

SYLLABUS

FOR

B.Sc. SEMESTER PATTERN IN

BIOTECHNOLOGY

SEMESTER I & II

GONDWANA UNIVERSITY

GADCHIROLI

INDIA

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Gondwana University, Gadchiroli
Teaching & Examination Scheme
Bachelor of Science
Three Year (SIX SEMESTER) Degree course

BIOTECHNOLOGY

1. There shall be total six Semesters. Total 3000 Marks.
2. The Division / Grade of the student shall be calculated on the basis of Science subjects as per the previous yearly pattern.
3. Each semester shall comprise of 90 teaching days.
4. Semester I and II shall be of 600 Marks
5. Semester III to IV shall be of 450 Marks
6. Semester V to VI shall be of 450 Marks
7. Biotechnology subject in each semester will comprise of
 - a. Two theory papers – 50 Marks each
 - b. One internal assessment based on two theory papers for 10 Marks each. Total 20 Marks.
 - c. One practical / Laboratory work – Total 30 marks
8. In addition to above Semester I and II will have
 - a. One compulsory English paper of 60 marks with 15 marks internal assessment.
 - b. One second language paper (Supp Eng / Hindi / Marathi / Urdu / etc) of 60 Marks with 15 marks internal assessment.
9. The Internal assessment shall be conducted by the University approved teachers in the relevant subjects.
10. The internal assessment shall be done by the respective college one month prior to the final exam of each semester. The Marks shall be sent to the university immediately after the internal assessment is over.
11. The pattern of Internal assessment and guidelines for the same shall be prepared by the respective subject Board of Studies
12. All Theory papers shall be divided into four units. Each unit shall be covered in 7.5 hours.
13. The theory question papers shall be of 3 hours duration and comprise of 5 questions with internal choice and with equal weightage to all units. (as per the previous pattern)
14. Practical exam shall be of 8 hours duration for one day.
15. Table of teaching and examination scheme attached.

Teaching & Examination Scheme

Bachelor of Science (Biotechnology)

Three Year (SIX SEMESTER) DEGREE COURSE

B. Sc. Part I (Semester I and II)

S. No.	Subject	Teaching scheme			Examination scheme										
		Th + Tu (Periods)	Pr (Periods)	Total Periods	Theory						Practical			Total Marks / credits (Th, Pr, IA)	
					Duration Hrs	Max Marks Th paper	Min Passing Marks Th	Max Marks Int Assessment	Min Passing IA	Total	Min passing Marks	Duration Hrs	Max marks practical		Min passing marks
1	Compulsory English	4+1	-	4+1	3	60	21	15	6	75	27	-	-	-	75
2	Second Language	3	-	3	3	60	21	15	6	75	27	-	-	-	75
3	Biotechnology Paper I- Cell and Cell Organelles	3+@	-	6+@	3	50	18	10	4	120	22	-	-	-	150
4		Biotechnology Paper II-General Microbiology	3+@		-	3	50	18	10		4	22	-	-	
5		Practical	-	6	6	-	-	-	-	-	-	-	6-8*	30	
6	Biotechnology Paper I- Biochemistry	3+@	-	6+@	3	50	18	10	4	120	22	-	-	-	150
7		Biotechnology Paper II- Genetics	3+@		-	3	50	18	10		4	22	-	-	
8		Practical	-	6	6	-	-	-	-	-	-	-	6-8*	30	
Grand Total of Semester I & II: 450 + 150 each semester = TOTAL – 600 Marks per semester															

Note: Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment; @ = Tutorials wherever applicable; * = If required, for two days.

B.Sc. Biotechnology Semester-I

Paper -I Cell and Cell Organelles

Unit-I Introduction to the Cell

- A. Discovery of cell: - Contribution of Robert Hook, Jan Evangelista Purkyne, Matthias Jakob Schleiden and Theodor Schwann.
- B. Cell as a basic unit of living systems.
- C. The Cell theory.
- D. Classification of cells based on Cell shape, Cell size, Cell volume and Cell Number.
- E. Typical structure of prokaryotic and eukaryotic cell.
- F. Structure of Plant cell. Structure of Animal cell. Difference between plant and animal cell.
- G. Structure and function of Muscle and Nerve Cell.

Unit-II Cell Organelles

- A. Structure and Function of Nucleus and Nucleolus.
- B. Cell Wall (Bacterial and Plant)
- C. Plasma Membrane (Fluid-Mosaic Model), Endoplasmic Reticulum (Rough, Smooth), Mitochondria, Golgi apparatus, Ribosomes and its subunits, Lysosomes, chloroplast.
- D. Centrioles (animal), Plastids (Plant), Vacuoles, Granules, cytosol.

