



**GONDWANA UNIVERSITY**

**GADCHIROLI**

**CHOICE BASE CREDIT SYSTEM  
(CBCS)**

**SYLLABUS FOR**

**B.Sc.**

**THREE-YEARS DEGREE COURSE  
IN**

**BIOTECHNOLOGY**

**From**

**Academic Year**

**2017-2018**

## **Preface**

The Graduate and Master program in "Biotechnology" is a scientific-biological study course, based on fundamental research with special focus on microbiology at its full diversity. This covers phylogeny, physiology, cell and molecular biology of organisms from all three domains of life. The program "Biotechnology" at the Gondwana-University is directed towards the education of excellent, competitive graduates with a great spectrum of methodology, interdisciplinary focus and international qualification for the assignment in research, and in companies. The close connection to the local job market allows an optimal change to occupation. Here, the potential of biology and in particular of molecular biology with focus on microbiology is increasingly used as platform for the networking of other disciplines. The combination and development of technology platforms of various institutes (e.g. proteome, transcriptome, metabolome analyses, chemical, biochemical, physical and cell biological analytics, fermentation) under, "Enabling Technologies" allows a strong focusing on research during the Master study program.

The Graduate and Master Study program "Microbiology" builds consecutively on a biological education and is focused on research. The study program is especially dedicated to the integration and consolidation of knowledge in microbiology. The job market for microbiologists is still excellent.

**Dr. Abhay B. Solunke**

**Chairman of Board of Studies in Biotechnology**

**Gondwana University, Gadchiroli. (Maharashtra)**

## **Preamble**

The B.Sc. Biotechnology courses are running in Gondwana University, Gadchiroli from its beginning followed the semester pattern and now Gondwana University, Gadchiroli, has adopted the CBCS (Choice Base Credit System) pattern that would be divided B.Sc. into three years- year I, year II and year III. Each part would consist of two semesters. Each semester would comprise of four theory papers including practicals. The new course will commence from the academic session 2017-18. The syllabus has been prepared keeping in view the unique requirements of B.Sc. Biotechnology students. The contents have been drawn to accommodate the widening horizons of the Biotechnology discipline. It reflects the changing needs of the students, pertaining to the fields of Chemistry, Statistics and Computational skills. The detailed syllabus for each paper is appended with a list of suggested readings.

Each practical batch should not have more than 16 students. Any number exceeding 20 will be divided into two equal batches. This is because Biotechnology practicals require individual attention for imparting correct and adequate hands – on training to the students. One short educational trip will be conducted to industry/national/research institutes in the 5<sup>th</sup> semester to keep the students abreast with latest developments in the field of microbiology.

**Approved by: Board of Studies in Biotechnology, in meeting held on 29-03-2016 & 15-05-2017.**

**Dr. Abhay B. Solunke**

**Chairman**

**Shri Govindrao Munghate Arts & Science College, Kurkheda**

**Members Present:**

1. Dr. P.H. Kumbhare Guru Nanak College, Ballarshah.
2. Dr. S.V. Kasbekar Sindhu Mahavidyalaya, Nagpur.
3. Dr. V.U. Thool Sardar Patel Mahavidyalaya, Chandrapur.
4. Dr. M. Kulkarni Chintamani Mahavidyalaya, Pomburna.

**Table**

Semester No.	Paper No.	Course Code	Title of Paper	Theory	Internal assessment	Marks
<b>B.Sc. First Year</b>						
<b>I</b>	<b>I</b>		<b>Cell and Cell Organelles</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>II</b>		<b>General Microbiology</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>III</b>		Practical's based on theory paper I & II	<b>30</b>	<b>20</b>	<b>50</b>
			Total			<b>150</b>
<b>II</b>	<b>IV</b>		<b>Biochemistry</b>			<b>50</b>
	<b>V</b>		<b>Genetics</b>			<b>50</b>
	<b>VI</b>		Practical's based on theory paper V & VI			<b>50</b>
			Total			<b>150</b>
<b>B.Sc. Second Year</b>						
<b>III</b>	<b>VII</b>		<b>Cell Metabolism</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>VIII</b>		<b>Molecular Biology and Enzymology</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>IX</b>		Practical's based on theory paper VII & VIII	<b>30</b>	<b>20</b>	<b>50</b>
<b>IV</b>	<b>X</b>		<b>Biophysical Techniques</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>XI</b>		<b>Immunology and Biostatistics</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>XII</b>		Practical's based on theory paper X & XI	<b>30</b>	<b>20</b>	<b>50</b>
<b>B.Sc. Third Year</b>						
<b>V</b>	<b>XIII</b>		<b>Genetic Engineering</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>XIV</b>		<b>Plant Biotechnology</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>XV</b>		Practical's based on theory paper XIII & XIV	<b>30</b>	<b>20</b>	<b>50</b>
<b>VI</b>	<b>XVI</b>		<b>Environmental Biotechnology</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>XVII</b>		<b>Animal Biotechnology</b>	<b>40</b>	<b>10</b>	<b>50</b>
	<b>XVIII</b>		Practical's based on theory paper XVI & XVII	<b>30</b>	<b>20</b>	<b>50</b>

**General Overview:**

**Total Credits for all semesters in B.Sc. Programme will be of 132.**

**The semester wise credit points earned by the learner from undergraduate programme shall be as follows:**

Programme	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
<b>Under Graduate</b>	<b>26</b>	<b>26</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>132</b>

**Credit Base Evaluation System:****Scheme of examination:**

It is divided into two points: Internal assessment and external assessment (Semester end Examination Conducted by University).

**Internal Assessment:**

Internal assessment includes Seminars, case studies, Quizzes, Viva, Unit test, etc.

**The semester end examination for each course with practical will be as follows:**

One theory courses of two papers: 100 marks (external Assessment- University examination)

20 Marks for (Internal assessment).

**Total 120**

One practical course 30 marks

(Practical Examination for odd semester will be at college level and for even semester at university level with external examiner)

1) Time duration of each Theory Paper will be of Three (3) Hrs.

2) There shall be 5 questions of 08 marks each.

3) The theory course will be divided into 4 units.

4) All questions will be compulsory and with internal choice.

3) Time Duration for Practical examination will be 4 hours for two consecutive days.

The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA & CGPA.

**Format for the Internal Assessment**

Sr. No.	Evaluation Type	Marks	Marks Obtained
<b>1</b>	<b>Assignments</b>	<b>05</b>	
<b>2</b>	<b>Class Test</b>	<b>10</b>	
<b>3</b>	<b>Active Participation in routine class activities / seminars, etc.</b>	<b>05</b>	

**Passing:**

For each course there is a passing with minimum **35%**(internal and external together)

**Allowed to keep terms (ATKT)**

1) A student shall be allowed to keep term for semester II irrespective of grades obtained in each course of semester I.

2) A student shall be allowed to keep term for semester II if he/she passes (Grade E or above in each course) each semester I & semester II **OR** He/she passes two course in each semester.

3) A student shall be allowed to keep term for semester IV irrespective of grades obtained in each course of semester II & can appear for semester IV examination.

4) A student shall be allowed to keep term for semester V if he/she passes semester I, II, III & IV. **OR** He/she has passes Semester I & Semester II and pass in at least 2 courses each of semester III & IV.

5) A student shall be allowed to keep term for Sem VI irrespective of grades obtained in each course of semester V.

There will be supplementary examination conducted for external evaluation (Semester end) by University.

**QUESTION PAPER PATTERN**

<b>Question .1</b>	<b>Long Question OR Short Questions (2 of 4marks each)</b>	<b>Unit I OR Unit I</b>	<b>08Marks</b>
<b>Question .2</b>	<b>Long Question OR Short Questions (2 of 4marks each)</b>	<b>Unit II OR Unit II</b>	<b>08 Marks</b>
<b>Question .3</b>	<b>Long Question OR Short Questions (2 of 4marks each)</b>	<b>Unit III OR Unit III</b>	<b>08 Marks</b>
<b>Question .4</b>	<b>Long Question OR Short Questions (2 of 4marks each)</b>	<b>Unit IV OR Unit IV</b>	<b>08 Marks</b>
<b>Question .5</b>	<b>Short Notes any Ten (08) out of Twelve (12) One Mark each (3 questions from each unit)</b>	<b>On All four Units.</b>	<b>08 Marks</b>

**Proposed Scheme for Choice Based Credit System in B.Sc.**

<b>Sem</b>	<b>Core Courses (12)</b>	<b>Ability enhancement Compulsory Course(AECC) [2]</b>	<b>Skill enhancement Course(SEC) [2]</b>	<b>Discipline Specific Elective (DSE) (6)</b>
<b>I</b>	<b>DSC-1A</b>	<b>(English/Hindi/MIL Communication)/ Environmental Science</b>		
	<b>DSC-2A</b>			
	<b>DSC-3A</b>			
<b>II</b>	<b>DSC-1B</b>	<b>Environmental Science/ (English/Hindi/MIL Communication)</b>		
	<b>DSC-2B</b>			
	<b>DSC-3B</b>			
<b>III</b>	<b>DSC-1C</b>		<b>SEC-1</b>	
	<b>DSC-2C</b>			
	<b>DSC-3C</b>			
<b>IV</b>	<b>DSC-1D</b>		<b>SEC-2</b>	
	<b>DSC-2D</b>			
	<b>DSC-3D</b>			
<b>V</b>			<b>SEC-3</b>	<b>DSE-1A</b>
				<b>DSE-2A</b>
				<b>DSE-3A</b>
<b>VI</b>			<b>SEC-4</b>	<b>DSE-1B</b>
				<b>DSE-2B</b>
				<b>DSE-3B</b>

