FOUR YEAR UNDERGRADUATE PROGRAM (NEP–2020)

Program: Bachelor in Life Sciences (2024 -28)

DISCIPLINE –BIOTECHNOLOGY

Session – 2024 -25

DSC -01 to 08		DSE -01 to 12		DGE -01 & 02	
Code	Title	Code	Title	Code	Title
BTSC -01T	Cell Biology & Biochemistry	BTSE -01T	Environmental Biotechnology	BTGE -01T	Cell Biology & Biochemistry
BTSC -01P	Lab course	BTSE -01P	Lab course	BTGE -01P	Lab course
BTSC -02T	Microbiology & Molecular Biology	BTSE -02T	Bioprocess engineering	BTGE -02T	Microbiology & Molecular Biology
BTSC -02P	Lab course	BTSE -02P	Lab course	BTGE -02P	Lab course
BTSC -03T	Genetics & Biophysics	BTSE -03T	Industrial Biotechnology		
BTSC -03P	Lab course	BTSE -03P	Lab course		
BTSC -04T	Recombinant DNA technology	BTSE -04T	Medical Biotechnology		
BTSC -04P	Lab course	BTSE -04P	Lab course		
BTSC -05T	Enzymology	BTSE -05T	Genomics		
BTSC -05P	Lab course	BTSE -05P	Lab course	SEC	
BTSC -06T	Immunology	BTSE -06T	Proteomics	BTSEC-01	Biopesticides & Biofertilizers
BTSC -06P	Lab course	BTSE -06P	Lab course		
BTSC -07T	Plant & Animal Biotechnology	BTSE –07T	Agricultural Biotechnology		
BTSC -07P	Lab course	BTSE –07P	Lab course	VAC	
BTSC -08T	Biostatistics & Bioinformatics	BTSE –08T	Pharmaceutical Biotechnology	BTVAC-01	Plants-based Secondary Metabolites

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BTSC -08P	Lab course	BTSE – 08P	Lab course		
		BTSE - 09T	Microbial Products for Human Consumption		
		BTSE - 09P	Lab course		
		BTSE - 10T	Microbial Products for Agriculture		
		BTSE - 10P	Lab course		
		BTSE - 11T	Microbial Products for Industrial uses		
		BTSE - 11P	Lab course		
		BTSE - 12T	IPR, Biosafety & Bioethics		
		BTSE - 12P	Lab course		

Program Outcomes (PO):

1) The student will develop competency to explore natural resources with scientific validation.
2) Multifold skills will be developed for their entrepreneurship competency and self-reliance.
3) The program will ensure scientific competency, research aptitude, and competency for the promotion of the future of the nation.

Program Specific Outcomes (PSO): (If any)

1) The graduates will be competent for sustainable scientific exploration in the field of agriculture, medicine, food and environment.
2) The program will integrate traditional and modern knowledge to meet the challenges of the future by the help of genomics, proteomics, bioprocess engineering and biotechnological tools for environmental corrections.

Name and Signature of Convener and Members of CBoS:

(Keshav Kant Sahu)

(Amrita Pande)

Dr. Shikani Sharma

(Dr. Neha Behal)

(Dr. Shubha Diwan)

11/6/24

(Dr. Sanjaya Bhagat)

Dr Pramod Malviya

(Dr. Amrita Kukreja)

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Certificate/Diploma/Degree/Honors)		Semester: **I Sem**	Session:**2024-2025**
1	Course Code	**BTSC-01-T**	
2	Course Title	**Cell Biology and Biochemistry**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to – • Explore and validate the Indian knowledge system and its significance in the field of biotechnology. • Understand cellular organization, their division for the continuation of life, and the natural cellular death mechanism. • Understand the basic biochemicals for organizational and functional expression of life. • Understand the metabolic regulations for survival and continuation of life.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Basics and IKS** 1. The modern concept of the origin of life. 2. Contribution of Indian scientists in biology. 3. Significance of ancient Indian knowledge system in medical science. 4. Structure of cell.	12 (12 Hrs)
II	**Cell structure and division** 1. Ultrastructure of cell organelles. 2. Ultrastructure of chromosomes. 3. Cell division- Mitosis and meiosis. 4. Biology of cancer cells and apoptosis.	11 (11 Hrs)
III	**Basics of biochemistry** 1. Carbohydrates- Structure and classification. 2. Lipid- Structure and classification. 3. Amino acids - Structure and classification. 4. Three-dimensional structure of proteins.	11 (11 Hrs)
IV	**Metabolism** 1. Enzymes- Nomenclature and classification, mechanism of action, and factors affecting enzyme action. 2. Carbohydrate metabolism- Glycolysis, Kreb cycle, gluconeogenesis, glycogenesis. 3. Lipid metabolism- Beta oxidation of fatty acids, fatty acid biosynthesis. 4. Protein metabolism- Transamination, deamination, and synthesis of amino	11 (11 Hrs)

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	acids.	
Keywords	Cell, Biomolecules, Cell Division.	

• Part C - Learning Resource
Text Books, Reference Books, Other Resources -
➢ Text Book- ➢ Biotechnology- U Satyanarayana. ➢ Cell Biology- C B Powar ➢ Cell and Molecular Biology- P K Gupta
Reference Book- • Practical Biochemistry- Wilson & Walker. o Cell biology – C.B.Powar o Molecular Biology of the Cell – Alberts o Molecular Cell Biology – Lodish o Cell and Molecular Biology – Gerald Karp o The Cell – Cooper o Lehninger- Principles of Biochemistry o Nelson & Cox. - Biochemistry o Voet& Pratt. - Biochemistry
Online resources- ➢ https://onlinecourses.nptel.ac.in/noc22_cy06/preview ➢ https://nptel.ac.in/courses/104105076

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

(Keshav Kant Singh) (Amrita Pande) (Dr. Neha Behal) (Dr. Shubha Diwan)

Dr. Shivani Sharma (Dr. Sanjana Bhagat) Dr. Ujwalaveyle

(Dr. Anil Kr. Kanojia) Dr Pramod Mahajan

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum – 2024-28

Part A: Introduction			
Program: Bachelor in Life Sciences (Certificate/Diploma/Degree/Honors)		Semester: **II Sem**	Session:**2024-2025**
1	Course Code	**BTSC-02-T**	
2	Course Title	**Microbiology and Molecular Biology**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand various categories of microbes in the living world. • Develop the capability to culture and maintenance of microbes. • Understand the regulatory mechanism for the precursor of life-DNA. • Understand the mechanism of genetic expression for the regulation of life.	
6	Credit Value	03 Credits	(Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Maintenance of microbes** 1. Classification of microorganisms and taxonomy. 2. Molecular basis of microbial taxonomy. 3. Growth media for culture of bacterial, viral, and fungal microbes; sterilization. 4. Isolation, purification, and culture methods of microbes (bacteria, virus, and fungi).	12 (12 Hrs)
II	**Microbial life** 1. Bacterial reproduction- Conjugation, transduction, and transformation. 2. Mycoplasma- Classification, structure, and pathogenesis. 3. Virus- Structure, classification, multiplication, pathogenesis and bacteriophages. 4. Food and water microbes.	11 (11 Hrs)
III	**Nuclear maintenance and expression** 1. DNA replication. 2. DNA damage and repair. 3. Transcription in prokaryotes and eukaryotes. 4. Processing of RNA- Capping, polyadenylation, and splicing.	11 (11 Hrs)
IV	**Genetic expression** 1. Genetic code. 2. Translation in prokaryotes and eukaryotes. 3. Operon concept. 4. Recombination.	11 (11 Hrs)
Keywords	Microbial taxonomy, RNA, DNA, operon.	

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• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Books- ➢ Textbook of Microbiology- A K Kushwaha. ➢ Microbiology – Dr. Preeti Sharma. ➢ Introduction To Medical Microbiology- Ananthnarayana's ➢ Cell and Molecular Biology- P K Gupta
Reference Book- • Molecular Biology; Watson. • Gene VIII; Benjamin Lewin. • The Cell, A molecular Approach; Geoffrey M. Cooper. • Molecular Biology of the Cell; Alberts • Cell and Molecular Biology; Lodish. • Microbiology – Prescott • Microbiology – Pelczar&Pelczar • General Microbiology I and II – Powar and Daginawala • Microbiology – Tortora.
Online resources- https://archive.nptel.ac.in/courses/102/103/102103015/ https://onlinecourses.nptel.ac.in/noc24_bt07/preview

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz **+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

(Keshav Kumar Sahu)

(Amit Panda)

Dr. Neha Behar

(Dr. Shubha Diwan)

Dr. Shivani Sharma

(Dr. Sanjaay Bhagat)

(Dr. Amrita Kashyap)

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSC-03-T**	
2	Course Title	**Genetics and Biophysics**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand classical genetics of inheritance • Understand variation in genes and its impact. • Understand the use of basic physical tools for the measurement of biological processes.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Chromosome and gene** 1. Techniques to study chromosomes: Karyotyping, banding, chromosome labeling, comparative genome hybridization. 2. Change in chromosome number & structure: Ploidy and rearrangement (Deletion, Duplication, Inversion &Translocation). 3. Concept of gene: Fine structure of gene, split gene, pseudogenes, non-coding genes, overlapping genes & multigene family. 4. Mutation: Classification, mechanism, repair, role in evolution.	12 (12 Hrs)
II	**Classical genetics** 1. Mendelian genetics- basic principles and interaction of genes. 2. Linkage, Crossing Over. 3. Sex-linked inheritance and pedigree. 4. Cytoplasmic inheritance.	11 (11 Hrs)
III	**Instrumentation I** 1. Simple microscopy, phase contrast microscopy, fluorescence, and electron microscopy (TEM and SEM). 2. pH meter, absorption, and emission spectroscopy 3. Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), 4. Centrifugation principle and its types.	11 (11 Hrs)
IV	**Instrumentation II** 1. Introduction to electrophoresis. Starch-gel, agarose-gel electrophoresis, immuno-electrophoresis. 2. Introduction to the principle of chromatography. Paper chromatography,	11 (11 Hrs)

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	thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC. 3. Introduction to Biosensors and their applications. 4. Radioisotopes in Biology. Autoradiography, DNA fingerprinting.	
Keywords	Gene, Genetic alteration, Spectrophotometry, Electrophoresis.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- ➢ Genetics- PS Verma ➢ Genetics- BD Singh ➢ Genetics- Veer Bala Rastogi
• Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons. • Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. • Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. • Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc. • De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. • Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
Online resources- https://archive.nptel.ac.in/courses/102/104/102104052/ https://onlinecourses.swayam2.ac.in/cec21_bt05/preview

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
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Name and Signature of Convener and Members of CBoS:

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Dr. Shivani Sharma (Dr. Sanjana Bhagat) (Dr. Amit Kr. Kashyap) Dr. Prasad Mahish Dr. Wawale

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **IV Sem**	Session:**2024-2025**
1	Course Code	**BTSC-04-T**	
2	Course Title	**Recombinant DNA technology**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand various tools of genetic engineering. • Develop competency in genetic exploitation for human welfare. • Understand the practical application of recombinant DNA technology. • Understand the use of information technology in the field of genome and proteome analysis.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Prerequisites of rDNA technology** 1. Recombinant DNA technology: General concept. Steps and application. 2. Host controlled Restriction Modification System, Ligases and Polymerases, Klenow fragment, Taq, Pfu polymerase. 3. Nuclease (Endo, Exo, and restriction endonuclease). 4. Modification Enzyme (Kinase, Phosphates and terminal deoxynucleotidyltransferase), Reverse Transcriptase.	12 (12 Hrs)
II	**Gene transfer** 1. Vectors: Based on Plasmid, Bacteriophages, Cosmid. 2. High capacity vectors. 3. The basic concept of Gene Transfer Methods: Microinjection, Electroporation, Lipofection, and Microprojectile. 4. Selection and Screening of Recombinants: Genetic and Hybridization methods.	11 (11 Hrs)
III	**Genomic validation** 1. PCR: Types of PCR, Steps, Applications, Advantages and Limitations of PCR. 2. Molecular Marker-RFLP, RAPD, and Microarray. 3. Human Genome Project. 4. Gene Library: Genomic and cDNA library, Chromosome walking and jumping.	11 (11 Hrs)
IV	**Application of genetic technology** 1. Gene Therapy: *In vivo* and *Ex vivo*, germline and somatic gene therapy. 2. Basic idea of stem cell technology: Types of stem cell cultures and their	11 (11 Hrs)

