KADI SARVA VISHWAVIDYALAYA, GANDHINAGAR

M.Sc. MICROBIOLOGY

SYLLABUS

W.E.F. JULY 2017

Kadi Sarva Vishwavidyalaya, Gandhinagar

CBCS Syllabus of M.Sc. Microbiology

Course Structure for M.Sc. Microbiology Programme

SEMESTER- 1

Sem.	Paper	Title	Hours/ week	Credits	Exam hours	Mid Term marks	External marks	Total marks
1	MBCT 101	Cellular Metabolism and Enzymology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
1	MBCT 102	Analytical Microbiology and Instrumentation	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
1	MBCT 103	Microbial Genetics	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
1	MBCT 104	Microbial Physiology and Cell Biology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
1	MBCP 105	Practicals related to theory papers in the semester	8	8	12	----	Max.: 200 Min: 80	Max.: 200 Min:80
		Total credits		24				

SEMESTER- 2

Sem.	Paper	Title	Hours / week	Credits	Exam hours	Mid Term marks	External marks	Total marks
2	MBCT 201	Microbial Diversity	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
2	MBCT 202	Bioprocess Technology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
2	MBCT 203	Recombinant DNA Technology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
2	MBCT 204	Research Methodology and Technical Writing in Microbiology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
2	MBCP 205	Practicals related to core theory papers in the semester	8	8	12	----	Max.: 200 Min: 80	Max.: 200 Min: 80
		Total credits		24				

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SEMESTER-3

Sem.	Paper	Title	Hours/ week	Credits	Exam hours	Mid Term marks	External marks	Total marks
3	MBCT 301	Immunology and Immunotechnology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
3	MBCT 302	Environmental Microbiology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
3	MBCT 303	Industrial Microbiology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
3	MBCT 304	Pharmaceutical Technology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
3	MBCP 305	Practicals related to theory papers in the semester	16	8	12	----	Max.: 200 Min: 80	Max.:200 Min:80
3	MBET 306A	Elements of Biostatistics	2	2	2	Max.:15 Min: 6	Max.:35 Min: 14	50
3	MBET 306B	Genomics	2	2	2	Max.:15 Min: 6	Max.:35 Min: 14	50
		Total credits		26				650

SEMESTER- 4

Sem.	Paper	Title	Hours/ week	Credits	Exam hours	Mid Term marks	External marks	Total marks
4	MBCT 401	Food and Dairy Microbiology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
4	MBCT 402	Medical Microbiology	4	4	3	Max.:30 Min: 12	Max.:70 Min: 28	100
4	MBCP 403	Practical's related to core theory papers in the semester	8	4	12	----	Max.: 100 Min: 40	Max.:100 Min:40
4	MBDI– 404	Dissertation/ Industrial Training	-	12	-	-	Max.:300 Min: 120	Max.300 Min: 120
4	MBET – 405A	Bioinformatics	2	2	2	Max.:15 Min: 6	Max.:35 Min: 14	50
4	MBET – 405B	Proteomics	2	2	2	Max.:15 Min: 6	Max.:35 Min: 14	50
		Total credits		26				650

% - Weightage of marks in percentage, Hrs- Number of teaching hours per week. MBCT- Microbiology Core Theory, MBCP- Microbiology Core Practical, MBET- Microbiology Elective Theory, MBDI – Microbiology Dissertation/ Microbiology Industrial Training.

General instructions:

1. The medium of instruction will be English for theory and practical courses.
2. There will be 4 lectures each of 55 mins duration / week / theory paper / semester.
3. There will be "*four*" units in each core theory paper. There will be 48 hrs. of theory teaching/ paper/ semester. Each theory paper / semester will be of 100 marks. There will be 30 marks for midterm evaluation and 70 marks for external evaluation.
4. There will be "*two*" units in each elective theory paper. There will be 24 hrs. of theory teaching/ paper / semester. Each theory paper / semester will be of 50 marks. There will be 15 marks for midterm evaluation and 35 marks for external evaluation.
5. In I, II and III semesters there will be 16 practical hours/ week / paper / batch. Each practical paper/ semester will be of 200 marks. There is no Mid Term Evaluation for practical work.
6. In semester 4, there will be 8 practical hours/ week / paper / batch. Each practical paper/ semester will be of 100 marks. There is no midterm evaluation for practical work.
7. Dissertation and Industrial Training in semester 4 shall be evaluated for 300 marks. Work carried out and written report carry 200 marks, presentation carry 100 marks.

Unit wise marks distribution and the question paper scheme of End Term Core Theory Papers

Section A	**Questions from each Unit**	**Questions to be answered**	**Marks**
Unit 1	Five MCQ, Two 5M questions, Four 3M questions	MCQ-**5** 5M questions **-1** 3M questions – **4**	**35 Marks**
Unit 2	Five MCQ, Two 5M questions, Four 3M questions	MCQ-**5** 5M questions **-1** 3M questions –(Minimum-1 & Maximum-**4**	
Section B	**Questions from each Unit**	**Questions to be answered**	**Marks**
Unit 3	Five MCQ, Two 5M questions, Four 3M questions	MCQ-**5** 5M questions **-1** 3M questions –(Minimum-1 & Maximum-**4**	**35 Marks**
Unit 4	Five MCQ, Two 5M questions, Four 3M questions	MCQ-**5** 5M questions **-1** 3M questions –(Minimum-1 & Maximum-**4**3M questions –**4**	
		Total	**70 Marks**

Unit wise marks distribution and the question paper scheme for End Term Elective Theory Paper

Section A	**Questions from each Unit**	**Questions to be answered**	**Marks**
Unit 1	Five MCQ, Two 5M questions, Four 3M questions	MCQ-**5** 5M questions **-1** 3M questions –(Minimum-1 & Maximum-**4**	
Unit 2	Five MCQ, Two 5M questions, Four 3M questions	MCQ-**5** 5M questions **-1** 3M questions –(Minimum-1 & Maximum-**4**	
		Total	**35 Marks**

M.Sc. Microbiology Course Description:

This course is designed to enable students to acquire understanding of fundamentals of Microbiology and applications of various Microbiological resources and techniques. It also provides opportunities for utilizing Microbial products for the benefit of mankind. The course also provides practical training on Microbiological resources, techniques and processes for creation of trained manpower for adsorption in upcoming Microbiology based Industries.

Paper	**Title of Paper**	**Credits**
Core	SEMESTER-1	
MBCT 101	Cellular Metabolism and Enzymology	4
MBCT 102	Analytical Microbiology and Instrumentation	4
MBCT 103	Microbial Genetics	4
MBCT 104	Microbial Physiology and Cell Biology	4
MBCP 105	Practicals related to theory papers in the semester	8
Core	SEMESTER-2	
MBCT 201	Microbial Diversity	4
MBCT 202	Bioprocess Technology	4
MBCT 203	Recombinant DNA Technology	4
MBCT 204	Research Methodology and Technical Writing in Microbiology	4
MBCP 205	Practicals related to core theory papers in the semester	8
Core	**SEMESTER-3**	
MBCT 301	Immunology and Immunotechnology	4
MBCT 302	Environmental Microbiology	4
MBCT 303	Industrial Microbiology	4
MBCT 304	Pharmaceutical Technology	4
MBCP 305	Practicals related to theory papers in the semester	8
Elective		
MBET 306A	Elements of Biostatistics	2
Or		
MBET 306B	Genomics	2
Core	**SEMESTER-4**	
MBCT 401	Food and Dairy Microbiology	4
MBCT 402	Medical Microbiology	4
MBCP 403	Practical's related to core theory papers in the semester	4
MBDI 404	Dissertation/ Industrial Training	12
Elective		
MBET 405A	Bioinformatics	2
Or		
MBET 405B	Proteomics	2
	Total Credits	100

MBCT- Microbiology Core Theory, MBCP- Microbiology Core Practical, MBDI – Microbiology Dissertation/ Microbiology Industrial Training, MBET – Microbiology Elective Theory.