**Total Credits is 132**

### Scheme for Choice Based Credit System in B.Sc.

Sem	Core Courses (12) of 6 credits each. Two papers for each core course. Total credits 72	Ability enhancement Compulsory Course (AECC) (4+4=8 Credits)	Skill enhancement Course(SEC) [2credits] One paper from pool of papers. Total credits 4X2=8 credits	Discipline Specific Elective (DSE) (6) of 6 credits each. Two papers of each discipline from poll of papers. Total credits 6X6=36 credits.
1	Core Course e.g. Course-I: Physics(Th+Pr) Course-II: Chemistry (Th+Pr) Course-III: Biotechnology(Th+Pr)	AECC I (English) AECC II (Marathi/Supl. English /Hindi/ Other language)		
2	Core Course e.g. Course-IV: Physics(Th+Pr) Course-v: Chemistry (Th+Pr) Course-VI: Biotechnology(Th+Pr)	AECC III (English) AECC IV (Marathi/Supl. English /Hindi/ Other language)		
3	Core Course e.g. Course-VII: Physics(Th+Pr) Course-VIII: Chemistry (Th+Pr) Course-IX: Biotechnology(Th+Pr)		SEC-I Environmental Studies Compulsory	
4	Core Course e.g. Course-X: Physics(Th+Pr) Course-XI: Chemistry (Th+Pr) Course-XII: Biotechnology(Th+Pr)		SEC-II Foundation Course to be chosen by student	
5			SEC-III Foundation Course to be chosen by student	DSE-I (Phy. Elective) [Th+Pr] DSE-II (Chem. Elective) [Th+Pr] DSE-IIIA (Biotechnology Elective) [Th+Pr]
6			SEC-IV Foundation Course to be chosen by student	DSE-IV(Phy. Elective) [Th+Pr] DSE-V (Chem. Elective) [Th+Pr] DSE-VI (Biotechnology Elective) [Th+Pr]



# SEMESTER-I

## B. Sc. I Year

<b>Semester-I</b>		
<b>Course Code .....</b>	<b>Paper-I</b>	<b>Marks: 40</b>
<b>Credits: 2</b>		<b>Total Hours: 48</b>
<b>CELL &amp; CELL ORGANELLES</b>		
<b>Objective:</b> To make the students to understand the fundamentals of cell		
Unit No.	Content	Hrs.
<b>1</b>	<b>Introduction to cell</b>	<b>12</b>
	Discovery of cell: - Contribution of Robert Hook, Jan Evangelista, Purkyne, Matthias Jakob Schleiden and Theodor Schwann.	
	Cell as a basic unit of living systems	
	The Cell theory	
	Classification of cells based on Cell shape, Cell size, Cell volume and Cell Number	
	Typical structure of prokaryotic and eukaryotic cell	
	Structure of Plant cell. Structure of Animal cell. Difference between plant and animal cell.	
	Structure and function of Muscle and Nerve Cell	
<b>2</b>	<b>Cell Organelles</b>	<b>12</b>
	Structure and Function of Nucleus and Nucleolus	
	Cell Wall (Bacterial and Plant)	
	Plasma Membrane (Fluid-Mosaic Model), Endoplasmic Reticulum (Rough, Smooth), Mitochondria, Golgi apparatus, Ribosomes and its subunits, Lysosomes, chloroplast.	
	Centrioles (animal), Plastids (Plant), Vacuoles, Granules, cytosol.	
<b>3</b>	<b>Cytoskeleton and Cell Locomotion</b>	<b>12</b>
	Structure and function of Actin filaments (Microfilaments), Microtubules (alpha tubulin and beta tubulin), Microtubule Motor (kinesins, dyneins) and intermediate filaments (keratins, lamins, neurofilaments, vimentins)	
	Dynamic instability. Tubulin synthesis and modification	
	Cell locomotion (amoeboid, flagellar and ciliar).	
<b>4</b>	<b>Cell Division</b>	<b>12</b>
	Cell division and cell cycle.	
	Stages of Mitosis and Meiosis- Prophase, Metaphase, Anaphase, Telophase, Cytokinesis.	
	G1, S, G2 phases of cell cycle.	
	Cell synchronization and its application, Cell senescence	
	Cell differentiation in plant and animals.	

**B. Sc. I****Semester-I****Course Code .....****Paper-II****Marks: 40****Credits: 2****Total Hours: 48****General Microbiology**

**Objective:** To make the students to understand the fundamentals on microbes and their study techniques.

<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	<p><b>History, Development and Microscopy</b></p> <p>A. History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner.</p> <p>B. Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance,</p> <p>C. Principle and application of dark field and fluorescent microscopy.</p> <p>D. Electron microscopy: Principle, ray diagram, applications, TEM and SEM, comparison between optical and electron microscope.</p>	<b>12</b>
<b>2</b>	<p><b>Bacterial Morphology and Organelles</b></p> <p>A. General morphology of bacteria: shapes and sizes.</p> <p>B. Generalized diagram of typical bacterial cell.</p> <p>C. Cell wall of Gram positive and Gram negative cells.</p> <p>D. Endospores: Study of Endospore structure and its formation, germination.</p> <p>E. General account of flagella and pili.</p> <p>F. Chromatin material, plasmids, definition and kinds of plasmids (conjugative and non-conjugative)</p> <p>G. Morphology of Archae: Archaeal cell membrane (differences between bacterial and archaea cell membrane), General Characteristics.</p>	<b>12</b>
<b>3</b>	<p><b>Microbial Diversity and Microbial staining techniques</b></p> <p>A. General characteristics of yeast, moulds and protozoa their importance.</p> <p>B. Stains and staining Procedure: Definition of Dye, stain.</p> <p>C. Concept of simple staining, differential staining, Endospore staining, flagella staining,</p> <p>D. Viruses: General characteristics of viruses, difference structure, shapes and symmetries of viruses with one example of each.</p> <p>E. Brief idea of lytic cycle and lysogeny.</p>	<b>12</b>
<b>4</b>	<p><b>Microbial growth, Nutrition and Control</b></p> <p>A. Growth: Growth rate, details of growth curve and its phases.</p> <p>B. Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat).</p> <p>C. Physical conditions required for growth: pH, Temperature.</p> <p>D. Pure culture: Concept, isolation methods, maintenance, preservation,</p> <p>E. Nutrition: Basic nutritional requirements such as water, carbon, nitrogen, sulfur and vitamins etc.</p> <p>F. Natural and synthetic media, Media composition. Role of Peptone, Beef extract, NaCl, Agar.</p> <p>G. Microbial Control: Concept of Sterilization, disinfection, antiseptic, sanitization, germicide and antimicrobial agents.</p> <p>H. Methods of Microbial Control- Physical method (Temperature, Radiation), Chemical method (halogens, alcohol, gaseous sterilization)</p>	<b>12</b>

**Practicals B. Sc. I**  
**Semester –I**  
**{Based on Paper -I & II}**

**TOTAL HOURS: 48**

**CREDITS: 2**

**Marks: 30**

1. Demonstration of common instruments used in Biotech lab.
2. Preparation of Nutrient media.
3. \*Isolation of pure culture by streak plate, pour plate.
4. Staining of bacteria: simple staining.
5. \*Gram Staining of Bacteria
6. \*Endospore Staining of Bacteria
7. Negative staining of Bacteria
8. \*Demonstration of motility of Bacteria by Hanging Drop method.
9. Anaerobic cultivation of microorganisms.
10. Cultivation of yeast and moulds.
11. \*Demonstration of Antibiotic sensitivity.
12. Oligodynamic action of heavy metals.
13. \*Demonstration of bacteriophage plaque assay.
14. \*Demonstration Stages of mitosis.
15. Demonstration Stages of meiosis.
16. \*Microscopic observation of Stomata and Root hairs.

