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Dr. S. S. (HOD)
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19/9/24

Department of Biotechnology

Scheme of Examination and Syllabus for
Under Graduate Programme
Under Multiple Entry and Exit, Internship and
CBCS-LOCF as per NEP-2020
w.e.f. session 2024-25 (in phased manner)

Subject: Biotechnology



Guru Jambheshwar University of Science & Technology
Hisar-125001, Haryana
(A+ NAAC Accredited State Govt. University)



Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana
('A+' NAAC Accredited State Govt. University)

Name of the Programme: Bachelor of Science
Subject: Biotechnology

Scheme of Examination & Syllabus for affiliated Degree College for UG Programme
 According to National Education Policy-2020



SEMESTER-I

Type of Course	Course Code	Nomenclature of Paper/ Course	Credits	Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
Discipline Specific Course	C24BBT101T/ C24MIN141T	Basics of Biotechnology	3	3	20	50	70	2.5
	C24BBT101P/ C24MIN141P	Basics of Biotechnology Lab	1	2	10	20	30	2
Minor Course	C24MIC141T	Introduction to Biotechnology	2	2	15	35	50	2
# Minor Course	C24MIN141T/ C24BBT101T	Basics of Biotechnology	3	3	20	50	70	2.5
	C24MIN141P/ C24BBT101P	Basics of Biotechnology Lab	1	2	10	20	30	2
Multidisciplinary Course	C24MDC101T	Applied Biology-I	2	2	15	35	50	2
	C24MDC101P	Applied Biology-I Lab	1	2	10	15	25	
Skill Enhancement Course	C24SEC126T	Biofertilizer and Biopesticide Production Technology	2	2	15	35	50	2
	C24SEC126P	Biofertilizer and Biopesticide Production Technology Lab	1	2	10	15	25	2
Value Added Course	C24VAC113T	Environmental Biotechnology	2	2	15	35	50	2

SEMESTER-II

Type of Course	Course Code	Nomenclature of Paper/ Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
Discipline Specific Course	C24BBT201T/ C24MIN241T	Fundamentals of Biochemistry	3	3	20	50	70	2.5
	C24BBT201P/ C24MIN201P	Fundamentals of Biochemistry Lab	1	2	10	20	30	2
Minor Course	C24MIC241T	Biomolecules	2	4	15	35	50	2
# Minor Course	C24MIN241T/ C24BBT201T	Fundamentals of Biochemistry	3	3	20	50	70	2.5
	C24MIN241P/ C24BBT201P	Fundamentals of Biochemistry Lab	1	2	10	20	30	2
Multidisciplinary Course	C24MDC201T	Applied Biology-II	2	2	15	35	50	2
	C24MDC201P	Applied Biology-II Lab	1	2	10	15	25	2
Skill Enhancement Course	C24SEC226T	Medical Laboratory Technology	2	2	15	35	50	2
	C24SEC226P	Medical Laboratory Technology Lab	1	2	10	15	25	2
Value Added Course	C24VAC113T	Environmental Biotechnology	2	2	15	35	50	2

Minor Course for Scheme C

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Programme Outcomes

- PO1 Fundamental knowledge of basic Biological Sciences and Biotechnology.
- PO2 Basic understanding: Knowledge regarding basic concepts and applied aspects of cell biology, biochemistry, biotechnology and environment.
- PO3. Interdisciplinary approach: Learning the relationships among animals, plants, microbes and Industry.
- PO4. Practical learning: Perform procedures and analysis as per laboratory standards in the areas of biology and biotechnology.
- PO5 Strong understanding of molecular biology, genetics, microbiology, biochemistry and allied subjects, preparing them for higher education, disciplinary & multidisciplinary research and to be a life-long learner.
- PO6 Analytical Thinking: Perceive things, events and framing ideas and decisions (intellectual, organizational, and personal) in the light of scientific principles.
- PO7 Effective Communication: Speak, read and write clearly and make personal growth by connecting with people, ideas, books, media and technology.
- PO8 Environment and Sustainability: Understand the issues of environmental deterioration, pollution and sustainable development. Developing critical problem-solving approach for these societal concerns using biotechnological tools and methods.

Biotechnology
Discipline Specific Course (DSC)
Basics of Biotechnology (Semester-I)

Paper Code: C24BBT101T/C24MIN141T
45 Hrs (3 Hrs /Week)
Credits: 3
Exam Time: 2.5 Hrs

External Marks : 50
Internal Marks : 20
Total Marks:70

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit in addition to the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the introduction and fundamental concepts of Biotechnology.

Unit-I

History and major landmarks in the development of biotechnology, Scope and Main areas of application of biotechnology; Biotechnology research in India and biotechnology in context of developing world; Brief account of safety guidelines, risk assessment and ethics in biotechnology.

Unit-II

Basics of Genetic Engineering: Introduction and history of genetic manipulations, Recombinant DNA technology, Genetically modified organisms (GMOs), Applications of genetic engineering.

Unit-III

Basics of Microbiology: Introduction, Definition, Importance and Scope of Microbiology, History of microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch etc., Branches of microbiology.

Viruses and Bacteria: Bacteria – Ultrastructure of bacteria cell (both Gram positive and Gram negative). Viruses – Structure and classification (A brief account). Introduction to classification of microorganisms.

Unit-IV

Cultivation and Maintenance of microorganisms: Nutritional requirements of microorganisms. Methods of isolation, purification and preservation of microorganisms. Sterilization methods (Physical and Chemical Methods)
Microbial growth: Study of growth curve, generation time, quantitative measurement of growth and factors affecting growth of bacteria.

Basics of Biotechnology Lab

Paper Code: C24BBT101P/C24MIN141P
30 Hrs (2 Hrs /Week)
Credits: 1
Exam Time: 2 Hrs

External Marks : 20
Internal Marks : 10
Total Marks: 30

Objective: Hands on knowledge of basic biotechnology lab, instruments and techniques.

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1. Safety measures and Laboratory precautions
2. Cleaning, drying and sterilization of glassware and disposal of laboratory waste and cultures
3. Principles and working knowledge of laboratory instruments: Compound Microscope, Autoclave, Hot Air Oven, pH meter, laminar airflow hood, Centrifuge, B.O.D. Incubator, Colony counter etc.
4. Media preparation (Nutrient agar, Nutrient broth, Luria broth etc.) and sterilization.
5. Observation of bacteria in curd by simple staining
6. To perform Gram staining
7. To perform negative staining
8. To perform fungal staining
9. Demonstration of ubiquitous nature of microorganisms
10. Enumeration of microorganism from soil, water etc. by serial dilution technique
11. Pure culture technique: Pour plate, Spread plate and Streak plate methods
12. To perform antibiotic sensitivity test

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Pelczar, Microbiology-Concepts and Applications, McGraw Hill Publications, New York
2. Dubey and Maheshwari, Practical Microbiology, S Chand Publishing House, New Delhi
3. Practical Manual Vol I, Deptt. of Biotechnology, G C Hisar

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Understand the principles and practices of biotechnology and effectively communicate with biotech and other interdisciplinary professionals.

CO2 Learn the scope, different areas of biotechnology and the associated safety concerns and measures.

CO3 Learn about basic microbiological and genetic engineering concepts.

CO4 Get aware with the biotechnological applications of plants tissue culture, animal tissue culture, plant and animal products, production & improvement of them.

Mapping of CO with PO C24BBT101T and C24BBT101P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

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Practicals:

1. Safety measures and Laboratory precautions
2. Cleaning, drying and sterilization of glassware and disposal of laboratory waste and cultures
3. Principles and working knowledge of laboratory instruments: Compound Microscope, Autoclave, Hot Air Oven, pH meter, laminar airflow hood, Centrifuge, B.O.D. Incubator, Colony counter etc.
4. Media preparation (Nutrient agar, Nutrient broth, Luria broth etc.) and sterilization.
5. Observation of bacteria in curd by simple staining
6. To perform Gram staining
7. To perform negative staining
8. To perform fungal staining
9. Demonstration of ubiquitous nature of microorganisms
10. Enumeration of microorganism from soil, water etc. by serial dilution technique
11. Pure culture technique: Pour plate, Spread plate and Streak plate methods
12. To perform antibiotic sensitivity test

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Pelczar, Microbiology-Concepts and Applications, McGraw Hill Publications, New York
2. Dubey and Maheshwari, Practical Microbiology, S Chand Publishing House, New Delhi
3. Practical Manual Vol I, Deptt. of Biotechnology, G C Hisar

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Understand the principles and practices of biotechnology and effectively communicate with biotech and other interdisciplinary professionals.

CO2 Learn the scope, different areas of biotechnology and the associated safety concerns and measures.

CO3 Learn about basic microbiological and genetic engineering concepts.

CO4 Get aware with the biotechnological applications of plants tissue culture, animal tissue culture, plant and animal products, production & improvement of them.

Mapping of CO with PO C24BBT101T and C24BBT101P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

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**Biotechnology
Minor Course (MIC)
Introduction to Biotechnology (Semester-I)**

Paper Code: C24BBT141T
30 Hrs (2 Hrs /Week)
Credits: 2
Exam Time: 2 Hrs

External Marks : 35
Internal Marks : 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1

Objective: This paper deals with the introduction and fundamental concepts of Biotechnology.

Unit-I

Introduction to biotechnology: Origin and definitions, history of biotechnology, ancient, classical and modern, branches of Biotechnology, Scope and importance, Biotechnology in India and its global trends, Major biotechnology institutes and companies in India. Brief account of safety guidelines, risk assessment and ethics in biotechnology. Commercially important biotech products and concerns.

Unit-II

Biotechnology and its applications: Applications of biotechnology in Agriculture, medicine, environment, veterinary sciences, food industry, pharmaceutical industry forensic science; Bio-remediation and waste treatment biotechnology, Cloning (DNA cloning, animal cloning), Genetically Modified Organisms, Stem cell technology.

Books Suggested:

1. Das H K, Textbook of Biotechnology, Willey Dreamtech Pvt Ltd, New Delhi
2. Gupta PK, Biotechnology and Genomics, Rastogi Publications, Meerut
3. Singh BD, Biotechnology: Expanding Horizons, Kalyani Publications, New Delhi

Course Outcomes:

At the end of the course, the students would be able to:

- CO1 Understand the principles and practices of biotechnology
- CO2 Learn the scope, different areas of biotechnology and the associated safety concerns
- CO3 Learn about basic microbiological and genetic engineering concepts.
- CO4 Get aware with the biotechnological applications of plants tissue culture, animal.

Mapping of CO with PO C24MIC141T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	S	M	M	S	M	M
CO2	S	M	M	M	S	M	M	S
CO3	M	S	M	M	M	S	M	S
CO4	S	M	S	M	S	S	M	S

S=Strong, M=Medium, W=weak

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**Biotechnology
Minor Course (MIN)
Basics of Biotechnology (Semester-I)**

Paper Code: C24MIN141T/C24MIN141T
45 Hrs (3 Hrs /Week)
Credits: 3
Exam Time: 2.5 Hrs

External Marks : 50
Internal Marks : 20
Total Marks:70

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit in addition to the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the introduction and fundamental concepts of Biotechnology.

Unit-I

History and major landmarks in the development of biotechnology, Scope and Main areas of application of biotechnology; Biotechnology research in India and biotechnology in context of developing world; Brief account of safety guidelines, risk assessment and ethics in biotechnology.

Unit-II

Basics of Genetic Engineering: Introduction and history of genetic manipulations, Recombinant DNA technology, Genetically modified organisms (GMOs), Applications of genetic engineering.

