

B.Sc. MICROBIOLOGY

B.Sc (Microbiology)

MADURAI KAMARAJ UNIVERSITY
SYLLABUS FOR
B.Sc. MICROBIOLOGY DEGREE COURSE
CHOICE BASED CREDIT SYSTEM (CBCS)
(For the affiliated colleges of MKU)

(EFFECT FROM THE ACADEMIC YEAR 2008 – 2009 ONWARDS)

Regulations

1. Qualifications for admissions *

Candidate should have passed the higher secondary examinations conducted by the Board of Higher Secondary Education, Govt. of Tamil Nadu or any other examination accepted by the syndicate as equivalent there to

- Biology/Physics/Chemistry as subjects in the Higher secondary education
- Candidates should have secured at least 60% in the above subjects and above in the aggregate
- A relaxation of 10% marks in the aggregate will be given to SC/ST candidates
- Candidates sponsored by the Industrial/ Hospitals/ Clinical laboratories may also be considered for admissions

2. Duration of the course

The students will undergo the prescribed course of study for a period of not less than three academic years (six semesters)

3. Medium of Instruction: English

4. Subjects of study & Scheme of Examinations: As given in Appendix A

5. Eligibility for the degree: Candidate will be eligible provided he/she completes the course and pass in the prescribed examinations

6. Attendance, progress and conduct certificate from the Head of the Institution will be required for the examination.

7. Guidelines regarding pass minimum:

To get a pass, a student should fulfill the following conditions.

A) Theory:

- 35% of the aggregate (External + Internal).
- No separate pass minimum for internal
- 23 marks out of 75 is the pass minimum for the External.

B) Practicals:

Handwritten notes:
20/10
20/10 - before regard to the PD
10

- a) 35% of the aggregate (External + Internal).
- b) No separate pass minimum for the internal
- c) 18 marks out of 60 is the pass minimum for the External.

C) Project

- a) 35% of the aggregate (Project evaluation + *Viva-voce*).
- b) No separate pass minimum for the *viva-voce*
- c) 24 marks out of 80 is the pass minimum for the project evaluation.

8. Candidates who have secured 60% and above in aggregate of the Part III will be given First Class; Candidates who have secured 60% and above but not less than 50% will be given a second class; Candidates who have secured 40% and above but below 50% will be given a third class.

9. Ranking will be made for the candidates who have necessarily completed the course without any arrears in each semester and scored the maximum total in the Part III be given the First Rank. Such candidates will be honoured with a Gold Medal if there is a sponsorship or an endowment.

10. Question paper pattern**a) For all 3 credits and above courses**

The existing pattern of Question Paper will be as follows:

Time: 3 Hours

Max Marks:75

Section A: (10 x1 = 10 Marks)

Question No.1 to 10

1. Two questions from each unit.
2. Four Choices in each question.
3. Answer all questions. Choose the write answer.

Section B: (5 x 7 = 35 marks)

Answer all questions- Either OR types

Answers not exceeding two pages.

(One question from each unit)

Question Nos.

11 a or 11 b

12 a or 12 b

13 a or 13 b

14 a or 14 b

15 a or 15 b

Section C: (3 x 10 = 30 marks)

Answers not exceeding four pages

Answer any **THREE** out of Five (one question from each Unit)

Question Nos. 16 – 20

The pattern for internal valuation may be:

- a) Two internal tests of 15 marks each: Average = 15 marks
- b) Group Discussion/Seminar/Quiz = 05 marks
- c) Two assignments: 5 marks each: Average = 05 marks

b) For all 2 credits courses

The existing pattern of Question Paper will be as follows:

Time: 3 Hours

Max Marks:75

Section A: (10 x 1.5 = 15 Marks)

Question No.1 to 10

Four Choices in each question.

Answer all questions. Choose the write answer.

Section B: (3 x 10 = 30 marks)

Answer all questions- Either OR types

Answers not exceeding three pages

(One question from each unit)

Question Nos.

11 a or 11 b

12 a or 12 b

13 a or 13 b

Section C: (2 x 15 = 30 marks)

Answers not exceeding four pages

Answer any **TWO** out of Three (one question from each Unit)

Question Nos. 14 – 16

The pattern for **internal valuation** may be:

- d) Two internal tests of 15 marks each: Average = 15 marks

- c) Group Discussion/Seminar/Quiz = 05 marks
 f) One assignment : = 05 marks

c) Practical Exams: External (Max: 60 Marks)

- One Major Experiment = 25
 One Minor Experiment = 10
 Two Spotters = 05
 Record Book = 05
 Viva voce = 15

The pattern for **internal valuation** for 40 marks may be:

- g) Two internal tests of 25 marks each: Average = 25 marks
 h) Observation book = 10 marks
 i) One assignment = 05 marks

Overall Course content of B.Sc. Microbiology (CBCS syllabus)

Sl. No	Subject	No. of Papers	No. of Hours	No. of credits
1	Tamil	4	24	12
2	English	4	24	12
3	Core subjects	15	64	59
4	Allied subjects	12	48	36
5	Skill Based Subjects	6	12	12
6	Elective Subjects	0	0	0
7	Non Major Electives	2	4	4
8	Environmental Studies	1	2	2
9	Value Education	1	2	2
10	Extension Activities	1	0	1
	Total	46	180	140

APPENDIX A

B.Sc., DEGREE COURSE IN MICROBIOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS)
 (For the affiliated colleges of MKU)

Work load per week, Credits per paper and Scheme of examinations
 (For those admitted in June 2008-2009 onwards)

