जननायक चंद्रशेखर विश्वविद्यालय, बलिया
Jananayak Chandrashekhar University, Ballia

**(w.e.f. 2019-2020)**

# SYLLABUS STRUCTURE
# B.Sc. (BIOTECHNOLOGY)

# JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

## Three Years Degree Course Syllabus for

## BIOTECHNOLOGY

(BASED ON UNIFORM SYLLABUS FOR U.P. STATE UNIVERSITIES)

**(w.e.f. Session 2019-20)**

| YEAR | PAPER NUMBER | TITLE OF PAPER | MARKS |
|---|---|---|---|
| I YEAR | PAPER I | Introductory Microbiology | 50 |
| | PAPER II | Biological & Biophysical Chemistry | 50 |
| | PAPER III | Cell Biology and Genetics | 50 |
| | | PRACTICAL | 50 |
| | | TOTAL | 200 |
| II YEAR | PAPER I | Bioenergetics and Biomembranes | 50 |
| | PAPER II | Animal and Plant Physiology | 50 |
| | PAPER III | Biostatistics and Computers | 50 |
| | | PRACTICAL | 50 |
| | | TOTAL | 200 |
| III YEAR | PAPER I | Molecular Biology and Genetic Engineering | 75 |
| | PAPER II | Animal and Plant Biotechnology | 75 |
| | PAPER III | Industrial and Environmental Biotechnology | 75 |
| | | PRACTICAL & ASSIGNMENT | 75 |
| | | TOTAL | 300 |
| | | B.Sc I+II+III YEAR GRAND TOTAL | 700 |

**Note:** There will be 9 questions in each paper and candidate has to attempt only 5 questions. **Q.1** will carry short answers and will be **compulsory** based on units I - IV. **Two** questions will be set from **each unit**, out of which one question has to be attempted. Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.

# B.Sc. Part-I (Biotechnology)

## Paper-I: Introductory Microbiology 50 Marks

**UNIT I**

1. History of Microbiology.
2. Pasteur's experiment disproving spontaneous generation.
3. The concept of sterilization and methods of sterilization (Dry heat, Wet heat, radiation, chemical and filtration).

**UNIT II**

4. The concept of microbial species and strains.
5. General study of various forms of microorganisms (Viruses, Mycoplasma, Bacteria & Viroids).
6. Nature of microbial cell surface: Gram positive and Gram negative bacteria.

**UNIT III**

7. Classification of microorganisms on the basis of nutrition and environment.
8. Introductory knowledge of microbial agent of diseases (Bacteria, Viruses, Fungi & Protozoa).

**UNIT IV**

9. Nitrogen fixing microbes in agriculture.
10. Introductory knowledge of industrial uses of Bacteria, Yeast and moulds.

**Books Recommended-**


1. Pelczar,M.L.,Reid,R.D. & Chan,E.C.S.(2009). Microbiology.Tata McGraw-Hill,New Delhi.
2. Presscott,L.M.,Harley,J.P.& Klein,D.A.(2010).Microbiology.McGraw-Hill,New York.
3. Singh, R.P. (2017). Microbiology. Kalyani Publishers, New Delhi.
4. Sharma, P.D.(2016). Microbiology. Rastogi Publishers, Meerut, U.P.
5. Baveja, C.P.(2017).Text Book of Microbiology.Arya Publications, New Delhi.
6. Maheshwari, D.K, D.K. & Dubey, R.C. (2013).A Text Book of Microbiology. S.Chand & Co. N.Delhi.

## Paper II: Biological & Biophysical Chemistry 50 Marks

**UNIT I**

1. General account of the chemical nature of living cells.
2. Carbohydrates: Classification, configurations and conformations, sugar derivatives, structural and storage polysaccharides.
3. Amino acids: General properties, peptide bond, essential and non-essential amino acids.
4. Lipids: Classification, properties of lipid aggregates, biological significance.

**UNIT II**

5. Nucleic acid: Chemical structure and base composition, double helical structures, Tm, supercoiled DNA.
6. Protein chemistry: Classification, different levels of protein structure, forces stabilizing protein structure, protein folding, protein modification.
7. Enzymes: Nomenclature, apoenzyme and holoenzyme, substrate specificity, coenzymes, factors affecting enzyme activity, regulation of enzyme activity, enzyme inhibition, isozymes, ribozymes, abzymes.
8. Vitamins, water and fat soluble vitamins, deficiency and diseases.