Semester-1

MBCT101- Cellular Metabolism and Enzymology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 101	Cellular Metabolism and Enzymology	4	48	30	70	100

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Carbohydrate metabolism: Classification and biological importance of Sugar. Aerobic and anaerobic glycolytic pathways. TCA cycle and various fates of Glucose 6 Phosphate in a cell - Gluconeogenesis, glycogen synthesis and breakdown. ATP Cycle, High energy compounds; Electron transport chain order and organization of carriers, proton gradient, respiratory controls and oxidative phosphorylation, ATP- synthetase complex. ED and PPP pathways.

Nucleic acid metabolism: Brief overview of central dogma. Structure of nucleoside, nucleotides, purines and pyrimidines. Biosynthesis and regulation of purines and pyrimidines. Structure and Function of Ribonucleotide reductase.

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Lipid metabolism: Classification of lipids. α, β and δ oxidation of fatty acids, metabolism of fatty acids with even and odd carbon atoms, saturated and unsaturated fatty acids. Metabolism and synthesis of phospholipids, glycolipids and sphingolipids; Ketone bodies –formation and degradation, Mobilization of fats.

Protein and Amino acid metabolism: Proteins structure: Classification of amino acids; Primary, secondary, tertiary and quaternary structure of proteins. Properties of amino acids, Biosynthesis and degradation of amino acid. Urea cycle. Nitrogen balance, Regulation of amino acid metabolism in microbial system.

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Introduction to Enzymes, nomenclature and classification of enzymes. Enzymes as biocatalysts, catalytic power, activation energy, substrate specificity, active site, theories of mechanisms of enzyme action. Factors affecting enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactors, Isolation & purification of enzymes. Methods of enzyme assay.

Enzyme Kinetics: Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Line weaver-Burke plot, Haldane-Briggs relationship, sigmoidal kinetics steady state kinetics and transient phases of enzyme reaction. Significance of Km, Vmax & Kcat. Introduction to allosteric enzymes and isozymes.

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Multi-enzyme system, Co-cooperativity. Types of Enzyme inhibition and **Mechanism of regulation of enzymes.**

Enzyme Technology: Immobilization of enzymes and their application.

References:

Sr. No.	Name of Book	Authors
1	Lehninger's Principles of Biochemistry	D. L. Nelson and M. M. Cox
2	Biochemistry	L. Stryer
3	Biochemistry	D. Voet and J. G. Voet.
4	Biochemistry: Chemical Reactions of the Living Cells (Vol. I & II)	D. Metzerler
5	Biochemistry	Jain & Jain
6	Fundamentals of Enzymology	N.C. Price and L. Stevens
7	Enzyme Structure and Mechanism	A. Fersht
8	Understanding Enzymes	T. Palmer
9	Enzymology	T. Devsena

Semester -I

MBCT–102: Analytical Microbiology and Instrumentation

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT102	Analytical Microbiology and Instrumentation	4	48	30	70	100

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Use of analytical microscopy in elucidating the structure-function relationship in microbes: Electron microscopy, phase contrast and fluorescence microscopy & scanning tunneling microscopy. Introduction to Osmosis, diffusion, Fick's law of diffusion and Donnan Equilibrium.

Centrifugation techniques: Principle of sedimentation, Sedimentation rate, types of centrifuges, Centrifugation techniques; Rate Zonal; Isopycnic; High speed; Ultra; preparative; Gradient Centrifugation.

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Chromatographic techniques: Principle, methodology and applications of Paper, Thin layer gel – filtration, ion –exchange and affinity chromatography; and gas chromatography; High performance liquid chromatography.

Electrophoresis: Principles, Factors affecting electrophoresis, types of Electrophoresis- Zone; Gel, Isoelectric; DISC; Immuno & Pulsed Field Gel Electrophoresis

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Basic concepts of Electromagnetic radiation – wave length, frequency, wave number, velocity. Properties of U.V and IR rays, fluorescence, Phosphorescence. Principles, instrumentation and applications of Visible, UV, IR, AAS.

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Principles, instrumentation and applications of NMR, ESR, and Mass spectroscopy. Fluorescence spectroscopy, Raman spectroscopy, CD, ORD, Characterization of macromolecules using X-ray diffraction analysis.

Principles and applications of **Radio isotopes:** Detection and measurement of radioactivity, Geiger Muller counters, Scintillation counting, Autoradiography and RIA; Applications of isotopes in biological studies.

References:

Sr. No.	Name of Book	Authors
1	Principle and techniques of biochemistry & molecular biology	Keith Wilson & John Walker
2	Instrumental methods of analysis	B. Sivasankar
3	Biophysical chemistry: Principle and techniques	Upadhyay & Nath
4	Instrumental methods of analysis	Willard, Merritt, Dean & Settle

5	Instrumental analysis	D.A. Skoog, Holler & Crouch
6	Physical Biochemistry:	David Freifelder
7	Principle and techniques of biochemistry & molecular biology	Keith Wilson & John Walker
8	Instrumental methods of analysis	B. Sivasankar
9	Biophysical chemistry: Principle and techniques	Upadhyay & Nath

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Semester -I

MBCT 103- Microbial Genetics

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 103	Microbial Genetics	4	48	30	70	100

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Structure of DNA, Z-DNA, A & B DNA, Denaturation and melting curves. Genome organization in prokaryotes and eukaryotes. Euchromatin, Heterochromatin, Karyotyping.

Bacterial Recombination types- Bacterial transformation- Competency and Horizontal gene transfer. Bacterial conjugation – Sex factor in bacteria, F and HFR transfer. Bacterial transduction – transduction phenomenon, methods of transduction, sexductions, generalized, specialized and abortive transduction.

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Replication - Detailed mechanism of Semiconservative replication. Requirements for Prokaryote replication– Enzymes & Proteins, Okazaki Experiments. Replication – Initiation, elongation & Termination. Differences between prokaryote and eukaryote replications. Eukaryotic telomere and its replication. Theta replication, Sigma replication.

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Genes, Promoters and enhancers. Prokaryote RNA polymerase and Mechanism of Transcription in prokaryotes- Initiation, elongation & Termination. Differences between Prokaryote & Eukaryote Transcriptions, splicing -types.

Translation, Genetic code, Wobble's hypothesis, tRNA & ribosome, Mechanism of translation in Prokaryotes & Differences between Prokaryote & Eukaryote Translation, Post- translational modification of proteins.

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Positive and Negative regulation of gene expression, Coordinate Regulation of gene expression in Prokaryotes - Operon concept-lac operon, trp operon. Regulation of gene expression: Operon concept-lac operon – positive and negative regulation, trp operon- negative regulation & Attenuation. Bacteriophages –General Properties, Life cycles of Lambda and M13 Phages.

References:

Sr. No.	Name of Book	Authors
1	Molecular Biology of Cell:	B. Alberts *et. al.*
2	Molecular Biology of the Gene	J. D. Watson *et. Al.*
3	Genes XI	B. Lewin
4	Instant notes on Molecular Biology- 4 Ed.	Turner
5	Principles of Genetics	Snustard
6	Fundamental Bacterial Genetics	Nancy Trun & Janie Trempy

Semester -I

MBCT 104- Microbial Physiology and Cell Biology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT104	**Microbial Physiology and Cell Biology**	**4**	**48**	**30**	**70**	**100**

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Overview of structure and functions of cellular organelles in Prokaryotes and Eukaryotes: Molecular Organization and functions of: Endoplasmic reticulum, Golgi complex, Lysosomes, Microbodies: Peroxisomes, Ribosomes, Mitochondria, Nucleus, Chloroplast.