Unit-III

Basics of Microbiology: Introduction, Definition, Importance and Scope of Microbiology, History of microbiology, contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch etc., Branches of microbiology.

Viruses and Bacteria: Bacteria – Ultrastructure of bacteria cell (both Gram positive and Gram negative). Viruses – Structure and classification (A brief account). Introduction to classification of microorganisms.

Unit-IV

Cultivation and Maintenance of microorganisms: Nutritional requirements of microorganisms. Methods of isolation, purification and preservation of microorganisms. Sterilization methods (Physical and Chemical Methods)

Microbial growth: Study of growth curve, generation time, quantitative measurement of growth and factors affecting growth of bacteria.

Basics of Biotechnology Lab

Paper Code: C24MIN141P/C24BBT101P
30 Hrs (2 Hrs /Week)
Credits: 1
Exam Time: 2 Hrs

External Marks : 20
Internal Marks : 10
Total Marks: 30

Objective: Hands on knowledge of basic biotechnology lab, instruments and techniques.

Practicals:

1. Safety measures and Laboratory precautions
2. Cleaning, drying and sterilization of glassware and disposal of laboratory waste and cultures
3. Principles and working knowledge of laboratory instruments: Compound Microscope,

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- Autoclave, Hot Air Oven, pH meter, laminar airflow hood, Centrifuge, B.O.D. Incubator, Colony counter etc.
- Media preparation (Nutrient agar, Nutrient broth, Luria broth etc.) and sterilization.
 - Observation of bacteria in curd by simple staining
 - To perform Gram staining
 - To perform negative staining
 - To perform fungal staining
 - Demonstration of ubiquitous nature of microorganisms
 - Enumeration of microorganism from soil, water etc. by serial dilution technique
 - Pure culture technique: Pour plate, Spread plate and Streak plate methods
 - To perform antibiotic sensitivity test

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

- Pelczar, Microbiology-Concepts and Applications, McGraw Hill Publications, New York
- Dubey and Maheshwari, Practical Microbiology, S Chand Publishing House, New Delhi
- Practical Manual Vol I, Deptt. of Biotechnology, G C Hisar

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Understand the principles and practices of biotechnology and effectively communicate with biotech and other interdisciplinary professionals.

CO2 Learn the scope, different areas of biotechnology and the associated safety concerns and measures.

CO3 Learn about basic microbiological and genetic engineering concepts.

CO4 Get aware with the biotechnological applications of plants tissue culture, animal tissue culture, plant and animal products, production & improvement of them.

Mapping of CO with PO

C24MIN141T/C24BBT101T and C24MIN141P/C24BBT101P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

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Paper Code: C24MDC101T
30 Hrs (2 Hrs /Week)
Credits: 2
Exam Time: 3 Hrs

Biotechnology
Multidisciplinary Course (MDC)
Applied Biology-I (Semester-I)

External Marks: 35
Internal Marks: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Objective: This paper deals with the introduction and fundamental concepts of applied biology.

Unit-I

Origin of life: Biogenesis and abiogenesis, theories, experimental evidence.
Cell-Basic unit of life: Cell theory, Structure of prokaryotic and eukaryotic cell, Cell organelles (Mitochondria, ER, GC, Lysosomes, Nucleus). Basic molecules of life – Carbohydrates, lipids, proteins, DNA, RNA (In brief).

Unit-II

Definition and importance of applied biology. Concept of gene and genome. Introduction to biotechnology. Basic concept of Genetic Engineering. Applications of biotechnology in food, agriculture, healthcare, medicine

Applied Biology-I Lab

Paper Code: C24MDC101P
30 Hrs (2 Hrs /Week)
Credits: 1
Time: 2 Hrs

External Marks : 15
Internal Marks : 10
Total Marks: 25

Objective: Hands on knowledge of basic biology lab, instruments and techniques.

Practicals:

1. Learn use of microscope to observe plant and animal cells
2. Preparation of temporary mounts (e.g., onion epidermis, cheek cells)
3. Demonstration of osmosis using potato or dialysis tubing
4. Effects of different concentrations of salt/sugar solutions on plant tissues (Plasmolysis/Deplasmolysis)
5. Testing for starch using iodine solution
6. Testing for reducing sugars using Benedict's solution
7. Testing for amino acids using ninhydrin reagent
8. Estimation of pH of different samples of soil and water samples using pH strip
9. Preparation of germination medium
10. Seed germination on germination media

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

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Recommended Books:

1. Verma P.S. and Agarwal V.K., Cell Biology, S. Chand Publishing House, New Delhi
2. Sharma A.K., Textbook of Cell and Molecular Biology, Rastogi Publications, Meerut, U.P.
3. Singh B.D., Biotechnology: Expanding Horizons, Kalyani Publishers, New Delhi

Course Outcomes:

At the end of the course, the students would be able to:

- CO1 Learn fundamental biology concepts
- CO2 Gain knowledge about cell, structure and its functions
- CO3 Know about evolution and applied aspects of biology
- CO4 Understand the basic biology practicals

Mapping of CO with PO

C24MDC101T and C24MDC101P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	M	M	M	M	M
CO2	S	M	M	M	M	M	M	M
CO3	M	M	M	M	M	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

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Biotechnology
Skill Enhancement Course (SEC)
Biofertilizer and Biopesticide Production Technology (Semester-I)

Paper Code: C24SEC126T
30 Hrs (2 Hrs/week)
Credits: 2
Exam Time: 2 Hrs

External Marks: 35
Internal Marks: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Objective: This paper deals with the introduction and fundamental concepts of Biofertilizer and Biopesticide Production Technology

UNIT-I

Introduction to Biofertilizers: Definition and importance, Types of biofertilizers, Role of biofertilizers in sustainable agriculture.

Production of Biofertilizers: Microorganisms used in biofertilizer production (Rhizobium, Azotobacter, Azospirillum, etc.), Isolation and characterization of biofertilizer strains, Techniques for mass production (fermentation, culture maintenance), Quality control and standards in biofertilizer production, Methods of application (seed treatment, soil application, etc.), Advantages and limitations.

UNIT-II

Introduction to Biopesticides: Definition and types (microbial, plant-based, biochemical), Importance and benefits over chemical pesticides, Role of biopesticides in integrated pest management (IPM)

Production of Biopesticides: Microorganisms and plants used in biopesticide production (Bacillus thuringiensis, Trichoderma, Neem, etc.), Methods for the production of biopesticides (fermentation, extraction, formulation), Quality control, safety, and regulatory aspects in biopesticide production, Methods of application (foliar spray, soil treatment, seed treatment).

Biofertilizer and Biopesticide Production Technology Lab

Paper Code: C24SEC126P
30 Hrs (2 Hrs/week)
Credits: 1
Exam Time: 2 Hrs

External Marks: 15
Internal Mark: 10
Total Marks: 25

Objective: Hands on knowledge of basic medical technology lab, instruments and techniques.

Practicals:

1. Handling and operation of common laboratory equipments
2. To isolate and identify Rhizobium bacteria from legume root nodules.
3. Isolation of Azospirillum from plant roots
4. To culture and maintain Azotobacter species.

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5. Mass production of biofertilizers i.e. Rhizobium, Azotobacter and Azospirillum
6. To assess the viability and purity of a biofertilizer sample
7. To purify and preserve the biofertilizers and biopesticides
8. Extraction of Neem Oil
9. To evaluate the efficacy of a biopesticide against a specific pest.
10. To prepare a simple biopesticide formulation using neem oil and emulsifier

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Prabhakaran Nair KP, Biofertilizers & Biopesticides, CBS Publishers & Distributors, New Delhi.
2. Rao Subba, Biofertilizers and Organic Farming. Scientific Publishers, Rajasthan India
3. Dubey RC, A Textbook of Biotechnology, S Chand Publishing, New Delhi.

Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Learn the significance of biofertilizers and biopesticides in sustainable agriculture.
 CO2 Recognize the environmental and economic benefits of using bio-based agriculture products
 CO3 Identify and describe the major microorganisms used in biofertilizer and biopesticide
 CO4 Perform a wide range of lab test regarding biopesticide and biofertilizers

Mapping of CO's with PO's

C24SEC126T & C24SEC126P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	S	S	S	M	M
CO2	M	S	M	S	S	S	M	M
CO3	M	M	M	S	S	S	M	M
CO4	M	M	M	S	S	S	M	M

S=Strong, M=Medium, W=weak

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Biotechnology
Value Aided Courses (VAC)
Environmental Biotechnology (Semester-I/Semester-II)

Paper code: C24VAC113T
30 Hrs. (2 Hrs /week)
Credits: 2
Exam Time: 2 Hrs

External Marks: 35
Internal Marks: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Objective: This paper deals with the introduction and fundamental concepts of Environmental biotechnology.

Unit-I

Environmental Biotechnology: Introduction and scope of environmental biotechnology. Biological control of pollution. Role of Biosensors for detection of pollutants.
Solid waste sources and management. Waste water treatment (Aerobic and Anaerobic process)
Biofuels: Need, types and production.

Unit-II

Bioremediation: Concept, Use of bacteria in bioremediation, Phyto-remediation, Biodegradation of Xenobiotic Compounds, Microbial insecticides. Use of recombinant DNA technology to enhance the efficacy of microbial insecticides. Biofertilizers (Brief only).

Recommended Books:

1. Agarwal S.K., Environmental Biotechnology, APH Publishing Corporation, New Delhi.
2. Singh B.D., Biotechnology: Expanding Horizons, Kalyani Publishers, New Delhi
3. Singh A. and Ward O.P., Biodegradation and Bioremediation: Soil Biology, Springer.

Course Outcomes:

At the end of the course, the students would be able to:

CO1 learn application of biotechnology in environment

CO2 learn about environmental quality evaluation

CO3 learn about the monitoring and remediation of contaminated environments.

CO4 gain knowledge about the role of genetic engineering in the environment conservation

Mapping of CO with PO for C24VAC113T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	M	M	S	M	S
CO2	M	M	M	S	M	S	M	S
CO3	M	M	S	S	M	S	M	S
CO4	M	M	M	S	M	S	M	S

S=Strong, M=Medium, W=weak

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Biotechnology
Discipline Specific Course (DSC)
Fundamentals of Biochemistry (Semester-II)
Paper Code: C24BBT201T/C24MIN241T
45 Hrs (3 Hrs /Week)
Credits: 3
Exam Time: 2.5 Hrs

External Marks : 50
Internal Marks : 20
Total Marks:70

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit in addition to the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the introduction and fundamental concepts of Biochemistry.

Biochemistry: Introduction, History and major landmarks in the development of biochemistry, Chemical Foundations of Life. Different types of molecular bonds. Water and weak interactions, pH, buffers and solutions.
Carbohydrates: Structure, Function and properties of biologically important monosaccharides, disaccharides and polysaccharides. Homo & Hetero Polysaccharides, Glycoprotein's and their biological functions.

Amino acids and Proteins: Structure and properties of amino acids, Essential amino acids, zwitterions; pKa value and titration curve. Proteins: Peptide bond, Structure and function of some biologically important peptides Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Levels of structural organization of proteins.

Lipids: Introduction and Classification – simple and complex lipids, Fatty acids – structure and nomenclature, soap value, acid value, iodine number, rancidity. Essential fatty acids, A general account of structure and function of Triacylglycerols, Phospholipids, Glycolipids.

Nucleotides and Nucleic acids: Building blocks: bases, sugars and phosphates, Structure and nomenclature of nucleosides and nucleotides; polynucleotides, DNA (A, B, Z-DNA) and RNA (rRNA, mRNA, tRNA). Properties of DNA – absorption, denaturation, renaturation, hybridization, Tm/Cot values.

