, antagonism and isolation of nitrogen fixing bacteria.
4) Development of biofilm on metal strips.
5) Microbial production and processing of polysaccharide schizophyllan.
6) Production of protoplast.
7) Isolation and purification of Photosynthetic pigments.
8) Determination of Shannon index as a measure of evenness H/Hmax from garden soil.
9) Isolation of sulphate reducing bacteria.
10) Isolation of bacteria capable of degrading polycyclic aromatic hydrocarbons from oil contaminated earth.

Minimum seven experiments must be performed in the semester.

SEMESTER-II
Paper –I
Advance Techniques in Microbiology (ATM)
MB2-T005

UNIT-I: - Biophysical Techniques-I

Determination of size, shape and Molecular weight of Macromolecules:- by Viscosity, CD/ORD, Light scattering, diffusion sedimentation and Centrifugation techniques.

UNIT-II: - Biophysical Techniques-II

Electrophoresis: Agarose Gel, SDS-page, two-dimensional gel electrophoresis, capillary electrophoresis, immune-electrophoresis.

UNIT-III: - Microscopical Techniques.

Electron Microscopy: SEM, TEM, Staining procedures and microscopy. Fluorescent Microscopy: Staining procedures and Microscopy, FISH. Laser scanning, confocal microscopy. Scanning tunneling and atomic force microscopy. Immunoelectron microscopy, cryoelectron microscopy.

UNIT-IV: - Other advance techniques

Blotting techniques: Western, southern, northern, Radioimmunoassay. NMR and its biological importance. Site-directed mutagenesis, transcriptional start point mapping.

SEMESTER-II
Paper-II
Membrane structure and Signal Transduction (MSST)
MB2-T006

UNIT-I: - Structure and organization of membranes

Mitochondria, endoplasmic reticulum, prokaryotic membrane, membrane junctions (Gap & tight junctions), techniques for membrane study: electron microscopic method, membrane vesicles, differential scanning colorimetry, flouroscence photobleaching recovery, flow cytometry.

UNIT-II: - Membrane Transport

Active and Passive transport, uniport, ATP powered pumps, non-gated ion channels, cotransport by symporters and antiporters, transepithelial transport.

UNIT-III: - Signal Transduction

General concept of cell signaling, G-protein coupled receptors and their effectors. RTK and MAP Kinases. Down regulations of pathways. Cytokine receptors and their mechanism (JAK-STAT pathway).

UNIT-IV: - Bacterial signal transduction

Basic two component system. Histidine kinase pathway Sporulation as a model of bacterial signal transduction. Osmoregulatory pathways. Heat shock proteins. Mating types of yeast.

SEMESTER-II
Paper-III
Microbial Methods for Environment Management (MMEM)
MB2-T007

UNIT-I: - Eutrophication, Biodeterioration and Biomagnification

Eutrophication: Microbial changes induced by organic and inorganic pollutants, factors influencing eutrophication process and control of eutrophication.

Biodeterioration: Definition and concept of biodeterioration, biodeterioration of woods and pharmaceutical products.

Biomagnification: concept and consequences, Biomagnifications of chlorinated hydrocarbons and pesticides.

UNIT-II: - Biotransformation and Bioleaching, Biodegradation

Biotransformations: metals and metalloids, mercury transformations, biotransformation of pesticides such as hexachlorobenzene.

Bioleaching: Bioleaching of ores, leaching techniques and applications.

Biodegradation: Biodegradation of plastics.

UNIT-III: - Pollution Management

Waste water management using activated sludge, aerated lagoons, trickling filter, rotary biological contractors, fluidized bed reactors, stabilization ponds. Concept of phytoremediation and applications.

UNIT-IV: - Global Environmental Problems

Ozone depletion, UV-B, green house effect, acid rain, their impact and biotechnological approaches for management. Acid mine drainage and associated problems. Global warming and climate change.