Organization of Cytoskeleton: Membrane Cytoskeleton interactions, Microtubule and its dynamics, motor proteins, Microfilament and its functions, Intermediate filaments and their functions, Cell division and overview of cell cycle.

Bio-membranes: Structures and Transport process

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Microbial growth: Definition, Mathematical expression of growth, Growth curve, Methods for measurement of microbial growth, Effect of environment on microorganisms.

Sterilization: various sterilization methods, Microbial contamination control and sterility testing. Applications in biotechnology.

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Microbial metabolic diversity: Photosynthesis: Photosynthetic pigments, oxygenic & anoxygenic Photosynthesis, Nitrogen fixation: Biological nitrogen fixation, Nitrogen fixation process, Nitrogenase enzyme, Regulation of nitrogen fixation.

Methanogenisis, Acetogenisis & Microbial respiration: Bacterial anaerobic and Aerobic respirations, Methanogenisis, Acetogenisis.

Microbial diversity : Nutritional Diversity , Extremophiles

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Culture collection: Maintenance of cultures, Biochemical characterization. **Antimicrobial agents**: Antibacterial, Antiviral, Antifungal agents, Mode of action and resistance to antibiotics

References:

Sr. No.	Name of Book	Authors
1	Molecular Biology of Cell:	B. Alberts *et. al.*
2	Molecular Biology of the Gene	J. D. Watson *et. Al.*
3	Genes XI	B. Lewin
4	Instant notes on Molecular Biology- 4 Ed.	Turner
5	Principles of Genetics	Snustard
6	Fundamental Bacterial Genetics	Nancy Trun & Janie Trempy

Semester-1

MBCP 105 Practicals

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Practical					Total Marks
			Hrs/ week	Max Marks				
				Experiments & writing	Spots	Viva	Journal	
MBCP 105	Practicals	8	16	120	40	20	20	200

Course Content:

1. Good laboratory practices and management.
2. Introduction to Instruments that are routine used in the laboratory.
3. Basics of weights, measurements and preparation of standard solutions.
4. Isolation of DNA from Animal source.
5. Isolation of the DNA from a plant source.
6. Estimation of DNA by Diphenyl amine method.
7. Visualization of the DNA samples by Agarose gel electrophoresis.
8. Isolation of proteins from plant source.
9. Estimation of proteins by Brad Ford's method/ U.V. spectrophotometry method.
10. Thin layer chromatography of fatty acids/lipids
11. Identification of carbohydrates by ascending paper chromatography technique.
12. Identification of carbohydrates by radial or circular paper chromatography.
13. Separation of amino acids by Paper electrophoresis
14. Separation of proteins by SDSPAGE
15. Effect of hypertonic, hypotonic and isotonic environment of human RBC.
16. Isoelectric point determination of amino acid – Glycine.
17. Protein estimation by Folin- Lowry's method.
18. Protein estimation by Biuret method.
19. Carbohydrate estimation by Anthrone method
20. Estimation of reducing sugar by DNSA method.
21. Isolation of casein from milk.
22. Isolation of lactose from milk.
23. Isolation of Urease enzyme from plant source.
24. Assay of Urease activity.
25. Enzyme Kinetics Studies (Amylase).
26. Determination of standard substrate curve.
27. Effect of substrate concentration on enzyme activity.
28. Effect of pH on enzyme activity.
29. Effect of Temperature on enzyme activity.
30. Effect of Incubation time on enzyme activity.
31. Microscopic examination of bacteria and yeast by different staining methods.
32. Monochrome staining
33. Negative staining
34. Gram's staining
35. Acid fast staining
36. Spore staining

37. Capsule staining
38. Isolation, cultivation & identification of molds
39. Preparation of sterile liquid and solid media for growth of microorganisms.
40. Isolation and maintenance of organisms from soil by plating, streaking and serial dilution methods, slant and stab culture.
41. Purification of cultures, maintenance and preservation of pure cultures.
42. Bacterial growth curve & factors affecting it.
43. Isolation and detection of Mitochondria from leaves.
44. Isolation and detection of Chloroplast from leaves.
45. Different stages of Mitosis and Meiosis.

References:

S.N.	Title	Author
1.	An introduction to Practical Biochemistry	David T.Plummer
2.	Biochemical Methods	S. Sadasivan & A. Manickam
3.	Practical Biotechnology	R.S.Guad, G. D. Gupta, S.B.Gokhale
4.	Methods In Enzymology	Shelby L Berger & Alan R. Kimmel
5.	Experimental Microbiology	R. J.Patel
6.	Laboratory exercises in Microbiology	Harley Prescot
7.	Laboratory manual in Biochemistry.	Jaynarayan

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Semester -2

MBCT 201- Microbial Diversity

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 201	**Microbial Diversity**	**4**	**48**	**30**	**70**	**100**

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

History and Scope of Microbiology: Prebiological evolution, proteinoids and protocells; Species concept, The five Kingdoms, Three domain concept of Carl Woese; Endosymbiont Theory, History and development of Microbiology. Contributions of Pioneers. Further developments and Scope.
Microbial biodiversity: Species, Genomic and Ecologic diversity microorganisms. Distinguishing features between prokaryotes and eukaryotes. Prions. Extremophiles. Associations: Lichens, Mycorrhiza.
Systematics and Phylogeny – Classical and Basic concepts in Taxonomy and Phylogeny, Phenetic, and molecular characteristics used in Taxonomy; Molecular phylogeny and Phylogenetic analysis

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Microbial cultivation: Sterilization method. Cultivation techniques, preservation and maintenance of Microbial cultures. Microbial Growth.
Bacterial systematics: Bergey's Manual of Systematic Bacteriology. Characteristics, distribution, replication, classification and Economic Importance of: Proteobacteria, Firmicutes. Actinobacteria, Mycoplasma, Spirochetes, Rickettsiae,

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Viruses: General characters, Structure and replication, nomenclature and classification of DNA and RNA viruses. Plant Viruses, Animal Viruses, Bacteriophages. Diagnosis and cultivation. Economic Importance.
Archaebacteria and Extremophiles. Characteristics, diversity, significance and potential applications of Archaebacteria, Alkalophiles and Acidophiles Halophiles and Barophile.

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Algae: Distribution, morphology, taxonomy and lifecycle. Economic Importance of algae.
Fungi and Yeast: General characters, Distribution, Morphology, Structure, nutrition and life cycle, Classification and Economic Importance. Yeast: genomics, diversity, economic application.
Protozoa: General characters, Morphology, Structure, nutrition and life cycle, Classification, Economic Importance

References:

Sr. No.	Name of Book	Authors
1	General Microbiology	R.Y. Stanier, John L. Ingraham and Mark L. Wheelis
2	Principles of Microbiology	Ronald M. Atlas, Me Graw Hill
3	Microbiology	Michael J. Pcleczar, Chan and Krieg, Mac Graw Hill.
4	Brocks Biology of	Michael T. Madigan, John M. Martinko. Jack Parker.

	Microorganisms,8th Ed.	
5	Microbiology Principle & Applications	J.J. Black, John Wiley, Prentice Hall
6	An Introduction to Fungi	H.C. Dubey: Vikas Publishing House Pvt. Ltd.
7	Introductory Mycology	C.J. Alexopoules
8	Structure & reproduction of the Algae	F.E.Fristsch

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Semester -2

MBCT 202 -Bioprocess Technology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 202	**Bioprocess Technology**	**4**	**48**	**30**	**70**	**100**

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Introduction to Fermentation & Bioprocess Technology.