Fundamentals of Biochemistry Lab

Paper Code: C24BBT201P/C24MIN241P
30 Hrs (2 Hrs /Week)
Credits: 1
Time: 2 Hrs

External Marks : 20
Internal Marks : 10
Total Marks: 30

Objective: Hands on knowledge of basics of biochemistry lab, instruments and techniques.

Practicals:

1. Preparation of Buffers and Solutions and determination of pKa value
2. Qualitative tests for Carbohydrates
3. Quantitative estimation of Carbohydrates
4. Qualitative tests for amino acids and proteins

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5. Quantitative estimation of proteins
6. Determination of saponification and iodine value of lipids
7. Titrimetric analysis of Vitamin C
8. Estimation of antioxidant activity
9. Estimation of Total soluble solids
10. Estimation of titrable acidity
11. Estimation of pH of different water and soil sample by pH meter, pH strip and universal indicator solution
12. Alcohol estimation

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Wilson and Walker, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press, New Delhi
2. Singh & Sawhney, Introductory Practical Biochemistry, Narosa Publishing House, New Delhi
3. Holme and Peck, Analytical Biochemistry, Pearson Education, New York

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Understand the principles and practices of biochemistry

CO2 Learn different analytical methods.

CO3 Learn about chemical processes related to living system

CO4 Get aware with lab-based science combining biology and chemistry

Mapping of CO's with PO's

C24BBT201T/C24MIN241T & C24BBT201P/C24MIN241P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	S	M	M
CO2	S	S	M	S	M	S	M	M
CO3	S	S	M	M	M	S	M	M
CO4	S	S	M	S	S	S	M	S

S=Strong, M=Medium, W=weak

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**Biotechnology
Minor Course (MIC)
Biomolecules (Semester-II)**

Paper Code: C24MIC241T
30 Hrs (2 Hrs /Week)
Credits: 2
Exam Time: 2 Hrs

External Marks : 35
Internal Marks : 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1

Objective: This paper deals with the introduction and fundamental concepts of Biomolecules.

Unit-I

Carbohydrates: Nomenclature and classification: Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides. Biological importance of carbohydrates.

Lipids: Definition, functions and major classes of storage and structural lipids. Structure and nomenclature of fatty acids.

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; polynucleotide chains, Functions and Types of nucleic acids'

Unit-II

Proteins: Structure and classification of Amino acids. Classification and functions of proteins. Structural organization of proteins,

Enzymes: Structure and function of enzymes, holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes (major classes only), Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), enzyme inhibition (Competitive and non-competitive) and factors affecting enzyme activity.

Books Suggested:

1. Nelson, D.L. and Cox, M.M. (2013), Lehninger Principles of Biochemistry, 6th Edition
2. Voet D., Voet J.G. and Pratt C.W. (2013), Principles of Biochemistry, 4th Edition John Wiley and Sons Inc., New York.
3. Jain, J.L., Fundamentals of Biochemistry, S Chand Publications, New Delhi
4. Satyanarayana and Chakrapani, Biochemistry, Elsevier Publication, New Delhi

Course Outcome:

At the end of the course, the students would be able to:

- CO1 Understand the principles and practices of biochemistry
- CO2 Learn different analytical methods.
- CO3 Learn about chemical processes related to living system
- CO4 Get aware with lab-based science combining biology and chemistry


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Mapping of CO's with PO's of C24MIC241T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	S	M	S	S	M	M
CO2	S	M	M	M	S	M	M	S
CO3	M	S	M	M	M	S	M	S
CO4	S	M	S	M	S	S	M	S

S=Strong, M=Medium, W=weak

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19/09/24

**Biotechnology
Minor Course (MIN)
Fundamentals of Biochemistry (Semester-II)**

Paper Code: C24MIN241T/C24BBT201T
45 Hrs (3 Hrs /Week)
Credits: 3
Exam Time: 2.5 Hrs

External Marks : 50
Internal Marks : 20
Total Marks:70

Note: The examiner is required to set nine questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 2 marks each. In addition to this, eight more questions (each question may be of 2-3 parts) will be set consisting of two questions from each unit. The student/candidate is required to attempt five questions in all selecting one from each unit in addition to the compulsory Question No.1. All questions carry equal marks.

Objective: This paper deals with the introduction and fundamental concepts of Biochemistry.

Unit-I

Biochemistry: Introduction, History and major landmarks in the development of biochemistry, Chemical Foundations of Life. Different types of molecular bonds. Water and weak interactions, pH, buffers and solutions.

Carbohydrates: Structure, Function and properties of biologically important monosaccharides, disaccharides and polysaccharides. Homo & Hetero Polysaccharides, Glycoprotein's and their biological functions.

Unit-II

Amino acids and Proteins: Structure and properties of amino acids, Essential amino acids, zwitterions; pKa value and titration curve. **Proteins:** Peptide bond, Structure and function of some biologically important peptides Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Levels of structural organization of proteins.

Unit-III

Lipids: Introduction and Classification – simple and complex lipids, Fatty acids – structure and nomenclature, soap value, acid value, iodine number, rancidity. Essential fatty acids, A general account of structure and function of Triacylglycerols, Phospholipids, Glycolipids.

Unit-IV

Nucleotides and Nucleic acids: Building blocks: bases, sugars and phosphates, Structure and nomenclature of nucleosides and nucleotides; polynucleotides, DNA (A, B, Z-DNA) and RNA (rRNA, mRNA, tRNA). Properties of DNA – absorption, denaturation, renaturation, hybridization, Tm/Cot values.

Fundamentals of Biochemistry Lab

Paper Code: C24MIN241T/C24BBT201T
30 Hrs (2 Hrs /Week)
Credits: 1
Time: 2 Hrs

External Marks : 20
Internal Marks : 10
Total Marks: 30

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Objective: Hands on knowledge of basics of biochemistry lab, instruments and techniques.

Practicals:

1. Preparation of Buffers and Solutions and determination of pKa value
2. Qualitative tests for Carbohydrates
3. Quantitative estimation of Carbohydrates
4. Qualitative tests for amino acids and proteins
5. Quantitative estimation of proteins
6. Determination of saponification and iodine value of lipids
7. Titrimetric analysis of Vitamin C
8. Estimation of antioxidant activity
9. Estimation of Total soluble solids
10. Estimation of titrable acidity
11. Estimation of pH of different water and soil sample by pH meter, pH strip and universal indicator solution
12. Alcohol estimation

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Wilson and Walker, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge University Press, New Delhi
2. Singh & Sawhney, Introductory Practical Biochemistry, Narosa Publishing House, New Delhi
3. Holme and Peck, Analytical Biochemistry, Pearson Education, New York

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Understand the principles and practices of biochemistry

CO2 Learn different analytical methods.

CO3 Learn about chemical processes related to living system

CO4 Get aware with lab-based science combining biology and chemistry

Mapping of CO's with PO's

C24BBT201T/C24MIN241T & C24BBT201P/C24MIN241P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	S	M	M
CO2	S	S	M	S	M	S	M	M
CO3	S	S	M	M	M	S	M	S
CO4	S	S	M	S	S	S	M	S

S=Strong, M=Medium, W=weak

AB
19/09/21

Biotechnology
Multidisciplinary Course (MDC)
Applied Biology-II (Semester-I)

Paper Code: C24MDC204T
30 Hrs (2 Hrs /Week)
Credits: 2
Exam Time: 2 Hrs

External Marks: 35
Internal Marks: 15
Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question Qo. 1.

Objective: This paper deals with the introduction and fundamental concepts of applied biology.

Unit-I

Introduction, Importance and Scope of Microbiology: Definition and history of microbiology, Introduction to microscopy, General shape and structure of bacteria. A brief introduction to fermentation technology and industrially important microorganisms.

Unit-II

Causes and Preventive measures for common microbial diseases. Concept of Vaccines and antibiotics. Immune System- Innate and Adaptive immunity. Components of immune system. Brief account of sterilization techniques.

Applied Biology-II Lab

Paper Code: C24MDC204P
30 Hrs (2 Hrs /Week)
Credits: 1
Time: 3 Hrs

External Marks: 15
Internal Mark: 10
Total Marks: 25

Objective: Hands on knowledge of applied biology lab, instruments and techniques.

Practicals:

1. Handling and operations of lab instruments (Laminar Air Flow, Incubator, Hot Air Oven and Autoclave)
2. Cleaning and sterilization of labwares
3. Operation and handling of Compound microscope
4. Study of bacterial morphology through permanent slides
5. Preparation of media for cultivation of microorganisms
6. Demonstration of alcoholic fermentation
7. Isolation of Microorganisms from environment (Soil, Water and Air)
8. Fixation and staining
9. Demonstration of production of fermented foods (Curd making etc.)
10. Blood group testing.

Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

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Recommended Books:

1. Arya, A, Introduction to Applied Biology, S Chand Publications, New Delhi
2. Dulsy Fatima, Immunology and Microbiology, Saras Publications, Kanyakumari
3. Sharma V, A practical Guide on Techniques in Microbiology and Immunology

Course Outcomes:

At the end of the course, the students would be able to:

- CO1 Learn about the disease and their cause
- CO2 Gain knowledge about basic lab instruments
- CO3 Know industrially important microorganisms
- CO4 Learn about the isolation and staining of microorganisms

Mapping of CO with PO C24MDC201T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	S	M	M	S	M	M
CO2	M	M	M	S	M	S	M	M
CO3	M	M	M	S	M	S	M	M
CO4	M	M	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

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19/09/24

Biotechnology
Skill Enhancement Course (SEC)
Medical Laboratory Technology (Semester-II)

Paper Code: C24SEC226T

30 Hrs. (2 Hrs /Week)

Credits: 2

Exam Time: 2 Hrs

External Marks: 35

Internal Marks: 15

Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Objective: This paper deals with the introduction and fundamental concepts of Medical Lab Technology.

Unit-I

Introduction to Clinical laboratory. Basic laboratory principles. The use of the laboratory. Safety measures in medical lab. Common Laboratory Equipments: BOD Incubator, Hot Air Oven, Water Bath, Centrifuge, Autoclave, Spectrophotometer, Weighing Balance, Microscope, Colorimeter, Blood Cell Counter etc. Staining principles. Fundamentals of Microscopy, Resolution & Magnification of light microscope.

Unit-II

Basic Steps for collection of blood samples, Phlebotomy, Sampling errors, Collection and preservation of biological fluids, Anticoagulants, Preservation of samples, chemical preservatives, process of analyzing the specimens – the laboratory report. Automation in Clinical Laboratory, ELISA technique.

Medical Laboratory Technology Lab

Paper Code: C24SEC226P

30 Hrs (2 Hrs /Week)

Credits: 1

Time: 3 Hrs

External Marks : 15

Internal Marks : 10

Total Marks: 25

Objective: Hands on knowledge of basic medical technology lab, instruments and techniques.

Practicals:

1. Handling and operation of common laboratory equipments
2. Sterilization of laboratory items
3. Use and care of microscopes.
4. Handling and use of micropipettes
5. Preparation of blood smear
6. Blood group testing
7. Hb testing
8. Total leucocyte count and Differential leucocyte count
9. RBC counting
10. Demonstration of ELISA and Autoanalyzer

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Note: Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Godkar B and Godkar P, Text book of Medical Lab Technology, Bhalani Publishing House, Mumbai.
2. Ahmed S, Practical Clinical Biochemistry: Methods and Interpretations, J.B. Medical Publishers, New Delhi.
3. Chaudhary B, Clinical Pathology and Clinical Biochemistry, J.B. Medical Publishers, New Delhi.