SEMESTER-II
Paper –IV
Microbial Metabolites (MMT)
MB2-T008

UNIT-I:- Overview of metabolites

Metabolites: General account of metabolites, secondary metabolites. Classification, structure and mode of action of secondary metabolites. Plants secondary metabolites: Digitoxine, Salicylic acid, Mycotoxins-Aflatoxin, Ochratoxin,Patulin.
Biopolymers: Polypeptides (collagen, casein and serum albumin),Polynucleotides and polysaccharides(amylose, amylopectin, alginate, cellulose) and other biopolymers like chitin, Xanthan, dextrin, Gellan, Pullulan, curdlan and hyluronic acid.
Polyamines: Brief outline and functions of polyamines. Synthesis of linear polyamine-putrescine, cadoverine, spermidine and spermine.

UNIT-II:- Antimicrobial drugs: Secondary metabolites

Antibiotics: History and discovery of antibiotics, Antibiotic resistance, Mechanisms of antibiotic resistance.
Structure and mode of action of antibiotics:
Aminoglycosides(Amikacin),Carbapenems(Imipenim),microlids(Azithromycin),Nitrofuran(nitrofurantoin),Penicillin(Amoxicillin),Quinolones(gatifloxacin/Ciprofloxacin),Sulphonamides(sulfamethoxazole),Tetracyclines(doxycyclines),Chloramphenicol,Fucanazole.

UNIT-III:- Pigments as secondary metabolites
General account of pigments, Chlorophylls, Carotenoids of eukaryotes, phycobilliproteins. Hemoglobin, Myoglobin, Melanin and bile pigments. Microbial pigments: Bacteriochlorophylls, Carotenoids of prokaryotes, rhodopsin and accessory pigments (Pulcherrimin, indigoidin, voalecin) Defensive role of pigments.
UNIT-IV:- Microbial vitamins
Characteristics of fats and water soluble vitamins.
Structure, function and chemistry of: Retinol (vitaminA), Riboflavin (vitaminB_2), Cynocobalamine (VitaminB_{12}) and ascorbic acid (vitaminC).
Deficiency diseases in humans: Xerophthalmia, BeriBeri. Pellegra, Scurvey, Keratomalacia, osteoporosis, Osteomalacia, Cheilosis, Glossitis, Pernicious anemia and Erythroid hypoplassia.

PRACTICAL-III
MB2-LAB3
LABORATORY EXERCISE 3

1) Separation of DNA by agarose gel electrophoresis and estimation of DNA by Diphenylamine method.
2) Estimation of RNA by Orcinol method.
3) Separation of amino acids by paper chromatography.
4) Separation of serum proteins by paper electrophoresis.
5) Thin layer chromatography of mycotoxins
6) SDS-Page of proteins.
7) Performance of affinity chromatography.
8) Performance of Gel filtration chromatography.
9) Demonstration of blotting technique.[any one].
10) Ion exchange chromatography

Minimum seven experiments must be performed in the semester.

PRACTICAL-IV
MB2-LAB4
LABORATORY EXERCISE 4

1) Estimation of Riboflavin/Thiamine by fluorometric method.
2) Production of antibiotic as secondary metabolite and its assay[any one antibiotic].
3) Microbial production of Dextran/xanthan as secondary metabolites.
4) Membrane disryption and separation subcellular organelles.
5) Production of microbial pigments using any pigment producing organism.
6) Biotransformation of toxic chromium(+6) into nontoxic(+3) by pseudomonas species.
7) Microbial dye decolourization.
8) Isolation of Mercury resistant bacteria.
9) Isolation of salmonella and bacteriphages from waste water/sewage.
10) Determination of Labaratory bioleaching process.

Minimum seven experiments must be performed in the semester.