Growth phases of microorganism, primary secondary metabolite. Effects of environmental factors on growth. Growth kinetics: Microbial growth cycle and measurement of growth. Primary and secondary screening, Preservation of industrially important microorganisms. Strain improvement techniques. Fermentation substrates used in media formulation. Optimization of media. Inoculum development Scale up of bioprocesses.

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Elements of biochemical engineering, Fermenter and Bioreactor design; Solid state / Submerged cultivation; Batch, fed batch and continuous cultivation. Sterilization techniques for media, reactor and air. Agitation and aeration and mass transfer of oxygen in different types of Bioreactors.

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Measurement and Control of Process parameters in Fermenter.

Automation: two position and proportionate control, biosensors, microprocessor based control systems. Cell separation and Cell disintegration techniques.

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Product enrichment and purification techniques. **Enzyme technology**: Use of immobilized enzymes in bioreactor and its applications. Bioprocess economics.

References:

S. N.	Name of Book	Authors
1	Principles of Fermentation Technology	A. Whitekar, P. F. Stanbury & S. J. Hall
2	Comprehensive Biotechnology	M. Moo-Young (Ed)
3	Methods in Industrial Microbiology:	G. Sikyta
4	Industrial Microbiology:	L. E. Casida
5	Biochemical Engineering Fundamentals	J. E. Bailey & D. F. Ollis
6	Microbial Technology	H .J. Peppler & D. Perlman (Ed)
7	Prescott & Dunn's Industrial Microbiology	G. Reed
8	Fermentation Technology	H A Modi
9	Industrial Microbiology	A H. Patel
10	Textbook of Biotechnology	W. Crueger and A. Crueger

11	Industrial Microbiology: An Introduction	M Waites, N Morgan, J Rockey and G Higton

Semester -2

MBCT 203- Recombinant DNA Technology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 203	Recombinant DNA Technology	**4**	**48**	**30**	**70**	**100**

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Genetic Engineering**,** Chimera, Recombinant DNA, Recombinant DNA technology, Tools of r-DNA technology. Restriction endonucleases, Modification methylases and other enzymes to modify the DNA.

Vectors – plasmids, bacteriophages, cosmids, phagemids, artificial chromosome vectors (YAC, BAC), Animal virus derived vectors - SV40 and retroviral vectors, Vectors in yeast and cloning in Plants.

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Molecular cloning, – isolation of DNA, Genomic DNA libraries, Shot gun gene cloning, cDNA libraries, full length cDNA cloning.

Transformation of recombinant DNA, screening of recombinants, Southern, Northern and Western blotting.

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Polymerase chain reaction and its applications, Sequencing of DNA – Maxam and Gilberts method, Sanger's method and other advances in sequencing, Overview of chemical synthesis of oligonucleotides

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Mutation, Mutagens and Mutagenesis, techniques of in vitro mutagenesis, Site-directed mutagenesis. Applications of genetic engineering: Transgenic microbes; Production of recombinant pharmaceuticals

References:

S. N.	Name of Book	Authors
1	A text book of Biotechnology	R.C. Dubey
2	Genetic Engineering:	Smita Rastogi
	Suggested Reading	
1	Principles of Gene Manipulation	R.W.Old, Twyman M. & S.B.Primrose
2	Concepts In Biotechnology	Balasubramanian D *et al*
3	Genetic Engineering	Sandya Mitra

4	Gene Biotechnology	S.N. Jogdand

Semester-2

MBCT204- Research Methodology and Technical Writing in Microbiology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 204	**Research Methodology and Technical Writing in Microbiology**	**4**	**48**	**30**	**70**	**100**

Course Content

Section A

Unit 1 **No. of Lectures: 12** **Weightage: 25%**

Current trends in microbiological research. Introduction, Types of research.

Research Process: Identification of the problem, Defining the problem, Literature search**:** Information sources

Unit 2 **No. of Lectures: 12** **Weightage: 25%**

Design of the experiment: Variables in the experiments, evolution and application of research designs, observations, measurements, error measurements, error analysis.

Progress of research: Evaluation of results, comparison with existing methodologies, validation of findings

Section B

Unit 3 **No. of Lectures: 12** **Weightage: 25%**

Scientific communication : Types of reports; Scientific writing skills, Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts, Plagiarism.

Unit 4 **No. of Lectures: 12** **Weightage: 25%**

Technical Writing : Guidelines for effective writing, Paragraph writing, Writing style of application, Personal Resume, Official letter and Memo including Requests, Complains, asking quotation etc.

References:

S. N.	Name of Book	Authors
1	Research Methodology	CR Kothari
2	Study and Communication Skills for the Biosciences	Stuart Johnson & Jon Scott

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Practical					Total Marks
			Hrs/ week	Max Marks				
				Experiments & writing	Spots	Viva	Journal	
MBCP 205	Practicals	8	16	120	40	20	20	200

Course Content:

1) Isolation of Amylase producing microorganisms from soil.
2) Isolation of Protease producing microorganisms from soil.
3) Isolation of Lipase producing microorganisms from soil.
4) Screening of antibiotic producing microorganisms from soil.
5) Screening of organic acid producing microorganisms from soil.
6) Citric acid estimation by titrometric method.
7) Estimation of Reducing and Non-reducing sugar by Cole's method.
8) Fermentative production of Citric acid. -
9) Gel entrapment of yeast cells & determination of invertase activity of immobilized yeast cells.
10) Isolation of RNA from yeast
11) Estimation of RNA by orcinol method.
12) Isolation of DNA from *E. coli.*
13) Isolation of plasmid DNA from *E. coli* culture.
14) Restriction digestion of DNA.
15) Ligation of DNA fragments.
16) Visualization of DNA samples by Agarose gel electrophoresis.
17) Transformation and selection of recombinants.
18) To write a review article
19) How to include the references in a paper
20) How to write a Title and to find out keywords in a scientific communication
21) How to write an abstract
22) How to write a thesis
23) How to write an Introduction for an article
24) How to write a short note on any Topic
25) How to describe a Diagram on any Topic
26) How to point out the mistakes in the scientific communication
27) To search and collect Microbes occurring in nature and to examine the collected samples exhibiting viruses, bacteria and molds.
28) To Isolate microbes from Mangrove ecosystem
29) To Isolate thermophilic microbes from Gujarat sites
30) To Isolate halophilic and alkalophlic microbes from Gujarat sites

References:

S.N.	Title	Author
1	An introduction to Practical Biochemistry	David T.Plummer
2	Biochemical Methods	S. Sadasivan & A. Manickam
3	Practical Biotechnology	R.S.Guad, G. D. Gupta, S.B.Gokhale

4	Methods In Enzymology	Shelby L Berger & Alan R. Kimmel
5	Experimental Microbiology	R. J.Patel
6	Laboratory exercises in Microbiology	Harley Prescot
7	Laboratory manual in Biochemistry.	Jaynarayan

MBCT 301- IMMUNOLOGY AND IMMUNOTECHNOLOGY

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 301	Immunology and Immunotechnology	4	48	30	70	100

COURSE CONTENTS

Section A

Unit 1 **Weightage:25%** **Lectures:12**

Adaptive immunity and innate immunity. Inflammation: Definition, Characteristics of inflammation, causes and mechanism of inflammation.

Cells of immune system: Hematopoiesis and structure and functions of immune cells, ADCC. **Organs of immune system**: Primary and secondary lymphoid organs.