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Students would learn basic techniques of collection of laboratory samples

CO2 Students will also learn about the diagnosis of various diseases

CO3 They will have hands on experience of various tools procedures of Medical Lab Technology.

CO4 They will be able to perform a wide range of clinical lab tests

Mapping of CO with PO

C24SEC226T and C24SEC226P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	S	S	S	M	M
CO2	M	S	M	S	S	S	M	M
CO3	M	M	M	S	S	S	M	M
CO4	M	M	M	S	S	S	M	M

S=Strong, M=Medium, W=weak

15/09/24

Biotechnology
Value Aided Courses (VAC)
Environmental Biotechnology (Semester-I/Semester-II)

Paper code: C24VAC113T

30 Hrs. (2 Hrs /week)

Credits: 2

Exam Time: 2 Hrs

External Marks: 35

Internal Marks: 15

Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this, four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory Question No. 1.

Objective: This paper deals with the introduction and fundamental concepts of Environmental biotechnology.

Unit-I

Environmental Biotechnology: Introduction and scope of environmental biotechnology. Biological control of pollution. Role of Biosensors for detection of pollutants.
Solid waste sources and management. Waste water treatment (Aerobic and Anaerobic process)
Biofuels: Need, types and production.

Unit-II

Bioremediation: Concept, Use of bacteria in bioremediation, Phyto-remediation, Biodegradation of Xenobiotic Compounds, Microbial insecticides. Use of recombinant DNA technology to enhance the efficacy of microbial insecticides. Biofertilizers (Brief only).

Recommended Books:

1. Agarwal S.K., Environmental Biotechnology, APH Publishing Corporation, New Delhi.
2. Singh B.D., Biotechnology: Expanding Horizons, Kalyani Publishers, New Delhi
3. Singh A. and Ward O.P., Biodegradation and Bioremediation: Soil Biology, Springer.

Course Outcomes:

At the end of the course, the students would be able to:

CO1 Learn application of biotechnology in environment

CO2 Learn about environmental quality evaluation

CO3 Learn about the monitoring and remediation of contaminated environments.

CO4 Gain knowledge about the role of genetic engineering in the environment conservation

Mapping of CO's with PO's

C24VAC113T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	M	M	M	M	M
CO2	M	M	M	M	M	S	M	S
CO3	M	M	S	S	M	S	M	S
CO4	M	M	M	S	M	S	M	S

S=Strong, M=Medium, W=weak

AB
15/09/2



H.O.D. Biotech.
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Convenor, NEP
T/P. Univ. Works.
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HISAR
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'A+' Grade, NAAC Accredited State Govt. University

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Acad./AC-III/BOS&R-7/2025/ 2858
Dated: 31-05-2025

1091
5/6/25

To

The Controller of Examinations,
GJUST, Hisar.

Sub: Approval of the Scheme of examinations and syllabi of subject of "Biotechnology" of B.Sc. Life Science programme – (3rd and 4th semester) under NEP-2020 for affiliated degree College(s) w.e.f. academic session 2024-25.

Sir,

I am directed to inform you that the Vice-Chancellor, on the recommendations of Dean, Faculty of Environmental and Bio Sciences & Technology on 23.05.2025, is pleased to approve the Scheme of examinations and syllabi of subject of "Biotechnology" of B.Sc. Life Science programme – (3rd and 4th semester) under NEP-2020 for affiliated degree College(s) w.e.f. academic session 2024-25, under Section 11(5) of the University Act, 1995 in anticipation of approval of the Academic Council.

A copy of the scheme of examinations & syllabi of above said course is enclosed herewith.

You are therefore, requested to take further necessary action accordingly.

Yours faithfully

Asstt. Registrar (Academic)
for Registrar

Endst. No. Acad./AC-III/BOS&R-7/2025/ 2859-2874 Dated: 31-05-2025

A copy of above is forwarded to the following for information and necessary action:-

1. Dean, Faculty of Environmental and Bio Sciences & Technology, GJUST, Hisar.
2. Chairperson, Department of Biotechnology, GJUST, Hisar. He is requested to arrange to upload the Scheme of examinations and syllabi of subject of "Biotechnology" of B.Sc. Life Science programme – (3rd and 4th semester) under NEP-2020 for affiliated degree College(s) w.e.f. academic session 2024-25 on the website of the University.
3. Principals, all Affiliated Degree College(s), GJUST, Hisar alongwith the Scheme of examinations and syllabi of subject of "Biotechnology" of B.Sc. Life Science programme – (3rd and 4th semester) under NEP-2020 for affiliated degree College(s) w.e.f. academic session 2024-25.
4. OSD to Vice-Chancellor (for kind information of the Vice-Chancellor), GJUST, Hisar.
5. Secretary office of the Registrar (for kind information of the Registrar), GJUST, Hisar.

Assistant Registrar (Academic)



**Guru Jambheshwar University of Science
and Technology**
Hisar-125001, Haryana
(‘A+’ NAAC Accredited State Govt. University)



**Scheme & Syllabi of Examination for
B.Sc. (Life Sciences) Biotechnology
(UG Three Years Programme)**

According to National Education Policy-2020

(With effect from 2024-25)

Affiliated Colleges,

**Guru Jambheshwar University of Science and Technology
Hisar-125001, Haryana**

AB



Scheme of Examination for
UG Three Years Programme

Name of the Programme: B.Sc. (Life Sciences)
Biotechnology
According to National Education Policy-2020

SEMESTER-III

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
Biotechnology (DSC)	C24BBT301T	Molecular Biology	3	3	20	50	70	2.5
	C24BBT301P	Molecular Biology Lab	1	2	10	20	30	2
*Chemistry (DSC)	C24CHE301T	Chemistry-III	3	3	20	50	70	2.5
	C24CHE301P	Chemistry-III Lab	1	2	10	20	30	2
*Botany (DSC)	C24BOT301T	Diversity of Seed Plants: Gymnosperms and Angiosperms	3	3	20	50	70	2.5
	C24BOT301P	Diversity of Seed Plants: Gymnosperms and Angiosperms Lab	1	2	10	20	30	2
*Zoology (DSC)	C24ZOO301T	Biomolecules and Mammalian Physiology	3	3	20	50	70	2.5
	C24ZOO301P	Biomolecules and Mammalian Physiology Lab	1	2	10	20	30	2
*Remarks: The students will choose any two out of DSC of Botany/Chemistry/Zoology								
Minor Course (MIC)		Choose from the MIC Pool Theory	3	3	20	50	70	2.5
		Choose from the MIC Pool Practical	1	2	10	20	30	2
Multidisciplinary Course (MDC)		Choose from the pool of MDC Theory	2	2	15	35	50	2
		Choose from the pool of MDC Practical	1	2	10	15	25	2
Ability Enhancement Course (AEC)		Choose from the AEC Pool	2	2	15	35	50	2
Skill Enhancement Course (SEC)		Choose from Pool of SEC theory	2	2	15	35	50	2
		Choose from Pool of SEC Practical	1	2	10	15	25	2
			24	29	185	415	600	

SEMESTER-IV

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
Biotechnology (DSC)	C24BBT401T	Recombinant DNA Technology	3	3	20	50	70	2.5
	C24BBT401P	Recombinant DNA Technology Lab	1	2	10	20	30	2
*Chemistry (DSC)	C24CHE401T	Chemistry-IV	3	3	20	50	70	2.5
	C24CHE401P	Chemistry-IV Lab	1	2	10	20	30	2
*Botany (DSC)	C24BOT401T	Plant Anatomy and Embryology	3	3	20	50	70	2.5
	C24BOT401P	Plant Anatomy and Embryology Lab	1	2	10	20	30	2
*Zoology (DSC)	C24ZOO401T	Molecular Biology	3	3	20	50	70	2.5

AB

	C24ZOO401P	Molecular Biology Lab	1	2	10	20	30	2
*Remarks: The students will choose any two out of DSC of Botany/Chemistry/Zoology								
Minor Course MIC (VOC)		Choose from the VOC Pool	2	2	15	35	50	2
			2	4	15	35	50	3
Ability Enhancement Course (AEC)		Choose from AEC Pool	2	2	15	35	50	2
Value Added Course (VAC)		Choose from VAC Pool	2	2	15	35	50	2
			10	25	150	350	500	

Internship of 4 credits of 4 weeks duration after fourth semester

*Internship		4	4	120	-	-	-	-
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*Four credits of internship earned by a student during summer internship after second semester or fourth semester, will be taken into account in fifth semester of a student who pursues three years UG programme without taking exit option

SEMESTER-V

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
Biotechnology (DSC)	C24BBT501T	Basics of <i>In Vitro</i> Culture Techniques	3	3	20	50	70	2.5
	C24BBT501P	Basics of <i>In Vitro</i> Culture Techniques Lab	1	2	10	20	30	2
*Chemistry (DSC)	C24CHE501T		3	3	20	50	70	2.5
	C24CHE501P		1	2	10	20	30	2
*Botany (DSC)	C24BOT501T	Plant Physiology Metabolism and Ecology	3	3	20	50	70	2.5
	C24BOT501P	Plant Physiology Metabolism and Ecology Lab	1	2	10	20	30	2
*Zoology (DSC)	C24ZOO501T	Evolution and Developmental Biology	3	3	20	50	70	2.5
	C24ZOO501P	Evolution and Developmental Biology Lab	1	2	10	20	30	2
*Remarks: The students will choose any two out of DSC of Botany/Chemistry/Zoology								
Minor Course MIC (VOC)		Choose from the VOC Pool	2	2	15	35	50	2
			2	4	15	35	50	3
			20	21	120	280	400	

SEMESTER-VI

Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours	Internal Marks	External Marks	Total Marks	Duration of Exam (Hr)
Biotechnology (DSC)	C24BBT601T	Microbial Biotechnology	3	3	20	50	70	2.5
	C24BBT601P	Microbial Biotechnology Lab	1	2	10	20	30	2
*Chemistry (DSC)	C24CHE601T		3	3	20	50	70	2.5
	C24CHE601P		1	2	10	20	30	2
*Botany (DSC)	C24BOT601T	Plant Biotechnology and Economic Botany	3	3	20	50	70	2.5
	C24BOT601P	Plant Biotechnology and Economic Botany Lab	1	2	10	20	30	2
*Zoology (DSC)	C24ZOO601T	Applied Zoology	3	3	20	50	70	2.5
	C24ZOO601P	Applied Zoology Lab	1	2	10	20	30	2
*Remarks: The students will choose any two out of DSC of Botany/Chemistry/Zoology								
Minor Course MIC (VOC)		Choose from the MIC Pool	3	3	20	50	70	2.5
			1	2	10	20	30	2
Minor Course MIC (VOC)		Choose from the VOC Pool	2	2	15	35	50	2

		2	4	15	35	50	3
		20	26	150	350	500	

- Notes:
- 1 Student opting for exit after first year must complete internship of 4 credits (120 Hrs) to get UG Certificate.
 - 2 Student opting for exit after second year must complete internship of 4 credits (120 Hrs) to get UG Diploma.
 - 3 In AEC, 50% of students of 1st semester of Department/ College/Institute will be offered a course on English and the remaining 50% will be offered course on Hindi. The students, who have taken English course in the 1st semester, will study a course on Hindi and vice-versa.
 - 4 In VAC, 50% of students of 1st semester of Department/ College/Institute will be offered a course on Environmental Studies and the remaining 50% will opt course from AEC Pool. The students, who have taken Environmental Studies in the 1st semester, will opt course from AEC Pool.