SEMESTER-I

Sub. Code	Title of the Paper	Weekly Contact Hours	No. of Credits	Exam. Hours	Marks		
					Int.	Ext	Tot.
TA1	PART- I Tamil	6	3	3	25	75	100
EN1	PART - II English	6	3	3	25	75	100
CS01	PAPER -III Core Subject General Microbiology	4	4	3	25	75	100
	Practical	2	-				
AS01	Allied Subject-I Chemistry -I (Organic, Inorganic & Physical chemistry -I)	4	4	3	25	75	100
	Practical	2	-				
SBS01	Skill based subjects Mushroom Technology	2	2	3	25	75	100
SBS02	Bio-control	2	2	3	25	75	100
NME1	Non Major Elective Subject Food & Dairy Microbiology	2	2	3	25	75	100
	Total	30	20				700

* Tamil and English syllabi and workload are as per the other degree courses.

* The Allied I (Chemistry) and Allied II (Biology) syllabi are as per other degree courses (e.g., B.Sc. Biochemistry).

SEMESTER-II

Sub. Code	Title of the Paper	Weekly Contact Hours	No. of Credits	Exam. Hours	Marks		
					Int.	Ext	Tot.
TA2	PART- I Tamil	6	3	3	25	75	100
EN2	PART - II English	6	3	3	25	75	100
	PAPER -III Core Subject						
CS02	Microbial physiology & Taxonomy	4	4	3	25	75	100
CS03	Major Practical -I	2	2	3	40	60	100
	Allied Subject-I						
AS02	Chemistry - II (Organic & Physical Chemistry-I)	4	4	3	25	75	100
AS03	Chem. Practical I- (Volumetric analysis)	2	1	3	40	60	100
	Skill based subjects						
SBS03	Cosmetic Microbiology	2	2	3	25	75	100
SBS04	Diagnostic Microbiology	2	2	3	25	75	100
	Non Major Elective Subject						
NMF2	Medical Lab Technology	2	2		25	75	100
	Total	30 ✓	23 ✓				900

SEMESTER-III

Sub. Code	Title of the Paper	Weekly Contact Hours	No. of Credits	Exam. Hours	Marks		
					Int.	Ext	Tot.
TA3	PART- I Tamil	6	3	3	25	75	100
EN3	PART - II English	6	3	3	25	75	100
CS04	PAPER -III Core Subject Molecular Biology & Microbial Genetics	4	4	3	25	75	100
	Practical	2	-				
AS04	Allied Subject-1 Chemistry-III (Organic, Inorganic & physical Chemistry-2)	4	4	3	25	75	100
	Practical	2	-				
AS05	Allied Subject-2 Biology-1 (General Biology)	4	4	3	25	75	100
	Practical	2	-				
Total		30/	18 /				500

SEMESTER-IV

Sub. Code	Title of the Paper	Weekly Contact Hours	No. of Credits	Exam. Hours	Marks		
					Int.	Ext	Tot.
TA4	PART- I Tamil	6	3	3	25	75	100
EN4	PART - II English	6	3	3	25	75	100
CS05	PAPER - III Core Subject Industrial Microbiology	4	4	3	25	75	100
CS06	Major Practical -2	2	2	3	40	60	100
AS06	Allied Subject-1 Chemistry -IV (Organic & Physical Chemistry-2)	4	4	3	25	75	100
AS07	Chem. Practical -2 (Organic analysis)	2	1	3	40	60	100
AS08	Allied Subject-2 Biology -II (Basic & Applied Ecology)	4	4	3	25	75	100
AS09	Biology Practical-1	2	1	3	40	60	100
Total		30 /	22 /	3			800

SEMESTER-V

Sub. Code	Title of the Paper	Weekly Contact Hours	No. of Credits	Exam. Hours	Marks		
					Int.	Ext	Tot.
CS07	PAPER -III Core Subject Medical Microbiology	4✓	4	3	25	75	100
CS08	Soil & Agriculture Microbiology	4✓	4	3	25	75	100
CS09	Immunology	4✓	4	3	25	75	100
	Major Practical	8✓	-				
AS10	Allied Subject -2 Biology -III (Biodiversity & Conservation) Practical	4✓ 2✓	4 -	3	25	75	100
SBS05	Skill Based Subject Computer applications in biology	2✓	2	3	25	75	100
EN01	Environmental Studies	2✓	2	3	25	75	100
	Total	30✓	20✓				600

SEMESTER-VI

Sub. Code	Title of the Paper	Weekly Contact Hours	No. of Credits	Exam. Hours	Marks		
					Int.	Ext	Tot.
	PAPER -III						
	Core Subject						
CS10	Biochemistry ✓	3	3	3	25	75	100
CS11	Biotechnology ✓	3	3	3	25	75	100
CS12	Enzymology & Enzyme technology ✓	3	3	3	25	75	100
CS13	Bioinformatics ✓	3	3	3	25	75	100
CS14	Major practical -3 ✓	-	7	3	40	60	100
CS15	Major practical -4 ✓	8	8	3	40	60	100
	Allied subject -2						
AS11	Biology -IV (Cell biology)	4	4	3	25	75	100
AS12	Biology Practical-2	2	1	3	40	60	100
	Skill Based Subject						
SBS06	Bioprocess technology	2	2	3	25	75	100
VE01	Value Education	2	2	3	25	75	100
EA01	Extension Activities	0	1	0	100	--	100
	Total	30 ✓	37 ✓				1100

- Schlegel, H.G.1993. General Microbiology. Cambridge University Press, Cambridge.
- Stainer, R.Y., Ingraham, Wheelis, M.G. and Paintor, P.R.1986. The Microbial World. Prentice Hall, New Jersey.
- Tauro, P., Kapoor, K.K.and Yadav, K.S.1989. An Introduction to Microbiology. Wiley Publications. New Delhi.
- P. Gunasekaran, Microbiology: A laboratory manual, , New Age international publishers. 1996.
- N. Kannan, Laboratory manual in general microbiology, , Panima publishers, 2002.
- J.G. Cappuccino and N. Sherman, Microbiology: A laboratory manual, , Addison-Wesley, 2002.
- J.G. Holt and N.R. Krieg. Bergey's manual determinative bacteriology, Lippincott Williams & Wilkin publishers, 2000.