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	Significance. 3. Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. 4. Introduction to protein structure, Chemical properties of proteins, physical interactions that determine the property of proteins, short-range interactions, electrostatic forces, van der Waal interactions, hydrogen bonds, and Hydrophobic interactions.	
Keywords	Recombinant DNA, Vectors, PCR, cDNA library.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- ➢ **P S Verma and A K Agrawal** ➢ **An introduction to genetic engineering- S T Tischoll**
• Molecular Biology; Watson. • Gene VIII; Benjamin Lewin. • The Cell, A molecular Approach; Geoffrey M. Cooper. • Molecular Biology of the Cell; Alberts • Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987. • Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010. • Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989. • Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
• Online resources- https://onlinecourses.swayam2.ac.in/cec21_bt05/preview • https://archive.nptel.ac.in/courses/102/104/102104052/ •

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: Q1. Objective – **10 x1= 10** Mark; Q2. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit- **4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

(Keshav Kant Sahu) (Dr. Amar Kr. Kashyap) (Dr. Neha Bokal) (Dr Shubha Diwan)

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Four Year Undergraduate Program (2024-28)
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Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **V Sem**	Session:**2024-2025**
1	Course Code	**BTSC-05-T**	
2	Course Title	**Enzymology**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop competency in enzymatic mechanism. • To explore the mechanistic process of enzymes. • Develop industrial application of enzymes. • Develop skills for entrepreneurship.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Basics of enzymes and their action** 1. Isolation, crystallization, and purification of enzymes, a test of homogeneity of enzyme preparation, methods of enzyme analysis. 2. Enzyme classification (rationale, overview, and specific examples) zymogens and their activation (proteases and prothrombin). 3. Enzyme substrate complex: the concept of E-S complex, binding sites, active site, specificity, kinetics of enzyme activity, Michaelis-Menten equation and its derivation. 4. Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temperature & pH. Collision and transition state theories, significance of activation energy and free energy.	12 (12 Hrs)
II	**Enzyme action mechanism** 1. Two substrate reactions (Random, ordered, and ping-pong mechanism) 2. Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor. 3. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. 4. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase, and alcohol dehydrogenase.	11 (11 Hrs)
III	**Regulation of enzymes** 1. Enzyme regulation: Product inhibition, feedback control, covalent modification 2. Allosteric enzymes with special reference to aspartate transcarbamoylase and phosphofructokinase.	11 (11 Hrs)

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	3. Qualitative description of concerted and sequential models. Negative cooperativity and half-site reactivity. 4. Enzyme - Enzyme interaction.	
IV	**Enzyme variations** 1. Protein-ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and Scatchard plots, and the kinetics of allosteric enzymes. 2. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. 3. Multienzyme complexes. Multifunctional enzyme-eg Fatty Acid synthase. 4. Ribozymes	11 (11 Hrs)
Keywords	Enzyme action, Enzyme Kinetics, Enzyme Regulation, Isoenzymes.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- Biochemistry- U Stayanarayana Modern enzymology- Dr. Vinod Ramkrishna Ragade and Dr. B.B. Sharma
• Lehninger Principles of Biochemistry; Nelson & Cox. • Biochemistry; Voet& Pratt. • Principles of Enzymology; Price & Stevens. • Enzyme Biocatalysis, Principle & Applications; Andres Illanes. • Enzyme Kinetics; Hans Bisswanger
Online resources- https://onlinecourses.nptel.ac.in/noc23_bt05/preview onlinecourses.swayam2.ac.in/cec20_bt20/preview

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

(Mohan Nand Sinha) (Dr. Ujjwala Sule) (Amrita Panda) (Dr. Neha Behal) (Dr. Amit Kr. Kashyap) (Dr. Shubha Diwan) Dr Shivani Sharma (Dr. Sanjana Bhagat) Dr Bijmol Mahish

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **VI Sem**	Session:**2024-2025**
1	Course Code	**BTSC-06-T**	
2	Course Title	**Immunology**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand the immunological organizations. • To explore antigens, antibodies, and cytokines. • To explore the regulation of immunological factors. • To compete with pathogenic factors related to immunology.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Concept of immunology** 1. Immunology – General concept, history, and development. 2. Immune system and immunity. 3. Organization of the immune system. 4. Cells are involved in the immune system.	12 (12 Hrs)
II	**Antigen & antibodies** 1. Types of Antigens. 2. Types and structure of antibodies. 3. Antigen-antibody interaction. 4. Basic structure and function of cytokines.	11 (11 Hrs)
III	**Immunological expression** 1. Major histocompatibility agents. 2. Cell-mediated immunity. 3. Interferons and hypersensitivity. 4. Immunohematology.	11 (11 Hrs)
IV	**Pathogenicity and immunology** 1. Monoclonal antibodies. 2. Autoimmune diseases: Hemolytic anemia, Rheumatoid arthritis, insulin-dependent diabetes, Myasthenia gravis. 3. Immunology of organ transplantation. 4. Immunodeficient disease -Cancer and AIDS.	11 (11 Hrs)
Keywords	Antigen, Antibody, MHC, Autoimmune Diseases.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book-

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Essentials of immunology- S K Gupta **A textbook of immunology- Latha P Madhavee**
• Immunology – Kuby • Textbook of microbiology – Anantnarayan&Panikar • Immunology – Roitt • Immunology – NandiniSethi • Fundamentals of Immunology – William Paul • Immunology – A short course 5th Edn – Eli Benjamin , Richard Coico
Online resources- https://archive.nptel.ac.in/courses/102/105/102105083/ https://archive.nptel.ac.in/courses/102/103/102103038/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

(Keshav Kant Shukla) (Amita Pande) (Dr. Neha Behal) (Dr. Shubha Diwan) Dr. Shivani Sharma (Dr. Sanjana Bhagat) Dr Pramod Malik (Dr. Amit Kr. Kashyap)

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VII Sem**	Session:2024-2025
1	Course Code	**BTSC-07-T**	
2	Course Title	**Plant and Animal Biotechnology**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills related to plant cell culture. • Develop competency for genetically modified plant products. • Understand the principles and factors of animal cell culture. • Develop skills for animal cell culture and application.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Basics of plant cell culture** 1. Callus & suspension cultures: Initiation and Maintenance of callus and suspension culture. 2. Single Cell Culture: Isolation and cloning of single cell & cell viability test 3. Shoot tip culture: Rapid clonal propagation & production of virus-free plant 4. Embryogenesis in Plant Tissue Culture: Somatic embryogenesis, Embryo culture & embryo rescue.	12 (12 Hrs)
II	**Advances in plant cell culture** 1. Haploid Plant Generation: Anther, Pollen, and ovary culture for production of hybrid plants. 2. Protoplast Culture: Protoplast isolation, fusion and its application in hybridization. 3. Plant transformation technology: Basis of tumor formation, Hairy root, Features of Ti &Ri plasmids, Use of Ti &Ri plasmids as vectors, Mechanism of DNA transfer. 4. Transgenic plants in crop improvement.	11 (11 Hrs)
III	**Basics of animal cell culture** 1. Aseptic technique: Objectives, elements of the aseptic environment, sterile handling, standard procedure, apparatus, and equipment. 2. Biology of cultured cell: Culture environment, cell adhesion, cell proliferation, differentiation, cell signaling, energy metabolism, origin of cultured cells. 3. Defined media and supplements: physicochemical properties, balanced salt solution, complete media, serum and its selection, and	11 (11 Hrs)

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	other supplements. 4. Serum-free media: Disadvantages of serum, Advantages of serum-free media, Disadvantages, Replacement of serum, Development and preparation of serum-free media.	
IV	**Advances in animal cell culture** 1. Primary cell culture and mammalian cell culture. 2. Scaling up and cryopreservation of cultured cells. 3. Stem cell culture and applications. 4. Transformation in cultured cells.	11 (11 Hrs)
Keywords	Callus, Embryogenesis, Protoplast Culture, Scaling, Transformation.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- **Textbook of Animal Biotechnology-** B Singh, S K Gautam and M S Chauhan **Textbook of Animal Biotechnology-** B Singh Introduction to plant biotechnology- H S Chawala. Plant Biotechnology- B D Singh.
• Animal cell culture – Freshney • Culture of Animal Cell – John Paul • Animal cell biotechnology, methods and protocol – Portner • H.S.Chawala: Biotechnology in crop improvement. • R.J. Henry: Practical application of plant molecular biology: Chapman & Hall. • B.D. Singh: Biotechnology, Expanding Horizons. • Kalyan Kumar De- Plant Tissue Culture. • M.K. Ragdan: Introduction to Plant Tissue Culture.
Online resources- https://archive.nptel.ac.in/courses/102/103/102103016/ https://onlinecourses.nptel.ac.in/noc24_ag08/preview

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

Dr. Shivani Sharma

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSC-08-T**	
2	Course Title	**Biostatistics and Bioinformatics**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Compete with data curation and standardization. • Compete with the data validation and interpretation. • Develop competency in standardized genetic prediction. • Develop competency in standardized proteomic prediction	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Central tendencies and significance** 1. Pictorial representation of data (graphical and tabular). 2. Mean, Median, Mode. 3. Measure of Dispersion: Standard Deviation, standard error 4. Test of Significance: Based on t distribution, Fisher 'Z' test, and Chi-Square test.	12 (12 Hrs)
II	**Applications of biostatistics** 1. Analysis of Variance: One-way Analysis of variance, Two-way Analysis of variance. 2. Probability: Calculation of Probability, Events, Addition Theorem, Multiplication Theorem, Bernoulli's Theorem, Bayer's Theorem. 3. Correlation: Types of correlation, Degree of correlation, Different methods to find out correlation. 4. Regression: Linear Regression, Regression coefficient.	11 (11 Hrs)
III	**Basics of bioinformatics** 1. Introduction to biological databases. 2. NCBI, Entrez. 3. Sequence alignment. 4. Gene prediction.	11 (11 Hrs)
IV	**Applications of bioinformatics** 1. Profiles and Hidden Markov Models. 2. Protein motifs and domain prediction. 3. Protein structure prediction. 4. Phylogenetics.	11 (11 Hrs)
Keywords	Central Tendencies, Test of Significance, NCBI, Phylogenetics.	

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• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text books- Introduction to Biostatistics- PK Banerjee Elements of Biostatistics- Satguru Prasad Bioinformatics: principles and applications- Zhumur Ghosh
• Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins Second Edition; Andreas D. Baxevanis& B. F. Francis Ouellette. • Practical Bioinformatics; Janusz M. Bujnicki (Ed.) • Introduction to Bioinformatics; Arthur M. Lesk, University of Cambridge. • Bioinformatics and Drug Discovery; Richard S. Larson. • Bioinformatics; Andrzej Polanski, Marek Kimmel.
Online resources- https://onlinecourses.nptel.ac.in/noc19_bt19/preview https://onlinecourses.nptel.ac.in/noc21_bt06/preview

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

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Dr. Shivani Sharma

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Certificate/Diploma/Degree/Honors)		Semester: **I Sem**	Session:**2024-2025**
1	Course Code	**BTSC-01-P**	
2	Course Title	**Cell Biology and Biochemistry**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per the program	
5	Course Learning Outcomes (CLO)	After completing this practical course, the students will be able to – • Identify animal and plant cells and its replication. • Understand karyogram. • Analyze biomolecules. • Develop expertise in chromatographic techniques.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Preparation of mitotic index from plants and animals. 2. Preparation of slide of blood cells. 3. Preparation of slide of giant chromosomes. 4. Preparation of slide of epithelial cells. 5. Biochemical test of carbohydrates. 6. Biochemical test of lipids. 7. Biochemical test of proteins. 8. The action of salivary amylase on starch. 9. The action of trypsin on proteins. 10. Separation of amino acids by chromatography. 11. Separation of chlorophyll by chromatography.	30
Keywords	Mitotic index, Giant chromosome, biomolecules.	

