S. S. Jain Subodh P. G. College, Jaipur
(AUTONOMOUS)

SYLLABUS
(Three Year Undergraduate Programme)

B.Sc. Biotechnology

I and II Semester examination 2025-26

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

(As per NEP 2020)

Contents:

1. Eligibility:

10+2 with 48% from Rajasthan Board / CBSE from Rajasthan state and 60% for CBSE or any other equivalent recognized Board from other state in Science Stream with Physics, Chemistry and Biology.

2. Scheme of Examination

Sr. No.	Paper	ESE	CIA	Total
1.	Theory	70%	30%	100
2.	Practical	60%	40%	100

Each theory paper syllabus is divided into four units. Each theory paper 3 hours duration. Each Practical /Lab work 4 hours duration

The number of papers and the maximum marks for each paper/ practical shall be shown in the syllabus for the paper concerned. It will be necessary for a candidate to pass in theory part as well as practical part of a subject separately.

Note: Maximum marks for a theory paper is 100 marks which include 70 marks for ESE and 30marks for internal assessment.

Mark distribution in question paper:
The question paper (EoSE - End of Semester Examination) will consist of two parts A & B
Part - A: 14 Marks
Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each and candidate can attempt any seven questions.
Part - B: 56 Marks
Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each question will carry 14 marks.

Skill Enhancement Courses (SEC)

Credits: 2 | Maximum Marks: 50

Classes per week: 2 | EoSE: 35

CIA:15

Examination will be of one hour.

Question paper will have multiple choice questions (35 in number).

Each question will be of **1 Mark each.**

Examination will be conducted on **OMR sheet.**

Name of proposed SEC from the upcoming session 2025-26.

Semester I: 101 Computer Fundamentals/104 Business Communication Skills

Semester II: 208 Introduction to Cyber Security/ 105 Effective Communication Skills

Semester III: 120 Disaster Management/ 109 Finance for everyone

Semester IV: 201 Environmental Management/ 220 Use of Chemicals in Daily Life

Semester VI: Logical and Critical Thinking

Or

108 Quantitative Aptitude and Data Interpretation

Value added Course (VAC)

Credits: 2 | Maximum Marks: 50

Classes per week: 2 | EoSE: 35

CIA:15

Examination will be of **one hour**.

Question paper will have multiple choice questions **(35 in number**).

Each question will be of **1 Mark each.**

Examination will be conducted on **OMR sheet.**

Name of proposed VAC from the upcoming session 2025-26.

S.No.	Course Code	Course Name
First Year (Semester I and Semester II)		
1.	VAC-51F-101/ VAC-52F-101	Anandam-I
2.	VAC-51T-102/ VAC-52T-102	Digital Enhancement
3.	VAC-51T-103/ VAC-52T-103	Understanding Indian society & Culture
4.	VAC-51T-104/ VAC-52T-104	Nutrition for Health and Fitness
5.	VAC-51T-105/ VAC-52T-105	Geriatric Wellness and Care
6.	VAC-51T-106	National Cadet Corps (NCC)-I (Semester I)
7.	VAC-51T-107/ VAC-52T-107	Indian value system
8.	VAC-51T-108	National Service Scheme (NSS)-I (Semester-I)
9.	VAC-51T-109/ VAC-52T-109	Financial Literacy
10.	VAC-52T-110	National Cadet Corps (NCC)-I (Semester II)
11.	VAC-52T-111	National Service Scheme (NSS)-II (Semester-II)
12.	VAC-51T-112/ VAC-52T-112	Environmental studies
Second Year (Semester III and Semester IV)		
1.	VAC-63F-201/VAC-64F-201	Anandam-II
2.	VAC-63F-203/VAC-64F-203	Traditional & modern medicine systems for Evereyday health solutions
3.	VAC-63F-204	National Service Scheme (NSS)-III (Semester-III)

4.	VAC-64F-205	National Service Scheme (NSS)-IV (Semester-IV)
5.	VAC-63F-206	National Cadet Corps (NCC)-III (Semester III)
6.	VAC-64F-207	National Cadet Corps (NCC)-IV (Semester IV)
7.	VAC-63T-208/VAC-64T-208	Content writing
8.	VAC-63T-209/VAC-64T-209	Cyber Law and Ethics
9.	VAC-63T-210/VAC-64T-210	Electoral Literacy

Multidisciplinary Course (MDC)

Credits: 4
Classes per week: 4

Maximum Marks: 100
EoSE: 70
CIA: 30

Examination will be of **three hours.**

The question paper (EoSE-End of Semester Examination) will consist of two parts A & B.