Antigens and antibodies: Properties of immunogens, haptens, epitopes, structure and classes of immunoglobulins, monoclonal antibodies and abzymes.

Complement: Definition, Classical, alternative and lectin pathway of complement system. Complement deficiency diseases. **Cytokines:** properties, receptors, associated diseases, therapeutic applications.

Unit 2 **Weightage:25%** **Lectures:12**

Antibody diversity: Antibody diversity definition, Organization of Ig genes, mechanism of gene rearrangement, generation of diversity; expression, synthesis and class switching.

Generation, activation and differentiation of B cells: B cell maturation, activation and proliferation. T-**cell receptor, T-cell maturation, activation and differentiation:** TCR- genetic organization and rearrangement of genes, TCR-complex, peptide binding, thymic selection, activation and differentiation of T cells.

Major histocompatibility complex: Definition, types, structure, organization of MHC genes and inheritance, Self MHC restriction.

Antigen processing and presentation: Cytosolic and endocytic pathway for antigen processing.

Section B

Unit 3 **Weightage:25%** **Lectures:12**

Antigen and antibody interaction: Precipitation and agglutination reactions

Transplantation immunology: Transplantation definition, transplantation types, mechanism of graft rejection, HLA matching, Mixed lymphocyte reaction.

Hypersensitivity reactions: Classification and types of hypersensitivity reactions.

Vaccines: Definiton, Passive Immunization and Active immunization, Classification of vaccines, Herd immunity.

Tumor immunology: Definiton of benign and malignant tumor, oncogenes, Process of metastasis, Tumor Antigen **(TATA, TSTA)**

Unit 4 **Weightage:25%** **Lectures:12**

Immune tolerance and autoimmunity: Establishment and failure of tolerance,

a. **Organ specific diseases** (Addison's disease, Autoimmune hemolytic anemia, Good pastures syndrome, Graves'disease, Hashimotosthyroditis, Insulin dependent diabetes mellitus, Myasthenia gravis, Glomerularnephritis and Pernicious anaemia)

b. Systemic diseases: Multiple sclerosis, Rheumatoid arthritis, Systemic lupus erythramatosis. **Immunodeficiency diseases. (**a). SCID, (b). WAS (c). Di George Syndrome, (d). Ataxia telengiectasia, (e). Chediak Higashi Syndrome, (f). Chronic granulamatous diseases.

REFERENCES:

Essential Immunology	Ivan Roitt
Kuby's Immunology:	R.A.Goldsby, T.J.Kindt and B.A.Osborne
Immunology:	I.Roitt, Brostoff, Mole
Introductory Immunology:	How Davies
Immunology Introductory Text Book	Shetty Nandini

MBCT: 302 - ENVIRONMENTAL MICROBIOLOGY

Teaching And Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 302	Environmental Microbiology	4	48	30	70	100

COURSE CONTENTS

Section A

Unit 1 **Weightage:25%** **Lectures:12**

Environmental issues: Types of pollution and its measurement.

Air pollution: Types of air pollutants, Effects of air pollution and control by physical and biological methods Climate change: Air pollution and its role in climate change. Introduction to Ecological foot print, Carbon credit Introduction to Kyoto Protocol, Introduction to Role of United Nations Framework Convention on Climate Change (UNFCCC).

Microbial indicators: WHO criteria for microbial indicators, Examples of microbial indicators and enumeration of microbial indicators

Unit 2: **Weightage:25%** **Lectures:12**

Waste water treatment: Introduction to waste water treatment.

Preliminary, Primary, Secondary: Introduction to aerobic and anaerobic treatment system Difference between aerobic and anaerobic waste water treatment,

Aerobic and anaerobic waste water treatment systems.

Tertiary treatment systems: Nitrogen removal, Phosphorus removal, removal of microbes.

Section B

Unit 3 Weightage:25% **Lectures:12**

Biofilms: Definition, Stage of biofilim development, Microbes involved in Biofilm, Problems related to biofilm formation its control method.

Microbiology of degradation of Xenobiotic in environment: Degradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, Surfactants, azo dyes, Insecticide: DDT, Herbicide: 2,4D.

Degradative plasmids: Plasmids involved in degradation of Toluene, 2,4-D.

Superbug : Discovery of superbug and its role

Unit 4 **Weightage:25%** **Lectures:12**

Bioremediation of solid waste: Principles of Bioremediation, Strategies of bioremediation: In situ and ex situ bioremediation technologies. Bioremediation of metals, Phytoremediation. Composting, Vermicomposting.

REFERENCES:

Waste Water Treatment for Pollution Control:	Arceivala.
Environmental Microbiology:	R. M. Maier, I. L. Pepper & G. P. Gerba
Comprehensive Biotechnology, Vol. 4	M. Moo-Young (Ed)
Environmental Microbiology and Biotechnology	Singer Samuel

Biotechnology for Waste and Wastewater Treatment	Nicholas P. Cheremisinoff,
Environmental Biotechnology Theory and Application	Gareth M. Evans & Judith C. Furlong
Environmental Biotechnology	S.N.Jogdand
Handbook of Environmental Biotechnology	S.C.Bhatia
Environmental Biotechnology	M.H.Fulekar
Environmental Microbiology	Pradipta K Mohaptra
Microbial Ecology (Fundamentals and applications)	Atlas and Bartha
Biodegradation and Bioremediation	Martin Alexandar

MBCT–303: INDUSTRIAL MICROBIOLOGY

Teaching And Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT–303	Industrial Microbiology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1 **Weightage:25%** **Lectures:12**

General concepts of Industrial Microbiology: Principles of exploitation of microbial biodiversity **Microbial production of**: **Enzymes:** Proteases, Amylases; **Vitamins:** Vitamin B_{12}, Vitamin B_2; **Amino acids:** Glutamic acid, Lysine.

Unit 2 **Weightage:25%** **Lectures:12**

Microbial production of: **Antibiotics:** Penicillin, Streptomycin; **Organic acids:** Citric acid, acetic acid, **Ethanol** (beer, wine, sake and brief overview of other distilled alcoholic beverages). **Alkaloids:** Production of Ergot Alkaloids and Microbial Transformations of Steroids.

Section B

Unit 3 **Weightage:25%** **Lectures:12**

Industrial applications of Algae: Brief specifications of Algal classification on the basis of size, pigments and polysaccharides, Techniques of mass culture of Algae, Application of Macro and Micro Algae as a Food and feed supplement, as a biofertilizer, in cosmetic and drug industry, as a biofuel etc.

Production of Biofertilizers: Symbiotic (*Rhizobium, Bradyrhizobium, Acetobacter, Frankia*, BGA) and Non-symbiotic N_2 fixing biofertilizers (*Azotobacter*), Phosphate solubilizing biofertilizers (Bacteria, Fungi and VAM) and Potassium fixing biofertilizers

Unit 4 **Weightage:25%** **Lectures:12**

Production of Biopesticides (*Bacillus, Metarhizium and Baculoviruses***)** and Biopreservatives **(Nisin).**

Biopolymers: Microbial polysaccharides: Overview of all microbial polysaccharides and detailed production of Xanthan gum and Dextran; **Biopolyesters** (polyhydroxyalkanoates and polylactate). **Bioconversions**: Biomining and bioleaching of ores, Biological fuel generation (Alcohols, Alkanes, Hydrogen and Methane), Microbial Enhanced Oil Recovery process.

REFERENCES:

S. N.	Name of Book	Authors
1	Comprehensive Biotechnology	Murray Moo-Young
2	Microbial Technology	H. J. Peppler& D. Perlman (Ed)
3	Microbial Biotechnology	Alexander N. Glazer & Hiroshi Nikaido (Ed.)