• Part C - Learning Resource
Text Books, Reference Books, Other Resources -
➢ Text Book- ➢ Biotechnology- U Satyanarayana. ➢ Cell Biology- C B Powar ➢ Cell and Molecular Biology- P K Gupta
Reference Book- • Practical Biochemistry- Wilson & Walker. o Cell biology – C.B.Powar

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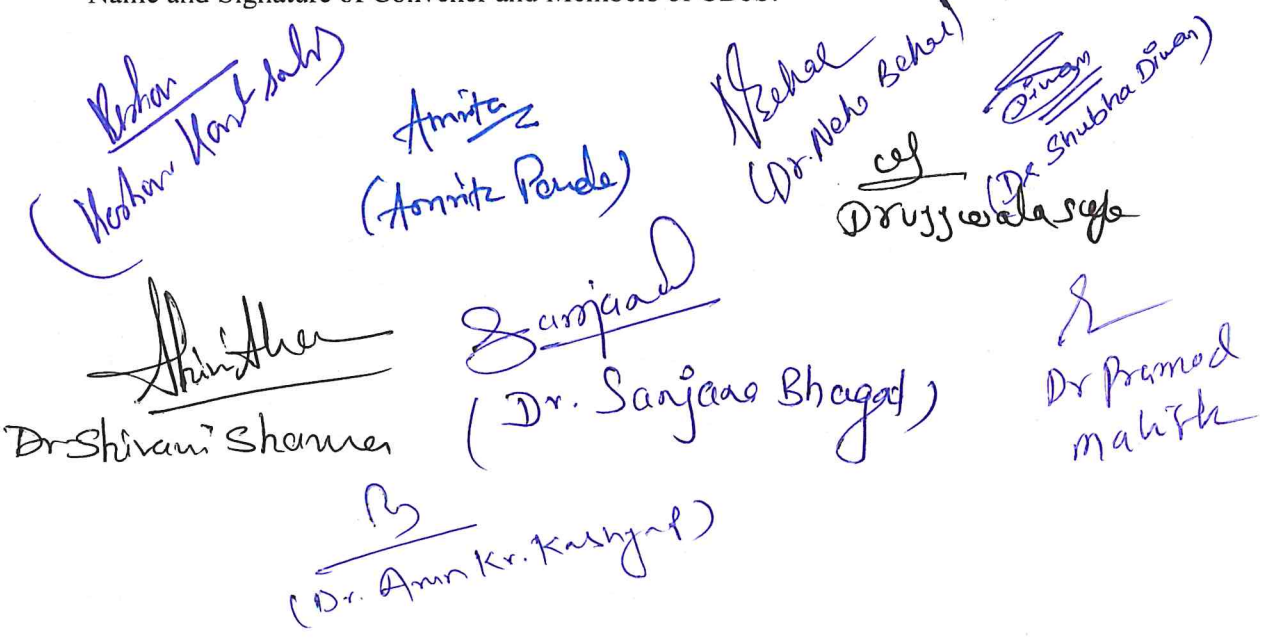
○ Molecular Biology of the Cell – Alberts ○ Molecular Cell Biology – Lodish ○ Cell and Molecular Biology – Gerald Karp ○ The Cell – Cooper ○ Lehninger- Principles of Biochemistry ○ Nelson & Cox. - Biochemistry ○ Voet& Pratt. - Biochemistry
Online resources- ➢ https://onlinecourses.nptel.ac.in/noc22_cy06/preview ➢ https://nptel.ac.in/courses/104105076

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 50 Marks **Continuous Internal Assessment (CIA):** 15 Marks **End Semester Exam (ESE):** 35 Marks		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:



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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
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Part A: Introduction			
Program: Bachelor in Life Sciences (Certificate/Diploma/Degree/Honors)		Semester: **II Sem**	Session:**2024-2025**
1	Course Code	**BTSC-02-P**	
2	Course Title	**Microbiology and Molecular Biology**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this practical course, the students will be able to - • Maintenance of microbes. • Identification of microbes. • Isolation of nucleic acid from microbes. • Elucidations of nucleic adis of microbes.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Various techniques for sterilization. 2. Preparation of microbial media. 3. Isolation and culture of microbes from air, soil, and water. 4. Determination of Gram-positive and Gram-negative bacteria. 5. Streak plate method for culturing of microbes. 6. Pour plate method for culturing of microbes. 7. Spread plate method for culturing of microbes. 8. Broth culture method for culturing of microbes. 9. Determination of bacterial growth curve. 10. Isolation of DNA from bacteria. 11. Estimation of DNA. 12. Estimation of RNA. 13. Elucidation of DNA bands by electrophoresis.	30
Keywords	Microbes, sterilization, RNA, DNA.	

• Part C - Learning Resource
Text Books, Reference Books, Other Resources -
Text Books- ➢ Textbook of Microbiology- A K Kushwaha. ➢ Microbiology – Dr. Preeti Sharma. ➢ Introduction To Medical Microbiology- Ananthnarayana's ➢ Cell and Molecular Biology- P K Gupta
Reference Book- • Molecular Biology; Watson. • Gene VIII; Benjamin Lewin.

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• The Cell, A molecular Approach; Geoffrey M. Cooper. • Molecular Biology of the Cell; Alberts • Cell and Molecular Biology; Lodish. • Microbiology – Prescott • Microbiology – Pelczar&Pelczar • General Microbiology I and II – Powar and Daginawala • Microbiology – Tortora.
Online resources- https://archive.nptel.ac.in/courses/102/103/102103015/ https://onlinecourses.nptel.ac.in/noc24_bt07/preview

Part D: Assessment and Evaluation			
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**			
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**		Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		Managed by course teacher as per lab status

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Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSC-03-P**	
2	Course Title	**Genetics and Biophysics**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Perform cellular replication. • To conduct genetic inheritance and interpretation. • Nucleic acid estimation. • Perform biological extraction, identification and measurement.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Permanent and temporary mount of mitosis and meiosis. 2. Karyotyping with the help of photographs. 3. Problems regarding Genetics and Mendelian deviations in dihybrid crosses. 4. Pedigree charts of some common characteristics like blood group, color blindness, and PTC tasting. 5. Temporary mount of Giant chromosome. 6. Photometric (colorimetric/spectrophotometric) estimation of nucleic acid. 7. Cellular fractionation by centrifugation. 8. Maintenance and operation of laminar airflow. 9. Extraction by using the Soxhlet method. 10. To identify lipids in a given sample by TLC. 11. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH. 12. Operation of electrophoresis for protein.	30
Keywords	Gene, Genetic alteration, Spectrophotometry, Electrophoresis.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book-

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➢ Genetics- PS Verma ➢ Genetics- BD Singh ➢ Genetics- Veer Bala Rastogi
• Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons. • Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. • Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. • Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc. • De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. • Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
Online resources- https://archive.nptel.ac.in/courses/102/104/102104052/ https://onlinecourses.swayam2.ac.in/cec21_bt05/preview

Part D: Assessment and Evaluation			
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**			
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**		Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		Managed by course teacher as per lab status

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Dr. Shivani Sharma (Dr. Sanjana Bhagat) Dr Pramod Malik

(Dr. Arun Kr. Kashyap)

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Four Year Undergraduate Program (2024-28)
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Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **IV Sem**	Session:**2024-2025**
1	Course Code	**BTSC-04-P**	
2	Course Title	**Recombinant DNA technology**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program	
6	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Isolate nucleic acid from biological cells. • Estimate and manipulate nucleic acid. • Amplify nucleic acid. • Analyse nucleic acid on the basis of database.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation of chromosomal DNA from plant cells 2. Isolation of chromosomal DNA from *E.coli* 3. Qualitative and quantitative analysis of DNA using spectrophotometer 4. Plasmid DNA isolation 5. Restriction digestion of DNA. 6. Ligation of DNA. 7. Transformation of competent cells. 8. Demonstration of PCR. 9. Use of SNP databases at NCBI and other sites. 10. Use of OMIM database 11. Detection of Open Reading Frames using ORF Finder	30
Keywords	Recombinant DNA, Vectors, PCR, cDNA library.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- ➢ **P S Verma and A K Agrawal** ➢ **An introduction to genetic engineering- S T Tischoll**
• Molecular Biology; Watson. • Gene VIII; Benjamin Lewin. • The Cell, A molecular Approach; Geoffrey M. Cooper. • Molecular Biology of the Cell; Alberts

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• Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987. • Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010. • Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989. • Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
• Online resources- https://onlinecourses.swayam2.ac.in/cec21_bt05/preview • https://archive.nptel.ac.in/courses/102/104/102104052/ •

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
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Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **V Sem**	Session:**2024-2025**
1	Course Code	**BTSC-05-P**	
2	Course Title	**Enzymology**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this practical course, the students will be able to - • Analyses factors affecting enzymatic activity. • Determine enzymatic activity. • Purify and estimate kinetics of enzymes. • Immobilize enzymes for industrial applications.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Effect of pH and temperature on the action of salivary amylase. 2. Determination of the activity of amylase enzyme (crude) extracted from sweet potato. 3. Determination of the specific activity of the enzyme. 4. Determine Vmax and Km in of enzyme. 5. Protein electrophoresis – native and denaturing conditions. 6. Enzyme purification and kinetic analysis. 7. Method for immobilization of enzyme.	30
Keywords	Enzyme action, Enzyme Kinetics, Enzyme Regulation, Isoenzymes.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- Biochemistry- U Stayanarayana Modern enzymology- Dr. Vinod Ramkrishna Ragade and Dr. B.B. Sharma
• Lehninger Principles of Biochemistry; Nelson & Cox. • Biochemistry; Voet& Pratt. • Principles of Enzymology; Price & Stevens. • Enzyme Biocatalysis, Principle & Applications; Andres Illanes. • Enzyme Kinetics; Hans Bisswanger
Online resources- https://onlinecourses.nptel.ac.in/noc23_bt05/preview onlinecourses.swayam2.ac.in/cec20_bt20/preview

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Part D: Assessment and Evaluation			
Suggested Continuous Evaluation Methods: **Maximum Marks:** 50 Marks **Continuous Internal Assessment (CIA):** 15 Marks **End Semester Exam (ESE):** 35 Marks			
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - 15		Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:

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Dr. Ushwalasy

(Dr. Sanjana Bhagat)

Dr Shivani Sharma

(Dr. Arun Kr. Kashyap)

(Dr. Shubra Diwan)

Dr Pramod Kumar Malik

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Four Year Undergraduate Program (2024-28)
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Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **VI Sem**	Session:**2024-2025**
1	Course Code	**BTSC-06-P**	
2	Course Title	**Immunology**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Identify immunological cells and tissues. • Perform antigen antibody interaction. • Estimate antigen antibody reactions. • Estimate immunological specificity.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Blood film preparation and identification of cells. 2. Lymphoid organs and their microscopic organization. 3. Immunization, collection of serum. 4. Blood grouping concerning antigen-antibody interaction. 5. Rh factor determination. 6. Widal test. 7. VDRL test. 8. Ouchterlony Double diffusion for antigen-antibody pattern. 9. Rocket Immunoelectrophoresis. 10. Radial Immunodiffusion. 11. DOT ELISA.	30
Keywords	Antigen, Antibody, MHC, Autoimmune Diseases.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- **Essentials of immunology- S K Gupta** **A textbook of immunology- Latha P Madhavee**
• Immunology – Kuby • Textbook of microbiology – Anantnarayan&Panikar • Immunology – Roitt • Immunology – NandiniSethi • Fundamentals of Immunology – William Paul

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• Immunology – A short course 5th Edn – Eli Benjamin , Richard Coico
Online resources- https://archive.nptel.ac.in/courses/102/105/102105083/ https://archive.nptel.ac.in/courses/102/103/102103038/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **10 +10** Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSC-07-P**	
2	Course Title	**Plant and Animal Biotechnology**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this practical course, the students will be able to - • Perform primary culture and subculturing of cells. • Maintain conditions for animal and plant tissue culture. • Develop competency for media preparation. • Analyse viability and apoptosis of cells.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1 Sterilization of plant materials. 2 Preparation of tissue culture media. 3 Plant tissue culture by plant parts. 4 Preparation of different medium. 5 Culture of cells from hen's egg. 6 Cell counting by hemocytometer. 7 Estimation of viability by dye exclusion.	30
Keywords	Callus, Embryogenesis, Protoplast Culture, Scaling, Transformation.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- **Textbook of Animal Biotechnology-** B Singh, S K Gautam and M S Chauhan **Textbook of Animal Biotechnology-** B Singh Introduction to plant biotechnology- H S Chawala. Plant Biotechnology- B D Singh.
• Animal cell culture – Freshney • Culture of Animal Cell – John Paul • Animal cell biotechnology, methods and protocol – Portner • H.S.Chawala: Biotechnology in crop improvement. • R.J. Henry: Practical application of plant molecular biology: Chapman & Hall. • B.D. Singh: Biotechnology, Expanding Horizons.