Part A: 14 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each and candidate can attempt any seven questions.

Part B: 56 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each question will carry 14 marks.

MDC will run in Semester III, IV and V.

Name of proposed MDC from the upcoming session 2025-26

1. **English**

Basics of English Grammar and Composition	English	III
Basics of English Grammar and Composition	English	IV
Basics of English Grammar and Composition	English	V

2. **History**

Historical Evolution of Indian Society	History	III
Historical Trends in Indian culture	History	IV
Historical Methods and Historiography	History	V

3. **Business Administration**

Business communication skills	BBA	III
E-commerce	BBA	IV
Trade Unions and Industrial Relations	BBA	V

4. **Botany**

Introduction of Botany	Botany	III
Plants and Human health	Botany	IV
Biodiversity Conservation and Ecotourism	Botany	V

5. **Psychology**

Basics of Psychology-I	Psychology	III
Basics of Psychology-II	Psychology	IV
Personality Development	Psychology	V

Note:

1. **MDC will run in three semesters and all the departments have to prepare the syllabus of**

B. Sc. (Bio) Biotechnology

3. Semester Structure: The details of the courses with title assigned are as given below.

Duration: 6 Semesters (3 Years)

Semester–I	**Name of Paper**	**Credits**	**Total Credits**
Paper I -	Biotechniques and Microbial world	4	
Lab-	Practicals Based on Theory Papers	2	6
Semester –II			
Paper I-	Cell Biology and Genetics	4	
Lab-:	Practicals Based on Theory Papers	2	6
Semester III			
Paper I-	Plant and Animal Biotechnology	4	
Lab-	Practicals Based on Theory Papers	2	6
Semester IV			
Paper I-	Immunology and Medical Biotechnology	4	
Lab-	Practicals Based on Theory Papers	2	6
Semester V			
Paper I A(E)	RDT and Industrial Biotechnology	4	

Paper I B(E)	Cellular Biophysics and Biochemistry	4	
Lab-	Practical's Based on Elective Papers	2	6
Semester VI			
Paper I A(E)	Biosafety, Bioethics and IPR in Biotechnology	4	
Paper I B(E)	Bioinformatics and Nanotechnology	4	
Lab-	Practical's Based on Elective Paper	2	6

***Students have to choose any one elective paper out of two in fifth and sixth semester.**
****Department will offer theory elective papers for the students based on options submitted by the students and availability of Faculty to teach the course.**

4. Programme Specific Outcomes:

By the end of the course, a student should be able to:

1. Students develop global competencies in the area of basic and applied biological sciences.
2. Enhancing the subject knowledge of students by using traditional and modern ICT based teaching methods and learning by doing.
3. To enrich students' knowledge and train them in various branches of Biotechnology such as genetics, molecular biology, biochemistry, immunology, fermentation technology, environmental biotechnology and tissue culture techniques.
4. To groom the students to meet futuristic challenges and national interests
5. To bestow the students with all the research skills required to work independently
6. To develop scientific temperament and social responsibilities in the students.
7. To inculcate nature care by imparting knowledge of advance modern techniques
8. As Biotechnology is an interdisciplinary course, empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.
9. Acquire knowledge in students of biotechnology enabling their applications in industry and research.

Course Outcomes:

1. Graduates will have a deep and comprehensive understanding of core biotechnology concepts, including molecular biology, genetics, bioinformatics, and bioprocessing.
2. Graduates will be proficient in designing, conducting, and analyzing complex biotechnological experiments, using advanced laboratory techniques and tools.
3. Graduates will be adept at applying biotechnological methods to solve real-world problems in healthcare, agriculture, environment, and industry.
4. Graduates will have hands-on experience and technical expertise in genetic engineering, recombinant DNA technology, cell culture, and other modern

biotechnological practices.