**UNIT III**

1. Water: Structure and interactions, water as solvent, proton mobility, acid-base reactions, pH and buffers, isoelectric pH.
2. Photometry: Basic principles of UV-Visible spectrophotometry and colorimetry, instrumentation and application.
3. Centrifugation: Principles and application, sedimentation coefficient, differential, density gradient and ultra-centrifugation.
4. Chromatography: Ion Exchange, partition, gel filtration and affinity chromatography their principles and applications.

**UNIT IV**

5. Electrophoresis: Principle, types (polyacrylamide and agarose gel electrophoresis), applications, Isoelectric focusing.
6. Microscopy: Principles and applications of light, phase contrast, fluorescence and electron microscopy.
7. Tracer technique: Applications of radioisotopes in biotechnology, autoradiography.
8. Elementary idea about DNA chip technology and biosensors.

**Books Recommended**


1. Goodwin, T.W. & Mercer, E.I. (2003). Introduction to Plant biochemistry. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
2. Day, P.M. & Harborne, J.B. (1997). Plant Biochemistry. Academic Press, UK.
3. Conn, E.E., Stumpf, P.K., Bruening, G. & Doi, R.H. (2006 ). Outlines of Biochemistry. Wiley.
4. Lehninger, A.L. (2013). Biochemistry. Kalyani publishers, New Delhi.
5. Jain, J.L., Jain, S. & Jain, N. (2016). Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
6. Wilson, K. & Walker, J. (2013). Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press, London.
7. Raghava,N.& Raghava,R.P.(2017).Biophysical methods: Tools and Techniques in Biology.Part I-Microscopy.Scholarink.com/Notion Press Media Pvt.Ltd,Chennai,TN.
8. Ghatak,K.L.(2011). Techniques and Methods in Biology.PHI Learning Pvt.Ltd.,New Delhi.

## Paper III: Cell biology and Genetics 50 Marks

**UNIT I**

1. Cell theory, cell as basic unit of life.
2. Structure and organization of prokaryotic and eukaryotic cells.
3. Cell organelles- structure, function and integration, micro bodies.

**UNIT II**

4. Cell division- mitosis and meiosis,
5. Cell cycle, its regulation and cancer, Characteristic of cancer cells.
6. Major signaling pathways of eukaryotic cells.

**UNIT III**

7. Mendel's law of inheritance, Gene interactions. Sex determination, linkage, crossing over, recombination and gene mapping.
8. Chromosome structure and behavior through the cell cycle, karyotype. Chromatin organization. Polytene and Lampbrush chromosome, Banding patterns in human chromosome,
9. Structural and numerical changes in chromosomes, hereditary defects.

**UNIT IV**

10. Extra-chromosomal inheritance, sex-linked inheritance in humans,
11. Mutation at phenotypic level, biochemical level and molecular level.
12. Gene frequencies in population, Hardy-Weinberg law.

**Books Recommended-**


1. Powar, C.B. (2010). Cell Biology. Himalaya publishing house, Mumbai.
2. Karp, G. (2013). Cell Biology, Wiley
3. Verma, P.S. & Agarwal, V.K. (2016). Cell biology. S. Chand & Company Ltd., New Delhi
4. Rastogi, S.C. (2005). Cell Biology. New age Publishers, New Delhi
5. Strickberger, M.W. (2015). Genetics. Pearson Education, India
6. Gardner, E.J. ,Simmons, M.J. & Snustad, D.P. (2006). Principles of Genetics. Wiley
7. Klug, W.S., Cummings, M.R., Spencer, C.A. & Palladino, M.A. (2016). Concepts of Genetics. Pearson Education, India.
8. Singh, B.D. (2009). Genetics. Kalyani Publishers, New Delhi
9. Gupta, P.K. (2009). Genetics. Rastogi Publishers, Meerut.


**Practical 50 Marks**

1. Preparation of buffers.
2. Qualitative tests of sugars.
3. Estimation of sugar by Anthrone method
4. Qualitative tests of proteins.
5. Estimation of protein by Lowry's method
6. Estimation of DNA by diphenylamine method
7. Estimation of RNA by Orcinol method
8. Chemistry practicals- group analysis, gravimetry
9. Assay of salivary amylase activity
10. Isolation of casein from milk.