CS 02 MICROBIAL PHYSIOLOGY & TAXONOMY

Unit I

Generation of Energy – Entropy, generation of ATP – substrate level phosphorylation, oxidative phosphorylation, proton motif force.

Unit II

Photosynthesis and inorganic metabolism – Photosynthesis in bacteria. Assimilation of inorganic phosphorus, sulfur and nitrogen in bacteria – sulfate reduction pathway, ammonia assimilation pathway, nitrogenase and nitrogen fixation. Transport of sugars and metabolites – active, passive and facilitated transport systems, chemiosmosis, ion gradients. Secretion in bacteria – type of secretion systems.

Unit III

Bacterial cell division and differentiation – Cell wall synthesis and cell division in *E. coli*, life cycle of *Bacillus*, stages of endospore formation, germination and outgrowth. Morphology and life cycles of *Hyphobacterium* and *Caulobacter*. Gliding bacteria and gliding motility, life cycle of fruiting bacteria – Myxobacteria. Sporulation in fungi.

Unit IV

Major characteristics used in taxonomy- Morphological, physiological, biochemical and molecular characteristics, Principles of chemotaxonomy and numerical taxonomy

Unit V

Classification of bacteria as per Bergey's Manual of Systematic Bacteriology – Organisms placed in the five kingdoms – Their salient features with examples.
 Classification of Algae by Fritsch, classification of Fungi by Alexopoulos & Mims.
 Principles of Virus taxonomy, characteristics used in nomenclature & classification of bacterial, plant and animal viruses- their major families with suitable examples.

References

1. Moat AG, Foster JW and Spector MP, Microbial Physiology, 4/e Wiley-Liss, 2002.
2. Prescott, Harley and Klein, Microbiology, 6/e The McGraw-Hill Companies, 2006.
3. Caldwell DR, Wm. Microbial physiology and metabolism, C Brown publishers, USA 2002
4. J.G. Cappuccino and N. Sherman, Microbiology: A laboratory manual, Addison-Wesley, 2002.
5. L.M. Prescott, J.P. Harley and D.A. Klein, 2005, Microbiology (6th edition) McGrawHill Publishers.
6. M.T. Maigan, J.M. Martinko and J. Parker, 2000. Brock Biology of Microorganisms, (9th edition).Prentice- Hall.
7. C.J. Alexopoulos and C.W. Mims 1979. Introductory Mycology(3rd edition) Wiley. New York..
8. E.W.Nester, C.V.Roberts and M.T.Nester 1995 Microbiology-A Human Perspectives. Iowa, USA.
9. R.Y.Stainer, J.L.Ingraham, M.L. Wheelis and P.R.Painter 1999 General Microbiology, McMillan Educational Ltd, London.

CS 03 MAJOR PRACTICALS - I**Basic Microbiology**

1. Parts, working principle and applications of compound microscope
2. Sterilization methods: moist heat, dry heat, filtration, disinfectants
3. Preparation of bacterial and fungal culture media
4. Isolation of bacteria and fungi from environmental samples
5. Enumeration of bacteria/fungi from environmental samples
6. Observation of bacterial/fungal colony morphology
7. Observation of bacterial/fungal cell morphology under microscope
8. Measurement of bacterial size by micrometry method

9. Pure culture techniques: streak, spread and pour plate methods
10. Observation of bacterial motility by hanging drop method
11. Staining methods: Gram-staining, capsule-staining, endospore-staining

Microbial taxonomy

Observation of permanent specimen slides:

Bacteria: *Bacillus*; *E. coli*; *Staphylococcus*; *Streptococcus*
 Algae: *Chlamydomonas*, *Chlorella*, *Euglena*, Diatoms
 Fungi: *Aspergillus*; *Penicillium*; *Rhizopus*; Yeast; *Agaricus*
 Viruses: T4; Lambda; TMV, Pox; Vaccinia (photomicrographs)

Biochemical tests for bacterial identification

1. Carbohydrate fermentation
2. Acid-gas production
3. IMVIC tests
4. MR-VP tests
5. Catalase test
6. Oxidase test
7. Starch, protein, and lipid hydrolysis

Microbial Physiology

1. Measurement of growth-
 - a) Determination of direct count and viable count
2. Effect of pH and Temperature on bacterial growth

References

1. P. Gunasckaran, Microbiology: A laboratory manual, New Age international publishers, 1996.
2. N. Kannan, Laboratory manual in general microbiology, Panima publishers, 2002.
3. J.G. Cappuccino and N. Sherman, Microbiology: A laboratory manual, Addison-Wesley, 2002.
4. P. Palanivelu, Analytical Biochemistry & Separation Techniques, III Edition – 21st Century Publication, Palkalai Nagar, Madurai - 625 021 (2004).
5. J. Jayaraman, Laboratory manual in biochemistry, 5/c, New Age international publishers, 1996.
6. K. Wilson and J. Walker, Principles of practical biochemistry, Cambridge University press, 2000.
7. Plummer, DT, An Introduction to practical biochemistry, TATA McGraw Hill, 1997.