B.Sc. (Life Sciences) w.e.f. Session 2024-25
Programme Outcomes

PO 1 Fundamental knowledge of basic Biological Sciences and Biotechnology.

PO 2 Basic understanding: Knowledge regarding basic concepts and applied aspects of cell biology, biochemistry, biotechnology and environment.

PO 3. Interdisciplinary approach: Learning the relationships among animals, plants, microbes and Industry.

PO 4. Practical learning: Perform procedures and analysis as per laboratory standards in the areas of biology and biotechnology.

PO 5 Strong understanding of molecular biology, genetics, microbiology, biochemistry and allied subjects, preparing them for higher education, disciplinary & multi disciplinary research and to be a life-long learner.

PO 6 Analytical Thinking: Perceive things, events and framing ideas and decisions (intellectual, organizational, and personal) in the light of scientific principles.

PO 7 Effective Communication: Speak, read and write clearly and make personal growth by connecting with people, ideas, books, media and technology.

PO 8 Environment and Sustainability: Understand the issues of environmental deterioration, pollution and sustainable development. Developing critical problem solving approach for these societal concerns using biotechnological tools and methods.

Bachelor of Science in Life Sciences
Biotechnology
Discipline Specific Course (DSC)
Molecular Biology

Course Code: (C24BBT301T)

45 Hrs (3 Hrs/week)

Credits: 3

Exam Time: 2.5 Hrs

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Marks for Major Test (External): 50

Marks for Internal Exam: 20

Total Marks: 70

Objective : This paper deals with the introduction and fundamental concepts of Molecular Biology.

Unit	Topics	Remarks
I	Central dogma of life, DNA structure and function as genetic material : Structure, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, DNA polymerases, The replication complex: proteins involved, primosome, replisome, Theta model of replication, Unique aspects of eukaryotic chromosome replication	12 Hrs
II	DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, SOS repair. RNA structure and types of RNA.	11 Hrs
III	Transcription and RNA processing: RNA polymerase, role of sigma factor, promoters. Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription. Post transcriptional modifications, RNA splicing and processing, processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, Inhibitors of transcription.	11 Hrs
IV	Prokaryotic and eukaryotic translation: Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, inhibitors of translation. Posttranslational modifications of proteins. Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system, lac, trp operons).	11 Hrs
V*	Molecular Biology Lab Course Code: C24BBT301P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 20 Marks for Internal Exam: 10 Total Marks: 30 Objective : Hands on knowledge of basic instruments and techniques used in molecular biology Practicals 1.Principles, handling and working of instruments used in Molecular biology lab. 2.Preparation of solutions for molecular biology experiments. 3.Isolation of DNA from bacterial cells 4.Isolation of Plasmid DNA 5.Isolation of genomic DNA from plant cells 6.Estimation of DNA using diphenylamine reagent. 7.Estimation of RNA using orcinol reagent. 8.Agarose gel electrophoresis of DNA 9.Preparation of restriction enzyme digests of DNA samples. 10. Demonstration of Polymerase Chain Reaction.	30 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Gupta, P.K., *Molecular Biology and Genetic Engineering*, Rastogi Publications, Meerut.
2. Verma, P.S. & Agarwal, V.K., *Molecular Biology*, S. Chand Publishing, New Delhi.
3. Mandal, Avinash & Mandal, Subrata, *Textbook of Molecular Biology*, McGraw Hill Education, India.

Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Understand the fundamental concepts of molecular biology, including DNA, RNA, and protein synthesis, and their roles in cellular function.
- CO2 Learn the mechanisms of gene regulation, replication, transcription, and translation in prokaryotic and eukaryotic systems.
- CO3 Develop an understanding of molecular techniques such as PCR, DNA sequencing etc.

AB

CO4 Gain knowledge about gene expression, DNA repair mechanisms, and their implications in genetic disorders and biotechnology.

Mapping of CO's with PO's

C24BIT301T & C24BBT301P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Discipline Specific Course (DSC)
Recombinant DNA Technology

Course Code: (C24BBT401T)

45 Hrs (3 Hrs/week)

Credits: 3

Exam Time: 2.5 Hrs

Marks for Major Test (External): 50

Marks for Internal Exam: 20

Total Marks: 70

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Objective: This paper deals with the introduction and fundamental concepts of Recombinant DNA Technology.

Unit	Topics	Remarks
I	History and basic steps involved in genetic engineering. Enzymes involved in genetic engineering (Nucleases, Restriction enzymes and their types, DNA ligases, Kinases, Phosphatases, Reverse transcriptase, Deoxynucleotidyl transferases, DNA polymerase).	12 Hrs
II	Cloning vectors - plasmid (pBR322 and pUC 18/19), cosmids, phage vectors (lambda and M13), phagemid, shuttle vectors, BAC and YAC, expression vectors. Gene transfer techniques - physical (Electroporation, microinjection and biolistic transformation) and chemical (CaCl ₂ mediated transformation and Lipofection). Selection of recombinants - blue and white screening, insertional inactivation, immunological screening, colony hybridization.	11 Hrs
III	Construction of genomic and cDNA library, advantages and limitations. PCR- steps involved, variants of PCR (hot-start, asymmetric, nested, quantitative real time, RT- PCR), applications and limitations. DNA sequencing.	11 Hrs
IV	DNA Fingerprinting, Restriction digestion, Blotting - southern, northern and western blotting, Applications of Genetic engineering in industry, medicine and agriculture and other areas. Genetically modified organisms.	11 Hrs
V*	Recombinant DNA Technology Lab Course Code: C24BBT401P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 20 Marks for Internal Exam: 10 Total Marks: 30 Objective : Hands on knowledge of instruments and techniques used in recombinant technology Practicals 1. Isolation of genomic DNA from plants 2. Isolation of genomic DNA from bacteria. 3. Agarose Gel Electrophoresis of genomic DNA. 4. To perform plasmid isolation from E. coli and its quality determination by agarose gel electrophoresis. 5. Separating DNA fragments based on size using agarose gel electrophoresis. 6. To perform Restriction digestion of given DNA sample. 7. Demonstration of Transformation of competent cells. 8. Demonstration of Southern Blotting technique. 9. Demonstration of Polymerase Chain Reaction.	30 Hrs

10. Visit to nearest large scale Biotechnology laboratory.

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. S.B. Primrose & R.M. Twyman, *Principles of Gene Manipulation and Genomics*, Narosa Publishing House, New Delhi.
2. T.A. Brown, *Gene Cloning and DNA Analysis: An Introduction*, Wiley India Pvt. Ltd., New Delhi.
3. P.K. Gupta, *Molecular Biology and Genetic Engineering*, Rastogi Publications, Meerut.
4. R.C. Dubey, *Advanced Biotechnology*, S. Chand Publishing, New Delhi.

Course Outcomes :

At the end of the course, the students would be able to:

CO1 Understand the fundamental principles and techniques of recombinant DNA technology and their applications in biotechnology.

CO2 Learn about different cloning vectors, gene transfer techniques, and molecular tools used in genetic engineering.

CO3 Gain knowledge of gene expression systems, recombinant protein production, and their applications in medicine and industry.

CO4 Apply recombinant DNA technology in fields such as agriculture, pharmaceuticals, environmental biotechnology, and gene therapy.

Mapping of CO's with PO's

C24BBT401T & C24BBT401P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	S	M	M
CO2	S	S	M	S	M	S	M	M
CO3	S	S	M	M	M	S	M	M
CO4	S	S	M	S	S	S	M	S

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences Biotechnology Minor Course (MIC) Molecular Basis of Life

Course Code: (C24MIC341T)

45 Hrs (3 Hrs/week)

Credits: 3

Exam Time: 2.5 Hrs

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Marks for Major Test (External): 50

Marks for Internal Exam: 20

Total Marks: 70

Objective : This paper deals with the introduction and fundamental concepts of Molecular basis of life.

Unit	Topics	Remarks
I	Introduction to the molecules and molecular processes of life. Concept of Central Dogma of Life. Structure and functions of DNA, Watson-Crick model, forms of DNA (A, B & Z). Prokaryotic and eukaryotic genome organization, Types and functions of RNA (mRNA, tRNA and rRNA).	12 Hrs
II	Features of DNA Replication in prokaryotes. Components of replication machinery: DNA polymerase, primase, topoisomerase. Proof of semiconservative nature of DNA replication. Bidirectional DNA replication. Features of DNA replication in eukaryotes.	11 Hrs
III	Transcription in prokaryotes with E. Coli as model system; Prokaryotic RNA polymerases, role of sigma factor, promoter. Mechanism of transcription in prokaryotes: Initiation, elongation and termination of RNA chains. mRNA processing and post-transcriptional modifications (in brief).	11 Hrs
IV	Translation – The relationship between genes and protein: the role of RNAs and translation. aminoacyl t-RNA synthetases, initiation, elongation and termination of protein synthesis in bacteria mRNA expression and regulation: Operon model of gene regulation, negative and positive regulation in prokaryotes, lac operon.	11 Hrs

ABZ

	Molecular Basis of Life Lab Course Code: C24MIC341P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 20 Marks for Internal Exam: 10 Total Marks: 30 Objective : Hands on knowledge of instruments and techniques used in recombinant technology Practicals 1. Safety measures and handling of instruments in laboratory. 2. Preparation of solutions. 3. Isolation of DNA from bacterial cells 4. Isolation of Plasmid DNA 5. Isolation of genomic DNA from plant cells 6. Estimation of DNA using diphenylamine reagent. 7. Estimation of RNA using orcinol reagent. 8. Agarose gel electrophoresis of DNA 9. Preparation of restriction enzyme digests of DNA samples. 10. Demonstration of Polymerase Chain Reaction.	
V*		30 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

4. Gupta, P.K., *Molecular Biology and Genetic Engineering*, Rastogi Publications, Meerut.
5. Verma, P.S. & Agarwal, V.K., *Molecular Biology*, S. Chand Publishing, New Delhi.
6. Mandal, Avinash & Mandal, Subrata, *Textbook of Molecular Biology*, McGraw Hill Education, India.

Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Understand the fundamental concepts of molecular biology, including DNA, RNA, and protein synthesis, and their roles in cellular function.
- CO2 Learn the mechanisms of gene regulation, replication, transcription, and translation in prokaryotic and eukaryotic systems.
- CO3 Develop an understanding of molecular techniques such as PCR, DNA sequencing, recombinant DNA technology, and gene cloning.
- CO4 Gain knowledge about relationship between gene and protein

Mapping of CO's with PO's

C24MIC341T & C24MIC341P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	S	M	M
CO2	S	S	M	S	M	S	M	M
CO3	S	S	M	M	M	S	M	M
CO4	S	S	M	S	S	S	M	S

S=Strong, M=Medium, W=weak

**Bachelor of Science in Life Sciences
Biotechnology
Vocational Course (VOC)
Basic concepts of Immunology**

Course Code: C24VOC0418T

30 Hrs (2 Hrs/week)

Credits: 2

Exam Time: 2 Hrs

Marks for Major Test (External): 35

Marks for Internal Exam: 15

Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Objective : This paper deals with the introduction and fundamental concepts of Immunology.