4	The Desk Encyclopedia of Microbiology	M. Schaechter (ed.)
5	Food Microbiology	Frazier William C and Westhoff Dennis C
6	Text Book of Industrial Microbiology	W Creuger& A Creuger
7	Industrial Microbiology	A. H. Patel
8	Industrial Microbiology: An Introduction	M. J. Waites, N. L. Morgan, J. S. Rockey, G. Higton
9	Biotechnology	H.J Rehm& G.I Reed
10	Fermentation Technology Volume 2	H. A Modi

MBCT–304 PHARMACEUTICAL TECHNOLOGY

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT – 304	Pharmaceutical Technology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1 **Weightage:25%** **Lectures:12**

Introduction to pharmaceutical microbiology, Biopharmaceuticals and introduction to animal, plant and microbial based pharmaceutical products

Microbiological aspects in pharmaceutical microbiology: Sterility testing, Autoclave and its validation, *In vitro* and *in vivo* testing for pyrogens and endotoxins, Microbiological assay of antibiotics, Water analysis, Bioburden determination, **Clean Rooms and Environmental monitoring**.

Unit 2 **Weightage:25%** **Lectures:12**

Concept and approaches for gene therapy, ex vivo and in vivo gene therapy, Potential target diseases for gene therapy (inherited disorders and cancer) Antigen and antisense therapy Vaccine: genetically improved vaccines, synthetic peptide based vaccines, nucleic acid vaccines Xenotransplantation in pharmaceutical biotechnology.

Section B

Unit 3 **Weightage:25%** **Lectures:12**

Dosage forms, Formulations and delivery routes for Biopharmaceutical: Oral delivery systems, pulmonary delivery, Nasal, Trans mucosal and transdermal delivery systems, Pharmacogenetics and its impact on drug therapy

Unit 4 **Weightage:25%** **Lectures:12**

Introduction to Different Pharmacopoeia, GMP Guidelines for manufacturing facilities, Regulatory market Inspections and their requirements, Quality Control analysis, QA and Documentation, SOP, Market complain analysis. USFDA, WHO

REFERENCES:

Sr. No.	Name of Book	Authors
1	Hugo and Russel's Pharmaceutical Microbiology:	Hugo and Russel's
2	Biopharmaceuticals Biochemistry and Biotechnology	Gary Walsh
3	Pharmaceutical Biotechnology: Drug Discovery & Clinical Applications:	O. Kayser& R.H. Muller
4	Biopharmaceuticals:	Jogdand, S.N
5	Molecular Biotechnology Therapeutic applications and Strategies	M. Sunil and P.D Salil
6	Pharmaceutical Biotechnology	S. P.Vyas and D.V. Kohli
7	Comprehensive Biotechnology	K G Ramawat&ShailyGoyal

8	Pharmaceutical Biotechnology Fundamentals & Applications	DJ Crommelin RD Sindler&Meibohm
9	Medical Biotechnology	P. Nallari& V V Rao

MBCP 305 PRACTICALS

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Practical					Total Marks
			Hrs/ week	Max Marks				
				Experiments & writing	Spots	Viva	Journal	
MBCP 305	Practicals	8	16	120	40	20	20	200

List of experiments: Experiments correspond to the theory papers in the current semester

1. To Perform Sandwich ELISA test
2. To Perform VDRL test for syphilis
3. To study Ag-Ab interaction by Immunoelectrophoresis.
4. To study Antigen-antibody interaction by using Oucterlony Double Diffusion (ODD) technique.
5. Bacteriological examination of water particularly for pathogenic microbes
6. Isolation of Coliphages from raw sewage
7. Detection of Coliform in water by membrane filter method
8. Determination of Chemical Oxygen demand of water
9. Determination of Dissolved Oxygen of Water
10. Determination of Biochemical Oxygen Demand of Water
11. Measurement of Total Solids, Suspended Solids and Dissolved Solids in a given sample of Water and Waste Water
12. Measurement of Acidity in given Water Sample
13. Measurement of Alkalinity of the given Water Sample
14. Determination of the Hardness of Water
15. Measurement of Sulfate in Water Sample
16. Determination of Chlorides concentration (Mohr's method)
17. Determination of Orthophosphate
18. Isolation of free living nitrogen fixing bacteria from soil.
19. Isolation of symbiotic nitrogen fixing bacteria from root nodules of leguminous plant.
20. Isolation of Phosphate Solubilizing Microorganisms from soil.
21. Isolation of Potassium Solubilizing Microorganisms from soil.
22. Estimation of alcohol by potassium dichromate method.
23. Fermentative production of alcohol by yeast.
24. Fermentative production of lactic acid
25. Fermentative production of protease
26. Isolation of Exopolysacharide producing Microorganisms from Citrus Canker
27. Mushroom spawn production technology
28. Sterility testing of paranteral products
29. Microbial limit test for oral dosage (capsules, tablet)
30. Enumeration of microbial load in class A and class B area by passive air sampling (settle plate method)
31. Analysis of microbial load in water. (purified water , WFI)
32. Tests for nonsterile pharmaceutical products.
33. Antibiotic potency testing.

34. Bioburden Estimation of medical devices.

MBET 306A ELEMENTS OF BIOSTATISTICS

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBET 306A	Elements of Biostatistics	2	24	15	35	50

COURSE CONTENT

Unit 1 **Weightage: 50%** **Lectures:12**

Biostatistics: Definition, branches and Scope of Biostatistics, Types of Variable and Measurement scale of Variable, Sample and statistic vs. Population and parameter.

Sampling: Rules for sample collection, Sampling error and Sampling techniques.

Analysis of data: Measures of central tendency – Mean (arithmetic, harmonic and geometric), Median and Mode.

Measures of dispersion (Standard deviation, Variance and coefficient of variance) and Standard Error and its significance.

Gaussian's Normal distribution

Unit 2 **Weightage:50%** **Lectures:12**

Inferential statistics: Basic idea of significance test, Statistical hypothesis, types of errors, level of significance.

Parametric and Nonparametric tests: Paired and Unpaired Student's t test and one way ANOVA as a parametric tests, Chi-square test as a Nonparametric test.

Measures of Relationship: Karl Pearson's Correlation coefficient and Simple linear regression.

Data Analysis using Microsoft office Excel

REFERENCES

S. N.	Name of Book	Authors
1	Biostatistical Analysis	Jerrold H. Zar
2	Basic Biostatistics: Statistics for Public health Practice	B. Burt Gerstman
3	An Introduction To Biostatistics	P.S.S. Sundar Rao, Richard J.
4	Research Methodology: Methods and Techniques	C. R. Kothari
5	Comprehensive Textbook of Biostatistics & Research Methodology	S. Kartikeyan, R.M. Chaturvedi, R.M. Bhosale
6	Methods In Biostatistics For Medical Students And Research Workers	B. K. Mahajan
7	Elements of Biostatistics	S. Prasad

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Semester-3

MBET: 306B GENOMICS

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBET: 306B	Genomics	2	24	15	35	50

COURSE CONTENT

Unit 1 **Weightage: 50 %** **No. of Lectures: 12**

Genomics: Concepts and Applications - Microbial genome and genome epidemiology. Organization of eukaryotic genomes. Repetitive and transposable genetic elements. Telomere regions. Structural genomics, Functional genomics and comparative genomics.

Whole genome analysis - Preparation of genome libraries (cosmid, BAC), shotgun sequencing, conventional and automated sequencing methods, Next generation sequencing methods. Genome mapping and DNA fingerprinting. Gene knockout, genome-wide mutagenesis.