**Note:** i) Minimum 4 major and 4 minor experiments are compulsory

ii) Underlined experiments are considered to be major experiments

iii) Experiments with asterisks are compulsory

iv) Duration of practical examination will be 8 hours a day

**Distribution of marks for practical examination:**

One major experiment .....	5 marks
Two minor experiments $5 \times 2 =$	10 marks
Spotting	5 marks
Viva-Voce	5 marks
Practical Record	5 marks

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**Total ..... 30 marks**

**TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS FOR B.Sc.  
semester I:**

1. GENERAL MICROBIOLOGY ,ROGER Y. STANIER, , 2008,COVER ILLUSTRATION
2. A TEXTBOOK OF MICROBIOLOGY, R.C.DUBEY,D.K.MHESHWARY, 2009, S.CHAND
3. TEXT BOOK OF BIOTECHNOLOGY, R.C.DUBEY, 2009, S.CHAND, DELHI
4. INFRASTRUCTURE OF CELLS, BUTTERWORTH, HEINEMANM, 2004, OPEN UNIVERSITY PUBL.
5. A TEXT BOOK OF BACTERIA, SUBRATA BHATTACHARYARJEE, 2009, DOMINANT PUBLISHERS
6. A TEXT BOOK OF VIRUS, K.C.SAWANT, 2009, DOMINANT PUBLISHERS
7. PLANT PHYSIOLOGY AND BIOCHEMISTRY, S.K.SINGH,SEEMA SRIWASTAVA, 2009, CAMPUS BOOKS INTERNATIONAL
8. EXPERIMENTS IN MICROBIOLOGY, PLANT PATHOLOGY AND BIOTECHNOLOGY, K.R.

ANEJA, 2003, NEW AGE INT.PVT.LTD

9. CELL BIOLOGY GENETICS MOLE BIOLOGY EVOLUTION AND ECOLOGY, P. S. VERMA, 2005, S. CHAND

10. GENERAL MICROBIOLOGY, R. Y. STANIER, 2008, MC MILLON PRESS LTD

11. BIOTECHNOLOGY (E.H.), B. D. SINGH, 2008, KALYANI PUBLICATION

12. GENERAL MICROBIOLOGY-5TH EDI, R. Y. STANIER, 1995, MAC MILLAN PRESS PVT. LTD. LONDON

13. FUNDAMENTAL PRINCIPLES OF BACTERIOLOGY IIED. A.J.SALLE. TATA-MCGRAWHILL (PUB.).

14. TEXT-BOOK OF MICROBIOLOGY- ANANTNARAYAN, C.K. JAYRAM, PANIKAR, 2005, ORIENT LONGMAN.

15. GENERAL MICROBIOLOGY-VOL-I, POWAR AND DAGINAWALA, 2008, HIMALAYA PUBLISHING HOUSE

16. CELL AND MOLECULAR BIOLOGY GERALD KARP, 2007. JOHN WILLEY AND SON PVT. LTD.

17. ELEMENTARY MICROBIOLOGY VOL-I, DR.H.A.MODI, 1995, EKTA PRAKASHAN

18. CELL BIOLOGY, C.B. POWAR, 2005, HIMALAYA PUBLISHING HOUSE.

19. CELL BIOLOGY, VARMA AND AGRAWAL, 2005, S. CHAND, DELHI

20. PLANT PHYSIOLOGY AND BIOCHEMISTRY, S. K. VERMA, 2006, S.CHAND, DELHI

21. CELL, B. LEWIN, 2007, JONES AND BARTLETT PUBLISHER, LONDON.

22. GENERAL MICROBIOLOGY, PELZAR, 2005, TATA MCGRAW HILL, DELHI

23. CYTOLOGY, VERMA AND ARGAWAL, 2005, S. CHAND, NEWDELHI

24. PRACTICAL MICROBIOLOGY, MAHESHWARI D.K., R. C. DUBEY, 2005, S. CHAND, DELHI

25. PRACTICAL MICROBIOLOGY, VINITA KALE & KISHORE BHASARI, HIMALAYA PUBLICATION

26.HISTORY OF MICROBIOLOGY AND MICROBIOLOGICAL METHODS, SOLUNKE, HAMDE, AWASTHI, THORAT. ATHARVA PUBLICATIONS, JALGAON.

27. MANUAL OF METHODS FOR PURE CULTURE STUDY, SOLUNKE, HAMDE, AWASTHI, WAKTE. NIP NEW DELHI.

# **SEMESTER-II**

## B.Sc. I

<b>Semester II</b>		
<b>Course Code .....</b>	<b>Paper-IV</b>	<b>Marks: 40</b>
<b>Credits: 2</b>		<b>Total Hours :48</b>
<b>BIOCHEMISTRY</b>		
<b>Objective:</b> To make the students to understand the fundamentals of Biochemistry.		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	<b>Fundamental of Biochemistry</b> A. Concept of atom, molecules. B. pH, Acid, Bases, Buffer, Solvent, Solute, Different types of Solution (Hypertonic, Hypotonic and isotonic) C. Concept of Normality, Molarity, Molality, Diffusion, Osmosis. D. Interaction between atoms and molecules (Ionic bond, Covalent bond, Vander wall force of attraction, coordinate interaction)	<b>12</b>
<b>2</b>	<b>Nucleic Acids, Chromosomes, Concept of Genes and Nucleosomes</b> A. Chemical structure and base composition of nucleic acids. B. Watson Crick Model (B-DNA), deviations from Watson-Crick model of DNA (A- and Z- DNA) C. Chargaff's rules, C-value and C-value paradox, basic idea of Cot curves. D. Structure of m-RNA, t-RNA and r-RNA. E. Chromosome structure: chromatids, centromere, telomere, heterochromatin and euchromatin. F. Chromatin structure: basic concept of nucleosome structure, 10 nm and 30 nm fibres. G. Concept of split genes, introns, exons, spacers. .	<b>12</b>
<b>3</b>	<b>Carbohydrates, lipids and vitamins</b> A. Definition, Classification, nomenclature of carbohydrates. B. Structures of monosaccharides: - Glucose, fructose. C. Structures of disaccharides: - Lactose, Maltose, Sucrose. D. Structures and properties of polysaccharides: Energy storage molecules- starch, glycogen. Building blocks - cellulose, chitin. E. Lipids-Types of lipids, Structures of saturated and unsaturated fatty acids, triglycerides, phospholipids and sphingolipids. F. Definition and structures of terpenoids, Liposomes and steroids. G. Vitamins-Types of vitamins, classification on the basis of solubility, physiological functions.	<b>12</b>
<b>4</b>	<b>Amino Acids and Proteins</b> A. Classification and Structures of Amino Acids. B. Physico-chemical properties of amino acids (solubility, reaction like Edman's, Sanger's Dansyl chloride, ninhydrin and formaldehyde). C. Primary structure of proteins: Determination of primary structure (end group analysis, cleavage of disulfide bonds, amino acid composition, use of endopeptidase specificity, assignment of disulfide position,). D. Secondary structure of proteins: The $\alpha$ -helix, $\beta$ -structures (parallel, antiparallel, mixed, $\beta$ -turn). E. Tertiary structure of proteins: Myoglobin F. Quaternary structure of proteins: Hemoglobin.	<b>12</b>

B.Sc. I year

Semester II

<b>Course Code .....</b>			<b>Paper-V</b>	<b>Marks: 40</b>
<b>Credits: 2</b>			<b>Total Hours :48</b>	
<b>Genetics</b>				
<b>Objective:</b> To make the students to understand and aware the fundamentals of Genetics				
Unit No.	Content	Hrs.		
<b>1</b>	<b>Mendel's laws of inheritance</b> A. Chromosome theory of inheritance B. Law of Dominance, Law of segregation, law of independent assortment. C. Genotypic and phenotypic ratio. D. Deviations from Mendelian ratio: Gene interactions: Allelic interactions (incomplete dominance of flower color in snapdragon, co-dominance of ABO blood groups in humans) and multiple alleles, non allelic interactions (ratios 9:7, 9:3:4, 13:3)	<b>12</b>		
<b>2</b>	<b>Linkage and Crossing over</b> A. Concept of linkage Sex-linkage, B. Sex determination in plant and animals C. Non disjunction as a proof of chromosomal theory of inheritance. D. Concept of crossing over: Holliday junction, chiasmata formation. E. Molecular mechanism of Crossing over.	<b>12</b>		
<b>3</b>	<b>Chromosomal Aberration</b> A. Chromosomal aberrations in plants and animals B. Numerical abnormalities: Turner Syndrome, Down Syndrome, Klinefelter's syndrome. C. Aneuploidy and polyploidy. D. Structural abnormalities: - Deletions, Duplications, Translocations, Inversions, Insertions.	<b>12</b>		
<b>4</b>	<b>Population genetics and Genetic disorders</b> A. Population genetics: Basic idea of Natural selection, Genetic Drift, Gene flow. B. Concept of gene pool, gene and genotypic frequencies. C. Principle of Hardy Weinberg equilibrium. D. Genetic disorders: Definition. a) Autosome Recessive-Sickle-cell anemia b) Autosome Dominant-Marfan Syndrome c) X-linked Dominant-Rett Syndrome d) X-linked Recessive- Haemophilia e) Y-linked- Male infertility	<b>12</b>		