8. Moat AG, Foster JW and Spector MP, Microbial Physiology, 4/e, Wiley-Liss, 2002.

CS 04 MOLECULAR BIOLOGY & MICROBIAL GENETICS

Unit I

Structural aspects of DNA – the double helical model- Various forms of DNA-hyperchromicity – Genome organization – Prokaryotes and Eukaryotes.

DNA replication- Semi conservative - Nature of replication- DNA polymerases in prokaryotes- the processes of DNA replication- Replication in eukaryotes- Mitochondrial DNA replication.

Unit II

Genetics- Microbial genetics vs. Mendelian genetics-DNA as genetic material-experimental evidence- concept of gene and mutations- fluctuation test and its significance- complementation.

Mutagens-chemical and physical mutagens- UV, NTG and hydroxylamine-mode of action- isolation of auxotroph and drug resistance mutants- DNA damage and repair.

Unit III

Genetic exchange in bacteria- transformation and transduction (generalized and specialized) and conjugation- co-transduction and its use in genetic mapping-chromosome transfer by Hfr strains- arriving at *E. coli* genetic map.

Unit IV

Genetic code, Codons, Anticodons, Wobble hypothesis, Protein synthesis- the stages of protein synthesis- the process of translation in prokaryotes factors involved in translation- the triplet nature of genetic code- an over view of comparisons with eukaryotic translation.

Unit V

Transcription – RNA polymerases in prokaryotes and eukaryotes – their function-process of transcription in prokaryotes- initiation and elongation and termination- factors involved. Regulation of gene expression in bacterial system- the operon model- detailed study of *lac* and *trp* operons.

References

1. Benjamin Lewin, Gene VII, 2000: Oxford University Press.
2. Watson, Hopkins, Roserts, Steits and Weiner, Molecular biology of the Gene, 4/e, 1987, The Benjamin/Cumming Publishing Company, Inc.
3. Larry Snyder and Wendy Champness, Molecular Genetics of Bacteria, 2/e, . 2003, ASM press, Washington DC.

4. David Friefelder, Microbial genetics, 1987, Narosa Publishing House.

CS 05 INDUSTRIAL MICROBIOLOGY

Unit I

Fermentor: Basic design, configurations, parts and function. Types: Air lift and CSTR tower fermentor and packed bed bioreactor. Control and monitoring of variables, temperature, pH, agitation, pressure, online measurement, on/off control, PD control. Computer applications in fermentation technology.

Unit II

Fermentation processes: Inoculum preparation, Inoculum build-up, Fermentor preculture, production processes. Parameters – physical, chemical and biological parameters in fermentation process, measurement using electrodes and computers.

Unit III

Fermentation types: aerobic, anaerobic and solid state fermentation. Bioreactor-operations-batch, fed batch, continuous process, etc .

Unit IV

Production processes: Aerobic fermentation (Penicillin, Glutamic acid, Lysine, Vitamin B12), anaerobic fermentation (Ethanol, Acetone - Butanol) and solid state (Gibberellic acid). Detection and assay of fermentation products, physicochemical, biological assays.

Unit V

Biosafety consideration: types of containment, personal practices, primary and secondary contaminant barriers, Risk assessment and Regulation, Biosafety levels, guidelines and regulations. Quality assurance and quality control of fermented products.

References

1. Crueger, W. and A. Crueger (2000), Biotechnology, A Text book of Industrial Microbiology, Panima Publishers, New Delhi.
2. Flinger, M.C., and Drew, S.W., (1999), Encyclopedia of Bioprocess technology – Fermentation, Biocatalysis and Bioseparation (Volumes I – V), John Wiley and Sons, New York.
3. Nandari, H., (2005), Industrial Biotechnology, Dominant Publications and Distributors, New Delhi.
4. Reed, G. (1987), Prescott and Dunn's Industrial Microbiology, CBS Publishers and Distributors, New Delhi.

5. Rita Singh and Ghosh, S. K., (2004), Industrial Biotechnology, Global Vision Publishing House, New Delhi.
6. Stanbury, O.F., Whitakar, A., and Hall, S.J., (1997), Principles of Fermentation Technology, Aditya Books (P) Ltd., New Delhi.
7. Winnacker, E.L., 1987, From Genes to Clones: Introduction to Gene Technology, VCH Publications, Germany.

CS 06 MAJOR PRACTICALS – II

Microbial genetics & Molecular Biology

1. Separation of proteins by acrylamide gel electrophoresis
2. Isolation of spontaneous mutant: antibiotic resistant mutants
3. Isolation of auxotrophic mutant by chemical and UV mutagenesis
 - i. (Replica plating technique)
4. Induction of *lac* operon

Industrial Microbiology

1. Isolation of amylase and protease producing bacteria and fungi
2. Crowded plate technique for antibiotics producing microbes
3. Alcohol (ethanol) production
4. Immobilization of yeast.