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Unit	Topics	Remarks
I	Unit- I –Concepts, Cells and Organs of the Immune System Introduction to immunity and its types. Antigen, antigenicity, immunogenicity, hapten, antibody (types). Cells, organs and mediators of the immune system (primary and secondary lymphoid organs, lymphocytes and cytokines). Introduction to complement components, MHC. Basic concepts of humoral and cell-mediated immune response.	15 Hrs
II	Unit-II-Vaccinology and Clinical Immunology Live, killed, attenuated, subunit and recombinant vaccines. Role and properties of adjuvants. Hybridoma technology, monoclonal antibodies and their application in immunodiagnosis. Antigen and antibody interactions - precipitation, agglutination, immune diffusion and ELISA. Introduction to hypersensitivity and autoimmunity.	15 Hrs
V*	Basic Concepts of Immunology Lab Course Code: C24VOC0418P 60 Hrs (4 Hrs/week) Credits: 2 Exam Time: 2 Hrs Marks for Major Test (External): 35 Marks for Internal Exam: 15 Total Marks: 50 Objective : Hands on knowledge of instruments and techniques used in immunology Practicals 1.ABO blood grouping and Rh typing. 2.Preparation of blood smear 3.Total Leukocyte count 4.Differential leukocyte count. 5.RBC counting using a haemocytometer. 6.Widal test 7.VDRL test 8.Dot ELISA. 9.Radial Immunodiffusion analysis. 10.Ouchterlony Double Diffusion	50 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Rao, C. Vaman, *An Introduction to Immunology*, Narosa Publishing, India.
2. Raj, Dipak K., *Textbook of Immunology*, I.K. International Publishing House, India.
3. Singh, Surjit, *Essentials of Immunology*, Narosa Publishing House, India.
4. Chandrasekaran, S., *Basic Immunology*, Vikas Publishing House, India.
5. Punt, Jenni; Stranford, Sharon; Jones, Patricia; Owen, Judith A., *Kuby Immunology*, W.H. Freeman & Company.

Course Outcomes :

At the end of the course, the students would be able to:

- CO1: Understand the fundamental concepts of immunology, including the structure and function of the immune system.
- CO2: Learn about the types of immunity, immune cells, and organs involved in immune responses.
- CO3: Comprehend the mechanisms of antigen recognition, antibody production, and immune response regulation.
- CO4: Gain knowledge about immunological techniques such as ELISA, flow cytometry, and immunoblotting.

Mapping of CO's with PO's

24VOC0418T & 24VOC0418T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	S	M	M
CO2	S	S	M	S	M	S	M	M
CO3	S	S	M	M	M	S	M	M
CO4	S	S	M	S	S	S	M	S

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Vocational Course (VOC)
Fundamentals of Bioinformatics

Course Code: C24VOC0518T
 30 Hrs (2 Hrs/week)
 Credits: 2
 Exam Time: 2 Hrs

Marks for Major Test (External): 35
 Marks for Internal Exam: 15
 Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Objective : This paper deals with the introduction and fundamental concepts of Bioinformatics.

Unit	Topics	Remarks
I	Unit-I Basics of Bioinformatics: Introduction to Bioinformatics: Definition, Scope, and Applications Biological Databases and their types (Nucleotide, Protein, and Structure Databases), Sequence Formats: FASTA, GenBank, and EMBL, Sequence Alignment: Basic Concepts, Pairwise vs. Multiple Sequence Alignment	15 Hrs
II	Unit-II Computational Tools and Applications: BLAST and FASTA: Tools for Sequence Similarity Searches, Basic Concepts of Genomics and Proteomics Gene and Protein Structure Prediction, Bioinformatics Software and Online Tools (NCBI, UniProt, PDB), Applications of Bioinformatics in Medicine and Agriculture	15 Hrs
V*	Fundamentals of Bioinformatics Lab Course Code: C24VOC0518P 60 Hrs (4 Hrs/week) Credits: 2 Exam Time: 2 Hrs Marks for Major Test (External): 35 Marks for Internal Exam: 15 Total Marks: 50 Objective : These practicals are effective in introducing students to bioinformatics tools and techniques. Practicals 1. Learn how to use a web browser efficiently for accessing information 2. Exploring Biological Databases by Navigating NCBI to retrieve nucleotide and protein sequences 3. Convert DNA/protein sequences between FASTA, GenBank, and EMBL formats. 4. Use NCBI BLAST to find homologous sequences for a given gene or protein. 5. Perform MSA using Clustal Omega. 6. View 3D protein structures using PyMOL or RasMol. 7. Use Expasy tools to analyze protein function and properties. 8. Identify open reading frames (ORFs) in a DNA sequence using the NCBI ORF Finder. 9. Exploring PubMed for research articles related to bioinformatics applications in medicine and agriculture. 10. Use RNAfold to predict the secondary structure of an RNA sequence.	60 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Rastogi, S.C., Mendiratta, N. & Rastogi, P., *Bioinformatics: Methods and Applications*, Prentice Hall India Learning, New Delhi.
2. Parry, D.K., *Bioinformatics: Basics, Algorithms, and Applications*, Universities Press, Hyderabad.
3. Ramasamy, P., *Bioinformatics*, MJP Publishers, Chennai.
4. Jin Xiong (2012), *Essential Bioinformatics*, Cambridge University Press.

Course Outcomes :

At the end of the course, the students would be able to:

Here are the Course Outcomes (COs) for Bioinformatics in the given format:

CO1 Understand the fundamental concepts of bioinformatics, including biological databases, sequence alignment, and computational tools.

CO2 Learn about the different applications of bioinformatics in genomics and proteomics.

CO3 Gain knowledge of sequence analysis techniques, including BLAST, FASTA, multiple and sequence alignment.
CO4 Apply bioinformatics tools for genome annotation, gene expression analysis, and molecular docking in biotechnology and pharmaceutical sciences.

Mapping of CO's with PO's

24VOC0518T & 24VOC0518P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	S	S	S	M	M
CO2	M	S	M	S	S	S	M	M
CO3	M	M	M	S	S	S	M	M
CO4	M	M	M	S	S	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Skill Enhancement Course (SEC)
Bioinformatics

Course Code: (C24SEC326T)

30 Hrs (2 Hrs/week)

Credits: 2

Exam Time: 2 Hrs

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Marks for Major Test (External): 35

Marks for Internal Exam: 15

Total Marks: 50

Objective: This paper deals with the introduction and fundamental concepts of Bioinformatics

Unit	Topics	Remarks
I	Basics of computer and Bioinformatics: Fundamental aspects of computer and Internet in relation to bioinformatics, Introduction, History, goals and Scope, applications and limitations of Bioinformatics. Biological Database (Primary, Secondary and Specialized database) and database management system (relational and object oriented), Information Networks (EMB-NET, NIC-NET, INFLIBNET).	15 Hrs
II	Computational Genomics - Internet basics, biological data analysis and application, Introduction to NCBI, File format, Protein Information Resources (PIR), Pairwise and multiple sequence alignment, Algorithm BLAST, Variants of BLAST, FASTA, DATA base searching using BLAST and FASTA.	15 Hrs
III*	Bioinformatics Lab Course Code: C24SEC326P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 15 Marks for Internal Exam: 10 Total Marks: 25 Objective : Hands on knowledge of basic concepts of Bioinformatics Practicals 1. Basic Web Browsing and Search Engine Use 2. To explore biological databases using the internet and understand their applications in retrieving biological information. 3. Introduction to NCBI website 4. To retrieve a DNA sequence from a public database and analyze it using bioinformatics tools. 5. To retrieve a protein sequence from a public database and analyze it using bioinformatics tools. 6. To perform pairwise sequence alignment using BLAST (Basic Local Alignment Search Tool) and compare two sequences. 7. To perform multiple sequence alignment (MSA) using Clustal Omega and analyze conserved regions in sequences. 8. Virtual Restriction digestion using Restriction Mapper. 9. Searching Open Reading Frames using ORF Finder. 10. Primer designing by bioinformatics tool	30 Hrs

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* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

5. Rastogi, S.C., Mendiratta, N. & Rastogi, P., *Bioinformatics: Methods and Applications*, Prentice Hall India Learning, New Delhi.
6. Parry, D.K., *Bioinformatics: Basics, Algorithms, and Applications*, Universities Press, Hyderabad.
7. Ramasamy, P., *Bioinformatics*, MJP Publishers, Chennai.
8. Jin Xiong (2012), *Essential Bioinformatics*, Cambridge University Press.

Course Outcomes :

At the end of the course, the students would be able to:

CO1 Understand the fundamental concepts of bioinformatics, including biological databases, sequence alignment, and computational tools.

CO2 Learn about the different applications of bioinformatics in genomics and proteomics.

CO3 Gain knowledge of sequence analysis techniques, including BLAST, FASTA, multiple and sequence alignment.

CO4 Apply bioinformatics tools for genome annotation, gene expression analysis, and molecular docking in biotechnology and pharmaceutical sciences.

Mapping of CO's with PO's

C24SEC326T & C24SEC326P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	S	S	S	M	M
CO2	M	S	M	S	S	S	M	M
CO3	M	M	M	S	S	S	M	M
CO4	M	M	M	S	S	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Value Added Course (VAC)
Agricultural Biotechnology

Course Code: (C24VAC316T)

30 Hrs (2 Hrs/week)

Credits: 2

Exam Time: 2 Hrs

Marks for Major Test (External): 35

Marks for Internal Exam: 15

Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Objective : This paper deals with the introduction and fundamental concepts of agricultural biotechnology.

Unit	Topics	Remarks
I	Introduction to Agricultural Biotechnology: Definition, Scope, and Importance, Basics of Plant Biotechnology, Plant Tissue Culture: Techniques and Applications, Role of Microbes in Agriculture (Biofertilizers & Biopesticides)	15 Hrs
II	Genetically Modified (GM) Crops: Concept, Examples, and Benefits, Molecular Breeding: Marker-Assisted Selection for Crop Improvement, Biotechnology in Crop Protection: Disease and Pest Resistance, Role of Biotechnology in Soil and Environmental Health, Future Prospects of Agricultural Biotechnology	15 Hrs

Recommended Books:

1. P.K. Gupta, *Biotechnology and Genomics*, Rastogi Publications, Meerut.
2. H.K. Das, *Textbook of Biotechnology*, Wiley India Pvt. Ltd., New Delhi.
3. R.C. Dubey, *Advanced Biotechnology*, S. Chand Publishing, New Delhi.

Course Outcomes :

At the end of the course, the students would be able to:

CO1 Understand the fundamental concepts, principles, and applications of agricultural biotechnology in crop and livestock improvement.

CO2 Gain knowledge of plant tissue culture, genetic engineering, and molecular breeding techniques for crop enhancement.

CO3 Explore the role of biofertilizers, biopesticides, and microbial inoculants in sustainable agriculture.

CO4 Understand the development and applications of genetically modified (GM) crops, their benefits, and potential risks

Mapping of CO's with PO's

C24VAC316T

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	M	M	M	M	M
CO2	M	M	M	M	M	S	M	S
CO3	M	M	S	S	M	S	M	S
CO4	M	M	M	S	M	S	M	S

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Multidisciplinary Course (MDC)
Applied Biology-III

Course Code: (C24MDC301T)

30 Hrs (2 Hrs/week)

Credits: 2

Exam Time: 2 Hrs

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Marks for Major Test (External): 35

Marks for Internal Exam: 15

Total Marks: 50

Objective : This paper deals with the introduction and fundamental concepts of applied biology.