**Practicals B. Sc. I**  
**Semester -II**  
**{Based on Theory Paper -IV & V}**

**TOTAL HOURS: 48**

**CREDITS: 2**

**Marks: 30**

1. \*Preparation of common buffers used in Biochemistry.
2. \*Qualitative Analysis of Carbohydrates.
3. Qualitative Analysis of proteins.
4. \*Qualitative Analysis of lipids.
5. \*Qualitative Analysis of Nucleic acid.
6. Quantitative estimation of sugars by DNS/Folin method.
7. \*Quantitative estimation of proteins by Biuret method.
8. \*Quantitative estimation of proteins by Lowry method.
9. \*Quantitative estimation of DNA Diphenylamine reagent.
- 10.\*Quantitative estimation of RNA Orcinol Reagent.
- 11.Determination of Iodine value of oil.
- 12.Estimation of Vit. C
- 13.\*Effect of osmotic pressure.
- 14.\*Verification of Mendel's law.
- 15.Preparation of giant chromosomes

**Note: -**

- 1. Underlined practicals are considered as major practicals.**
- 2. Practical with asteric mark are compulsory practicals.**
- 3. At least 10 (4 major and 6 minor Compulsory) practical to be carried out in a semester.**
- 4. The theory involved with each practical must be taught before conducting the practical.**

**Note:** i) Minimum 4 major and 4 minor experiments are compulsory

ii) Underlined experiments are considered to be major experiments

iii) Experiments with asterisks are compulsory

iv) Duration of practical examination will be 8 hours a day

**TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS FOR B.Sc.**  
**semester II:**

1. GENETICS, P.J. RUSSEL, BENJAMIN/CUMMINGS.
2. MICROBIAL GENETICS BY KEYA CHAUDHARI, 2014 TERI PRESS, NEW DELHI
3. PRINCIPLES OF GENETICS, E.J. GARDNER, 2006, JOHN W.H. SONS INC.
4. PRINCIPLES OF GENETICS, D.P. SUNTAN & M.J. SIMMONS, 2005, JOHN WILEY & SONS INC.
5. MOLECULAR BIOLOGY OF GENE (FIFTH EDITION) J.D. WATSON, A.M. WEINER & N.H. HOPKINS, ADDISON-WESLY PUBLISHING.
6. ELEMENTARY BIOCHEMISTRY, J.L.JAIN,SANJAI JAIN, 2007, S.CHAND
7. FUNDAMENTAL OF BIOCHEMISTRY, J.L.JAIN,SANJAI JAIN, 2008, S.CHAND
8. SELECTED QUESTION WITH ANSWER IN BIOCHEMISTRY, AMIT KRISHNA DE, 1997, S.CHAND
9. QUALITATIVE TEST AND QUANTITATIVE PROCEDURES IN BIOCHEMISTRY, PUSHPA SUNDARARAJ,ANUPA SIDHU, 1995, S.CHAND
10. ANALYSIS OF AMINO ACID OF PROTEINS AND NUCLEIC ACID, BUTTERWORTH,HEINEMANM, 2004, OPEN UNIVERSITY PUBL
11. BIOCHEMISTRY, U.SATYANARAYANA, 2009, BOOKS AND ALLIED
12. BIOCHEMISTRY, C.B. POWAR, 2006, HIMALAYA

13. PRINCIPLE OF BIOCHEMISTRY, L. NELSON AND COX, 2008, REPLIKA PRESS
14. GENETICS, MONROE W. STRICTBERGER, 2008, PEARSON EUD.
15. BIOCHEMISTRY- U.SATYANARAYANA, 2009, BOOKS AND ALLIED
16. BIOCHEMISTRY- A.C. DEB, 1998, NEW CENTRAL BOOK AGENCY, CALCUTTA.
17. BIOCHEMISTRY- STRYER, 6<sup>TH</sup> EDI., FREEMAN PUBLICATION.
18. BIOCHEMISTRY- VOET AND VOET, 2005, JOHN WILEY & SONS, INC..
19. BIOPHYSICAL CHEMISTRY- UPADYAY AND NATH, 2007, HIMALAYA PUBLICATION.
20. GENETICS- C.B. PAWAR, 2005, S. CHAND, NEWDELHI.
21. GENETICS- STRICTBERGER, 3<sup>RD</sup> EDI., PHI LEARNING PVT. LTD. NEWDELHI.
22. BIOCHEMISTRY- PAWAR AND CHATWAL, 2005. HIMALAYA PUBLICATION HOUSE.
23. BIOCHEMISTRY PRACTICAL MANUAL, JAIRAMAN, 2008.
24. EXPERIMENTS IN MICROBIOLOGY, PLANT PATHOLOGY AND BIOTECHNOLOGY, K.R. ANEJA, 2003, NEW AGE INT.PVT.LTD.
25. STANDARD METHODS OF BIOCHEMICAL ANALYSIS, S. R. THIMMAIAH.

# **SEMESTER-III**

## B.Sc. II

<b>Semester III</b>		
<b>Course Code</b> .....	<b>Paper-VII</b>	<b>Marks: 40</b>
<b>Credits: 2</b>		<b>Total Hours :48</b>
<b>Cell Metabolism</b>		
<b>Objective:</b> To make the students to understand the fundamentals of physiological and metabolic pathways.		
Unit No.	Content	Hrs
<b>1</b>	<b>Bioenergetics</b> A. Concept of free energy, entropy, enthalpy and redox potential. B. Concept of high energy bonds as related to the structure of phosphoenolpyruvate, creatine phosphate etc. C. ATD-ADP cycle D. Energy charge (Phosphate potential) and its relation to metabolic regulation.	<b>12</b>
<b>2</b>	<b>Carbohydrate Metabolism</b> A. Cellular respiration, glycolysis (pathway, its regulation and inhibitors) B. Glyconeogenesis (bypass reaction) C. TCA cycle and its regulation D. Electron transport chain-ATP synthesis, oxidative phosphorylation E. Photophosphorylation, Hill reaction, CO <sub>2</sub> fixation a) F. Glycogenesis and glycogenolysis	<b>12</b>
<b>3</b>	<b>Lipid Metabolism</b> A. Biosynthesis of fatty acids, fatty acid synthase complex B. Oxidation of fatty acids, $\alpha$ , $\beta$ and $\omega$ C. Ketogenesis, ketosis and ketoacidosis D. Diseases of fat metabolism- Gaucher's disease, Tay-Sachs disease, Niemann Pick disease, Fabry's disease	<b>12</b>
<b>4</b>	<b>Metabolism of Nitrogenous Compound</b> A. Trasamination (Mechanism) B. Urea cycle- detail account, linkage of urea cycle and TCA cycle, regulation C. Metabolic disorders of urea cycle D. Transmethylation and decarboxylation, physiological important products of decarboxylation E. Biosynthesis of purine and pyrimidines	<b>12</b>

## B.Sc. II

<b>Semester III</b>		
<b>Course Code .....</b>	<b>Paper-VIII</b>	<b>Marks: 50</b>
<b>Credits: 2</b>		<b>Total Hours :48</b>
<b>Molecular Biology and Enzymology</b>		
<b>Objective:</b> To make the students to understand the fundamentals of Molecularbiology and enzymology.		
Unit No.	Content	Hr s.
<b>1</b>	<b>Introduction to the Enzymology</b> A. Terminology- Active site, holoenzyme, apoenzyme, substrate, coenzyme, cofactor, inhibitor, activator, modulator, allosteric enzyme, isoenzyme, ribozyme B. Concept of activity, specific activity, turnover number, unit of enzyme activity (Katal, international unit) C. Nomenclature and classification of enzyme D. Mechanism of action- Activation energy, Lock and Key model (Fischer's template theory), Koshland model (Induce fit model)	<b>12</b>
<b>2</b>	<b>Enzyme Catalysis</b> A. Mechanism of enzyme catalysis- Acid base catalysis, covalent catalysis, metal ion catalysis B. Enzyme kinetics- Michaelis-Menten equation, Lineweaver- Burke plot C. Enzyme inhibition- Reversible inhibition, irreversible inhibition, D. Factors affecting enzyme activity- concentration of enzyme, concentration of substrate, effect of temperature, effect of pH, temperature quotient E. Enzyme immobilization	<b>12</b>
<b>3</b>	<b>Replication and Transcription in Prokaryotes</b> A. <b>Replication</b> - Enzymology of replication DNA polymerase I, brief treatment of pol II and III, helicases, topoisomerases, single strand binding proteins, primase. B. Proof for semiconservative replication, Okazaki fragments, C. Replication origins, initiation, elongation and termination. D. <b>Transcription</b> - Concept of promoter (-10 and -35 sequences and their significance) E. RNA polymerase F. Four steps of transcription (promoter binding and activation, RNA chain initiation, and promoter escape, chain elongation, termination and release). G. Regulation of Transcription in Prokaryotes: Basic idea of lac- and trp operons.	<b>12</b>
<b>4</b>	<b>Genetic Code and Translation in Prokaryotes</b> A. General characteristics of Genetic code B. Codon- anticodon interaction –the wobble hypothesis. C. Selection of initiation codon – Shine-Dalgarno sequence and the 16S r RNA. D. Protein synthesis: - Initiation, elongation and termination. E. Concept of Couple transcription-translation.	<b>12</b>

## Practicals B. Sc. II Semester III { based on Paper -VII & VIII}

**Total Hours: 48**

**CREDITS: 2**

**Marks: 30**

1. \*Isolation of RNA from bacteria.
2. \*Determination of Vmax and Km for  $\alpha$ -amylase.
3. Effect of different concentration of metal ions on activity of  $\alpha$ -amylase enzyme.
4. Effect of pH on enzyme activity.
5. Assay of activity of  $\beta$ -galactosidase.
6. Isolation of mitochondria and assay of marker enzyme.
7. Isolation and determination of concentration of photosynthetic pigments from spinach leaves.
8. Estimation of free fatty acids by titration method.
9. \*Effect of substrate concentration on enzyme activity.
10. Determine the heat of reaction (Enthalpy).
11. \*Immobilization of enzyme in alginate gel.
12. Production microbial enzyme (amylase) and conversion of starch to glucose and detection of formed glucose by anthrone method.
13. Demonstration of genetic code.