References

1. P. Palanivelu, Analytical Biochemistry & Separation Techniques, III Edition – 21st Century Publication, Palkalai Nagar, Madurai - 625 021 (2004).
2. Maniatis, T., Fritsch, E.F. & Sambrook, J. Cold Spring, Molecular Cloning, A laboratory manual, Harbor laboratory (2002).
3. David, RW, Botstein, D & Roth, JR., Advanced bacterial genetics, Cold Spring Harbor laboratory (1980).
4. Roitt, I.M. 1998. Essential of immunology. ELBS, Blackwell scientific publication.
5. Kuby, J. 1997. Immunology -3rd edition. W.H.Freeman and Company, New York.
6. Travers, J. 1997. Immunobiology- The immune system in health and disease-3rd edition- Garland publishers, NY.
7. Klaus, E., Elgert, 1996. Immunology understanding of immune system, Wiley Liss, New York.
8. Abbas, A.K. Lichtman, A.H. 2000. Cellular and Molecular Immunology. 5th edition, Sunders.

CS 07 MEDICAL MICROBIOLOGY**Unit I**

The History of Infectious Diseases: Human – microbe interactions – epidemiology of infectious diseases - Systemic bacteriology - Role of virulent factors in bacterial adhesion and colonization - Host-defense mechanisms.

Unit II

Diagnosis and control of microbial diseases – Collection and identification of pathogens from specimen - Biochemical tests for bacteria - Diagnosis of viral infections using immunological tests and phage typing. Principle and significance of antimicrobial chemotherapy and susceptibility testing. Mechanism of action of β -lactams - drugs affecting protein and nucleic acid synthesis – Mode of action of antiviral and antifungal drugs- Development of drug resistance.

Unit III

Bacterial diseases: Transmission, diagnosis, clinical symptoms and treatment for bacterial diseases, plague, tuberculosis, leprosy, cholera, typhoid, shigellosis, peptic ulcer, Staphylococcal and Streptococcal diseases.

Unit IV

Viral diseases: Etiology, prophylaxis, clinical symptoms and treatment for human viral diseases. rabies, viral hepatitis, poliomyelitis, AIDS.

Unit V

Fungal and protozoan diseases: Cutaneous mycoses, systemic mycoses, opportunistic mycoses. Life cycle, diagnosis and treatment of following protozoan diseases – amoebiasis, giardiasis, malaria, kala-azar, trypanosomiasis.

References

1. Jawetz, E. Melnic, J.L., & Adclberg, EA. Medical microbiology 22/e McGraw Hill Companies, 2004.
2. Mims, C. Playfair, J. Roitt, I. Wakelin, D. & Williams, R. Medical Microbiology, 3/e Mosby publications, 2004.
3. Prescott, Harley and Klein, Microbiology, 6/e The McGraw-Hill Companies, 2008.
4. Ananthanarayanan R. & Jayaram Panicker, C.K. Textbook of Microbiology, Orient Longman, 2005.

CS 08 SOIL AND AGRICULTURE MICROBIOLOGY**Unit I**

Soil microbes: Bacteria, Fungi and Actinomycetes (distribution) – Microbial interaction: mutualism, amensalism and commensalisms - Soil enzymes – Plant microbial interactions- N_2 fixation, symbiotic and free living- phosphate solubilization – Rhizosphere effect – Mycorrhizal association; ceto and endomycorrhizae, actinorrhizae

Unit II

Plant microbe interactions - pathogenesis, mechanism of pathogen establishment and symptoms. Plant diseases caused by Bacteria, *Xanthomonas*, *Mycoplasma*, Fungi, *Pyricularia*, *Fusarium* and Viruses, TMV, CMV.

Unit III

Disease control- Fungicides, Pesticides, Biological control mechanisms - Production of bioinsecticides, bacterial and viral.

Unit IV

Biofertilizers: production and methods of application – Biopesticides: bacterial, fungal and viral – Microbial nematicides and microbial herbicides – Biotechnology in Agriculture: Bt, cotton and herbicide tolerant plants, PGPR, Mycorrhizae and role of microbizaes in agriculture.

Unit V

Role of microorganisms in biogeochemical cycles (N, P and C cycles) – Biodegradation of xenobiotics (chlorinated pesticides) – MEOR - bioleaching of metals – microbes in waste treatment: solid waste (sanitary land fill and composting) and liquid waste – sewage treatment – BOD – pollution indicating microbes.

References

1. Rangasami G and Bagyaraj DJ. 1993. Agricultural Microbiology 2/e Prentice-Hall publications.
2. Ronald Atlas, Bartha, Richard, 1987. Microbial ecology 2/e Benjamin-Cummings publications.
3. Prescott, Harley and Klein, 2006. Microbiology. The McGraw Hill companies.
4. Madigan, M.T., Martinko, J.M. and Parker, J. 1997, Brock Biology of Microorganisms 8/e, Prentice-Hall Inc.

CS 09 IMMUNOLOGY

Unit I

Elements of Immunity: Overview of the Immune system- Basic concepts in immunology (History), principles of innate and acquired immunity - Cells and organs of the immune system - Classes of antigens and their characteristics.

Unit II

Antibody structure; Classification and characterization, agglutination, complement system, immune tolerance.

Unit III

Humoral and cell mediated immune response: B-cell maturation, Activation and differentiation, Major Histocompatibility complex (MHC) - antigen processing and presentation T and B cell maturation, activation and differentiation.

Unit IV

Hypersensitivity reaction: Different types, disorders of immune response, auto immunity, T and B cell Phagocytic and NK cell associated diseases.

Unit V

Transplantation immunology: Basics of graft rejection, Tissue typing, Clinical transplantation, Tumor antigen, Immune response to tumor, Cancer immuno therapy.

References

1. Roitt, I.M., Essential of immunology, 1998., ELBS, Blackwell scientific publication.
2. Kuby, J., Immunology, 3/e, 1997., W.H. Freeman and company, NY.
3. Travers, J., Immunobiology, The immune system in health and disease-3/e - 1997 - Garland publishers, NY.
4. Klaus, F., Elgert, Immunology understanding of immune system. 1996, Wiley Liss, NY.
5. A.K. Lichtman, A.H, Cellular and Molecular Immunology. 5/e, Abbas, 2000, Sunders.