Unit 2 **Weightage: 50 %** **No. of Lectures: 12**

Transcriptomics and Microarray - Introduction to transcriptomics and Global gene expression profiling. RNA and DNA Microarray preparation, working and analysis. DNA Chips, SNPs EST, SAGE.

Proteomics - concepts and applications of Expressional Proteomics, Functional Proteomics, Structural Proteomics.

Protein separation techniques: Affinity purification of proteins and TAP tag, 2D Gel electrophoresis, ITRAQ, Isoelectric Focusing (IEF).

REFERENCE:

S. N.	Name of Book	Authors
1	Biochemistry	J. M. Berg, J. L. Tymoczko, L. Stryer
2	Principles & Techniques of Biochemistry & Mol. Biology	Keith Wilson & John Walker
3	The Cell: A Molecular Approach	G.M.Cooper&R.E.Hausman
4	Gene IX	Lewin
5	Molecular Biology of the Gene	Watson et al.
6	Protein Structure Prediction: Methods and Protocols	Webster, David
7	Bioinformatics: A Practical guide to the Analysis of genes and Proteins	A. D. Bzxevanis and B. F. F. Onellette
8	Bioinformatics Methods and protocols: Methods molecular biology Vol. 132	S. Misenes and S. A. Krawetz (Eds)
9	Biopharmaceuticals Biochemistry and Biotechnology	G. Walsh

MBCT 401- FOOD AND DAIRY MICROBIOLOGY

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 401	Food and Dairy Microbiology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1 **Weightage:25%** **Lectures:12**

Factors affecting the growth and survival of microorganisms in Food: Intrinsic Factors (Moisture content, pH, Nutrient Content, Biological Structure, Redox potential, Antimicrobials, Competitive Microflora) and Extrinsic Factors (Types of Packaging/ Atmospheres, Time, Temperature, Storage and Holding Conditions).

Natural Sources of microbial Contamination of Food: (Air, Water, Soil, Sewage, Surface of plants and fruits, Surface of Animals, Improper handling and processing).

Food preservation by Asepsis, removal of microbes, Maintenance of anaerobic conditions, High and Low Temperature, Drying, Food additives and radiation.

Microorganisms as food: single cell protein, yeast, algae and fungal biomass production

Unit 2 **Weightage:25%** **Lectures:12**

Fermented Foods: Fermented Milk Products: Cheese, Curd, Yoghurt, Acidophilus Buttermilk, Bulgarian Buttermilk, Kefir, Kumiss, Skyr).

Fermented Vegetable Products: Sauerkaraut, Kimchi, Cucumber and Olive pickles.

Fermented Fruit Products: Wine, Vinegar, Coffee, Citron, Cacao.

Fermented Cereal grain products: bread, beer, sake, and Oriental Fermented foods (Soy Sauce, Tofu, Tempeh, Ang-Khak, Idli, miso, Minchin).

Fermented Meat and Fish products (Salami, Iao- Chao)

Section B

Unit 3 **Weightage:25%** **Lectures:12**

Microbial spoilage of food (Cereals and cereal products; Vegetable and Fruits, Meat and Meat Products, Poultry and eggs, Milk and milk products, Fish and seafoods, Canned foods, Sugars and sugar products), Pickles.

Unit 4 **Weightage:25%** **Lectures:12**

Indicator microorganisms and Quality criteria of different foods.

Detection, Identification and Analysis of Foodborne Pathogens: Enumeration procedures, Pure culture methods, Microscopic examination, Immunological detection and Electrical methods.

Food Sanitation, control and Inspection: Indian and International food safety laws and standards (Codex Alimentarius, FDA, HACCP- System, FSSAI, Agmark, ISO and BIS certification)

REFERENCES:

Name of Book	**Authors**
Food Microbiology	Frazier William C and Westhoff Dennis C
Food Microbiology: An Introduction	Adam M. and Dick M.
Fundamental Food Microbiology	Bibek Ray
Microbiology and Technology of Fermented Foods	Robert W. Hutkins
Modern Food Microbiology	Jay M. James
Industrial Microbiology: An Introduction	M. J. Waites, N. L. Morgan, J. S. Rockey, G. Higton
Comprehensive Biotechnology	Murray Moo-Young
Microbial Technology	H. J. Peppler& D. Perlman
Dairy Microbiology	H. A. Modi
Introductory Food Microbiology	H. A. Modi
Fermented Food Microbiology	H. A. Modi
Microbial spoilage of Food	H. A. Modi

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Semester 4

MBCT: 402 MEDICAL MICROBIOLOGY

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 402	Medical Microbiology	4	48	30	70	100

SectionA

Unit 1 **Weightage:25%** **Lectures:12**

Basics in Medical microbiology: Terminology related to medical microbiology. Types of Infections. Epidemology of diseases, Collection of sample - Collection, transport, preservation and preliminary processing of clinical samples from different anatomical sites. Biomedical waste management.

Unit 2 **Weightage:25%** **Lectures:12**

Bacteriology: Characteristics, classification, pathogenesis, pathology, diagnosis, treatment, prevention and control of diseases caused by (**1) Gram positive:** *Staphylococci, Streptococci, Bacillus, Clostridium, Corynebacterium, Mycobacteri*a. **(2) Gram negative:** *Escherichia, Salmonella, Shigella, Klebsiella, Proteus, Vibrio, Pseudomonas, Spirochaetes, Rickettsia*.

Section B

Unit 3 **Weightage:25%** **Lectures:12**

Virology: Structure, multiplication, and medical importance of **DNA viruses** - *Pox, Herpes, Hepatitis B, Adeno.* ***RNA virus****: Poliovirus, Influenza, Rubella, Hepatitis A, and HIV virus.*

Protozoa: *Trypansomiasis* and *Amoebiasis*

Unit 4 **Weightage:25%** **Lectures:12**

Mycology: Human mycotic infections caused by *Dermatophytes, Histoplasma, Cryptococcus, Candida.* Oppurtunistic infection caused by *Aspergillus, Mucor, Pencillium*Mycotoxins.

REFERENCES:

Ananthanarayan and Panikers Textbook of Microbiology	R. AnanthanarayanandCK JayaramPaniker
Mechanism of Microbial Diseases	Chaechter M. Medoff G. and Eisenstein BC.
Practical Medical Microbiology,	Collee, JG. Duguid JP, Fraser AG, Marimon BP.
Medical Microbiology. 14th edition.	David Greenwood, Richard CD, Slack, John F Peutherer
Pharmaceutical Microbiology	Hugo WB and Russell AD.
Clinical Microbiology	Joan Stokes E, Ridgway GL and Wren MWD
Microbiology: Fundamentals & Applications.	Ronald M. Atlas.

MBCP 403 PRACTICALS

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Practical					Total Marks
			Hrs/ week	Max Marks				
				Experiments & writing	Spots	Viva	Journal	
MBCP 403	Practicals	4	8	60	20	10	10	100

List of Experiments:

Experiments related to the Theory papers offered in the current semester.

1. Qualitative Examination of milk by methylene blue reduction test (MBRT).
2. Qualitative Examination of milk by resazurin test.
3. Metachromatic granules staining from curd.
4. Fermentative production of Cheese.
5. Fermentative production of Yogurt
6. Quantitative Examination of various food samples by total viable count (TVC).
7. Quantitative Examination of various food samples byMPN
8. Biochemical test: IMViC, TSI,Urease, Catalase, Oxidase.
9. Isolation and identification of pathogenic organisms from any two biological samples
10. Identification of microbes by biochemical test Kits
11. Antibiotic sensitivity tests

MBDI-404- DISSERTATION/ INDUSTRIAL TRAINING

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBDI 404	DISSERTATION/ INDUSTRIAL TRAINING	12	---	---	300	300

- Project work and Dissertation must be based on applied aspects of Microbiology, Biotechnology, Pharmaceuticals, Agriculture, Dairy & Food Processing, Environmental Issues and Bioinformatics.

