KADI SARVA VISHWAVIDYALAYA, GANDHINAGAR

M.Sc. BIOTECHNOLOGY

CBCS SYLLABUS

W.E.F. JULY 2017

M.Sc. Biotechnology, I Year Course Description:

Paper	Title of Paper	Credits
Core	SEMESTER-1	
BTCT – 101	Molecular Biology	4
BTCT – 102	Principles of Biochemistry and Enzymology	4
BTCT – 103	Bioinstrumentation	4
BTCT – 104	Cell Biology and Cellular Physiology	4
BTCP – 105	Practicals related to core theory papers in the semester	8
	SEMESTER-2	
Core		
BTCT – 201	Genetic Engineering	4
BTCT – 202	Systematics of Microbial Life	4
BTCT – 203	Biotechnological Research and Technical Writing	4
BTCT – 204	Bioprocess Engineering	4
BTCP – 205	Practicals related to core theory papers in the semester	8

BTCT- Biotechnology Core Theory, BTCP- Biotechnology Core Practical.

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Semester-1

BTCT 101- Molecular Biology

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 101	**Molecular Biology**	**4**	**48**	**30**	**70**	**100**

COURSE CONTENT

S.N.	Title	%	Hrs
	Section A		
1	Genetic material & Recombination: Genetics, Overview of Mendelian Genetics, Central Dogma of life, Genetic Material – Properties, DNA is genetic material - Experimental proof, RNA is genetic material - Experimental proof, Transduction, Conjugation & Overview of transposons. Replication: Proposed models for Mechanism of DNA replication – Semiconservative and conservative and experimental proof for semi conservative mode of replication. Enzymes & accessory proteins involved in DNA replication. Okazaki's experiments, Replication process in prokaryotes & Eukaryotes- Rolling circle mode of replication, Theta replication, D loops. End replication problem in eukaryotes, Telomerase.	25	12
2	Genome organization: Genomic organization in prokaryotes, Packaging of DNA as nucleosomes and higher order of packaging in eukaryotes, C-value paradox. Euchromatin, Heterochromatin, Bar bodies. Chromosomes types based on centromere location, Special type of chromosomes: lamp brush and giant chromosomes. DNA damage by radiations and chemicals. DNA Repair - Light Repair & Dark Repair – Excision Repair, Mismatch Repair, Recombination Repair, SOS Repair.	25	12
	Section B		
3	Promoters & Other Regulatory Sequences: Transcription- Definition, Cis and Trans elements, Importance of DNA binding Proteins, Transcription factors, Promoters and enhancers. Transcription: RNA polymerase and Mechanism of Transcription in prokaryotes & Eukaryotes, Processing of mRNA- 5' capping, 3' polyadenylation, splicing.	25	12
4	Translation: Definition, role of tRNA & ribosomes, Mechanism of translation in Prokaryotes & Eukaryotes, Post translational modification of proteins such as phosphorylation, adenylation, acylation and glycosylation. Regulation of gene expression: Operon concept-lac operon – positive and negative regulation, trp operon- negative regulation & Attenuation.	25	12

References

S.N.	Title	Author
1	Instant notes on Molecular Biology- 4 Ed.	Turner *et. al.*
2	Fundamental Bacterial Genetics	Nancy Trun & Janie Trempy
	Suggested Reading	
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	Principles of Genetics	Snustard

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Semester-1

BTCT 102- Principles of Biochemistry and Enzymology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 102	**Principles Of Biochemistry 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 over view 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. **Proteins and Amino acids 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. Factor 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:

S.N.	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

BTCT 103- Bioinstrumentation

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 103	**Bioinstrumentation**	**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; High speed; Isopycnic; Ultra; preparative; Gradient Centrifugation techniques	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, AA Spectroscopy	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 isotope techniques:** Detection and measurement of radioactivity, Geiger Muller counters, Scintillation counting, Autoradiography and RIA; Applications of isotopes in biological studies.	25	12

REFERENCES:

S. N.	Name of Book	Authors
1	Principle & 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-1

BTCT 104- Cell Biology & Cellular Physiology

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 203	**Cell Biology & Cellular Physiology**	**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

Semester-1

BTCP 105 Practicals

Teaching and Evaluation Scheme:

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

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Semester-2

BTCT: 201 - Genetic Engineering

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 201	**Genetic Engineering**	**4**	**48**	**30**	**70**	**100**

COURSE CONTENT

S.N.	Title	%	Hrs
	Section A		
1	Genetic Engineering**,** Chimera, Recombinant DNA, Invitro gene manipulation and its tools. Restrtiction 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; Strain construction, 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

BTCT: 202 - Systematics of Microbial Life

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 303	**Systematics of Microbial Life**	**4**	**48**	**30**	**70**	**100**

COURSE CONTENT

S.N.	Title	%	Hrs
	Section A		
1	**History of Science**: Prebiological chemical evolution, proteinoids and protocells; Species concept, theory. Kingdom to Species, The five Kingdoms, Three domain concept of Carl Woese; Endosymbiont. Scope, History and development and Scope of Biotechnology. Contributions of Pioneers. **Microbial biodiversity** Species, Genomic and Ecologic diversity and classification of microorganisms. Distinguishing characteristics between prokaryotes and eukaryotes. Prions. Extremophiles. **Taxonomy and Phylogeny** – Classical and Basic concepts in Taxonomy and Phylogeny, Morphological and molecular Taxonomy; Phylogenetic analysis, Phylogenetic trees.	25	12
2	**Disinfection / Sterilization**: Physical and chemical agents, radiation & filtration. Indicator organism's for sterilization methods. Cultivation techniques, preservation and maintenance of Microbial cultures. **Bacterial systematics**: Bergey's Manual of Systematic Bacteriology. Distribution, General features, characters, and replication, Systematics and Economic Importance of various groups of bacteria. *Proteobacteria*, *Firmicutes.* Actinobacteria, Mycoplasma,, Spirochetes, Rickettsiae,	25	12
	Section B		
3	**Viruses**: General characters, Structure and replication, nomenclature and classification of DNA and RNA viruses. Plant Viruses, Animal Viruses, Bacteriophages. Virus Diagnosis and cultivation. Economic Importance. **Archaebacteria and other extremophiles**. Characteristics, diversity, significance and potential applications of Archaebacteria, Alkalophiles and Acidophiles Halophiles and Barophile.	25	12
4	**Algal diversity and importance**: Distribution, morphology, taxonomy and lifecycle. Economic Importance of algae (algal pigments, biofuels, hydrogen production, important bioactive molecules). **Fungi**: General characters, Distribution, Morphology, Structure, nutrition and life cycle, Classification and Economic Importance. Associations: Lichens, Mycorrhiza. Yeast: genomics, diversity, and 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-II

BTCT: 203- Research Methodology and Technical Writing in Biotechnology

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 104	**Biotechnological Research and Communication**	**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

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

Semester-2

BTCT 204- Bioprocess Engineering

Teaching and Evaluation Scheme:

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BTCT 202	**Bioprocess and Biochemical Engineering**	**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:

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

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Semester-2

BTCP: 205 Practical

Teaching and Evaluation Scheme:

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

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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