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• Kalyan Kumar De- Plant Tissue Culture. • M.K. Ragdan: Introduction to Plant Tissue Culture.
Online resources- https://archive.nptel.ac.in/courses/102/103/102103016/ https://onlinecourses.nptel.ac.in/noc24_ag08/preview

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSC-08-P**	
2	Course Title	**Biostatistics and Bioinformatics**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this practicle course, the students will be able to - • Understand and present the data. • Standarize and validate the significance of the data. • Explore database for nucleic acid and genes. • Explore and interpret database for proteins.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Graphical presentation of data. 2. Tabular presentation of data. 3. Measurement of central tendencies from given data. 4. Measurement of test of significance from given data. 5. Literature mining using PubMed Central. 6. Browse the ExPASy sites and write the information received in your record. 7. Retrieving Protein and DNA Sequences using Entrez at NCBI. 8. Retrieving Protein and DNA Sequences using SRS at EBI 9. Nucleotide BLAST – Search nucleotide database using nucleotide query. 10. Protein BLAST – Search Protein database using protein query 11. BLAST – X: Search the Protein database using a translated nucleotide query 12. Multiple Sequence Alignment – CLUSTALW. 13. Problems on biostatistics.	30
Keywords	Central Tendencies, Test of Significance, NCBI, Phylogenetics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text books- Introduction to Biostatistics- PK Banerjee

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Elements of Biostatistics- Satguru Prasad Bioinformatics: principles and applications- Zhumur Ghosh
• Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins Second Edition; Andreas D. Baxevanis& B. F. Francis Ouellette. • Practical Bioinformatics; Janusz M. Bujnicki (Ed.) • Introduction to Bioinformatics; Arthur M. Lesk, University of Cambridge. • Bioinformatics and Drug Discovery; Richard S. Larson. • Bioinformatics; Andrzej Polanski, Marek Kimmel.
Online resources- https://onlinecourses.nptel.ac.in/noc19_bt19/preview https://onlinecourses.nptel.ac.in/noc21_bt06/preview

Part D: Assessment and Evaluation			
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**			
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**		Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		Managed by course teacher as per lab status

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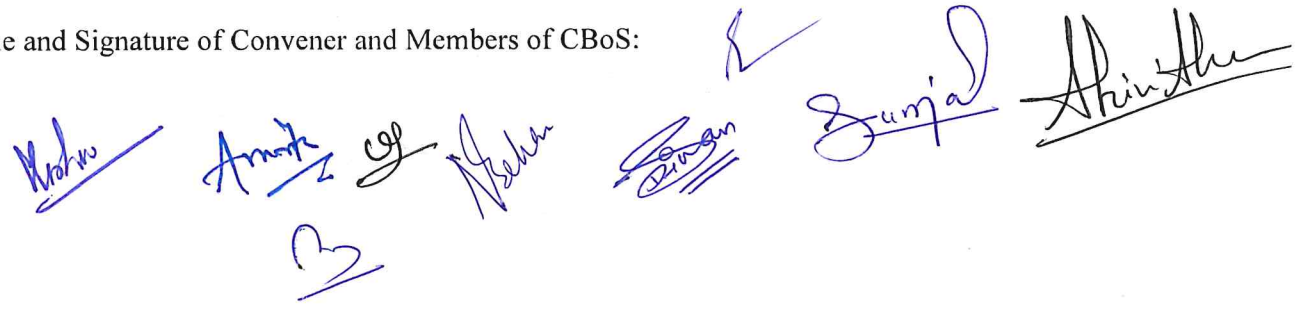

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Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSE-01-T**	
2	Course Title	**Environmental Biotechnology**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand wastewater management. • Understand the significance and scope of biodegradation. • Develop skills for bioremediation. • Develop skills for the management of xenobiotics.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Environmental treatments** 1. Domestic (municipal) and industrial wastewater treatments: primary, secondary and tertiary. 2. Important microorganisms in wastewater treatment, principles of their growth and plasmid-borne metabolic activities. 3. Aerobic biological treatments: activated sludge process rotating biological contactors. 4. Anaerobic biological treatments: airlift membrane bioreactors packed bed (column reactor.)	12 (12 Hrs)
II	**Environmental degradation** 1. Biodegradation: definition and concept, ready biodegradation, ultimate biodegradation and inherent biodegradation. 2. Aerobic and anaerobic degradation pathways in microbes. 3. Biodegradation of hydrocarbon with suitable example. 4. Concept of municipal solid waste management.	11 (11 hrs)
III	**Environmental remediation** 1. Introduction, definition and concept, methods of bioremediation (in situ and ex-situ methods) 2. Bioremediation of soil (saline soil and alkaline soil) 3. Phytoremediation: concept and types. 4. Applications of bioremediation.	11 (11 hrs)

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IV	**Environmental contamination** 1. Xenobiotics and recalcitrancy. 2. Xenobiotics degradation: pesticide degradation, herbicide degradation 3. Metabolism of xenobiotics. 4. Cytochrome p450 system, phase I, phase II, metabolic reactions.	11 (11 hrs)
Keywords	Wastewater management, biodegradation, bioremediation, xenobiotics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- • Murugesan A. G.and Rajakumari C-Environmental Science and Biotechnology: Theory &Techniques, MJP • Asthana D.K. and Asthana M.,-Environment: Problems and Solutions- S. Chand • Chatterji A.K., Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd
Reference Book- • Jogdand S.N.- Environmental Biotechnology- Himalaya Publishing House • Kalaichelvan P.T., I Arul Pandi- Bioprocess Technology, MJP Publishers • Rajendran, Gunashekaran- Microbial Bioremediation-MJP • Hammer & Hammer-Water & Wastewater Technology-PHI • Metcaf & Eddy-Waste water Engineering-TMH • Indushekhar Thakur- Environmental Biotechnology-I K Internation
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt41/preview http://acl.digimat.in/nptel/courses/video/102105088/102105088.html

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 100 **Marks** **Continuous Internal Assessment (CIA):** 30 **Marks** **End Semester Exam (ESE):** 70 **Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: IV Sem	Session:2024-2025
1	Course Code	**BTSE-02-T**	
2	Course Title	**Bioprocess Engineering**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand the prerequisite of bioprocess engineering. • Develop skills for the operation of bioreactors. • Develop skills for industrial production. • Understand the geological exploitation by the process of bioprocess engineering.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Concept of bioprocess engineering** 1. Introduction to bioprocess engineering. 2. Isolation, preservation, and maintenance of industrial microorganisms. 3. Media for industrial fermentation. 4. Kinetics of microbial fermentation.	12 (12 Hrs)
II	**Bioreactors** 1. Types of fermentation processes. 2. Operations of bioreactors. 3. Measurement and control of bioprocess parameters. 4. Downstream processing.	11 (11 hrs)
III	**Bioproducts** 1. Production of alcohol, acids and solvents. 2. Production of antibiotics. 3. Production of amino acids. 4. Whole cell immobilization for industrial application.	11 (11 hrs)
IV	**Microbial role and regulation** 1. Application of microbes in mineral beneficiation. 2. Application of microbes for oil recovery. 3. Quality control, quality assurance and standard operating procedures of fermenter. 4. Good manufacturing practices.	11 (11 hrs)

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Keywords	Fermentation, bioreactors, fermentation-based production, mineral beneficiation.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- Industrial Biotechnology- D Das • Industrial Microbiology- A.H. Patel.
Reference Book- • Wastewater Engineering- Treatment, Disposal & Reuse. Metall and Eddy, Inc., Tata Mcgraw Hill, N. Delhi. • Microbiology- Pelczar&Pelczar. • Environmental Biotechnology, PrathamVashishith. Dominant Publishers And Distributors, N.Delhi. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
Online resources- https://archive.nptel.ac.in/courses/102/105/102105058/ http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **V Sem**	Session:2024-2025
1	Course Code	**BTSE-03**	
2	Course Title	**Industrial Biotechnology**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to – • Understand about mutants for significant industrial production. • Develop skills in physical and chemical methods for industrial products. • Develop skills in the fermentation process for industrial products. • Understand economics and quality control.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Industrial mutants** 1. Selection of mutants producing improved levels of primary metabolites with suitable examples. 2. Isolation of mutants that do not produce feedback inhibitors or repressors. 3. Mutants that do not recognize the presence of inhibitors or repressors. 4. Modification of permeability.	12 (12 Hrs)
II	**Industrial methodologies** 1. Removal and recovery of cell mass (precipitation, filtration, and centrifugation) 2. Cell disruption - Physical and chemical methods. 3. Purification of product liquid-liquid extraction: solvent recovery. 4. Chromatography: Adsorption, ion-exchange, HPLC	11 (11 hrs)
III	**Industrial bioneeds** 1. Fermentation processes: Microorganisms involved, inoculum preparation, the medium used and product recovery. 2. Enzyme: Protease, pectinase. 3. Organic acid and vitamins: Citric acid, vitamin B12 and vitamin B2. 4. Antibiotics: Penicillin, erythromycin.	11 (11 hrs)
IV	**Testing and quality control** 1. Testing- Sterility, pyrogen, carcinogenicity, and toxicity. 2. Fermentation economics- Cost estimates, process design, capital cost estimates, operating cost.	11 (11 hrs)

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	3. Concept of quality control and quality assurance. 4. Good laboratory practices and good manufacturing practices.	
Keywords	Mutants, removal and recovery, fermentation process, fermentation economics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ **Text book-** Industrial Biotechnology- D Das ➢ Industrial Microbiology- A.H. Patel.
• Peppler H.J and Perlman D - Microbial Technology, Vol I and II-Elsevier • Stanbury P.F., Whitaker A. and Hall S.J - Principles of Fermentation Technology-Elsevier • Prescott and Dunn"s- Industrial Microbiology-CBS 7. Ed. • G. Subramaniam- Bioseparation& Bioprocessing • Casida L.E - Industrial Microbiology- New Age • Crueger W and Crueger A - Biotechnology: A Textbook of Industrial Microbiology-Panima Publishing • Patel A.H. - Industrial Microbiology, Macmillan
Online resources- https://archive.nptel.ac.in/courses/102/105/102105058/ http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
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Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: VI Sem	Session:2024-2025
1	Course Code	**BTSE-04-T**	
2	Course Title	**Medical Biotechnology**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand about rDNA technology and its outcome. • Understand about diagnostics methods. • Understand about tissue engineering and its therapeutics. • Understand about immunodeficiency and biomarkers.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Immunization and therapy** 1. Immunization- Immunization, live, killed, attenuated, subunit vaccine. 2. Recombinant DNA and protein-based vaccines. 3. Transfusion of immuno-competent cells. 4. Stem cell therapy.	12 (12 hrs)
II	**Diagnostics** 1. Antibody-based diagnosis 2. Monoclonal antibodies as diagnostic reagents. 3. Diagnosis of bacterial, viral, and parasitic diseases by using ELISA. 4. Diagnosis of bacterial, viral, and parasitic diseases by using western blot.	11 (11 hrs)
III	**Tissue engineering and therapy** 1. Concept of tissue engineering. 2. Cellular therapy. 3. Role of scaffolds and growth factors. 4. Ethical issues.	11 (11 hrs)
IV	**Immunological imbalance and pathogenicity** 1. Primary immunodeficiency (SCID, X-linked agammaglobulinemia, Defects in complement system). 2. Secondary immunodeficiency (AIDS). 3. Biomarkers for organ dysfunctions. 4. Therapeutic intervention of uncontrolled cell growth.	11 (11 hrs)
Keywords	Immunization, Diagnostics, Cellular Therapy, Ethical Issues.	