5. Course Details:

- The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase BSc Biotechnology Admissions are mainly done on the basis of merit list.
- The BSc Biotechnology Courses are offered in Full Time Education.
- The syllabus of BSc in Biotechnology includes subjects like Biophysics & Instrumentation, Bioinformatics, Cell Structure & Dynamics, Principles of Microbiology, Molecular Genetics, etc.
- The different Job profiles after completion of the degree are Biotech Analyst, BioChemist, Research scientist and many more.
- Also, it is being recommended that the Project Work and Industrial Tour/ Institute visit is compulsory for all the students as per their respective semester curriculum.

Semester I

Paper: Biotechniques And Microbial World

1 credit -25 Marks

4 credit- 100 Marks

Question paper: 70 Marks

Internal Assessment: 30 Marks

80 Hrs. (6 hrs/week)

Course objective: This course introduces fundamental techniques in biotechnology and microbiology, focusing on microscopy, centrifugation, chromatography, electrophoresis, and spectroscopy. It covers microbial diversity, structure, growth, metabolism, and reproduction, along with methods of cultivation and preservation. The course also highlights the role of microorganisms in water and food microbiology, laying a strong foundation for further studies in biotechnology.

Unit I

Microscopy- Principles, types and applications of Microscopy. Bright field, Dark-field, fluorescent microscopy, Electron Microscope. Procedure for Preparation of Slides for microscopic study.

Centrifugation: Definition of centrifugation v/s sedimentation. Centrifuge: Principle, Parts, Types (Low, high and ultra-centrifuge), and their Applications.

Unit II

Chromatography: General principle of chromatographic separation. Principle, Instrumentation and applications of Paper Chromatography and Thin Layer Chromatography.

Electrophoresis: Basic principle and types of electrophoresis. Factors affecting electrophoretic migration, Technique and uses of Agarose gel electrophoresis.

Spectroscopy- Principle and applications of colorimeter and spectrophotometer, Beer-Lambert law. Light absorption and transmission.

Unit III

History and Evolution of Microbiology and Microbial diversity: Microbial phylogeny and Classification of micro-organisms on the basis of nutrition. Morphology and cell structure of major groups of microorganisms e.g. Bacteria, Fungi, and Viruses.

Cultivation and Maintenance of microorganisms: Culture media composition types and their functions. Media Preparation and sterilisation. Different methods of microbes isolation (Streak plate, pour plate spread plate method), Preservation of micro-organisms.

Unit IV

Microbial growth, metabolism and reproduction: Growth curve, Generation time, synchronous growth, measurement of growth and factors affecting growth of bacteria. Microbial metabolism and reproduction.

Water and Food Microbiology: Bacterial pollutants of water, coliforms and non-coliforms. Sewage composition and its treatment. Important microorganism in food Microbiology: Yeasts, bacteria. Preservation of various types of foods.

Suggested Readings:

1. Walker J. M. and Ging old, E.B. (1983). Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.
2. Boyer, R.F. (2000). Modern Experimental Biochemistry, 3rd Edition, Prentice Edition. Wiley-Inter science, USA.
3. Friefelder, D.M. (1983). Physical Biochemistry: Applications to Biochemistry Hall publishers, USA.
4. P.Palanivelu and M.Salihu. (2009). Analytical Biochemistry and Separation and Molecular Biology. 2nd Revised edition. W. H. Freeman, USA.
5. Upadhyay and Upadhyay Nath. (2009). Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
6. Wilson and Walkar. (2000). A Biologist Guide to Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, UK.
7. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12^{th} edition. Pearson/Benjamin Cummings.
8. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
9. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5^{th} edition. McMillan.
10. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.

Lab Practical Based on Theory papers

Maximum practical Marks = 50 marks
Internal marks = 30 Marks
External marks = 20 Marks
60 Hours

Course objective: The objective of a "Biotechniques and Microbial World" practical course is to equip students with the fundamental knowledge and practical skills necessary to work with microorganisms in a biotechnology context. This includes understanding microbial diversity, cultivation, identification, and applying various biotechnological techniques to harness their potential for various applications.