# B.Sc. Part II (Biotechnology)

## Paper I: Bioenergetics and Biomembranes 50 Marks

**UNIT I**

1. Fundamentals of thermodynamics- endergonic and exergonic processes, enthalpy, entropy, activation energy, free energy change,
2. Phosphoryl transfer reaction, oxidation reduction reaction, redox potential, equilibrium and non equilibrium thermodynamics, high energy compounds, causes of energy richness in ATP.

**UNIT II**

3. Glycolytic pathway and its regulation, homolactic fermentation, alcoholic fermentation, energetics of fermentation, glycogen breakdown, Citric acid cycle and its regulation,gluconeogenesis,
4. Electron transport and oxidative phosphorylation, pentose phosphate pathway, glyoxalate pathway.

**UNIT III**

5. Fatty acid oxidation- major and minor pathways of fatty acid oxidation, ketone bodies.
6. Metabolic breakdown of amino acids, transamination, deamination, urea cycle.

**UNIT IV**

7. Biological membranes- membrane proteins, fluid mosaic model of membrane structure, erythrocyte membrane, plant cell membrane, bacterial cell wall.
8. Thermodynamics of transport, kinetics and mechanism of transport, active and passive transport, ATP-driven active transport, Ion gradient driven active transport.

**Books Recommended-**


1. Conn, E.E., Stumpf, P.K., Bruening, G. & Doi, R.H. (2006 ). Outlines of Biochemistry. Wiley.
2. Lehninger, A.L. (2013). Biochemistry. Kalyani publishers, New Delhi.
3. Jain, J.L., Jain, S. & Jain, N. (2016). Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
4. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2002). Biochemistry. W.H.Freeman & Co. Ltd.
5. Pankaja, N.(2017). Essentials of Biochemistry. Jaypee Brothers Medical Publishers, N.Delhi.
6. Gupta, R.C. & Bhargava, S. (2013). Practical Biochemistry.CBS Publishers & Distributors, New Delhi.

## Paper II: Plant and Animal Physiology 50 Marks

**UNIT I**

1. Photosynthesis: Photosynthetic pigments, electron transport, Photophosphorylation and Carbon fixation pathways. Fixation of atmospheric nitrogen by plants and microorganisms. Nitrate uptake and metabolism.
2. Plant hormones: Cytokinins, Gibberellic acid, Auxins, Ethylene. Abscissic acid- their physiological effects and mode of action. Nutrition- Macronutrients and micronutrients and their uptake by plants.
3. Seed germination and dormancy. Photoperiodism. Vernalization, Flowering. Senescence. Abscission.

**UNIT II**

4. Blood, its cellular and chemical composition, blood clotting.
5. Respiratory system: diffusion of oxygen and carbon dioxide, transport of oxygen, role of hemoglobin, dissociation curve of oxyhemoglobin and its significance, Bohr's effect, transport of CO2 and chloride shift. Various buffer system of the blood, acidosis, alkalosis. Role of lung and kidney in regulation of acid base balance.

**UNIT III**

6. Kidney- structure, its organization and function. Structural and functional characteristics of tubules, ultrafiltration, selective reabsorption and secretion, role of aldosterone and antidiuretic hormones and mechanism of urine formation.
7. Digestive System- different components, digestion and absorption of carbohydrates, lipids and proteins,

**UNIT IV**

8. Endocrine- brief outline of various endocrine glands and their physiological roles, storage and secretion of hormones. Nervous System- Nerve cells, nerve fibers, nerve impulse and neurotransmission, chemical and electrical synapses, functional properties of nerve fibers, action potential, the reflex action and reflex arc.
9. Immunity, antigen, antibody, hapten, antigen-antibody interaction, introduction to antigen presentation, role of MHC, complement system, vaccines.

**Books Recommended-**


1. Salisbury,P.B. & Ross,C.W.(1992).Plant Physiology.Wadsworth Publishing,California.
2. Pandey,S.N. & Sinha,B.K.(2016).Plant Physiology,Vikas Publishing House Pvt.Ltd,New Delhi.
3. Verma,S.K.& Verma,M.(2012).Plant Physiology,Biochemistry and Biotechnology.S.Chand & Company, Ltd.,New Delhi.
4. Noggle,G.R.&Fritz,G.J.(1986).Introductory Plant Physiology.Prentice-Hall of India Pvt Ltd,New Delhi.
5. Devlin,R.M.& Witham,F.H.(1986).Plant Physiology.CBS Publishers & Distributors,New Delhi.
6. Arumugam, N. & Kuttikan, A.M. (2014). Animal Physiology. Saras Publication, Kanyakumari.
7. Moyes, C.D. & Schulte, P.M. (2016). Principles of Animal Physiology. Pearson Education, India.
8. Rastogi, S.C. (2007). Essentials of Animal Physiology. New Age International Pub., New Delhi.
9. Verma ,P.S., Tyagi, B.S. & Agarwal, V.K. (2000). Animal Physiology. S. Chand & Co. Ltd., New Delhi.