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• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- **Essentials of immunology- S K Gupta** **A textbook of immunology- Latha P Madhavee**
• Immunology – Kuby • Textbook of microbiology – Anantnarayan&Panikar • Immunology – Roitt • Immunology – NandiniSethi • Fundamentals of Immunology – William Paul • Immunology – A short course 5thEdn – Eli Benjamin , Richard Coico
Online resources- https://archive.nptel.ac.in/courses/102/105/102105083/ https://archive.nptel.ac.in/courses/102/103/102103038/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 100 **Marks** **Continuous Internal Assessment (CIA):** 30 **Marks** **End Semester Exam (ESE):** 70 **Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four-Year Undergraduate Program (2024-2028)
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Part A: Introduction			
Program: Bachlor in Life Sciences (Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-05-T**	
2	Course Title	**Genomics**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Analyse and interpret genomic data. • Develop competency related to genomic and epigenomic alteration. • Understand about gene expression and regulation. • Develop an understanding of various RNA interphases.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Concept of genomics** 1. Genomics- Introduction, comparative genomics, Cot and Rot value, forward and reverse genetics. 2. DNA sequence analysis methods: Sanger dideoxy method and fluorescence method. 3. Gene variation and Single Nucleotide Polymorphisms (SNPs); Expressed sequenced tags (ESTs). 4. Gene disease association.	12 (12 hrs)
II	**Epigenetics and genomic stability** 1. Epigenetic control of gene expression- DNA methylation and its role in gene expression. 2. Genome stability by DNA methylation. 3. Chromatin modifications implicated in gene silencing and activation. 4. Epitranscriptome- resetting the epigenome.	11 (11 hrs)
III	**Control and regulation of gene expression** 1. Transcriptional control of gene expression- Gene architecture, promoter architecture. 2. Regulation sequences, enhancers, and mechanism of their action. 3. Mediator complex and general transcription factors. 4. DNA binding and activation domains, activation of latent activators, and co-activators.	11 (11 hrs)
IV	**RNA regulated regulations**	11 (11 hrs)

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	1. Post-transcriptional control of gene expression- Introns and exons, mechanism of RNA splicing. 2. Polyadenylation. 3. Small RNA and RNA interference. 4. Catalytic RNA.	
Keywords	DNA sequencing, Epitranscriptome, Transcriptional Control, RNA polyadenylation.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ **Text books-Introduction to genomics- A M Lesk** ➢ **Genome analysis and bioinformatics- T R Sharma**
Reference book- ➢ Latchman DS (2015), Gene control, Garland Science, New York. • Krebs, JE, Goldstein ES, Kilpatrick SJ (2014) Lewins Genes XI, Jones Bartlett Publishers.
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt39/preview https://nptel.ac.in/courses/102103017

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 100 **Marks** **Continuous Internal Assessment (CIA):** 30 **Marks** **End Semester Exam (ESE):** 70 **Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four-Year Undergraduate Program
Department of Biotechnology
Course Curriculum – 2027-2028

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-06-T**	
2	Course Title	**Proteomics**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understanding protein structure and design of workflow. • Develop an understanding of technology related to proteomics. • Develop competency in protein sequencing and related methods. • Understand quantitative and high throughput methods related to proteomics.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Concept of proteomics** 1. Protein structure and folding basic concepts and techniques. 2. Proteome- Basics and workflow design of proteomics technology. 3. Comparative proteomics and importance of proteomics. 4. An overview of systems biology.	12 (12 hrs)
II	**Basic techniques in proteomics** 1. Tools and techniques in proteomics: Principle and application of separation of 1D and 2D polyacrylamide gel electrophoresis. 2. Workflow. 3. Two-dimensional fluorescence difference in-gel electrophoresis (DIGE). 4. Staining the gel of DIGE.	11 (11 hrs)
III	**Advanced techniques in proteomics** 1. Protein sequencing. 2. MS analysis and related techniques (LC-MS(MS). 3. Advanced methods in proteomics (microfluidic chips, ICAT, iTRAQ). 4. Advanced methods in proteomics (SILAC)	11 (11 hrs)
IV	**Application of proteomics** 1. Database search, relative quantification, analysis, and interpretation. 2. Quantitative proteomics. 3. Post-translational modification and their profiling. 4. High throughput methods for the interaction of proteins with other	11 (11 hrs)

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	biomolecules.	
Keyword	Proteome, Protein Sequencing, Quantitative Proteomics, System Biology.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text Book-** Introduction to Proteomics: Tools for the New Biology, D.C. Liebler, Humana Press, 2002. • Principles of Proteomics, R.M. Twyman, Bios Scientific Pub., 2004
Reference Book- • Proteomics for Biological Discovery, T.D. Veenstra, J.R. Yates III, John-Wiley & Sons, Hoboken, New Jersey, USA; 2006. • Protein Biochemistry and Proteomics (The Experimenter Series), R. Hubert, Academic Press, 2006. • Proteomics in Practice: A Guide to Successful Experimental Design, R. Westermeier, T. Naven, H-R. HÃ¶pker, Wiley-VCH, 2008 • Proteomics: A Cold Spring Harbor Laboratory Course Manual, A.J. Link and J. LaBaer, Cold Spring Harbor Laboratory Press, 2009
Online resources- https://onlinecourses.nptel.ac.in/noc20_bt20/preview https://nptel.ac.in/courses/102101007

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: VII Sem	Session:2024-2025
1	Course Code	**BTSE-07-T**	
2	Course Title	**Agricultural Biotechnology**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills related to the use of microbes for the improvement of nitrogen fixation. • Develop skills related to the development of biofertilizers. • Understand about pathogens related to agriculture. • Develop skills related to biopesticides development.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Basic biotechnological need** 1. Symbiotic nitrogen fixation. 2. Non symbiotic nitrogen fixation. 3. Nitrate assimilation and nitrification. 4. Phytohormones.	12 (12 hrs)
II	**Production of agrobiotics** 1. Concept and types of biofertilizers. 2. Microbial inoculum. 3. Sulfur and phosphate solubilizing biofertilizers 4. Applications of biofertilisers.	11 (11 hrs)
III	**Biotechnological control of pathology** 1. Concept of plant pathology. 2. Classification of plant diseases. 3. Causative agent, symptoms, mechanism of action, and control majors of plant diseases. 4. Pathogenesis mechanism related to enzymes, toxins, and nutrition.	11 (11 hrs)
IV	**Biotechnological control of pests** 1. Definition and types of biopesticides 2. Advantages of biopesticides. 3. Composition and types of biomasses and their conversion and neutralization.	11 (11 hrs)

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	4. Single-cell proteins and their nutritive values.	
Keywords	Nitrogen Fixation, Inoculum, Pathology, Single Cell Protein.	

Text Books, Reference Books, Other Resources -
➢ **Text** Book- Agricultural Biotechnology- A Singh ➢ Agricultural Biotechnology at a Glance- A K Thakur
Reference book- • Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication. • Guptal PK ad genetics and biotechnology in crop improvement- Rastogi Publication • Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanoical publication. • Vyas S and Modi HA- Biofertisers and organic farming- AKTA Prakashan.
Online resources- https://onlinecourses.nptel.ac.in/noc24_ag08/preview https://archive.nptel.ac.in/courses/102/103/102103016/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-08-T**	
2	Course Title	**Pharmaceutical Biotechnology**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand about secondary metabolite production and applications. • Understand about antibiotics and their antimicrobial applications. • Understand the mechanism of disease-based drug action. • Develop concepts of pharmacokinetics and pharmacodynamics.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Secondary metabolites** 1. Introduction to secondary metabolites. 2. Types and Medicinal Applications of Secondary Metabolites. 3. Production of Secondary metabolites in Plants through hairy Root Culture. 4. Factors affecting Secondary metabolite production (Precursors, Growth Factors, and Nutrients.	12 (12 hrs)
II	**Microbial exploitation** 1. Types and classification of antibiotics. 2. General characteristics of an Antimicrobial Drug. 3. Mechanism of action of antimicrobial agent. 4. Microbial Resistance to antibiotics and antimicrobial agents.	11 (11 hrs)
III	**Drug action** 1. Structure, and Applications of Antibacterial Drug. 3. Mechanism of Action. 4. Mechanism of action of Anticancer drugs. 4. . Mechanism of action of Antidiabetic drugs and Antihypertensive drugs.	11 (11 hrs)
IV	**Regulatory mechanism of drugs** 1. Protein engineering: Principles and Application. 2. Molecular Biology and Combinatorial drug discovery. 3. Concept of Pharmacokinetics, Pharmacodynamics. 4. Drug delivery systems.	11 (11 hrs)

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Keywords	Pharmacokinetics, Pharmacodynamics, Secondary Metabolites, Combinatorial Drugs.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text book-** FSK Barar- Pharmaceutical- Essentials of Pharmaceuticals- S.Chand ➢ S.P. Vyas, Dixit- Pharmaceutical Biotechnology-CBS Gupta P.K. - Biotechnology and Genomics, Rastogi Publication
Reference book- • Hugo W. B. and Russell A. D. - Pharmaceutical Microbiology -Wiley India • B.Razdan-Medicinal Chemistry-CBS • Satoskar, Bhandarkar- Pharmacology and Pharmacotherapeutics- Popular • Purohit, Saluja- Pharmaceutical Biotechnology-Student Edition
Online resources- https://nptel.ac.in/courses/104102113 https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-09-T**	
2	Course Title	**Microbial products for human consumption**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand the concept of antibiotic fermentation and application. • Develop concepts for the production of various pharmaceuticals. • Develop an understanding of biotechnological approaches for food and nutraceuticals. • Develop a skill in the production of various kinds of alcoholic drinks.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Antibiotics and microbes** 1. Antibiotic fermentations for production of β lactams (penicillins), semi-synthetic penicillins and cephalosporins. 2. Antibiotic fermentations for production of amino-glycosides (streptomycin). 3. Antibiotic fermentations for the production of macrolids (erythromycin). 4. Antibiotic fermentations for the production of quinines.	12 (12 hrs)
II	**Microbes and metabolic products** 1. Production of vitamins (B12, riboflavin, A), 2. Production of enzymes for pharmaceutical industries, 3. Production of recombinant proteins (insulin, interleukins and interferons), 4. Biotransformations - hormones	11 (11 hrs)
III	**Microbes and food technology** 1. Microbes in the food industry. 2. Biotechnological approaches for fermented foods (breads, sauerkraut, pickles, tofu), 3. Biotechnological approaches for dairy products (cheese, curd, yogurt) 4. Microbes as food - single cell protein, mushrooms, probiotics.	11 (11 hrs)
IV	**Microbes and beverages** 1. Production of beer (brewing) – media (raw materials used), process, maturation, carbonation.	11 (11 hrs)

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	2. Types of beer (lager, pilsner, bock, ale, stout, porter). 3. Types and production – Whiskey. 4. Production of wine – media and raw material used, different types (sparkling wine, burned wine, cider, wine vinegar), vinegar.	
Keywords	Fermentation, Biotransformations, Wine Production, Single Cell Protein.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ Text book- ➢ **Microbial Products for Health, Environment and Agriculture- PK Aurora** ➢ **Microbial Products- S Singh**
• Industrial Microbiology- A.H. Patel. • Microbiology- Pelczar&Pelczar. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
• Online resources- https://archive.nptel.ac.in/courses/102/103/102103015/ • https://onlinecourses.swayam2.ac.in/cec19_ag03/preview

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 100 **Marks** **Continuous Internal Assessment (CIA):** 30 **Marks** **End Semester Exam (ESE):** 70 **Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-4x10=**40 Marks**	

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Four-Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-10**	
2	Course Title	**Microbial products for agriculture**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills in biofertilizer production. • Develop skills in biopesticide production. • Develop skills in BT-based GM crop development. • Understand bio composting, biofuels, and metal recovery.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Microbes and biofertilizers** 1. Biofertilizers – history of, production of biofertilizers. 2. Production of biofertilizers from symbiotic and asymbiotic nitrogen fixers. 3. Phosphate solubilizing microbes, phytohormones from microbes. 4. Applications of microbes in fields.	12 (12 hrs)
II	**Microbes and biopesticides** 1. Biopesticides-history of development. 2. Production of biopesticides from bacteria. 3. Production of biopesticides from fungi and viruses. 4. Production of biopesticides from insect hormones.	11 (11 hrs)
III	**Transgenicity** 1. Bacillus thuringiensis (Bt) as a major biopesticide. 2. Role of Bt in pest control 3. Transgenic crops from Bt. 4. Issues related to GM crops	11 (11 hrs)
IV	**Microbial role in geological product** 1. Composting – static pile, aerated pile. 2. Bioreactor process for composting. 3. Biofuels – ethanol, methane, hydrogen, and biogas. 4. Recovery of metals – bioleaching of copper, gold, and uranium.	11 (11 hrs)
Keywords	Biofertilisers, Biopesticides, Transgenic Crops, Composting.	