Unit	Topics	Remarks
I	Microbial Technology and Fermentation: Substrates for fermentation (grains, fruits, dairy, etc.) Microorganisms used in beverage fermentation (yeast, bacteria), Fermentation process and conditions, Quality Checking Parameters (pH, alcohol content, microbial contamination, sensory evaluation).	15 Hrs
II	Mushroom Technology: Edible mushrooms, cultivation of different mushrooms (Spawn preparation, composting, casing, harvesting of Button Mushroom, Substrate selection, spawn running, fruiting, harvesting of Oyster Mushroom (<i>Pleurotus</i> spp.) and Substrate preparation, inoculation, fruiting <i>Conocybe nitidaris</i> , Nutritional value, medicinal properties, industrial applications of Different Mushrooms.	15 Hrs
III*	Applied Biology-III Lab Course Code: C24MDC301P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 15 Marks for Internal Exam: 10 Total Marks: 25 Objective : Hands on knowledge of basic biology lab, instruments and techniques. Practicals 1. Preparation of potato dextrose agar media. 2. Growing bacteria/yeast in broth and agar plates. 3. Hands-on training on media pouring and inoculation. 4. Setting up a small-scale fermentation using yeast. 5. Estimation of alcohol 6. Estimation of TSS 7. Demonstration of spawn production techniques. 8. Substrate Preparation for Mushroom Cultivation using straw, sawdust, or organic waste. 9. Setting up mushroom bags and monitoring growth. 10. Harvesting and yield of cultivated mushrooms.	30 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Recommended Books:

1. V.K. Joshi & Ashok Pandey, *Advances in Fermentation Technology*, CBS Publishers & Distributors, New Delhi.
2. K. Vamshu & K.R. Chandrabas, *Industrial Fermentation Technology*, New India Publishing Agency, New Delhi.
3. T.N. Kaul, *Biology and Cultivation of Edible Mushrooms*, Oxford & IBH Publishing, New Delhi.
4. S.T. Chang & P.G. Miles, *Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact*, CRC Press, India Edition.

Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Students would learn fundamental fermentation technology
 CO2 Students will gain knowledge about different mushrooms
 CO3 Students will know about cultivation of mushrooms
 CO4 Students will understand the advanced biology practicals

Mapping of CO's with PO's**C24MDC301T**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	M	M	M	M	M
CO2	S	M	M	M	M	M	M	M
CO3	M	M	M	M	M	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Discipline Specific Course (DSC)
Basics of in vitro culture techniques

Course Code: (C24BBT501T)**45 Hrs (3 Hrs/week)****Credits: 3****Exam Time: 2.5 Hrs**

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Marks for Major Test (External): 50**Marks for Internal Exam: 20****Total Marks: 70**

Objective : This paper deals with the theoretical aspects of in vitro culture of plants and animals.

Unit	Topics	Remarks
I	Animal Cell & Tissue Culture: Introduction, History, Scope and Applications. Culture Media: Media components, Serum containing and serum free media. Natural media- Plasma clot, biological fluids, tissue extracts. Growth factors, Chemically defined media, balanced salt solutions. Physical requirements for growing animal cells in culture. Contamination in animal cell cultures. Primary Cell Culture techniques: Preparation and sterilization of substrates (glass, plastic, metals). Isolation of tissue explants, disaggregation (enzymatic and mechanical disaggregation), development of primary culture and cell lines. Secondary Culture. Organ Culture: different organ culture techniques.	12 Hrs
II	Plant Tissue Culture: Introduction, Concept, History, Scope and Applications. Plant Tissue Culture Laboratory: Layout, organization, equipments and instruments. Aseptic Techniques: General sanitation/cleanliness of PTC laboratory and precautions regarding maintenance of aseptic conditions, Washing, drying and sterilization of glassware, sterilization of media. Culture Media: Nutritional requirements for plant tissue culture, role of different media components, plant growth regulators, different culture media viz. MS and White's medium. In-vitro methods in plant tissue culture: Explants, their cellular characteristics, dedifferentiation and redifferentiation, cellular totipotency, organogenesis and somatic	11 Hrs

- role of culture media.
- O2 They will learn various techniques, such as establishing cultures, performing micropropagation, inducing organogenesis and animal tissue cultures.
- O3 Students will understand the applications of plant and animal tissue culture in areas like crop improvement, disease-free plant production, production of monoclonal antibodies, animal cell lines etc.
- O4 They will be familiar with the role of tissue culture in genetic transformation and the production of transgenic plants and animals.

Mapping of CO's with PO's

C24BBT501T & C24BBT501P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Discipline Specific Course (DSC)
Microbial Biotechnology

Course Code: (C24BBT601T)

15 Hrs (3 Hrs/week)

Credits: 3

Exam Time: 2.5 Hrs

Marks for Major Test (External): 50

Marks for Internal Exam: 20

Total Marks: 70

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Objective : This paper deals with the theoretical aspects of microbial biotechnology.

Unit	Topics	Remarks
I	Microbial Biotechnology: General concept, History, Scope and Applications. Screening and Isolation of Microorganisms: Industrially important microbes, their screening and isolation, enrichment culture. Strain improvement: Bacterial genetics, mutant selection, recombination, recombinant DNA technology. Strain preservation and maintenance. Nutrition and cultivation of microorganisms: Basic nutrition and metabolism, Natural and Synthetic media. Sterilization techniques.	12 Hrs
II	Microbial Fermenters/Bioreactors: Basic design of fermenters. Physico-chemical standards used in bioreactors (agitation, aeration, pH, temp., dissolved oxygen etc.). Types of fermenters- stirred tank, airlift fermenters. Fermentation types – Continuous, Batch culture, Solid state and Submerged fermentation. Quantification of growth, thermodynamics of growth, effect of different factors on growth.	11 Hrs
III	Process Development and Downstream Processing: Shake flask fermentation, scale up of the process. Separation of particles, disintegration of cells, extraction, concentration, purification and drying of the products. Microbial Products: Production procedures and techniques of certain industrial products such as Alcohol, Alcoholic beverage (Beer), Organic acids (Citric acid), Antibiotics (penicillin), Amino acids (glutamic acid), enzymes (protease, amylase) Microbial Foods: Single Cell Proteins.	11 Hrs
IV	Sewage waste water treatment: Aerobic and anaerobic digestion.	11 Hrs

	Bioremediation, Biodegradation of xenobiotic compounds, Biotransformation, Biomining, Bioleaching, Biogas production. Microbial technology in agriculture- Bioinsecticides, Bioherbicides, Biocontrol agents for disease control, advantages over chemical methods, Biofertilizers.	
V*	Microbial Biotechnology Lab Course Code: C24BBT601P 30 Hrs (2 Hrs/week) Marks for Major Test (External): 20 Credits: 1 Marks for Internal Exam: 10 Exam Time: 2 Hrs Total Marks: 30 Objective : Hands on experience of <i>in vitro</i> culture of plant and animal cells, tissues and organs. Practicals 1. Growth Curve Study – Bacteria and Yeast. 2. Screening of microorganisms for production of extracellular enzymes 3. Microbial biomass production 4. Production of industrial alcohol 5. Production of wine 6. Estimation of alcohol in wine/fermented broth 7. Estimation of percent lactic acid in milk and curd. 8. Estimation of lactose in milk sample 9. Production of acetic acid/vinegar 10. Screening of antibiotic producing microorganisms.	30 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Biotechnology: Expanding Horizons by B D Singh
2. Elements of Biotechnology by P K Gupta
3. Microbial Biotechnology by Glazer
4. Practical Fermentation Technology by McNeill
5. Principles of Fermentation Technology by Stanbury
6. Practical Manual Vol III, Deptt. of Biotechnology, G C Hisar

Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Students will grasp the principles of isolation, screening and exploitation of microorganisms.
 CO2 They will learn how to improve the wild strains for higher productivity.
 CO3 Students will understand the design, functioning and handling of different types of fermenters.
 CO4 They will become familiar with production of different industrially important products using microorganisms and also isolation, extraction and purification of microbial products.

Mapping of CO's with PO's

C24BBT601T & C24BBT601P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Minor Course (MIC)
Genetic Engineering

Course Code: (C24MIC641T)

45 Hrs (3 Hrs/week)

Credits: 3

Exam Time: 2.5 Hrs

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Marks for Major Test (External): 50

Marks for Internal Exam: 20

Total Marks: 70

Objective : This paper deals with the introduction and fundamental concepts of Genetic Engineering

Unit	Topics	Remarks
I	Genetic Engineering Basics - Overview of recombinant DNA technology. Isolation and purification of genomic DNA and Plasmid DNA. Enzymes used in genetic engineering. Restriction endonucleases - Classification, nomenclature and properties. Restriction mapping. DNA polymerase-I. Polynucleotide kinase. Terminal nucleotide transferase, Alkaline phosphatase, Reverse transcriptase, S1 nuclease, DNA Ligases and ligation of foreign DNA to vectors - cohesive and blunt end methods.	12 Hrs
II	Vectors - Salient features of cloning vectors: Types of cloning vectors - plasmids, cosmids, phages (lambda and M13 phage vectors), Bacterial Artificial Chromosomes (BACs), Yeast Artificial chromosomes (YACs). Expression vectors. Techniques of gene transfer - transformation, transfection, micro-injection, electroporation, silicon carbide fiber method. Liposome-mediated Gene transfer (lipofection). Biolistic Transformation (Gene gun method).	11 Hrs
III	Selection of Recombinant cells after Gene transfer - Selection of <i>r</i> -DNA clones and their expression. Marker genes and reporter genes. Colony hybridization. Fluorescent in-situ hybridization. Polymerase Chain Reaction and its applications. Real-Time PCR. Reverse Transcription PCR. DNA microarray technology.	11 Hrs
IV	Restriction digestion and its applications. Introduction to Genome editing technology - CRISPR / Cas9. Applications of genetic engineering in agriculture, animal husbandry, medicine and industry. Safety concerns of genetic modification.	11 Hrs
V*	Genetic Engineering Lab Course Code: C24MIC641P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 20 Marks for Internal Exam: 10 Total Marks: 30 Objective : Hands on knowledge of instruments and techniques used in genetic engineering. Practicals 1. Total genomic DNA isolation from plants. 2. Total genomic DNA isolation from bacteria. 3. Agarose Gel Electrophoresis of plant and bacterial DNA. 4. Isolation of plasmid DNA from E.Coli and its quality determination by agarose gel electrophoresis. 5. To perform Restriction digestion of given DNA sample. 6. Agarose gel electrophoresis of restriction digests and their size estimation using DNA ladder. 7. Transformation of competent cells (Demonstration). 8. Polymerase Chain Reaction (Demonstration). 9. Southern Blotting technique (Demonstration). 10. Visit to nearest large scale Biotechnology laboratory.	30 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. S.B. Primrose & R.M. Twyman, *Principles of Gene Manipulation and Genomics*, Narosa Publishing House, New Delhi.
2. T.A. Bawa, *Gene Cloning and DNA Analysis: An Introduction*, Wiley (India) Pvt. Ltd., New Delhi.

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3. P.K. Gupta, *Molecular Biology and Genetic Engineering*, Rastogi Publications, Meerut.
4. R.C. Dubey, *Advanced Biotechnology*, S. Chand Publishing, New Delhi.

Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Understand the fundamental principles and techniques of recombinant DNA technology and their applications in biotechnology.
- CO2 Learn about different cloning vectors, gene transfer techniques, and molecular tools used in genetic engineering.
- CO3 Gain knowledge of gene expression systems, recombinant protein production, and their applications in medicine and industry.

Mapping of CO's with PO's

C24MIC641T & C24MIC641P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences Biotechnology Vocational Course (VOC)

Industrial Biotechnology

Course Code: C24VOC0618T

30 Hrs (2 Hrs/week)

Credits: 2

Exam Time: 2 Hrs

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Marks for Major Test (External): 35

Marks for Internal Exam: 15

Total Marks: 50

Objective : This paper deals with the introduction and fundamental concepts of industrial biotechnology.