### **TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS FOR B.Sc. semester III:**

1. CELL BIOLOGY GENETICS MOLE BIOLOGY EVOLUTION AND ECOLOGY BY P. S. VERMA, S. CHAND COMPANY, 2005
2. BIOCHEMISTRY BY C.B. POWAR HIMALAYA PUBLICATION, 2006
3. BIOCHEMISTRY BY J. L. JAIN, S. CHAND COMPANY, 2005
4. PRINCIPLE OF BIOCHEMISTRY (LEHNINGER) BY D. L. NELSON, REPLIKA PRESS, 2008
5. PRINCIPLE OF BIOCHEMISTRY BY D.J. VOET & C. W. PRATT, JOHN WILEY AND SONS PUBL., 2008
6. BIOCHEMISTRY, U.SATYANARAYANA, BOOKS AND ALLIED PUBL., 2011
7. BIOCHEMICAL METHOS BY S. SADASIVAM AND A. MANICKAM, NEW AGE INT. PVT. PLB., 2010
8. LABORATORY MANUAL IN BIOCHEMISTRY BY J. JAYARAMAN, NEW AGE INT. PVT , 2011
9. STANDARD METHODS OF BIOCHEMICAL ANALYSIS BY S. R. THIMMAIAH, KALYANI PUBLICATION, 2009
10. ELEMENTARY BIOCHEMISTRY, J.L.JAIN,SANJAI JAIN, 2007, S.CHAND
11. QUALITATIVE TEST AND QUANTITATIVE PROCEDURES IN BIOCHEMISTRY, PUSHPA SUNDARARAJ,ANUPA SIDHU, 1995, S.CHAND
12. BIOCHEMISTRY- A.C. DEB, 1998, NEW CENTRAL BOOK AGENCY, CALCUTTA.
13. BIOCHEMISTRY- STRYER, 6TH EDI., FREEMAN PUBLICATION.
14. BIOCHEMISTRY- PAWAR AND CHATWAL, 2005. HIMALAYA PUBLICATION HOUSE.
15. PLANT BIOTECHNOLOGY-PRACTICAL MANUAL, C.C.GIRI,ARCHANA GIRI, I.K.INT.PUB HOUSE, 2007
16. BIOCHEMISTRY, MATHEWS VAN HOLDDE,AHERN, PEARSON EUD., 2005
17. AN INTRODUCTION TO PRACTICAL BIOCHEMISTRY, DAVID T. PLUMMER, TATA MCGRAW HILL, 2008
18. BIOCHEMISTRY AND MOLECULAR BIOLOGY OF PLANTS , BUCHANAN,CRUISSEN JONES,

I.K.INT.PUB HOUSE, 2007

19. ANALYSIS OF AMINO ACID OF PROTEINS AND NUCLEIC ACID, BUTTERWORTH, HEINEMANM, OPEN UNIVERSITY PUBL, 2004

20. GENERAL ENZYMOLOGY, KULKARNI & DESHPANDE, HIMALAYA PUBLICATION

21. INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS, CHATWAL & ANAND, HIMALAYA PUBLICATION

22. ENZYMOLOGY & ENZYME TECHNOLOGY, S. M. BHATT, S. CHAND

23. BIOCHEMISTRY, TREHAN, KESHAR, NEW AGE PUBLICATION

24. ENZYMES, TREVOR PALMER, AFFILIATED EAST-WEST PRESS PVT. LTD.

25. PRINCIPALS OF CELLS ENERGETICS, BUTTERWORTH, HEINEMANM, OPEN UNIVERSITY PUBL, 2004

26. PRINCIPLES OF ENZYMOLOGY FOR TECHNOLOGICAL APPLICATION, BUTTERWORTH, HEINEMANM, OPEN UNIVERSITY PUBL, 2004

27. GENETICS BY C. B. PAWAR, HIMALAYA PUBLICATION, 2008

# **SEMESTER-IV**



## B.Sc. II

<b>Semester-IV</b>		
<b>Course Code .....</b>	<b>Paper-X</b>	<b>Marks: 50</b>
<b>Credits: 2</b>		<b>Total Hours :48</b>
<b>Biophysical Techniques</b>		
<b>Objective:</b> To make the students to understand the fundamentals Techniques.		
Unit No.	Content	Hrs.
<b>1</b>	<b>Spectrophotometry</b> A. Concept of electromagnetic radiation, spectrum of light absorption of electromagnetic radiations, involvement of orbital in absorption of electromagnetic radiations. B. Concept of chromophores. C. Concept of Lambert and Beer's law D. Difference between spectrophotometer and colorimeter. E. Instrumentation and applications of UV and visible Spectrophotometry.	<b>12</b>
<b>2</b>	<b>Chromatography</b> A. Partition principle, partition coefficient, brief account of paper chromatography. B. Thin layer chromatography C. Gel filtration-concept of distribution coefficient, types of gels and glass beads, applications. D. Ion-exchange chromatography-Principle, types of resins, choice of buffers, applications including amino acid analyzer. E. Affinity chromatography-Principle, selection of ligand, brief of ligand attachment.	<b>12</b>
<b>3</b>	<b>Electrophoresis and Centrifugation</b> A. <b>Electrophoresis</b> - Migration of ions in electric field, factors affecting electrophoretic mobility, B. Gel electrophoresis-Types of gels, solubilizers, procedure, column, slab gels and submarine electrophoresis, detection. C. SDS-PAGE electrophoresis- applications D. <b>Centrifugation</b> - Basic principles, concept of RCF, E. Preparative centrifugation- Differential and density gradient centrifugation. F. Analytical centrifugation- Sedimentation coefficient,	<b>12</b>
<b>4</b>	<b>Isotopic Tracer Technique</b> A. Radioactive and stable isotopes, rate of radioactivity decay, units of radioactivity B. Measurement of radioactivity- Ionization chamber, proportional counters, Geiger-Muller counter, solid and liquid scintillation counter (Principle, instrumentation and techniques), C. Measurement of stable isotopes- Falling drop method for deuterium, Mass spectrometry D. Principle of tracer techniques, advantage and limitations, Application of isotopes in biotechnology (distribution studies, metabolic studies, autoradiography)	<b>12</b>

**B.Sc. II**

<b>Semester-IV</b>		
<b>Course Code .....</b>	<b>Paper-XI</b>	<b>Marks: 50</b>
<b>Credits: 2</b>		<b>Total Hrs :48</b>
<b>Immunology and Biostatistics</b>		
<b>Objective:</b> To make the students to understand the fundamentals of the <b>Immunology and Biostatistics</b> .		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	<b>Basics of Immunology</b> A. Historical background B. Concept of Immunity and their classification C. Cells of Immunity- Lymphocytes, Granulocytes and Agranulocytes. D. Organs of Immunity- Primary lymphoid organs (Bone marrow, Thymus), Secondary lymphoid organs (Spleen, Lymph node) E. Immunoglobulin and their classes	<b>12</b>
<b>2</b>	<b>Immune Response</b> A. Innate Immunity B. Humoral Immunity C. Cell mediated Immunity- ADCC, Complement system D. MHC-I and MHC-II molecules E. Hypersensitivity- Delayed type hypersensitivity F. Vaccination- Discovery, Principle and their significance G. Concept of autoimmunity	<b>12</b>
<b>3</b>	<b>Immunological Techniques</b> A. Antigen-antibody reactions- Precipitation, agglutination, complement fixation, toxin-antitoxin reaction B. Radial immunodiffusion, ELISA, VDRL and widal. C. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnosis.	<b>12</b>
<b>4</b>	<b>Biostatistics</b> A. Measures of central tendency: mean, mode, and median. B. Measures of dispersion: range, mean deviation, standard deviation. C. Methods of sampling, sampling error, non-sampling errors, standard error. D. Chi-square test, meaning of correlation and regression. E. Presentation of stastical data: tabulation (simple tables, frequency distribution table); charts and diagrams (bar charts, histograms, pie charts, dendogram).	<b>12</b>

**Practicals B. Sc. II  
(Semester IV)  
{based on Paper -X & XI}**

**Total Hours: 48**

**CREDITS: 2**

**Marks: 30**

1. Gel electrophoresis of proteins.
2. \*Agarose gel electrophoresis of nucleic acid.
3. \*SDS-PAGE of an oligomeric protein.
4. Determination of absorption spectrum of oxy- and deoxyhaemoglobin.
5. Spectrophotometric titration of proteins.
6. Protein estimation by E280/E260 method.
7. \*Paper chromatography of amino acids/sugars.
8. TLC of lipid/amino acids.
9. Antigen- antibody reactions: blood group (demo only), pregnancy (demo only) and widal (quantitative).
- 10.\*Radial immunodiffusion.
- 11.\*ELISA
- 12.Cellular fractionation and separation of cell organelles using centrifuge.
- 13.\*Calculation of mean, median and mode (manual / computer aided)
- 14.Calculation of standard deviation and standard error (manual / computer aided).
- 15.Biostatistical problem based on standard deviation.
- 16.Computer presentation of statistical data, chart and diagrams.

**TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS FOR B.Sc.  
semester IV:**

1. BIOTECHNOLOGY, B. D. SINGH, KALYANI PUBLICATION, LUDHIANA, 2008
2. CELL AND MOLECULAR BIOLOGY, GERALD KARP, WILEY PUB., 2007
3. BIOTECHNOLOGY A LAB. MANUAL, JEFFERY M. BECKER, ACADEMIC PRESS, 1998
4. IMMUNOLOGY, KUBY, W.H.FREEMAN AND COMPANY, 2007
5. BIOLOGICAL INSTRUMENTATION AND METHODOLOGY, P.K.BAJPAI, S.CHAND, 2008
6. TEXT BOOK OF BIOTECHNOLOGY, R.C.DUBEY, S.CHAND, 2009
7. TEXT OF IMMUNOLOGY AND IMMUNOTECHNOLOGY, B.ANNADURAI, S.CHAND, 2008
8. INTRODUCTION TO BIOPHYSICS, PRANAB K.BANERJEE, S.CHAND, 2008
9. ENCYCLOPEDIA OF BIOSTATISTICS VOL-I, D.UPRETTI, R.P.RASTOGI, DOMINANAT PUBLISHERS, 2008
10. ENCYCLOPEDIA OF BIOSTATISTICS VOL-II, D.UPRETTI, R.P.RASTOGI, DOMINANAT PUBLISHERS, 2009
11. ENCYCLOPEDIA OF BIOSTATISTICS VOL-III, D.UPRETTI, R.P.RASTOGI, DOMINANAT PUBLISHERS, 2009
12. ENCYCLOPEDIA OF BIOSTATISTICS VOL-IV, D.UPRETTI, R.P.RASTOGI, DOMINANAT PUBLISHERS, 2009
13. ENCYCLOPEDIA OF BIOSTATISTICS VOL-V, D.UPRETTI, R.P.RASTOGI, DOMINANAT PUBLISHERS, 2009
14. ENCYCLOPEDIA OF IMMUNOLOGY VOL-I, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
15. ENCYCLOPEDIA OF IMMUNOLOGY VOL-II, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
16. ENCYCLOPEDIA OF IMMUNOLOGY VOL-III, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
17. ENCYCLOPEDIA OF IMMUNOLOGY VOL-IV, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
18. ENCYCLOPEDIA OF IMMUNOLOGY VOL-V, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
19. ENCYCLOPEDIA OF IMMUNOLOGY VOL-VI, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
20. ENCYCLOPEDIA OF IMMUNOLOGY VOL-VII, SURENDRA NAHA,RABINDRA NARAIN, DOMINANAT PUBLISHERS, 2009
21. TOOLS AND TECHNIQUES OF BIOTECHNOLOGY, MADHAV SHARMA, NIRMAL TRIPATR, CRESCENT PUB CORPORATION, 2008
22. BIOSTATISTICS, WAYNE W. DINIEL, WILEY INDIA, 2007
23. BIOPHYSICAL CHEMISTRY, UPADYAY, NATH, HIMALAYA PUBLISHING HOUSE, 2009
24. PRINCIPLE OF TECHNIQUES, KEITH WILSON, JOHN WALKER, CAMBRIDGE UNI. PRESS, 2008
25. ROITT'S ESSENTIAL IMMUNOLOGY, PETER J. DELVES, BLAKWELL PUBLISHING, 2006
26. TECHNIQUES IN LIFE SCIENCES, DR. D. B. TEMBHARE, HIMALAYA PUBLICATION, 2006
27. BIOPHYSICS, PRANAVKUMAR CHATTERJI, S. CHAND, 2008

# **SEMESTER-V**

**B.Sc. III**

<b>Semester-V</b>		
<b>Course Code .....</b>	<b>Paper-XIII</b>	<b>Marks: 40</b>
<b>Credits: 2</b>		<b>Total Hours :48</b>
<b>Genetic Engineering</b>		
<b>Objective:</b> To make the students to understand the fundamentals of <b>Genetic Engineering</b> .		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs</b>
<b>1</b>	<b>Introduction of Genetic Engineering</b> A. Basics of genetic engineering B. DNA manipulation enzymes: nucleases, ligases, polymerases alkaline phosphatase, T4 polynucleotide kinase. C. Restriction endonuclease enzyme and their types D. Isolation of DNA- lysis of cells, direct purification of DNA E. Generation of DNA fragments for cloning- cDNA, Genomic DNA library F. Amplification of DNA: polymerase chain reaction (PCR)	<b>12</b>
<b>2</b>	<b>Cloning Vectors and r-DNA Preparation</b> A. Plasmid vectors (pBR322, pUC 18/19) B. Cosmid vectors C. Bacteriophage vector (lambda phage) D. Phagemid vector E. Artificial chromosome (YAC, BAC) F. Insertion of foreign DNA into a vector (use of linkers, adaptors and homopolymer tailing)	<b>12</b>
<b>3</b>	<b>Insertion of rDNA into host cells</b> A. Transformation B. Transfection- calcium phosphate coprecipitation, DEAE-dextran mediated transfection C. Particle gun method D. Lipofection E. Microinjection F. Screening of recombinants- direct section and Blue-White selection method	<b>12</b>
<b>4</b>	<b>Application of rDNA</b> A. Gene therapy-somatic gene therapy B. DNA fingerprinting C. Interferon production D. Disease diagnosis- antenatal diagnosis, genetic counseling E. Monoclonal antibodies production	<b>12</b>

B.Sc. III

<b>Semester-V</b>		
<b>Course Code .....</b>	<b>Paper-XIV</b>	<b>Marks: 40</b>
<b>Credits: 2</b>	<b>Plant Biotechnology Total Hours :48</b>	
<b>Objective: To make the students understand the fundamentals of techniques of Plant Biotechnology</b>		
Unit No.	Content	Hrs
<b>1</b>	<b>Introduction to Plant Tissue Culture</b> A. Introduction and history of cell and tissue culture technique. B. Plant tissue culture media (composition and preparation and its role in media) C. Role of growth hormone (auxins, cytokinins and others) D. Callus and suspension cultures: initiation and maintenance, single cell clones.	<b>12</b>
<b>2</b>	<b>Techniques of Plant Tissue Culture</b> A. Shoot tip culture: rapid clonal propagation and production of virus free plants. B. Organogenesis. embryogenesis C. Embryo culture and embryo rescue. D. Protoplast isolation, culture and fusion. E. Selection and regeneration of hybrid plants, cybrid. F. Production of haploid plants: anther and pollen culture	<b>12</b>
<b>3</b>	<b>Plant Transformation Technology</b> A. Basis of tumor formation, hairy root. B. General features of Ti and Ri plasmids. C. Mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors D. Methods of nuclear transformation, biological and physical transformation methods. E. Brief idea of chloroplast transformation.	<b>12</b>
<b>4</b>	<b>Application of Plant Tissue Culture</b> A. Herbicide resistance -phosphinothricine glyphosate, sulfonyl urea B. Insect resistance-Bt genes. C. Virus resistance, coat protein mediated nucleocapsid gene. D. Fungal resistance, disease resistance, nematode resistance. E. Improvement of crop yield and quality - long shelf life of fruits and flowers. F. Male sterile lines.	<b>12</b>

**Practical's B.Sc. III  
(Semester V)  
{Practical's based on Paper -XIII & XIV}**

**Total Hours: 48**

**CREDITS: 2**

**Marks: 30**

1. \*Isolation of genomic DNA
2. \*Isolation of Plasmid DNA
3. Isolation of  $\lambda$  phage DNA
4. Isolation of Chloroplast DNA
5. \*Restriction digestion of DNA
6. Construction of recombinant DNA
7. DNA amplification by PCR method
8. Preparation of plant tissue culture media.