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• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text book-** Industrial Microbiology- A.H. Patel. • Guptal PK ad genetics and biotechnology in crop improvement- Rastogi Publication • Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanoical publication.
References book- • Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication. • Vyas S and Modi HA- Biofertisers and organic farming- AKTA Prakashan • Microbiology- Pelczar & Pelczar. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
Online resources- https://archive.nptel.ac.in/courses/126/105/126105013/ https://onlinecourses.swayam2.ac.in/cec19_ag03/preview

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:2024-2025
1	Course Code	**BTSE-11-T**	
2	Course Title	**Microbial products for industrial use and application**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills in the production of sugar-based products. • Develop skills in the production acid acid-based products. • Develop skills in the production of alcohol-based products. • Develop skills in microbial production at the industrial level.	
6	Credit Value	03 Credits	(Credit = 15 Hours - learning & observation)
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Production of enzymes** 1. Production and applications of amylase, proteases, and invertase. 2. Production and applications of pectinase and cellulase. 3. Production and applications of glucose oxidase and glucose isomerase. 4. Production and applications of catalase, lipase, and polymerase.	12 (12 hrs)
II	**Production of acids** 1. Production and applications of citric acid and fumaric acid. 2. Production and applications of lactic acid and benzoic acid. 3. Production and applications of gluconic acid and kojic acid. 4. Production and applications of itaconic acid and acetic acid.	11 (11 hrs)
III	**Production of alcohol and glycerol** 1. Production and applications of industrial alcohol, 2. Production and applications of acetone-butanol 3. Production and applications of glycerol from yeasts. 4. Production and applications of glycerol from bacteria.	11 (11 hrs)
IV	**Production of pigments and others** 1. Microbial production of xanthene, dextrane, and alginate. 2. Microbial production of gellan, cellulose and curdlan. 3. Microbial production of pullulan and scleroglucan. 4. Microbial production of polyesters - bioplastics (polyhydroxyalkanoates).	11 (11 hrs)
Keywords	Amylase, Lactic Acid, Glycerol, Biopasltics.	

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• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- ➢ Hand book of fermentation technology- E S Minj ➢ Industrial Microbiology- A.H. Patel.
Reference book- • Wastewater Engineering- Treatment, Disposal & Reuse. Metall and Eddy, Inc., Tata Mcgraw Hill, N. Delhi. • Microbiology- Pelczar&Pelczar. • Environmental Biotechnology, PrathamVashishith. Dominant Publishers And Distributors, N.Delhi. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
Online resources- https://onlinecourses.nptel.ac.in/noc20_bt21/preview https://unacademy.com/content/cbse-class-12/study-material/biology/microbes-in-industrial-products/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100 Marks** **Continuous Internal Assessment (CIA):** **30 Marks** **End Semester Exam (ESE):** **70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts., **1out of 2** from each unit-**4x10=40 Marks**	

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Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-12-T**	
2	Course Title	**IPR, Biosafety, and Bioethics.**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Generate basic concepts related to intellectual property. • Develop skills related to patenting and registration of geographical indications. • Develop concepts related to biosafety and its regulation. • Develop skills related to the assessment of biotechnological products.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Basic concepts of IPR** 1. Patent laws, patent application procedure. 2. Copyright laws, ownership, and enforcement of copyrights. 3. Patents and copyrights, transfer. 4. Trademarks – objectives, rights, and protection.	12 (12 hrs)
II	**Rights and Conservation** 1. Intellectual property rights. 2. Biotechnology and IPR, issues in patenting biotechnological inventions, commercial potential of biotechnology inventions, 3. Patenting of life forms (GEMs) – objectives, rationale, international treaties, Indian perspectives. 4. Geographical indications.	11 (11 hrs)
III	**Legal protection of biosafety** 1. Biosafety regulation of products. 2. Individual, national, and international concerns of biosafety. 3. Biosafety regulations in laboratories. 4. Handling of recombinant products.	11 (11 hrs)
IV	**Protocol and assessment** 1. Assessment of the impact of transgenic crops- foods, drugs, and vaccines. 2. Assessment of recombinant products. 3. International biosafety protocols	11 (11 hrs)

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	4. Biological weapons and their control.	
Keywords	Patent, Trademark, Copyright, Geographical Indications.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- • IPR, Biosafety, and Bioethics by Goel and Parashar. • Intellectual property rights, biosafety, and bioethics (ethical frontiers) by Dr. Alok Kumar Srivastav et al.
Reference Book- • PR Handbook for Pharma Students and Researchers- P Bansal. • Law relating to intellectual property right- V K Ahuja.
Online resources- https://onlinecourses.nptel.ac.in/noc21_lw04/preview https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=qpl3yaiUxBHqOVkf/L23mw==

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks: 100 Marks** **Continuous Internal Assessment (CIA): 30 Marks** **End Semester Exam (ESE): 70 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

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Four Year Undergraduate Program (2024-28)
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Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSE-01-P**	
2	Course Title	**Environmental Biotechnology**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand and analyze physical and chemical parameters of the water bodies. • Estimate biological pollutants from the water bodies. • Determine physical and nutritional conditions of the soil. • Estimate various inorganic and organic contents from pollutants.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Determination of DO, and BOD, from polluted water sample. 2. Determination of COD from a polluted water sample. 3. Bacterial examination of water by MPN test. 4. Coliform test. 5. Determination of soil pH and total organic carbon. 6. NPK determination from soil. 7. Determination of alkalinity and hardness of water. 8. Estimation of total nitrogen in Kjeldahl's method.	30
Keywords	Wastewater management, biodegradation, bioremediation, xenobiotics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- • Murugesan A. G.and Rajakumari C-Environmental Science and Biotechnology: Theory &Techniques, MJP • Asthana D.K. and Asthana M.,-Environment: Problems and Solutions- S. Chand • Chatterji A.K., Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd
Reference Book- • Jogdand S.N.- Environmental Biotechnology- Himalaya Publishing House

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• Kalaichelvan P.T., I Arul Pandi- Bioprocess Technology, MJP Publishers • Rajendran, Gunashekaran- Microbial Bioremediation-MJP • Hammer & Hammer-Water & Wastewater Technology-PHI • Metcaf & Eddy-Waste water Engineering-TMH • Indushekhar Thakur- Environmental Biotechnology-I K Internation
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt41/preview http://acl.digimat.in/nptel/courses/video/102105088/102105088.html

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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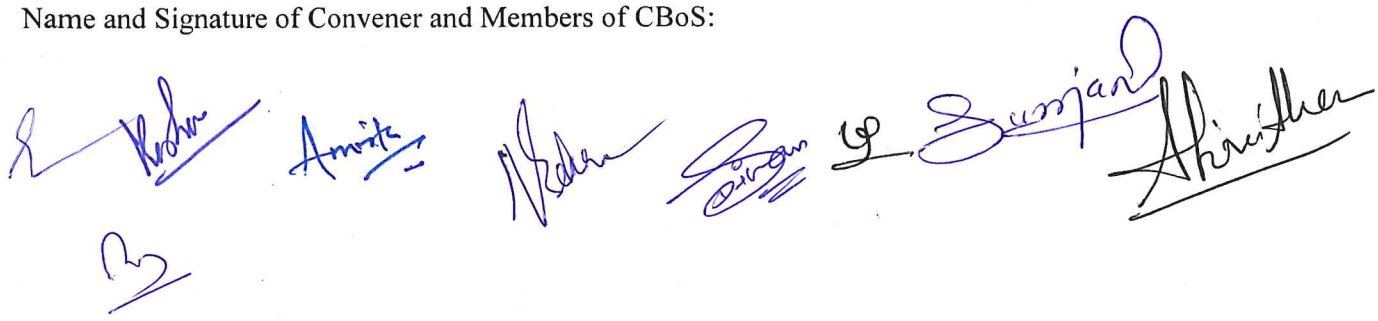

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
.Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **IV Sem**	Session:**2024-2025**
1	Course Code	**BTSE-02-P**	
2	Course Title	**Bioprocess Engineering**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this practical course, the students will be able to - • Isolate and maintain industrially significant microbes. • Develop skills for alcoholic production. • Develop skills for acid production. • Develop skills for antibiotic and enzyme production.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation of industrially important microorganisms for microbial process. 2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganisms. 3. Comparative studies of ethanol production using different substrates. 4. Microbial production of citric acid using *Aspergillus niger.* 5. Microbial production of antibiotics *(Penicillin)* 6. Production and estimation of alkaline protease.	30
Keywords	Fermentation, bioreactors, fermentation-based production, mineral beneficiation.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- Industrial Biotechnology- D Das • Industrial Microbiology- A.H. Patel.
Reference Book- • Wastewater Engineering- Treatment, Disposal & Reuse. Metall and Eddy, Inc., Tata Mcgraw Hill, N. Delhi. • Microbiology- Pelczar&Pelczar. • Environmental Biotechnology, PrathamVashishith. Dominant Publishers And Distributors, N.Delhi. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
Online resources- https://archive.nptel.ac.in/courses/102/105/102105058/ http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058

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Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Ceritificate/Diploma/Degree/Honors)		Semester: **V Sem**	Session:**2024-2025**
1	Course Code	**BTSE-03-P**	
2	Course Title	**Industrial Biotechnology**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to – • Isolation and maintenance of industrially significant microbes. • Understand and develop concept of fermentation technology. • Develop skills for industrially significant acid production. • Develop skills for industrially significant nutrients production.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 70	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation and screening of industrially important microbes. 2. Isolation and identification of bacteria from milk and water samples. 3. Fermentative production, purification, and estimation of citric acid. 4. Fermentative production, purification, and estimation of alcohol. 5. Wine production and estimation of alcohol. 6. Production of cheese using different substrates and microorganisms.	30
Keywords	Mutants, removal and recovery, fermentation process, fermentation economics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ **Text book-** Industrial Biotechnology- D Das ➢ Industrial Microbiology- A.H. Patel.
• Peppler H.J and Perlman D - Microbial Technology, Vol I and II-Elsevier • Stanbury P.F., Whitaker A. and Hall S.J - Principles of Fermentation Technology-Elsevier • Prescott and Dunn"s- Industrial Microbiology-CBS 7. Ed. • G. Subramaniam- Bioseparation& Bioprocessing • Casida L.E - Industrial Microbiology- New Age • Crueger W and Crueger A - Biotechnology: A Textbook of Industrial Microbiology-Panima Publishing • Patel A.H. - Industrial Microbiology, Macmillan
Online resources- https://archive.nptel.ac.in/courses/102/105/102105058/ http://www.ndl.gov.in/he_document/nptel/downloads_new_lecturenotes_102105058_102105058

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Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 50 Marks **Continuous Internal Assessment (CIA):** 15 Marks **End Semester Exam (ESE):** 35 Marks		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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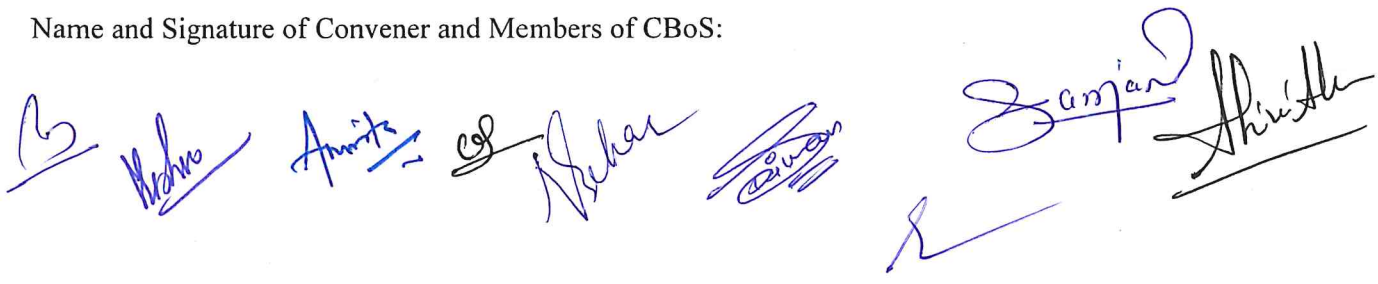

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachlor in Life Sciences (Ceritificate/Diploma/Degree/Honors)		Semester: **VI Sem**	Session:**2024-2025**
1	Course Code	**BTSE-04-P**	
2	Course Title	**Medical Biotechnology**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this practical course, the students will be able to - • Interpret the immunological reactions. • Estimate immunological molecules. • Analyze biomarkers. • Evaluate molecules related to organ physiology.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Study of Ag-Ab reaction. 2. Widal test. 3. VDRL test. 4. Haemogram preparation. 5. TLC, DLC counting. 6. Hb estimation. 7. Total protein, albumin, and globulin estimation. 8. Lipid profiling. 9. Sugar testing. 10. SGPT/SGOT estimation.	30
Keywords	Immunization, Diagnostics, Cellular Therapy, Ethical Issues.	