## Paper III: Biostatistics and Computers 50 Marks

**UNIT I**

1. Graphic and Diagrammatic representations.
2. Classification and tabulation.
3. Measures of central tendency and dispersion. Skewness and Kurtosis.

**UNIT I**

4. Introduction to probability and distribution, sampling theory and errors.
5. Tests of significance: Z-, t-, Chi square and F-test. Analysis of variance.
6. Correlation and regression.

**UNIT I**

7. Introduction to computers, hardware, storage and memory devises, input and output devises, file and folders concepts.
8. File management, networks, printers, floppies, mouse, and keyboard.

**UNIT I**

9. Different types of booting, operating systems-single user, multi-user and multi tasking operating systems with examples.
10. Internet and E-Mail. Important services provided by internet. Use of internet in Biotechnology studies and research.

**Books Recommended-**


1. Banerjee, P.K.(2007). Introduction to Biostatistics. Rastogi publication, Meerut.
2. Rastogi, V.B. (2015). Biostatistics. Meditech Publishers, New Delhi.
3. Ramakrishna, P. (2015). Biostatistics. Saras Publication, Kanyakumari
4. Prasad, S. (2009). Elements of Biostatistics. Rastogi Publication, Meerut
5. Ambrosius, W.T.(2010). Topics in Biostatistics. Humana Press. New Jersey.
6. Sinha, P.K.(2004). Computer Fundamentals.BPB Publications, N.Delhi.
7. Changeriya, C.S.(2010). Basic Computer Course. Chetan Publication, N.Delhi.


**Practical** **50 Marks**

1. Determination of urine urea nitrogen.
2. Isolation of serum albumin by salting out method.
3. Determination of serum albumin by Bromocresol green method.
4. Determination of total cholesterol.
5. Determination of SGOT.
6. Determination of SGPT.
7. Determination of serum bilirubin.
8. Blood group analysis
9. Ouchterlony double diffusion test
10. Determination of haemoglobin content by haemoglobinometer.
11. Statistical analyses of data. (Numerical on Central tendencies, dispersion)

## B.Sc. III year (Biotechnology)

## Paper I: Molecular Biology and Genetic Engineering Marks 75

**UNIT I**

1. Nucleic acids as genetic material, structure of A-, B- and Z-DNA, palindromic sequences, structure of RNA (t-RNA, m-RNA and r-RNA),
2. DNA denaturation and renaturation.
3. DNA replication in prokaryotes, DNA polymerase I, II and III, modes and mechanism of DNA replication, DNA repair mechanisms.

**UNIT II**

4. Transcription in prokaryotes, RNA polymerase, types and functions of RNA polymerases in eukaryotes.
5. Genetic code.

**UNIT III**

6. Translation in prokaryotes, Post-translational modifications.
7. Gene organization, Operon concept and introduction to gene regulation mechanisms.
8. Transposons: An elementary idea

**UNIT IV**

9. Basic concept of recombinant DNA technology, principles of gene cloning. Restriction modification systems, use of restriction enzymes in biotechnology, cloning vectors.
10. Methods of gene transfer, DNA libraries.
11. Introduction to PCR, RFLP, DNA sequencing, blotting techniques.

**Books Recommended-**


1. Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley
2. Rastogi, S.C. (2010). Molecular Biology of the Cell. New Age International publisher, New Delhi.
3. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut.
4. Gupta, P.K. (2005). Molecular Biology and Genetic engineering. Rastogi Publications, Meerut.
5. Vidyavathi, N. & Chetan, D.M. (2009). Molecular biology. I.K.International Publishing House Pvt. Ltd., New Delhi.
6. De Robertis,E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U. S.
7. Govil,C.M.,Aggarwal,A. & Sharma,J.(2017).Plant Biotechnology and Genetic Engineering. PHI Learning Pvt Ltd,Delhi.
8. Dube, R.C. (2014). A Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi
9. Singh, B.D. (2012). Biotechnology. Kalyani Publishers, New Delhi.
10. Gupta, P.K. (2016). Plant Biotechnology. Rastogi Publications, Meerut.