CS 10 BIOCHEMISTRY**Unit I**

Water and Life – pH and Buffers. Law of Thermodynamics-Oxidative and reduction reactions, redox potential, free energy and reaction, ATP energetics.

Unit II

Carbohydrates- Biological significance-Classification, Embden-Meyerhof-Parnas, Entner-Doudoroff, Pentose Phosphate pathways - TCA cycle.

Unit III

Lipids- fatty acids- simple fats. Physical and Chemical properties- Nomenclature of fatty acids- Phospholipids- Spingolipids- Lipoproteins- Reaction of phospholipids and Eicosanoids, Oxidation of fatty acids (β -Oxidation) - Fatty acid synthesis.

Unit IV

Proteins- Structure- Classification, properties of amino acids and proteins. Primary, secondary, tertiary and quaternary structures of proteins .

Unit V

Nucleic acids – Components, Double helical structure- Nucleic acid denaturation-Classes of nucleic acids.

References:

1. Lehninger, AL., Principles of Biochemistry. 1993, 2nd edition, CSB Publishers.
2. Conn, E.E., Stumpf, P.K., Bruening, G and Doi, Outlines of Biochemistry, 5/e - R.H, John Wiley & Sons (1987)
3. Voet, D and Voet, JG, Biochemistry, 1990, John Wiley & Sons, NY.
4. Devlin, T.M., Text book of Biochemistry. 2/e, 1986, Wiley Medical Publications, NY.
5. Stryer, L., Biochemistry, 2/e, 1998, W.H. Freeman and Company, NY.
6. Zubay, G., Biochemistry-2/e, 1998. McMillan Publishers NY, Collier McMillan Company Publishers, London.
7. P. Palanivelu, Enzymes, Ribozymes and DNazymes, 2007, Twentyfirst Century Publications, Palkalai Nagar, Madurai - 625 021.

Biochemistry

1. Acid-Base titration to determine pK_a values

2. pH meter- principle and measurements
3. Colorimetry- Beer & Lambert's law
4. Estimation of Carbohydrates
5. Estimation of Proteins (Lowry's method)
6. Separation of amino acids by Paper chromatography

CS 11 BIOTECHNOLOGY

Unit I

History and scope of Biotechnology: Biotechnology as an inter-disciplinary course - General Strategies of cloning - Vectors: Plasmids- constructed plasmids, pBR322, pUC18 - Lambda phage derived vectors, cosmids and their applications. BAC and YAC as vectors.

Unit II

Gene manipulation techniques: DNA isolation, Plasmid isolation- Restriction enzymes: Types and properties- DNA ligation. - Methods of gene transfer - Gene gun method, Southern and Northern blotting techniques.

Unit III

Animal & Plant Biotechnology: Transgenic animals: transgenic mice and sheep, - Agrobacterium mediated gene transfer mechanism - Markers and Reporter genes and their applications - Transgenic plants - insecticide resistance, herbicide and drought tolerance.

Unit IV

Microbial production of recombinant proteins: Expression vectors- Constitutive and inducible promoters - Production of recombinant DNA proteins using microbial hosts - Production of Insulin- Growth hormone- Interferons, etc.

Unit V

Intellectual property rights - GATT and IPR, different forms of IPR, IPR in India, patent co-operation treaty, forms of patents, process of patenting, Indian and international agencies involved in patenting, patenting biological materials.

References

1. Ratledge, C and Kristiansen, B., Basic Biotechnology 3/e, Cambridge University Press (2008)
- Brown, T.A., Genetics - A Molecular Approach, Chapman Hall, London, 2004.
2. Darnell, J. Lodish, H., and Baltimore, D., Molecular Cell Biology, Scientific American Books Inc., Iowa, 2006

3. Glick, B.R. and Pasternak, J.J., 2006, *Molecular Biotechnology- Principles and Applications of Recombinant DNA technology*, ASM press, Washington.
4. Gower, D.M., 2001, *DNA Cloning- A Practical Approach*, IRI press, Oxford.
5. Mitra, S., 2001, *Genetic Engineering*, Macmillan, India Limited, New Delhi.
6. Paoella, P., 2003, *Introduction to Molecular Biology*, McGraw Hill Publication, Boston.
7. Demain A.L., Atlas R M., Hu W.S, Willson R C., Hershberger C. L., Cohen G., Davies J. E., Sherman D. H. and David Wu J. H., 1999 *Manual of Industrial Microbiology and Biotechnology*, 2nd Edition ASM press,
8. Waites MJ, 2001 *Industrial Microbiology: An Introduction (Illustrated)* Blackwell Science Inc,

CS 12 ENZYMOLGY & ENZYME TECHNOLOGY

Unit- I

1. Nomenclature and Classification of enzymes (with examples)
2. General properties of enzymes (Optimum pH, Optimum Temp & Substrate Concentration)
3. Steady state kinetics and derivation of Michaelis-Menten, Linweaver-Bürk, equations and their plots.
4. Activation energy
5. Enzyme specificity

Unit- II

1. Extraction of enzymes
2. Assay of enzymes, Calculation of enzyme units
3. Purification of enzymes
4. Enzyme inhibitors

Unit- III

1. Allosteric enzymes
2. Multienzyme complexes (Pyruvate dehydrogenase complex & Fatty acid synthetase complex)
3. Coenzymes of Water soluble vitamins