• Part C - Learning Resource
Text Books, Reference Books, Other Resources -
Text book- **Essentials of immunology- S K Gupta** **A textbook of immunology- Latha P Madhavee**
• Immunology – Kuby • Textbook of microbiology – Anantnarayan&Panikar

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• Immunology – Roitt • Immunology – NandiniSethi • Fundamentals of Immunology – William Paul • Immunology – A short course 5thEdn – Eli Benjamin , Richard Coico
Online resources- https://archive.nptel.ac.in/courses/102/105/102105083/ https://archive.nptel.ac.in/courses/102/103/102103038/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four-Year Undergraduate Program (2024-2028)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-05-P**	
2	Course Title	**Genomics**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Be competent for isolation and estimation of nucleic acids. • Develop skill for pathogenic alteration and nucleic acids in cells. • Explain and estimate nucleic acid alterations. • Correlate nucleic acid base pair and database.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation of DNA from plants. 2. Isolation of DNA from blood. 3. DNA molecular size determination. 4. Preparation of slide to observe micronuclei. 5. Banding pattern study of DNA through electrophoresis. 6. Genetic variation study by RAPD. 7. Genetic variation study by RFLP. 8. Use of NCBI database for homology study.	30
Keywords	DNA sequencing, Epitranscriptome, Transcriptional Control, RNA polyadenylation.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ **Text books-Introduction to genomics- A M Lesk** ➢ **Genome analysis and bioinformatics- T R Sharma**
Reference book- ➢ Latchman DS (2015), Gene control, Garland Science, New York. • Krebs, JE, Goldstein ES, Kilpatrick SJ (2014) Lewins Genes XI, Jones Bartlett Publishers.
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt39/preview https://nptel.ac.in/courses/102103017

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Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **10 +10** Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four-Year Undergraduate Program (2024-2028)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: VII Sem	Session:2024-2025
1	Course Code	**BTSE-06-P**	
2	Course Title	**Proteomics**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Isolate and purify proteins. • Quantify and elucidate protein. • Perform mining of protein database. • Analyze structural domains of proteins.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation of protein. 2. Purification of protein. 3. Quantification of protein. 4. Electrophoretic observation of protein. 5. Protein database mining. 6. Homology study of protein by using the database. 7. Structural elucidation of protein by using the database. 8. Analysis of protein domains using the database.	30
Keyword	Proteome, Protein Sequencing, Quantitative Proteomics, System Biology.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text Book-** Introduction to Proteomics: Tools for the New Biology, D.C. Liebler, Humana Press, 2002. • Principles of Proteomics, R.M. Twyman, Bios Scientific Pub., 2004
Reference Book- • Proteomics for Biological Discovery, T.D. Veenstra, J.R. Yates III, John-Wiley & Sons, Hoboken, New Jersey, USA; 2006. • Protein Biochemistry and Proteomics (The Experimenter Series), R. Hubert, Academic Press, 2006. • Proteomics in Practice: A Guide to Successful Experimental Design, R. Westermeier, T. Naven, H-R. HÃ¶pker, Wiley-VCH, 2008 • Proteomics: A Cold Spring Harbor Laboratory Course Manual, A.J. Link and J. LaBaer, Cold Spring Harbor Laboratory Press, 2009

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Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-07-P**	
2	Course Title	**Agricultural Biotechnology**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Isolate and maintain symbiotic and non-symbiotic microbes for agricultural applications. • To apply leghemoglobin and oxidase to enhance agricultural prodcutin • To develop skill for economically viable microbes. • To develop skill for estimation of agriculturally significant community.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation of Rhizobium sp. from root nodule of leguminous plant. 2. Isolation & Study of nonsymbiotic nitrogen-fixing organisms 3. Isolation and study of PSBs. 4. Estimation of leg hemoglobin from root nodule of leguminous plant. 5. Determination of IAA Oxidase activity. 6. Cultivation and study of Spirulina algae, Mushrooms 7. Study of community by quadrate method (Frequency, Density, and Abundance of Species)	30
Keywords	Nitrogen Fixation, Inoculum, Pathology, Single Cell Protein.	

Text Books, Reference Books, Other Resources -

- **Text** Book- Agricultural Biotechnology- A Singh
- Agricultural Biotechnology at a Glance- A K Thakur

Reference book-

- Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication.
- Guptal PK ad genetics and biotechnology in crop improvement- Rastogi Publication
- Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanoical publication.
- Vyas S and Modi HA- Biofertisers and organic farming- AKTA Prakashan.

Online resources- https://onlinecourses.nptel.ac.in/noc24_ag08/preview
https://archive.nptel.ac.in/courses/102/103/102103016/

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Part D: Assessment and Evaluation			
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**			
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**		Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Degree/Honors)		Semester: **VII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-08-P**	
2	Course Title	**Pharmaceutical Biotechnology**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skill for antibiotic production • Develop skill for maintenance of pharmaceuticals. • Develop skill for regulation of pharmaceutical products. • Develop sill for determination of side effects of pharmaceuticals.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Assay of antimicrobial activity of penicillin, streptomycin, and ciprofloxacin. 2. Antibiotic-resistant technique. 3. Microbial spoilage testing of pharmaceuticals. 4. Bioassay of antifungal compound. 5. Self-life determination of expired antibiotics. 6. Sterility testing for commercial pharmaceuticals. 7. Determination of minimum inhibitory concentration (mic) of antibiotics.	30
Keywords	Pharmacokinetics, Pharmacodynamics, Secondary Metabolites, Combinatorial Drugs.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text book**- FSK Barar- Pharmaceutical- Essentials of Pharmaceuticals- S.Chand ➢ S.P. Vyas, Dixit- Pharmaceutical Biotechnology-CBS Gupta P.K. - Biotechnology and Genomics, Rastogi Publication
Reference book- • Hugo W. B. and Russell A. D. - Pharmaceutical Microbiology -Wiley India • B.Razdan-Medicinal Chemistry-CBS • Satoskar, Bhandarkar- Pharmacology and Pharmacotherapeutics- Popular • Purohit, Saluja- Pharmaceutical Biotechnology-Student Edition
Online resources- https://nptel.ac.in/courses/104102113 https://onlinecourses.nptel.ac.in/noc19_bt23/preview

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Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **10 +10** Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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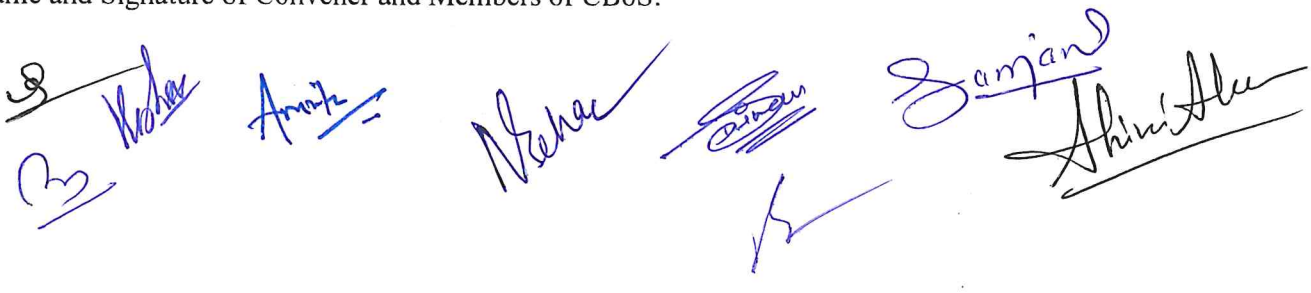

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-09-P**	
2	Course Title	**Microbial products for human consumption**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills for antibiotic production, • Develop skills for enzymatic production. • Develop skills for nutraceutical production.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1) Production of Penicillin by using microbes. 2) Production of enzymes by using microbes. 3) Preparation of fermented food, viz., bread, tofu, etc. 4) Production of yogurt, and cheese by using microbes. 5) Production of alcohol by using microbes.	30
Keywords	Fermentation, Biotransformations, Wine Production, Single Cell Protein.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
➢ Text book- ➢ **Microbial Products for Health, Environment and Agriculture- PK Aurora** ➢ **Microbial Products- S Singh**
• Industrial Microbiology- A.H. Patel. • Microbiology- Pelczar&Pelczar. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
• Online resources- https://archive.nptel.ac.in/courses/102/103/102103015/ • https://onlinecourses.swayam2.ac.in/cec19_ag03/preview

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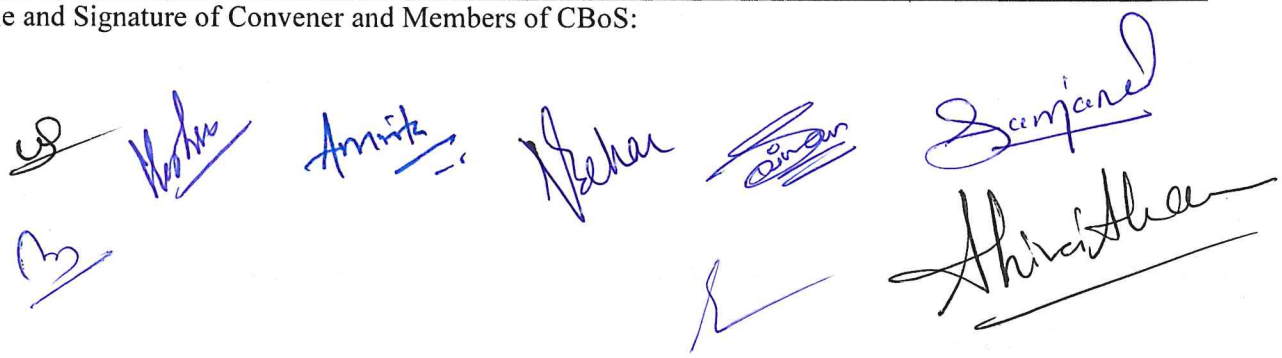
Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:



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Four-Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:2024-2025
1	Course Code	**BTSE-10-P**	
2	Course Title	**Microbial products for agriculture**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Isolate and maintain symbiotic and a symbiotic microorganism • Develop skill for biofertilizer and biopesticide production. • Develop skill for genetic modification of plants. • Develop skill for fertilizer developments.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Isolation and characterization of asymbiotic bacteria. 2. Isolation and characterization of symbiotic bacteria. 3. Isolation and characterization of *Bacillus thuringenesis* (BT). 4. Preparation of biofertilizers by using microbes. 5. Preparation of biopesticides by using plant products. 6. Determination of comparative efficiency of plant-based biofertilisers. 7. Determination of comparative efficiency of plant-based biopesticides against various pests. 8. Comparative study on growth of plant by using non-Bt and Bt strains. 9. Preparation of compost. 10. Comparative study of the efficacy of compost and inorganic fertilizers.	30
Keywords	Biofertilisers, Biopesticides, Transgenic Crops, Composting.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
• **Text book-** Industrial Microbiology- A.H. Patel. • Guptal PK ad genetics and biotechnology in crop improvement- Rastogi Publication • Pathak VN Khatri, Pwathak M- Fundamentals of plant pathology- Arobotanoical publication.
References book- • Bilgrami KS and Dubey HG- Textbook of modern plant pathology, Vikas publication. • Vyas S and Modi HA- Biofertisers and organic farming- AKTA Prakashan • Microbiology- Pelczar & Pelczar.

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• Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.
Online resources- https://archive.nptel.ac.in/courses/126/105/126105013/ https://onlinecourses.swayam2.ac.in/cec19_ag03/preview

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachlor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-11-P**	
2	Course Title	**Microbial products for industrial use and application**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Develop skills industrially useful enzymes. • Develop skills for industrially usable microbes. • Develop skills for production of organic acids. • Develop skills for industrially significant microbes.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Production of amylase using microbes. 2. Production of catalase using microbes. 3. Production of lipase using microbes. 4. Production of organic acids using microbes. 5. Production of alcohol using microbes. 6. Culture and maintenance of industrially significant bacteria. 7. Culture and maintenance of industrially significant yeast and fungus.	30
Keywords	Amylase, Lactic Acid, Glycerol, Bioplastics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- ➢ Hand book of fermentation technology- E S Minj ➢ Industrial Microbiology- A.H. Patel.
Reference book- • Wastewater Engineering- Treatment, Disposal & Reuse. Metall and Eddy, Inc., Tata Mcgraw Hill, N. Delhi. • Microbiology- Pelczar&Pelczar. • Environmental Biotechnology, PrathamVashishith. Dominant Publishers And Distributors, N.Delhi. • Principles of Fermentation Technology; Stanburry. • Industrial Microbiology; Casida.

