KADI SARVA VISHWAVIDYALAYA, GANDHINAGAR

M.Sc. MICROBIOLOGY

SYLLABUS
W.E.F. JULY 2017

Kadi Sarva Vishwavidyalaya, Gandhinagar
CBCS Syllabus of M.Sc. Microbiology

M.Sc. Microbiology I Year Course Description:

Paper	**Title of Paper**	**Credits**
Core	SEMESTER-1	
MBCT – 101	Cellular Metabolism and Enzymology	4
MBCT – 102	Analytical Microbiology & 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
	SEMESTER-2	
Core		
MBCT – 201	Microbial Diversity	4
MBCT – 202	Bioprocess Technology	4
MBCT – 203	Recombinant DNA Technology	4
MBCT – 204	Research Methodology & Technical Writing in Microbiology	4
MBCP – 205	Practicals related to core theory papers in the semester	8

MBCT- Microbiology Core Theory, MBCP- Microbiology Core Practical.

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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

S.N.	Title	%	Hrs
	Section A		
1	**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.	25	12
2	**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.	25	12
	Section B		
3	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.	25	12
4	**Multi-enzyme system, Co-cooperativity.** **Types of Enzyme inhibition** and **Mechanism of regulation of enzymes.** **Enzyme Technology:** Immobilization of enzymes and their application.	25	12

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

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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

S.N.	Title	%	Hrs
	Section A		
1	**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	25	12
2	**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	25	12
	Section B		
3	**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	25	12
4	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.	25	12

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

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Semester -I

MBCT 103- Microbial Genetics

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

S.N.	Title	%	Hrs
	Section A		
1	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.	25	12
2	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.	25	12
	Section B		
3	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.	25	12
4	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	25	12

REFERENCES

S.N.	Molecular Biology of Cell:	B. Alberts *et. al.*
1	Molecular Biology of the Gene	J. D. Watson *et. Al.*
2	Genes XI	B. Lewin
3	Instant notes on Molecular Biology- 4 Ed.	Turner
4	Principles of Genetics	Snustard
5	Fundamental Bacterial Genetics	Nancy Trun & Janie Trempy

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Semester-1

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	
MBCT-202	**Microbial Physiology and Cell Biology**	**4**	**48**	**30**	**70**	**100**

COURSE CONTENT

S.N.	Title	%	Hrs
	Section A		
1	**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	25	12
2	**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	25	12
	Section B		
3	**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	25	12
4	**Culture collection**: Maintenance of cultures, Biochemical characterization. **Antimicrobial agents**: Antibacterial, Antiviral, Antifungal agents, Mode of action and resistance to antibiotics	25	12

REFERENCES:

S. N.	Name of Book	Authors
1	Cell & Molecular Biology	E.D.P. De Roberties and E.M.F. De Roberties
2	Microbial Physiology	A.G.Moat and J.W.Foster
3	General Microbiology	Roger Stanier *et al*
4	Microbiology	Pelczar Michael J *et al*
5	Microbiology and Immunology	Johnson Arthur G
6	The Cell: A Molecular Approach	G.M.Cooper & R.E.Hausman
7	Microbiology	L.M.Prescott
8	Cell Biology & Molecular Biology	Verma & Agarwal
9	Cell Biology	T. Devasena
10	Brock's Biology of Microorganisms	Michael T. Madigan, John M. Martinko, David Stahl, David P. Clark

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Semester-1

MBCP 105 Practicals

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Practical					Total Marks
			Hrs	Max Marks				
				Experiments & writing	Spots	Viva	Journal	
MBCP 105	Practicals	8	48	120	40	20	20	200

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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	
MBCT201	**Microbial Diversity**	**4**	**48**	**30**	**70**	**100**

COURSE CONTENT

S.N.	Title	%	Hrs
	Section A		
1	**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	25	12
2	**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,	25	12
3	**Section B**	8	4
4	**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.	25	12
5	**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	25	12

REFERENCES:

S. N.	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 Microorganisms,8th Edition	Michael T. Madigan, John M. Martinko. Jack Parker.
5	Microbiology Principle & Applications	J.J. Black, John Wiley, Prentice Hall
6	An Introduction to Fungi	H.C. Dube : 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

S.N.	Title	%	Hrs
	Section A		
1	**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.	25	12
2	**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.	25	12
	Section B		
3	**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.	25	12
4	Product enrichment and purification techniques. **Enzyme technology**: Use of immobilized enzymes in bioreactor and its applications. Bioprocess economics.	25	12

REFERENCES:

Sr. No.	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

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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

S.N.	Title	%	Hrs
	Section A		
1	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.	25	12
2	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,	25	12
	Section B		
3	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	25	12
4	Mutation, Mutagens and Mutagenesis, techniques of in vitro mutagenesis, Site-directed mutagenesis. Applications of genetic engineering: Transgenic microbes; Production of recombinant pharmaceuticals	25	12

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

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Semester-2

MBCT204- Research Methodology & Technical Writing in Microbiology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MBCT 104	**Research Methodology & Technical Writing in Microbiology**	**4**	**48**	**30**	**70**	**100**

COURSE CONTENT

Section A			
UNIT	**CONTENT**	**Weightage**	**No of lectures**
1	**Current trends in biotechnological research** Introduction, Types of research **Research Process:** Identification of the problem, Defining the problem, Literature search**:** Information sources,	**25%**	**12**
2	**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	**25%**	**12**
SECTION B			
3	**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	**25%**	**12**
4	**Technical Writing** : Guidelines for effective writing, Paragraph writing, Writing style of application, Personal Resume, Official letter and Memo including Requests, Complains, asking quotation etc.	**25%**	**12**

REFERENCES:

Sr. No.	Name of Book	Authors
1	Research Methodology	CR Kothari
2	Study and Communication Skills for the Biosciences	Stuart Johnson & Jon Scott

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Semester-2

MBCP 205 Practicals

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Practical					Total Marks
			Hrs	Max Marks				
				Experiments & writing	Spots	Viva	Journal	
MBCP 205	Practicals	8	48	120	40	20	20	200

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The question paper scheme

The End Term paper shall be of 70 Marks to be answered in 3 hours duration. Each paper comprises of two sections each carrying 35 marks. From each unit of the paper there will be 5 MCQ, two 5M questions, four 3M questions out of which the students have to answer all MCQ, one 5 M question and at least one or a maximum of four 3M questions.

Unit wise marks distribution and paper scheme

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 –at least **1** & maximum **4**	**35 Marks**
Unit 2	5 MCQ, four 5M questions, four 3M questions	MCQ-**5** 5M questions -**1** 3M questions –at least **1** & maximum **4**	
Section B	**Questions from each Unit**	**Questions to be answered**	**Marks**
Unit 3	5 MCQ, four 5M questions, four 3M questions	MCQ-**5** 5M questions -**1** 3M questions –at least **1** & maximum **4**	**35 Marks**
Unit 4	5 MCQ, four 5M questions, four 3M questions	MCQ-**5** 5M questions -**1** 3M questions –at least **1** & maximum **4**	
		Total	**70 Marks**

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Department of Microbiology
Scheme for End Term Examination, KSV

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)

A. 5M Question (Unit1)
or
B. 5 M Question (Unit1)

C. 5M Question (Unit2)
or
D. 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)

1.
2.
3.
4.
5.
6.
7.
8.

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)

A. 5M Question (Unit1)

or

B. 5 M Question (Unit1)

C. 5M Question (Unit2)

or

D. 5 M Question (Unit2)

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)

1.
2.
3.
4.
5.
6.
7.
8.

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