- Semester 4 students will be at Industry / Research Institution / Department during entire term for Project Work and Dissertation. The Students have to devote 3 days, 8 hours per day at the work place that may be an Institute, Industry, Department and Hospital Laboratory.

- The Students will have to undergo continuous interaction and one evaluation of progress by a team of Departmental experts. A student who has undergone such evaluations only will be entitled to present his complete project work to the University for Exam.

- The University End Term Practical Examination will be carrying 300 marks divided as underneath and shall be conducted by One external expert along with an Internal expert:

- Thesis Write up : 100 marks
- Thesis Content : 100 marks
- Thesis Presentation : 50 marks
- Viva Voce : 50 marks

- Area of Final Project can be any of the following :
  - Biopharmaceuticals,
  - Biofertilizers,
  - Biopesticides
  - Enzymes
  - Biofuels,
  - Diagnostic Procedures
  - Dairy & Food Processing,
  - Tissue Culture
  - Bioremediation,
  - Bioleaching,
  - Pollution Abatement,
  - Extremophiles
  - Biological Effluent Treatment
  - Environmental Issues and
  - Bioinformatics.

MBET 405A BIOINFORMATICS

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBET 405A	Bioinformatics	2	24	15	35	50

Section A

Unit 1 **Weightage: 50%** **Lectures: 12**

Origin, history, aims and scope of bioinformatics, branches of bioinformatics;

Gene structure and information content: Nucleotides and theirs orientation, Promoter sequences, Open reading frames, Introns and Exons, Structural features of RNA: Primary, Secondary, Tertiary Structures.

Protein structure: Primary, secondary and tertiary. Nature of chemical bonds

Unit 2 **Weightage:50%** **Lectures:12**

Biological Data Acquisition: Biological Data Acquisition by Sequencing, PCR, Blotting, Microarrays, Restriction digestion**,** Cloning, NGS.Introduction to **Databases** (NCBI, PDB and CATH).

Similarity Searches, Database searches: BLAST, FASTA, **Visualisation tools**: 3D structure viewers (Rasmol), Introduction to Molecular Docking.

REFERENCES:

S.N.	Name of Book	Authors
1	Genetic Engineering	SmitaRastogi
2	Biotechnology	U. Satyanarayana
3	Developing Bioinformatics Computer Skills	C. Gibas and P. Jamback.
4	Bioinformatics A machine learning approach	P. Baldi& S. Brunak
5	Bioinformatics: A Practical guide to the analysis of LIENES and Proteins	A. D. Bzxevanis and B. F. F. Onellette

Kadi Sarva Vishwavidyalaya, Gandhinagar

CBCS Syllabus of M.Sc. Microbiology

Semester-4

MBET 405B PROTEOMICS

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBET 405B	Proteomics	2	24	15	35	50

COURSE CONTENT

Unit 1 **Weightage: 50 %** **No. of Lectures: 12**
Protein-Protein interactions- Yeast-two hybrid Assays, Phage display. Fluorescent tagging and FRET microscopy. Protein crystallization**:** technique and application. **Mass spectrometry in proteomics –** Principle, techniques, data analysis and applications (MALDI-TOF, LC-MS, MS/MS).Peptide sequencing. Protein Microarray

Unit 2 **Weightage: 50 %** **No. of Lectures: 12**
Applications of Genomics and Proteomics: In basic research and medical genetics: Metagenomics, Pharmacogenomics: Overview, concept and application of Individualized Therapy; RNAi: Targeted Medicine and gene silencing. Peptidomics/ Drug discovery, Toxicoproteomics, Biomarkers in disease diagnosis, Identification and characterization of novel proteins. **Genomics and proteome data analysis**: Public domain databases for NA and proteins (EMBL, GeneBank), Similarity, homology, sequences alignments and genome analysis program (BLAST, FASTA, GCC, ClustalW etc.). ORFs, genes annotation, conserved protein motifs related structure / function analysis (PROSITE, PFAM, Profile Scan, PDB).

REFERENCES:

S. N.	Name of Book	Authors
1	Biochemistry	J. M. Berg, J. L. Tymoczko, L. Stryer
2	Principles and Techniques of Biochemistry & Mol. Biology	Keith Wilson & John Walker
3	The Cell: A Molecular Approach	G.M.Cooper&R.E.Hausman
4	Gene IX	Lewin
5	Molecular Biology of the Gene	Watson et al.
6	Protein Structure Prediction: Methods and Protocols	Webster, David
7	Bioinformatics: A Practical guide to the Analysis of genes and Proteins	A. D. Bzxevanis and B. F. F. Onellette
8	Bioinformatics Methods and protocols: Methods molecular biology Vol. 132	S. Misenes and S. A. Krawetz (Eds)
9	Biopharmaceuticals Biochemistry and Biotechnology	G. Walsh

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to Proteomics
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams

TEACHING AND EXAMINATION

UNIT	Examination Scheme %weightage	Teaching Scheme No. of Lectures
Unit 1	50	12
Unit 2	50	12
Total	100	24

KADI SARVA VISHWAVIDYALAYA, GANDHINAGAR
Department of Microbiology
Scheme for Core Theory End Term Examination

Time: 3 hrs **Date:** **Maximum marks: 70**

SECTION-A

Q.1 Answer all questions. Each question carries 1 mark (10X1=10 Marks)
(MCQ. Out of these 5 will be from Unit 1 and 5 will be from Unit 2)

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)

Q. 2 Answer all questions. Each question carries 5 marks (2X5=10M)

I) 5M Question (Unit1)
or
II) 5 M Question (Unit1)

III) 5M Question (Unit2)
or
IV) 5 M Question (Unit2)

Q. 3 Answer any 5 questions. Each question carries 3 marks (5X3=15 Marks)
(4 questions from Unit 1 and 4 from Unit 2)

a)
b)
c)
d)
e)
f)
g)
h)

P.T.O

SECTION-B

Q.4 Answer all questions. Each question carries 1 mark (10X1=10 Marks)
(MCQ. Out of these 5 will be from Unit 3 and 5 will be from Unit 4)

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)

Q. 5 Answer all questions. Each question carries 5 marks (2X5=10M)

I) 5M Question (Unit3)
or
II) 5 M Question (Unit3)

III) 5M Question (Unit4)
or
IV) 5 M Question (Unit4)

Q.6 Answer any 5 questions. Each question carries 3 marks (5X3=15 Marks)
(4 questions from Unit 3 and 4 questions from Unit 4)

a)
b)
c)
d)
e)
f)
g)
h)

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KADI SARVA VISHWAVIDYALAYA, GANDHINAGAR
Department of Microbiology
Question Paper Scheme for Elective Theory End Term Examination

Time: 3 hrs **Date:** **Maximum marks: 35**

Q.1 Answer all questions. Each question carries 1 mark (10X1=10 Marks)
(MCQ. Out of these 5 will be from Unit 1 and 5 will be from Unit 2)

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)

Q. 2 Answer all questions. Each question carries 5 marks (2X5=10M)

I) 5M Question (Unit1)
or
II) 5 M Question (Unit2)

III) 5M Question (Unit1)
or
IV) 5 M Question (Unit2)

Q. 3 Answer any 5 questions. Each question carries 3 marks (5X3=15 Marks)
(4 questions from Unit 1 and 4 from Unit 2)

a)
b)
c)
d)
e)
f)
g)
h)

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