# **SEMESTER-VI**

### B.Sc. III

<b>Semester-VI</b>		
<b>Course Code.....</b>	<b>Paper No. XVI</b>	<b>Marks: 50</b>
<b>Credits: 2</b>	<b>Environmental Biotechnology</b>	<b>Total Hrs :48</b>
<b>Objective:</b> To make the students to understand the fundamentals of <b>Environmental Biotechnology</b> .		
Unit No.	Content	Hrs.
<b>1</b>	<b>Introduction to Environmental Problems</b> A. Environmental education-Problems and need. B. Environmental pollution: classification of pollutants C. Water pollution- water pollutants- organic, inorganic, microbial, radioactive, eutrophication, D. Air pollution- sources and pollutants. E. Ozone depletion, green-house effect and acid rain	<b>12</b>
<b>2</b>	<b>Water Pollution and Waste water treatment</b> A. Waste water: composition, types B. Measurement of water pollution- BOD (Biochemical oxygen demand), COD (chemical oxygen demand) C. Waste water treatment: classification, types (flow sheet) D. Biological waste water treatment: activated sludge, trickling filter, oxidation pond, rotating biological contactor, anaerobic digester. E. Treatment scheme of industries: paper and sugar industries	<b>12</b>
<b>3</b>	<b>Xenobiotics, Biodegradation and Bioremediation</b> A. Basic concept of xenobiotics, types B. Bioaccumulation and biomagnification C. Biodegradation of xenobiotics in environment: degradative plasmids, Biodegradation of hydrocarbons, surfactant, pesticides, synthetic dyes D. Bioleaching of heavy metals: Copper, mercury, advantages and disadvantages of bioleaching.	<b>12</b>
<b>4</b>	<b>Biofertilizer, Bioenergy and Pest Management</b> A. Biogeochemical cycles: - (nitrogen, carbon and sulphur) B. Biofuel: alcohol C. Biological nitrogen fixation- symbiotic and non-symbiotic nitrogen fixation, mechanism, Role of rDNA technology in nitrogen fixation. D. Biofertilizers- bacterial biofertilizers, algal biofertilizers, fungi as biofertilizers (VAM) E. Biopesticides: Examples and integrated pest management(IPM)	<b>12</b>

**B.Sc. III**

<b>Semester-VI</b>		
<b>Course Code.....</b>	<b>Paper XVII</b>	<b>Marks: 50</b>
<b>Credits: 2</b>	<b>Animal Biotechnology</b>	<b>Total Hrs :48</b>
<b>Objective:</b> To make the students to understand the fundamentals of <b>Animal Biotechnology</b>		
Unit No.	Content	Hrs.
<b>1</b>	<b>Basics of Animal Cell Culture</b> A. Concept of animal cell culture B. Various systems of animal tissue culture, advantages and limitations. C. Culture media: Natural media, synthetic media, balanced salt solutions. D. Chemical, physical and metabolic functions of different constituents of culture medium, role of CO <sub>2</sub> , serum and supplements. E. Characteristics of cells in culture: contact inhibition, anchorage dependence, cell-cell communication.	<b>12</b>
<b>2</b>	<b>Methods of Animal Tissue Culture</b> A. Isolation of cells: various methods of separation of cell types B. Primary culture: behavior of cells, properties C. Explant culture; suspension culture. D. Established cell line cultures: definition, maintenance and management; cryopreservation, germplasm conservation	<b>12</b>
<b>3</b>	<b>Developmental Techniques in Animal Cell Culture</b> A. Apoptosis: measurement of cell death. apoptosis (death domain, role of cytochrome C) B. Cell transformation, cell cloning C. Cell synchronization and cell manipulation E. Stem cell cultures, embryonic stem cells and their applications. F. Three dimensional cultures	<b>12</b>
<b>4</b>	<b>Application of Animal Tissue Culture</b> A. Mass production of biologically important compounds- vaccines, insulin B. Manipulation of reproduction in animals: artificial insemination, embryo transfer in human C. <i>In vitro</i> fertilization technology: embryo cloning and embryonic stem cell. D. Transgenic animals- mice, large animals( sheep)	<b>12</b>

**Practical's B.Sc. III (Semester VI)**  
**{Practical's based on Paper -XVI & XVII} USMBP18**

**Total Hours: 48**

**CREDITS: 2**

**Marks: 30**

1. Development of primary cell lines/maintenance of established cell lines.
2. \*Determination of chemical oxygen demand (COD) of sewage sample.
3. \*Production of microbial fertilizers (*Rhizobium/Azotobacter/VAM*).
4. Determination of total dissolved solids of water
5. \*Determination of hardness and alkalinity of water sample.
6. Determination of dissolved oxygen concentration of water sample
7. \*Determination of biochemical oxygen demand of sewage sample
8. Isolation of xenobiotic degrading bacteria by selective enrichment technique
9. Test for the degradation of aromatic hydrocarbons by bacteria
10. Preparation and formulation of microbial biopesticide (bacteria, fungi)
11. Effect of mycorrhizal fungi on growth promotion of plants.
12. Preparation of animal cell culture media.
13. \*Cell count by haemocytometer (RBC/WBC)
14. \*Microtomy-Fixation, dehydration, embedding, sectioning and staining of animal tissues.
15. Microphotography

**TEXT BOOKS & REFERENCES FOR THEORY AND PRACTICALS FOR B.Sc. semester VI:**

1. ENVIRONMENTAL MICROBIOLOGY BY: RALPH MITCHELL, JOHN WILEY AND SONS INC.
2. ENVIRONMENTAL BIOTECHNOLOGY BY: C.F. FROSTER AND D.A. JOHN WASE, ELIS HORWOOD.
3. BIOCATALYSIS AND BIODEGRADATION: MICROBIAL TRANSFORMATION OF ORGANIC COMPOUNDS. BY: LAWRENCE P. WACEKETT.
4. A MANUAL OF ENVIRONMENT MICROBIOLOGY. BY: CHRISTON J. HURST, ASM PUBLICATION.
5. BIODEGRADATION AND BIOREMEDIATION ACADEMIC PRESS BY: SAN DIEGO.
6. BIOTECHNOLOGY IN THE SUSTAINABLE ENVIRONMENT, PLENUM PRESS, NY BASIC PRINCIPLES OF GEOMICROBIOLOGY. BY: A.D. AGATE.
7. ENVIRONMENTAL MICROBIOLOGY BY: R.M. MAIER, I.C. PAPPER AND C.P. GERBA.
8. METHODS IN MICROBIOLOGY: LYNCH AND HOBBIIE.
9. EXPERIMENTAL MICROBIAL ECOLOGY. BY: AROSISON ACADEMIC PRESS.
10. ADVANCES IN APPLIED MICROBIOLOGY. BY: D. PEARLMAN ACADEMIC PRESS.
11. MICROBIOLOGY OF EXTREME ENVIRONMENTS, EDITED BY CLIVE EDWARD, OPEN UNIVERSITY PRESS, MILTON KEYNES.
12. ENVIRONMENTAL SCIENCE WORKING WITH THE EARTH. BY: MILLER.
13. MICROBIAL BIOTECHNOLOGY, PRINCIPLES AND APPLICATIONS. LEE YUAN KUN.
14. MICROBIAL BIOTECHNOLOGY, FUNDAMENTALS OF APPLIED MICROBIOLOGY. BY: ALEXANDER N. GLAZER. HIROSHI NIKAIDO.
15. TEXTBOOK OF ORGANIC MEDICINAL AND PHARMACEUTICAL CHEMISTRY. BY: JAIME N. DELGADO WILLIAM A. REMERS

16. MICROBIAL ECOLOGY BY LYNCH ET AL.
17. EXPERIMENTAL MICROBIAL ECOLOGY BY BURNS ET AL. ENVIRONMENTAL MICROBIOLOGY (2004) BY K. VIJAYA RAMESH, MJP PUBLISHERS
18. SOIL MICROBIOLOGY (2006) BY N.S. SUBBA RAO OXFORD & IBH PUBLISHING CO.PVT. LTD.
19. INTRODUCTION TO SOIL MICROBIOLOGY (1961) BY MARTIN ALEXANDER, JOHN WILEY & SONS , INC. NEW YORK , LONDON
20. MICROBIAL ECOLOGY (1993) BY RONALD M. ATLAS AND RICHARD BARTHA
21. TEXT BOOK OF BIOTECHNOLOGY, R.C.DUBEY, 2009, S.CHAND, DELHI
22. BIOTECHNOLOGY (E.H.), B. D. SINGH, 2008, KALYANI PUBLICATION
23. CELL BIOLOGY GENETICS MOLE BIOLOGY EVOLUTION AND ECOLOGY, P. S. VERMA, 2005, S.CHAND
24. INDUTRIAL BIOTECHNOLOGY, THAKUR
25. BIOTECHNOLOGY, U. SATYANARAYAN, BOOKS AND ALLIED, 2007
26. BIOTECHNOLOGY, B. D. SINGH, KALYANI PLB, 2007
27. TECHNIQUES IN LIFE SCIENCES, DR. D. B. TEMBHARE, HIMALAYA PUBLICATION, 2004
28. ANIMAL BIOTECHNOLOGY, M.M. RANGA, HIMALAYA PUBLISHING HOUSE, 2007
29. BIOTECHNOLOGY A LAB. MANUAL, JEFFERY M. BECKER, ACADEMIC PRESS, 1998
30. CULTURE OF ANIMAL CELLS, IAN FRESHNEY, A JOHN WILLEY 2007
31. TEXT BOOK OF BIOTECHNOLOGY, R.C.DUBEY, S.CHAND, 2009
32. INVITRO CULTIVATION OF OF ANIMAL CELLS, BUTTERWORTH,HEINEMANM, OPEN UNIVERSITY PUBL, 2004
33. EXPERIMENTAL BIOTECHNOLOGY, MADHAV SHARMA,NIRMAL TRIPATR, CRESCENT PUB CORPORATION, 2008
34. ANIMAL CELL CULTURE, JOHN R. W. MASTERS, OXFORD UNI. PRESS NEWYORK, 2000
35. BIOCHEMICAL METHODS, SADASHIVAM,2006