Unit- IV

1. Mechanism of Enzyme catalysis
2. Metal ions in Enzyme catalysis
3. Mechanism of action of enzymes (Chymotrypsin)

Unit- V

1. Application of enzymes (Clinical & Industrial)
2. Immobilization of enzymes

References

1. P. Palanivelu, Enzymes, Ribozymes and DNAzymes, Twentyfirst Century Publications, Palkalai Nagar, Madurai - 625 021 (2006).
2. T. Palmer, Enzymes-Biochemistry, Biotechnology, Clinical chemistry- -East-West press, New Delhi (2004)
3. T. Palmer 4th edition, Fundamentals of Enzymology- Handbook on Enzyme Biotechnology- Alan Wiseman, John Wisely & Sons, NY (1985)
4. P. Palanivelu, Analytical Biochemistry & Separation Techniques, III Edition - 21st Century Publication, Palkalai Nagar, Madurai - 625 021 (2004).
5. Conn, E.E., Stumpf, P.K., Bruening, G and Doi, R.H, John Wiley & Sons, Outlines of Biochemistry, 5/e - (1987)

CS 13 BIOINFORMATICS**Unit I**

Components of computers input/output devices. Storage devices. Graphic devices. Program and representation of information, Operations, system. MS DOS & WINDOWS - Networks-Intranet and Internet LAN.

Unit II

Use of commercial software: Wordstar, Windows, Power Point, MS Excel, Print artist.

(MS-office)

Unit III

Biological resource databases- Examples and application - Sequence analysis-Protein Nucleic acid: Genome analysis.

Unit IV

Collection and downloading information from databases- Literature search - CCOD-Medline Biological websites.

Unit V

Accessing information through Internet Bionet news groups- WWW Software. (HTTP, HTML.).

References

1. Christopher J Rawlings, Software Directory for molecular Biologists Stockton Press, Mac Millan Publishers, 1986.

2. A directory – DBT, Data basis in life sciences and Biotechnology: Govt. of India, March 1995.
3. R.M.Kamp, T. Choli-Papadaopoulou B. Witman Liebold., Protein Structure Analysis – Springer Lab Manual.
4. T.N. Bryant, JWT Wimpenny, Computer in microbiology- a practical approach. IRL, Press, 1989.
5. By Zar, Bio-Statistics Analyses. Second Edition. Prentice Hall International Englewood Cliffs, New Jersey.

CS 14 MAJOR PRACTICALS – III

Medical Microbiology

1. Antibiotic susceptibility test: disc diffusion method
2. Measurement of minimal inhibitory concentration (MIC) and minimal lethal concentration (MLC)
3. Isolation and identification of pathogenic bacteria from clinical specimens: *Staphylococcus*, *Streptococcus*, *Salmonella*, *Shigella*, *Vibrio*.
4. Preparation of blood smear for malarial parasite
5. Collection and processing of medical samples

Soil and Agricultural Microbiology

6. Isolation and characterization of soil microbes
7. Serial dilution method for enumeration of soil bacteria
8. Identification of microbial pathogen in paddy and vegetable crops (field study).
9. Isolation of symbiotic nitrogen fixing bacteria from root nodules - *Rhizobium*
10. Isolation of free-living nitrogen fixing bacteria from rhizosphere - *Azotobacter*
11. Isolation of phosphate solubilizing bacteria – *Pseudomonas*
12. Examination of mycorrhizae – VAM
13. Potability testing of water (MPN test)

Immunology

14. Lymphoid organs in experimental animals – mouse/rat/rabbit
15. Immunization and bleeding techniques
16. Separation of serum/plasma
17. Erythrocyte sedimentation rate
18. Blood cell count: RBC count, WBC count – total and differential
19. Blood typing: ABO, Rh
20. Agglutination tests: Widal test
21. Precipitation: Ouchterlony's double immunodiffusion

References

1. Rangasami G and Bagyaraj DJ. 1993. Agricultural Microbiology 2/e Prentice-Hall publications.

2. Ronald Atlas, Bartha Richard, 1987. Microbial ecology 2/e Benjamin/ Cummings publications.
3. Prescott, Harley and Klein, 2006. Microbiology, The McGraw Hill companies.
4. Madigan, M.T., Martinko, J.M. and Parker, J., 1997. Brock's Biology of Microorganisms 8/e. Prentice-Hall Inc.
1. Jawetz, E, Melnic, J.L. & Adelberg, E.A. Medical microbiology 22/e McGraw Hill Companies, 2001.
2. Mims C, Playfair J, Roitt I, Wakelin D and Williams R, Medical Microbiology, 3/e Mosby publications, 2004.
3. Prescott, Harley and Klein, Microbiology, 6/e The McGraw-Hill Companies, 2006.
4. Ananthanarayanan, R and Jayaram panicker, CK, Textbook of Microbiology, Orient Longman, 1997.

CS 15 MAJOR PRACTICALS - IV

Biochemistry

1. Acid-Base titration to determine pK_a values
2. pH meter- principle and measurements
3. Colorimetry- Beer & Lambert's law
4. Estimation of Carbohydrates
5. Estimation of Proteins (Lowry's method)
6. Separation of amino acids by Paper chromatography

Biotechnology

7. Isolation of chromosomal DNA from microbial cells.
8. Separation of DNA by agarose gel electrophoresis
9. Determination of purity and quantification of DNA
10. Isolation and purification of a plasmid DNA
11. Restriction Digestion Analysis
12. Ligation
13. Transformation of *E. coli* using plasmid (pUC18/19)
14. Blue-white Selection of transformants

References

Maniatis, T., Fritsch, E.F. & Sambrook, J. 1. Molecular Cloning, A laboratory manual, Cold Spring Harbor laboratory (2002).