List of recommended books

- The Biochemistry of copper By:Jack Peisach,Phillip Aisen.
- Biochemistry:-By:Rex Montgomery.
- Lehninger Principles of BiochemistryBy:-David L. Nelson and Cox
- Metabolic Pathways .By:-David M.Greenberg.
- Harper's BiochemistryBy:Robert K.Myrray.
- Enzymes:By: Trevor Palmer.
- Enzyme structure and mechanism By:Alan Fersht.
- Methods in Enzymology By: S.Berger,A.Kimmel.
- Fundamentals of Enzymology By;N.Price,L.stevens.
- Immobilization of Enzymes and cells.By:Gordon Bickerstaff.
- Environmental MicrobiologyBy:Ralph Mitchell,John Wiley and Sops.Inc.
- Environmental BiotechnologyBy:C.F.Froster and D.A.John Wase,Elis Horwood.
- Biocatalysis and Biodegradation: Microbial Transformation of organic compounds.
- y:Lawrence p.Wacekett.
- A manual of environment Microbiology.By:Christon J.hurst,ASM publication.
- Biodegradation and bioremediation Academic pressBY:San Diego.
- Biotechnology in the sustainable environment,Plenum press,NYBasic principles of Geomicrobiology. By:A.D.Agate.
- Environmental MicrobiologyBy:R.M.Maier,I.C.Papper and C>P>Gerba.
- Methods in Microbiology:Lynch and Hobbie.
- Experimental Microbial Ecology.By:Arosison Academic Press.
- Advances in Applied microbiology.By:D.Pearlman academic press.
- Microbiology of Extreme environments,edited by Clive Edward,Open University press,Milton Keynes.
- Principles of Biochemistry.By:Donald J.voet,Judith G.Voet,Charlotte W.Pratt.
- Brock Biology of Microorganisms.By:John M. Martinko.
- Introduction to Genetic analysis.By;Griffiths,Wessler.lewontin,Gelbart,Suzuki,Miller.
- Biophysical Chemistry VOL:I,II,III;The conformation of biological macromolecules. By;Cantor and Schimmel. Hans-Peter schmauder,Michael schweizer,Lilian M.Schweizer.
- Environmental Science working with the Earth.By:Miller.
- Microbial Biotechnology,Principles and Applications.Lee Yuan Kun.
- Microbial Biotechnology,Fundamentals of Applied Microbiology. By:Alexander N.Glazer.Hiroshi Nikaido.
- Textbook of Organic Medicinal and Pharmaceutical Chemistry.By:Jaime N.Delgado William A.Remers.
- Biophysical ChemistryBy:Upadhaya Upadhyaya Nath.
- Microbial Ecology by Lynch et al.
- Experimental microbial ecology by Burns et al.
- Environmental Microbiology (2004) by K. Vijaya Ramesh, MJP Publishers
- Soil Microbiology (2006) by N.S. Subba Rao Oxford & IBH Publishing Co.PVT. LTD.
- Introduction to Soil Microbiology (1961) by Martin Alexander, John Wiley & sons , INC. New York , London
- Microbial Ecology (1993) by Ronald M. Atlas and Richard Bartha

- Ecology,Theories and applications.By:Peter Stiling.
- Introductory Mycology, 7th Ed., Alouxopolus C.J., Willey Eastern Pvt. Ltd., New Delhi.
- Bergey's Manual of Systemic Bacteriology 2nd Ed., Vol. 2, Springer, USA.
- Basic Bacteriology, 3rd Ed., Lamanna C., Mallette F., the Willium and Wilkins company.Calcutta.
- Fundamental Principles of Bactetriology, 3rd Ed. Salle A.J., TMH Publishing Company, New Delhi.
- The Yeast- A.H. Rose
- General Microbiology, 5th Ed. -R.Y. Stanier
- Principles and Techniques of Practical Biochemistry by K. Wilson and J. Walker, CambridgeUniversity Press
- Text book of biochemistry 4th edn by West, Tood, Mason and Burgen
- Principles of biochemistry 5th edn, by White, Handler, Smith
- Lehniger's principles of biochemistry by Nelson kocs.
- Biochemistry by Zubay
- Elements pf Biochemistry by O.P. Agrawal
- Bacterioal metabolism by Doelle
- Bacterial metabolism by Gotschalk
- Advances in general microbiology by Shrivastava
- Biochemistry by Strior
- The Prokaryotes. A handbook on the biology of bacteria: ecophysiology, isolation, identification, applications. Volumes I-IV by Balows, A., Truper, H. G., Dworkin, M., Harder, W., Schleifer, K. H. Springer-Verlag, New York; 1992
- Bacterial Systematics, by Logan, A., Niall A. Logan, Wiley-blackwell; 1994
- Principles of Microbiology by R.M. Atlas , Mosby publishers, St. Louis; 1995
- Textbook of Microbiology-Ananthnarayan and Panikers-University press(8^{th} ed.)
- Cell Biology-Channarayappa- University Press,Hyderabad