### **Books Recommended for Theory& Practical of B.Sc. III Year**

1. Essentials of Molecular Biology by D. Freidfelder
2. Molecular biology by J.D. Watson.
3. Biophysical Chemistry by Chatwal & Anand.
4. Microbial Genetics by D. Freidfelder
5. Microbial Technology by Vol. I & II by A.H. Peppler.
6. Microbial Technology of TCA by A. B. Solunke, V.S. Hamde, P.S. Wakte
7. Principles of Genetics by R.H. Tamarin.
8. Molecular Biology and Genetic engineering by Narayanan.
9. Fundamentals of Bacterial Genetics by Nancy Trum and J. Trumphy.
10. Industrial Microbiology by A.H. Patel
11. Industrial Microbiology by Prescott & Dunn.
12. Modern Industrial Microbiology & Biotechnology by Nduka Okafoe.
13. The Book of Citric Acid by A.B. Solunke
14. Industrial Microbiology: An Introduction by Wastes, Morgan, Rockey and Highten.
15. Text Book of, Microbial Genetics by P.H.Kumbhare & V.U.Thool Rajani Prakashan, Nagpur
16. Biotechnology by P. Prave
17. Industrial Microbiology by Casida.
18. Text Book of Bioinstrumentation by P.H.Kumbhare & Dr. Megha Kulkarni, Rajani Prakashan, Nagpur.
19. DNA Chromatography by Doughlas
20. Ion Chromatography by J. Weiss
21. Encyclopedia of Bioprocessing Technology by M.C. Flickinger & S.W. Drew.
22. Textbook of Microbiology, Molecular Biology and Bioinstrumentation by R.M. Bhute and S.V. Kasbekar.
23. Microbiology for Analytical Chemists by R.K. Dart

## B.Sc. III

DSE.....

<b>Semester-VI</b>		
<b>Course Code.....</b>	<b>Paper .....</b>	<b>Marks: 50</b>
<b>Credits: 2 HUMAN MICROBIAL DISEASES, CAUSES AND CONTROL Total Hrs :48</b>		
<b>Objective:</b> To make the students to understand the fundamentals of diseases and their control and Transmission.		
<b>Unit No.</b>	<b>Content</b>	<b>Hr s.</b>
<b>1</b>	Morphology, pathogenicity and laboratory diagnosis- Gram positive organisms: Staphylococcus aureus, Streptococcus pyogenes, Bacillus anthracis, Corynebacterium diphtheriae, Clostridium perfringens, Clostridium tetani. Morphology, pathogenicity and laboratory diagnosis- Gram negative organisms Escherichia coli, Klebsiella, Proteus, Salmonella, Shigella, Pseudomonas, Vibrio cholerae.	<b>12</b>
<b>2</b>	Morphology, pathogenicity and laboratory diagnosis- Mycobacterium Tuberculosis, Mycobacterium leprae, Treponema pallidum, Leptospira, Chlamydia, Rickettsiae.	<b>12</b>
<b>3</b>	Mycology: superficial infections - Dermatophytes- Microsporum - Trichophyton, Epidermophyton- Madura mycosis - Opportunistic fungal infections- Candida Albicans, Aspergillus, Mucor. Parasitic diseases- Plasmodium vivax, Giardia, Taenia solium, Ancylostoma, Ascaris, Wuchereria bancrofti, Enterobius, Trichuris trichura.	<b>12</b>
<b>4</b>	Antibiotics and chemotherapeutic agents- Mechanism of actions - Drug resistance - Antimicrobial susceptibility testing- Disc diffusion- Kirby Bauer.	<b>12</b>

### References:

1. Mackie and Mc catney, 1994, Medical Microbiology No I and II. Churchill Livingstone, 14th edition.
2. Ananthanarayanan R and CK Jayaram Panicker, 1994, Textbook of microbiology Orient Longman.
3. Chakraborty P 1995, A Text book of microbiology, New Central Book Agency Pvt Ltd. Calcutta.
4. Bailey and Scotts, 1994, Diagnostic Microbiology, 9th edition, Baron and Finegold CV Mosby Publications.
5. Jawetz E Melnic JL and Adelberg EA 1998, review of Medical Microbiology Lange Medical Publications, USA.

**B.Sc. III**

DSE.....

<b>Semester-VI</b>		
<b>Course Code.....</b>	<b>Paper .....</b>	<b>Marks: 50</b>
<b>Credits: 2</b>	<b>COMMERCIAL MICROBIOLOGY</b>	<b>Total Hrs :48</b>
<b>Objective:</b> To make the students to understand the fundamentals of Commercial Microbiology		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	Cosmetic Microbiology: definition, Microorganisms used in production of cosmetics. Sterility testing of cosmetic products.	<b>12</b>
<b>2</b>	Textile Microbiology: definition, Sterility test for textile products. Rubber Microbiology: definition, Production of antimicrobial rubber articles.	<b>12</b>
<b>3</b>	<b>Glass Microbiology: Definition, history of glass, Production of Antimicrobial glass. Various Methods. Applications.</b> <b>Paper Microbiology: antimicrobial Paper Production, antimicrobial currency.</b>	<b>12</b>
<b>4</b>	<b>Space Microbiology: Definition,</b> <b>Energy Microbiology: Production of Hydrogen, biodiesel, etc.</b>	<b>12</b>



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<b>Semester-VI</b>		
<b>Course Code.....</b>	<b>Paper .....</b>	<b>Marks: 50</b>
<b>Credits: 2</b>	<b>Instruments in Microbiology</b>	<b>Total Hrs :48</b>
<b>Objective:</b> To make the students to understand the fundamentals of various instruments used in Microbiology		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	Autoclave: definition, principle, and application. Types of autoclaves. Incubator: definition, principle, and application. Types of Incubators. PasteurizerS: Definition, working, and applications. Types of Pasteurizers.	<b>12</b>
<b>2</b>	Microscopes; Compound Microscope, Electron Microscope, Phase Contrast Microscope, AFM Microscope, Confocal Microscope. Principles, working and applications.	<b>12</b>
<b>3</b>	<b>Reactors: Types of reactors.</b> <b>Batch reactors, Continious reactors, Spiral vane reactor, Anaerobic reactors.</b> Principles, working and applications. <b>Drum Reactor for Manufacturing of Raw Materials by Aerobic Fermentation</b>	<b>12</b>
<b>4</b>	<b>Biosensors:</b> Principles, working and applications.	<b>12</b>

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<b>Semester-VI</b>		
<b>Course Code .....</b>	<b>Paper .....</b>	<b>Marks: 50</b>
<b>Credits: 2</b>	<b>Raw Materials in Microbiology</b>	<b>Total Hrs :48</b>
<b>Objective:</b> To make the students to understand the fundamentals of various raw materials and their instruments used in Industries.		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>	Peptone: Definition, Chemistry, Classification, production methods. Production of vegetable peptone and rice peptone. Applications of peptone. Albumin: definition, Types of albumin, detection of albumin, Albumin Collection apparatus. <b>BEEF EXTRACT: Definition, Chemistry, classification, production methods.</b> <b>Meat extract: Definition, Chemistry, classification, production methods.</b> <b>Yeast extract: Definition, Chemistry, production methods.</b>	<b>12</b>
<b>2</b>	Corn steep Liquor(CSL): Definition, Chemistry, Classification, production Methods. Cellulose: Definition, Chemistry, Classification, production Methods.	<b>12</b>
<b>3</b>	<b>Molasses: Definition, Chemistry, classification, production methods.</b> <b>Bagasse: Definition, Chemistry, classification, production methods.</b>	<b>12</b>
<b>4</b>	<b>Drum Reactor for Manufacturing of Raw Materials by Aerobic Fermentation</b> <b>Methods of Reduction of the Toxic Effect of Impurities from Raw Materials</b>	<b>12</b>

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DSE.....

<b>Semester-VI</b>		
<b>Course Code.....</b>	<b>Paper .....</b>	<b>Marks: 50</b>
<b>Credits: 2 .....</b>	<b>Total Hrs :48</b>	
<b>Objective:</b> To make the students to understand the fundamentals of .....		
<b>Unit No.</b>	<b>Content</b>	<b>Hrs.</b>
<b>1</b>		<b>12</b>
<b>2</b>		<b>12</b>
<b>3</b>		<b>12</b>
<b>4</b>		<b>12</b>