Unit	Topics	Remarks
I	Unit-I Fundamentals of Industrial Biotechnology: Definitions, Scope and Applications of Industrial Biotechnology, Microbial Strains and their improvements methods, Fermentation, Selection, Isolation, and Maintenance of industrially important microbes, Basic Concepts of Upstream and Downstream Processing, Production, Purification, and Applications of Industrial Enzymes, Types, Design, and Operation of Bioreactors.	15 Hrs
II	Unit-II Industrial Applications of Biotechnology: Production of Primary and Secondary Metabolites (Ethanol, Antibiotics, Vitamins), Microbial Biotechnology in Food and Dairy Industries, Waste Treatment and Bioremediation, Biotechnology in Biopharmaceuticals, and Therapeutic Proteins, Recent Trends in Industrial Biotechnology.	15 Hrs
	Industrial Biotechnology Lab Course Code: C24VOC0618P 60 Hrs (4 Hrs/week) Credits: 2 Exam Time: 2 Hrs Objective : These practicals are effective in introducing students to the tools, techniques and methods of industrial biotechnology	Marks for Major Test (External): 35 Marks for Internal Exam: 15 Total Marks: 50

V*	Practicals 1. Isolation and purification of bacteria from soil and water by serial dilution method 2. Isolation of industrially important microorganisms from soil, water, rotten fruits/vegetables etc. 3. Enrichment method of microbial screening. 4. Production of ethanol. 5. Antibiotic screening. 6. To screen microbes for enzyme production (e.g., amylase or protease). 7. Production of probiotics. 8. To study different types of bioreactors and their components. 9. To detect the presence of lactic acid bacteria in yogurt or curd. 10. To observe microbial degradation of pollutants in wastewater samples.	60 Hrs
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* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Das, D., & Pandit, S., *Industrial Biotechnology*, CRC Press, Boca Raton.
2. Shastri, V., *Industrial Biotechnology*, Gyan Publishing House, New Delhi.
3. Yadav, M., Kumar, V., & Schrawat, N., *Industrial Biotechnology: Plant Systems, Resources and Products*, De Gruyter, Berlin.
4. Behera, B. K., *Conceptual Development of Industrial Biotechnology for Commercial Production of Vaccines and Biopharmaceuticals*, Elsevier, Amsterdam.

Course Outcomes :

At the end of the course, the students would be able to:

Here are the Course Outcomes (COs) for Bioinformatics in the given format:

CO1 Explain the principles and applications of industrial biotechnology in the production of bio-based products.

CO2 Describe the role of microorganisms and enzymes in industrial bioprocesses.

CO3 Analyze fermentation techniques, bioreactors, and process optimization for large-scale production.

CO4 Evaluate the production and commercial applications of biofuels, bioplastics, pharmaceuticals, and food biotechnology.

Mapping of CO's with PO's

24VOC0618T & 24VOC0618P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	S	S	S	M	M
CO2	M	S	M	S	S	S	M	M
CO3	M	M	M	S	S	S	M	M
CO4	M	M	M	S	S	S	M	M

S=Strong, M=Medium, W=weak

	Bioremediation. Biodegradation of xenobiotic compounds. Biotransformation, Biomining, Bioleaching, Biogas production.	
	Microbial technology in agriculture- Bioinsecticides, Bioherbicides, Biocontrol agents for disease control, advantages over chemical methods. Biofertilizers.	
	Microbial Biotechnology Lab	
	Course Code: C24BBT601P	
	30 Hrs (2 Hrs/week)	Marks for Major Test (External): 20
	Credits: 1	Marks for Internal Exam: 10
	Exam Time: 2 Hrs	Total Marks: 30
	Objective : Hands on experience of <i>In vitro</i> culture of plant and animal cells, tissues and organs.	
	Practicals	
V*	1. Growth Curve Study – Bacteria and Yeast. 2. Screening of microorganisms for production of extracellular enzymes 3. Microbial biomass production 4. Production of industrial alcohol 5. Production of wine 6. Estimation of alcohol in wine/fermented broth 7. Estimation of percent lactic acid in milk and curd. 8. Estimation of lactose in milk sample 9. Production of acetic acid/vinegar 10. Screening of antibiotic producing microorganisms.	30 Hrs

* Students are required to obtain minimum passing marks separately in practical component and theory as per the University rules.

Books Suggested:

1. Biotechnology: Expanding Horizons by B D Singh
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3. Microbial Biotechnology by Glazer
4. Practical Fermentation Technology by McNeil
5. Principles of Fermentation Technology by Stanbury
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Course Outcomes :

At the end of the course, the students would be able to:

- CO1 Students will grasp the principles of isolation, screening and exploitation of microorganisms.
 CO2 They will learn how to improve the wild strains for higher productivity.
 CO3 Students will understand the design, functioning and handling of different types of fermenters.
 CO4 They will become familiar with production of different industrially important products using microorganisms and also isolation, extraction and purification of microbial products.

Mapping of CO's with PO's

C24BBT601T & C24BBT601P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

AB

Bachelor of Science in Life Sciences
Biotechnology
Minor Course (MIC)
Genetic Engineering

Course Code: (C24MIC641T)

45 Hrs (3 Hrs/week)

Credits: 3

Exam Time: 2.5 Hrs

Note: The examiner is requested to set nine questions in all, selecting two from each unit and one compulsory question of short answer/objective type covering the entire syllabus. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Marks for Major Test (External): 50

Marks for Internal Exam: 20

Total Marks: 70

Objective : This paper deals with the introduction and fundamental concepts of Genetic Engineering

Unit	Topics	Remarks
I	Genetic Engineering Basics - Overview of recombinant DNA technology. Isolation and purification of genomic DNA and Plasmid DNA. Enzymes used in genetic engineering. Restriction endonucleases - Classification, nomenclature and properties. Restriction mapping. DNA polymerase-I. Polynucleotide kinase. Terminal nucleotide transferase, Alkaline phosphatase, Reverse transcriptase, S1 nuclease, DNA Ligases and ligation of foreign DNA to vectors - cohesive and blunt end methods.	12 Hrs
II	Vectors - Salient features of cloning vectors. Types of cloning vectors - plasmids, cosmids, phages (lambda and M13 phage vectors), Bacterial Artificial Chromosomes (BACs), Yeast Artificial chromosomes (YACs). Expression vectors. Techniques of gene transfer - transformation, transfection, micro-injection, electroporation, silicon carbide fiber method. Liposome-mediated Gene transfer (lipofection). Biolistic Transformation (Gene gun method).	11 Hrs
III	Selection of Recombinant cells after Gene transfer - Selection of r-DNA clones and their expression. Marker genes and reporter genes. Colony hybridization. Fluorescent in-situ hybridization. Polymerase Chain Reaction and its applications. Real-Time PCR. Reverse Transcription PCR. DNA microarray technology.	11 Hrs
IV	Restriction digestion and its applications. Introduction to Genome editing technology - CRISPR / Cas9. Applications of genetic engineering in agriculture, animal husbandry, medicine and industry. Safety concerns of genetic modification.	11 Hrs
V*	Genetic Engineering Lab Course Code: C24MIC641P 30 Hrs (2 Hrs/week) Credits: 1 Exam Time: 2 Hrs Marks for Major Test (External): 20 Marks for Internal Exam: 10 Total Marks: 30 Objective : Hands on knowledge of instruments and techniques used in genetic engineering. Practicals 1. Total genomic DNA isolation from plants. 2. Total genomic DNA isolation from bacteria. 3. Agarose Gel Electrophoresis of plant and bacterial DNA. 4. Isolation of plasmid DNA from E.Coli and its quality determination by agarose gel electrophoresis. 5. To perform Restriction digestion of given DNA sample. 6. Agarose gel electrophoresis of restriction digests and their size estimation using DNA ladder. 7. Transformation of competent cells (Demonstration). 8. Polymerase Chain Reaction (Demonstration). 9. Southern Blotting technique (Demonstration). 10. Visit to nearest large scale Biotechnology laboratory.	30 Hrs

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Mapping of CO's with PO's

C24MIC641T & C24MIC641P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	S	M	S	M	M	M	M
CO2	S	S	M	M	M	M	M	M
CO3	S	S	M	S	S	M	M	M
CO4	S	S	M	S	M	S	M	M

S=Strong, M=Medium, W=weak

Bachelor of Science in Life Sciences
Biotechnology
Vocational Course (VOC)

Industrial Biotechnology

Course Code: C24VOC0618T

30 Hrs (2 Hrs/week)

Credits: 2

Exam Time: 2 Hrs

Marks for Major Test (External): 35

Marks for Internal Exam: 15

Total Marks: 50

Note: The examiner is required to set five questions in all. The first question will be compulsory consisting of five short questions covering the entire syllabus consisting of 3 marks each. In addition to this four more questions (each question may be of 2 parts) will be set consisting of two questions from each unit. Student is required to attempt three questions in all selecting one question from each unit consisting of 10 marks each in addition to compulsory question no. 1

Objective : This paper deals with the introduction and fundamental concepts of industrial biotechnology.

Unit	Topics	Remarks
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II	Unit-II Industrial Applications of Biotechnology: Production of Primary and Secondary Metabolites (Ethanol, Antibiotics, Vitamins), Microbial Biotechnology in Food and Dairy Industries, Waste Treatment and Bioremediation, Biotechnology in Biopharmaceuticals, and Therapeutic Proteins, Recent Trends in Industrial Biotechnology.	15 Hrs
	Industrial Biotechnology Lab Course Code: C24VOC0618P 60 Hrs (4 Hrs/week) Credits: 2 Exam Time: 2 Hrs Objective : These practicals are effective in introducing students to the tools, techniques and methods of industrial biotechnology	Marks for Major Test (External): 35 Marks for Internal Exam: 15 Total Marks: 50

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V*	Practicals 1. Isolation and purification of bacteria from soil and water by serial dilution method 2. Isolation of industrially important microorganisms from soil, water, rotten fruits/vegetables etc. 3. Enrichment method of microbial screening. 4. Production of ethanol. 5. Antibiotic screening. 6. To screen microbes for enzyme production (e.g., amylase or protease). 7. Production of probiotics. 8. To study different types of bioreactors and their components. 9. To detect the presence of lactic acid bacteria in yogurt or curd. 10. To observe microbial degradation of pollutants in wastewater samples.	60 Hrs
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3. Yadav, M., Kumar, V., & Schrawat, N., *Industrial Biotechnology: Plant Systems, Resources and Products*, De Gruyter, Berlin.
4. Behera, B. K., *Conceptual Development of Industrial Biotechnology for Commercial Production of Vaccines and Biopharmaceuticals*, Elsevier, Amsterdam.

Course Outcomes :

At the end of the course, the students would be able to:

Here are the Course Outcomes (COs) for Bioinformatics in the given format:

CO1 Explain the principles and applications of industrial biotechnology in the production of bio-based products.

CO2 Describe the role of microorganisms and enzymes in industrial bioprocesses.

CO3 Analyze fermentation techniques, bioreactors, and process optimization for large-scale production.

CO4 Evaluate the production and commercial applications of biofuels, bioplastics, pharmaceuticals, and food biotechnology.

Mapping of CO's with PO's

24VOC0618T & 24VOC0618P

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	S	S	S	M	M
CO2	M	S	M	S	S	S	M	M
CO3	M	M	M	S	S	S	M	M
CO4	M	M	M	S	S	S	M	M

S=Strong, M=Medium, W=weak

ABM