## Paper II: Animal and Plant Biotechnology 75 Marks

**UNIT I**

1. Introduction to Plant tissue culture techniques,
2. *In vitro* pollination and fertilization, embryo culture and its applications, embryogenesis and organogenesis, micropropagation, haploids and their applications, somaclonal variations and applications, Endosperm culture and production of triploids.

**UNIT II**

3. Introduction to protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization. Protoplast and tissue culture manipulation for genetic manipulation of plants, methods of gene transfer in plants, crop improvement and development transgenic plants.
4. Single cell protein (SCP), economic implications of SCP.

**UNIT III**

5. Basic techniques in animal cell culture and organ culture, cell line and isolation of cell line, culture media, contaminations and their laboratory management, cell fusion, cell differentiation and growth of cultured cells, bioreactors for large scale culture of cells.
6. Cloning in mammalian cells, integration of DNA into mammalian genome- different methods.

**UNIT IV**

7. Development of recombinant vaccines, monoclonal antibody their applications.
8. Introduction to trangenics, gene therapy. Production of secondary metabolites/products: Insulin, growth hormones, interferons etc.

**Books Recommended-**


1. Singh, B., Gautam, S.K., Chauhan, M.S. & Singh, S.K. (2013). Textbook of Animal biotechnology. The Energy and Resources Institute TERI,
2. Kumaresan, V. (2014). Animal Biotechnology. Saras Publication, Kanyakumari.
3. Srivastava, A.K., Singh, R.K & Yadav, M.P. (2006). Animal Biotechnology. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Govil,C.M.,Aggarwal,A. & Sharma,J.(2017).Plant Biotechnology and Genetic Engineering. PHI Learning Pvt Ltd,Delhi.
5. Dube, R.C. (2014). A Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi
6. Singh, B.D. (2012). Biotechnology. Kalyani Publishers, New Delhi.
7. Gupta, P.K. (2016). Plant Biotechnology. Rastogi Publications, Meerut.

## Paper III: Industrial and Environmental Biotechnology 75 Marks

**UNIT I**

1. General characteristics of microorganisms, structure of bacteria and viruses, bacterial growth - bacterial growth curve, factors affecting bacterial growth.
2. Recombination in bacteria- transformation, conjugation and transduction, reproduction in bacteria, Bacterial diseases of humans, Food spoilage, food preservation.

**UNIT II**

3. Environmental microbiology- water pollution, treatment of water and sewage, biogeochemical cycles of elements in the environment.
4. Renewable and non renewable sources of energy. Disposal of solid wastes, oil spills, cellulose etc.

**UNIT III**

5. Microbes in industry – foods from microorganism (vinegar and cheese). production of citric acid, amylases, proteases, vitamin B12, beer, wine, biogas, methane, hydrogen
6. Bacteriology of water and sewage, Bacteriological examination of water.

**UNIT IV**

7. Biodegradation of plastic , pesticides and hydrocarbons Bioremediation, Bioleaching, Biosorption, Biopesticides, Biofertilizers, Biofuels, Biosensors, Bioindicators, Biodegradable plastics

**Books Recommended-**


1. Ahmed, N., Qureshi, F.M. & Khan, O.Y. (2001). Industrial and Environmental Biotechnology. Garland Science, New Delhi.
2. Pramanik, K. & Patra, K.K. (2014). Industrial and Environmental Biotechnology. Studium Press India Pvt Ltd.
3. Singh, R.P. (2017). Microbiology. Kalyani Publishers, New Delhi.
4. Sharma, P.D.(2016). Microbiology. Rastogi Publishers, Meerut, U.P.
5. Maheshwari, D.K, & Dubey, R.C. (2013).A Text Book of Microbiology. S.Chand & Co. New Delhi.


**Practicals** **75 Marks**

1. Methods of sterilization.
2. Preparation of culture media
3. Simple staining
4. Differential staining
5. Culture of bacteria on solid medium
6. Culture of bacteria on liquid medium (broth culture)
7. Determination of bacterial growth by turbidimetric method.
8. Preparation of alcohol from fruit juice(s).
9. Isolation and of DNA
10. Agarose gel electrophoresis of DNA