Unit-III Cytoskeleton and Cell Locomotion

- A. Structure and function of Actin filaments (Microfilaments), Microtubules (alpha tubulin and beta tubulin), Microtubule Motor (kinesins, dyneins) and intermediate filaments (keratins, lamins, neurofilaments, vimentins)
- B. Dynamic instability. Tubulin synthesis and modification.
- C. Cell locomotion (amoeboid, flagellar and ciliar).

Unit-IV Cell Division

- A. Cell division and cell cycle.
- B. Stages of Mitosis and Meiosis- Prophase, Metaphase, Anaphase, Telophase, Cytokinesis.
- C. G₁, S, G₂ phases of cell cycle.
- D. Cell synchronization and its application, Cell senescence
- E. Cell differentiation in plant and animals.

B.Sc. Biotechnology

Semester-I

Paper – II General Microbiology

Unit-I History, Development and Microscopy

- A. History and development of microbiology: contributions of Louis Pasteur, Robert Koch and Edward Jenner.
- B. Microscopy: Compound microscopy: Numerical aperture and its importance, resolving power, oil immersion objectives and their significance,
- C. Principle and application of dark field and fluorescent microscopy.
- D. Electron microscopy: Principle, ray diagram, applications, TEM and SEM, comparison between optical and electron microscope.

Unit-II- Bacterial Morphology and Organelles

- A. General morphology of bacteria:- shapes and sizes.
- B. Generalized diagram of typical bacterial cell.
- C. Cell wall of Gram positive and Gram negative cells.
- D. Endospores: Study of Endospore structure and its formation, germination.
- E. General account of flagella and pili.
- F. Chromatin material, plasmids, definition and kinds of plasmids (conjugative and non-conjugative)
- G. Morphology of Archea: archaeal cell membrane (differences between bacterial and archaea cell membrane), General Characteristics.

Unit-III-Microbial Diversity and Microbial staining techniques

- A. General characteristics of yeast, moulds and protozoa their importance.
- B. Stains and staining Procedure: Definition of Dye, stain.
- C. Concept of simple staining, differential staining, Endospore staining, flagella staining,
- D. Viruses: General characteristics of viruses, difference structure, shapes and symmetries of viruses with one example of each.
- E. Brief idea of lytic cycle and lysogeny.

Unit-IV Microbial growth, Nutrition and Control

- A. Growth: Growth rate, details of growth curve and its phases.
- B. Concept of synchronous cultures, continuous and batch cultures (chemostat and turbidostat).

- C. Physical conditions required for growth: pH, Temperature.
- D. Pure culture : Concept, isolation methods, maintenance, preservation,
- E. Nutrition: Basic nutritional requirements such as water, carbon, nitrogen, sulfur and vitamins etc.
- F. Natural and synthetic media, Media composition. Role of Peptone, Beef extract, NaCl, Agar.
- G. Microbial Control: Concept of Sterilization, disinfection, antiseptic, sanitization, germicide and antimicrobial agents.
- H. Methods of Microbial Control- Physical method (Temperature, Radiation), Chemical method (halogens, alcohol, gaseous sterilization)

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B.Sc. Biotechnology Semester-I

PRACTICALS

Cell biology and General Microbiology

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: -

1. **Underlined practicals are considered as major practicals.**
2. **Practicals 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.**

Distribution of marks during semesterwise practical examinations of B.Sc. I (Semester I)

1. One major experiment	10
2. Two minor experiment 2 X 4=	8
3. Viva voce	4
4. Spotting	4
5. Practical record	4

Total	30
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Duration of exam will be 8 hrs. on a day

**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

B.Sc. Biotechnology Semester-II

Paper – I Biochemistry

Unit-I Fundamental of Biochemistry

- 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)

Unit-II- Nucleic Acids, Chromosomes, Concept of Genes and Nucleosomes

- 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.

Unit-III- Carbohydrates, lipids and vitamins

- 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,

Unit-IV- Amino Acids and Proteins

- 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 α -helix, β -structures (parallel, antiparallel, mixed, β -turn).
- E. Tertiary structure of proteins: Myoglobin
- F. Quaternary structure of proteins: Hemoglobin.

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B.Sc. Biotechnology Semester-II

Paper – II Genetics

Unit-I Mendel's laws of inheritance

- 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)

Unit-II Linkage and Crossing over

- 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,

Unit-III Chromosomal Aberration

- 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.

Unit-IV Population genetics and Genetic disorders

- 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.Sc. Biotechnology Semester-II

PRACTICALS

Biochemistry and Genetics

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

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5. Practical record	4

Total	30

Duration of exam will be 8 hrs. on 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, 6TH 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, 3RD 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.