SKILL BASED SUBJECTS

SBS 01 MUSROOM TECHNOLOGY

Unit I

History of edible mushrooms- Major genera of edible mushrooms - Structure and key for identification - Food values of mushroom - Medicinal values of mushrooms.

Unit II

Methods of cultivation of mushrooms - Substrate for mushroom production - Insect, pest and diseases of mushroom - Mushroom industry - Economics of mushroom production.

Unit III

Exotic mushrooms - Truffles (*Tuber melanosporum*) - Poisonous mushrooms - identification

References

1. By Nitabhal, Mushroom Technology Publications (--)
2. ICAR Publications (--), Cultivation of edible mushrooms - .
3. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi (2000)

SBS 02 BIOCONTROL

Unit I

Outline of pest management programme - Insect pest management and Rodent pest management - Need of Biocontrol agents. Economics of Biocontrol

Unit II

Biopesticides - microbes used in biopesticides, *Bacillus thuringensis*, *B. sphaericus*, *Metarizyum* and *Trichoderma*- Insect control, Nuclear Polyhedro Virus and CPV- potentials and limitations.

Unit III

Biology and ecology of organisms for Biocontrol- Predators and Parasitoids- *Trichogramma*

References

1. Roy G. Van Driesche and Bellows Jr. TS., Biological Control – Guide to its applications, Springer (1996).
2. Helmut Fritz Van Embden and Service MW, Pest and vector control, Cambridge University Press (2004).

SBS 03 COSMETICS MICROBIOLOGY

Unit I

History of cosmetic microbiology- Need for cosmetic microbiology – Scope of cosmetic microbiology – Role of microbes in cosmetics preparation.

Unit II

Quality control measures in cosmetics preparation – Microbial resistance – Critical control points, etc – Antimicrobial property of natural cosmetic compounds; garlic, neem, turmeric, thulasi.

Unit III

Microorganisms in cosmetics- Preservation of cosmetics- Mechanism of action of cosmetic preservatives – Enzymes in cosmetics

References

1. Daniel K. Brannan, Cosmetic Microbiology, A practical Handbook, CRC Press (2004)

SBS 04 DIAGNOSTIC MICROBIOLOGY

UNIT I

Role of Microbiology Lab; safety regulations. Types , collection and handling of specimens. Preparation of serum and plasma.

UNIT II

Laboratory identification of infectious agents. Staining techniques: simple, Gram, acid-fast and spore staining. Diagnosis of mycotic and parasitic infections.

UNIT III

Microbiological analysis of different types of clinical specimens: urine, blood, stool, pus and throat swab. Determination of minimal inhibitory concentration (MIC) of antibiotics. Antimicrobial susceptibility tests.

References:

Mukherjee, K.L., 1988, Medical Laboratory Technology Volumes-I to III, Tata McGraw-Hill Publishing Company Limited, New Delhi

SBS 05 COMPUTER APPLICATIONS IN BIOLOGY

Unit I

Computer architecture- Generations of Computers – Computer languages, BASIC, COBOL, FORTRAN, JAVA, etc Structural components of computer and their uses. -

Unit II

Role of computer in Biological research – Internet and Email- Reference collection – Data submission – Phylogenetic analysis – Structural prediction – Biostatistical analysis- Current trends in IT technology

Unit III

Genomics on the worldwideweb - Nucleic acid sequence analysis- Protein sequence database search and analysis- Multiple sequence alignment- Statistical packages.

References

1. Balagurusamy, N. 2001. Basics of computers, Himalaya Publications, New Delhi, India
2. Lreon, A & Leon, M. 1999. Introduction to computers. Vikas publications, New Delhi, India
3. Mount, D. W. Bioinformatics- sequence and genome analysis. CBS publishers & distributors, New Delhi.
4. S. A. Krawetz & Womble D. D., Introduction to Bioinformatics A Theoretical and practical approach. Humana press, Totowa, NJ

SBS 06 BIOPROCESS TECHNOLOGY

Unit I

Production and preliminary characterization of an antibiotic or an enzyme – assay - paper chromatography or T.L.C.

Unit II

Concentration steps: Ammonium sulphate precipitation, acetone precipitation, PEG precipitation - Dialysis- Ultrafiltration.

SBS 05 BIOPROCESS TECHNOLOGY

Unit I

Production and preliminary characterization of an antibiotic or an enzyme – assay - paper chromatography or TLC.

Unit II

Concentration steps: Ammonium sulphate precipitation, acetone precipitation, PEG precipitation - Dialysis- Ultrafiltration.

Unit III

Purification steps: Principle and applications of by ion exchange and gel filtration chromatographic techniques, Affinity chromatography

References

- Analytical Biochemistry & Separation Techniques, III Edition – P. Palanivelu, 21st Century Publication, Palkalai Nagar, Madurai - 625 021 (2004).
- Principles of Fermentation Technology, P.F. Stanbury and A. Whitaker (1984) Pergamon Press.
- Chemical Engineering, J.M. Coulson and J.F. Richardson (1984) Pergamon Press.
- Bioprocess sequencing Basic concepts, Michael L. Shuler and Fikret Kuzi (1992) Prentice-Hall Inc.
- Bioprocess sequencing: Kinetics, mass transport reactors and gene expression, Wolf R. Vieth (1994) John Wiley & sons, Inc.