1. To study the principle and applications of important laboratory instruments (weighing balance, hot air oven, autoclave, LAF, hot plate, pH meter, and water bath) used in the biotechnology laboratory.
2. Organization and working of optical microscopes: Dissecting and Compound Microscope.
3. Separation of amino acids by paper chromatography.
4. Separation of plant pigment by TLC.
5. Demonstrate the basic principle of centrifugation.
6. Preparation of nutrient agar and broth media & sterilization methods.
7. Perform the technique of Serial dilution.
8. Perform the different types of culture methods (pour plating, spreading, streaking).
9. Isolation of micro-organisms from different sources (air, water and soil)
10. Perform the Different types of staining methods: simple staining, Gram staining, acid fast staining

Semester II

Paper: Cell Biology and Genetics

1 credit -25 Marks
4 credit- 100 Marks
Question paper: 70 Marks
Internal Assessment: 30 Marks
80 Hrs. (6 hrs/week)

Course objective: This course aims to provide foundational knowledge of cell structure, function, and genetic mechanisms. It covers the ultrastructure of prokaryotic and eukaryotic cells, chromosomes, cell cycle regulation, DNA replication, transcription, and gene expression. Students will learn classical and molecular genetics, Mendelian inheritance, chromosomal alterations, and mutation concepts, preparing them for advanced studies in cell and molecular biology.

Unit I

Cell and cell organelles: Ultra-structure of prokaryotic and eukaryotic cell, Structure and functions of cytoskeleton structures (microtubules, microfilaments and intermediate filaments). Structural organization and functions of plasma membrane and cell wall.

Chromosomes: Morphology and structural organization, Centromere, Euchromatin and Heterochromatin. Special type of chromosomes: Salivary gland and Lamp brush chromosomes.

Unit II

Cell cycle: An overview of cell cycle, components of cell cycle control system, cell division (Mitosis and meiosis).

DNA structure, replication and transcription: DNA as genetic material, Structure, types and functions of DNA, Replication of DNA in prokaryotes and eukaryotes. RNA structure types and

their functions. Transcription in prokaryotes: Prokaryotic RNA polymerase, promoter, initiation, elongation and termination.

Unit III

Concept and organization of genetic material in bacteria, plant and animal (*E. coli, Arabidopsis thaliana, Coenorhabditis elegans*) as a model organism.

Concept of Gene: Allele, multiple alleles, pseudo alleles and complement test. Cytogenetic: Human karyotype, Banding techniques, Human genetic diseases. Pedigree analysis.

Unit IV

Mendelian principles and laws of inheritance: Law of dominance, segregation, independent assortment, co-dominance and incomplete dominance and pleiotropy. Back cross and Test cross.

Structural and numerical alterations of chromosome: Deletion, Inversion, Duplication, Translocation. Ploidy and their genetic implications. Mutation: (Spontaneous and Induced) Mutagens. Biochemical basis of mutation.

Suggested Reading:

1. Cooper, G. M. and Hausman, R. E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. De Robertis, E. D. P. and De Robertis, E. M. F. (2006). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Alberts, B. (2015). Molecular Biology of the Cell (6th ed.). W.W. Norton & Company
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
5. Gardener E.J, Simmons M.J and Snustad , D.P.(2005). Principles of Genetics–John Wiley& Sons Publications.
6. Concepts of Genetics by Klug, Cummings, Spencer, and O'Brien
7. Genetics: A Conceptual Approach by Benjamin A. Pierce
8. Lewin, B. (2014). Lewin's Genes XI (11th ed.). Jones & Bartlett Learning.

Lab Practical Based on Theory papers

Maximum practical Marks = 50 marks
Internal marks = 30 Marks
External marks = 20 Marks
60 Hours

Course objective: Cell Biology and Genetics practical courses aim to equip students with a solid understanding of cell structure, function, and heredity. Key objectives include mastering microscopy techniques, learning cell division processes, and applying genetic principles to solve problems. Students will also gain practical experience with genetic experiments and analysis.

1. To observe and distinguish between prokaryotic and eukaryotic cells using curd and onion peel or cheek cells.
2. Observation of chromosomes at different stages of mitosis using onion root tip
3. Observation of chromosomes at different stages of meiosis using Flower bud.
4. Preparation of polytene chromosomes from *Drosophila* salivary gland.
5. Explanation of Structure of RNA and DNA by charts and model.
6. Extract DNA from onion, banana, or blood sample using salt-detergent-alcohol method.
7. Demonstrate the Mendel's law of Genetics-Mono and Dihybrid crosses.
8. Rearing morphology of Drosophila (mutant types identification)
9. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans*)- By Permanent slides
10. Identification of Barr body from blood cells

*** Any other practical exercise as per theory syllabus.**