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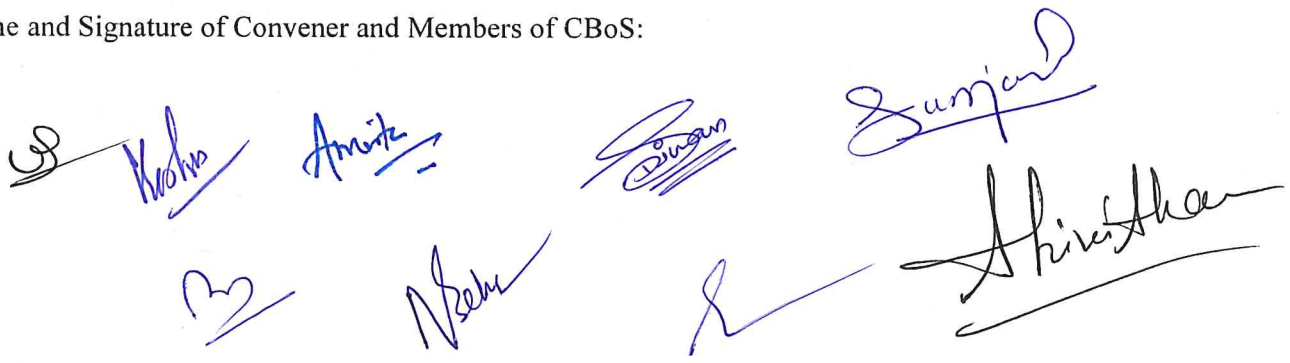
Online resources- https://onlinecourses.nptel.ac.in/noc20_bt21/preview https://unacademy.com/content/cbse-class-12/study-material/biology/microbes-in-industrial-products/

Part D: **Assessment and Evaluation**			
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**			
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**		Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**		Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:



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Four-Year Undergraduate Program (2024-2025)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Honors)		Semester: **VIII Sem**	Session:**2024-2025**
1	Course Code	**BTSE-12-P**	
2	Course Title	**IPR, Biosafety, and Bioethics.**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand about the industrial property right. • Develop skill for patent filing. • Develop competency for local right protection. • Develop competency for protection of commerce and literary outcomes.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Preparation of application for patent filing. 2. Suitability study for patenting of products. 3. Suitability study for geographical indications. 4. Suitability study for trademark. 5. Suitability study for copyright claim.	30
Keywords	Patent, Trademark, Copyright, Geographical Indications.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text book- • IPR, Biosafety, and Bioethics by Goel and Parashar. • Intellectual property rights, biosafety, and bioethics (ethical frontiers) by Dr. Alok Kumar Srivastav et al.
Reference Book- • PR Handbook for Pharma Students and Researchers- P Bansal. • Law relating to intellectual property right- V K Ahuja.
Online resources- https://onlinecourses.nptel.ac.in/noc21_lw04/preview https://elearning.icar.gov.in/DisplayUG_ECoursesContent.aspx?CourseCode=qpl3yaiUxBHqOVkf/L23mw==

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Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:



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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Certificate/Diploma/Degree/Honors)		Semester: **II Sem**	Session:**2024-2025**
1	Course Code	**BTSEC-01**	
2	Course Title	**Biopesticides and Biofertilizer**	
3	Course Type	Skill Enhancement Course (SEC)	
4	Pre-requisite (if any)	As per requirement.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand the basic concept of biofertilizers and biopesticides. • Understand the significance and applications of biofertilizers and biopesticides. • Develop skills for the production and application of biofertilizers. • Develop skills for the production and application of biopesticides.	
6	Credit Value	02 credits (1C + 1C) Credit=15 hours- Theoretical learning and = 30 hours laboratory or field learning/ training.	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods Theory- 15 Periods (15 Hrs) and Lab or Field learning/Training30 periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Theory Contents	**Concept of biofertilizers and biopesticides** 1. Biofertilizers: classification and applications. 2. Symbiotic and asymbiotic process for nitrogen fixation. 3. Methods for production of biofertilizers. 4. Study of VA-mycorrhiza and its application. 5. Biopesticides: classification and applications. 6. Process of production of biopesticides. 7. Importance of *Trichoderma, Pseudomonas, and Bacillus* species as biocontrol agents. 8. Factors responsible for the effectiveness of bioagents against seed-borne and soil-borne pathogens.	15
Lab/Field Training Contents	1. Media preparation to culture microorganisms. 2. Collection and isolation of agriculturally important microorganisms. 3. Identification and characterization of microorganisms. 4. Screening of superior strains using in vitro techniques. 5. Inoculum development. 6. Preparation of carrier. 7. Mixing of inoculum and carrier. 8. Efficiency check of developed inoculant by using pot experiments.	30
Keywords	Biofertilisers, biopesticides, bioagents.	

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• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- Biofertilisers and biopesticides – K Acharya, S Sen, M Rai • S. Kannaiyan- Biofertiliser Technology-Scientific Publishers. • Environmental Biotechnology- Himalaya Publishing House.
Reference Book- • Dr. Himadri Panda- The Complete Technology Book on Biofertilizer and Organic Farming- NPCS.
Online resources- https://archive.nptel.ac.in/courses/126/105/126105024/ https://archive.nptel.ac.in/courses/102/105/102105058/

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **50 Marks** **Continuous Internal Assessment (CIA):** **15 Marks** **End Semester Exam (ESE):** **35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory/Field Skill Performance: On spot Assessment** **A. Performed the task based on learned skill - 20 Marks** **B. Spotting based on tools (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by Coordinator as per skilling

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Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: BSc in Life Sciences (Certificate/ Diploma/Degree/Honors)		Semester: **I Sem**	Session:**2024-2025**
1	Course Code	**BTVAC-01**	
2	Course Title	**Plants-based Secondary Metabolites**	
3	Course Type	Value Addition Course (VAC)	
4	Pre-requisite (if any)	As per requirement.	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand the medicinal values applicable to the Indian knowledge system. • Identify the plants with medicinal viability. • Explore the scientific validation of our traditional knowledge. • Develop competency for exploration of secondary metabolites and their application.	
6	Credit Value	02 credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 30 Periods (30 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Medicinal plants and their viability** 1. General account of medicinal plant. 2. Scope of medicinal plants in the Indian market and abroad. 3. Role of medicinal plants in human health, advantage and limitation. 4. The basic theory of instrumental mechanism e.g. Soxhlet, oven, lyophilizer, etc.	08 (08 Hrs)
II	**Significance of the Indian knowledge system** 1. Extraction techniques used for secondary metabolite isolation. 2. Secondary metabolite storage. 3. Systems of Indian medicines: Ayurveda, Unani, Siddha, and Homeopathy. 4. Classification of crude drugs: Morphological, taxonomical, chemical, and pharmacological.	07 (07 Hrs)
III	**Methods for phytochemical screening** 1. Preparation technique of herbal infusions, decoctions, lotions, etc. 2. Introduction to phytochemical screening-alkaloids, polyphenolic compounds. 3. Introduction to phytochemical screening- glycosides. 4. Introduction to biological testing of herbal drugs (analgesics, anti-inflammatory and antianxiety agents).	08 (08 Hrs)
IV	**Essential industrial regulations** 1. Calibration and validation as per ICH and USFDA guidelines. 2. Production management, supply chain management & challenges 3. Government subsidy & industries,	07 (07 Hrs)

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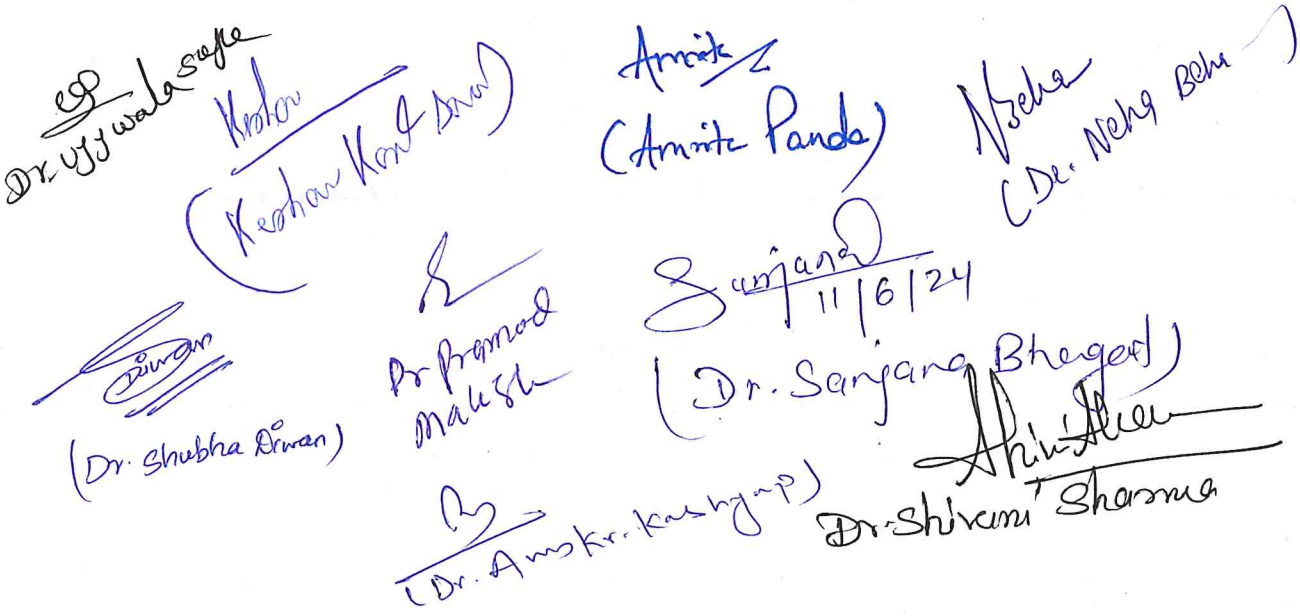
	4. Types of diseases by controlled bioagent formulations.	
Keywords	Secondary metabolite, alkaloids, medicinal plants, phytochemicals.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- Plants Secondary Metabolites- AK Sharma **Plant Secondary Metabolites for Human Health- Dr. M M Abid Ali Khan**
• Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur. • Tribal medicine – D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta – 700 006. • Contribution to Indian ethnobotany – S.K. Jain 1995, 3rd edition, Scientific publishers, P.B.No. 91, Jodhpur, India. • A Manual of Ethnobotany – S.K.Jain, 1995, 2nd edition.
Online resources- https://onlinecourses.nptel.ac.in/noc20_bt34/preview http://acl.digimat.in/nptel/courses/video/102106080/lec14.pdf

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **10 +10** Assignment / Seminar - 05 Total Marks - **35**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – 05 **x1**= 05 Mark; **Q2**. Short answer type- **5x2** =10 **Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x05**=20 **Marks**	

Name and Signature of Convener and Members of CBoS:



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FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

COURSE CURRICULUM

PART A: INTRODUCTION			
Program: Certificate Course		**Semester- I Sem**	**Session: 2024-25**
1	**Course Code**	**AEC 01**	
2	**Course Title**	**Environmental Studies**	
3	**Course Type**	**Ability Enhancement Course (AEC)**	
4	**Prerequisite (If Any)**	**As per requirement**	
5	**Course Outcome (CO)**	**At the end of this course, students will be able to –** **CO 01:** relate the basic concept of the environment **CO 02:** explain environmental alterations **CO 03:** develop skills in environmental measurement **CO 04:** examine correction measures of the environment	
6	**Credit Value**	**02 C**	**01 Credit = 15 Hrs. Teaching-Learning**
7	**Total Marks**	**Max. Marks: 50**	**Minimum Pass marks: 20**

PART: B CONTENT OF THE COURSE		
Total No. of Teaching-Learning Periods: 30Hours/ 30Periods		
UNIT	**TOPIC (Course Contents)**	**No. of Hours**
I	**Basic Composition:** 1. Abiotic and Biotic components of the environment 2. Biodiversity—Concept, types, and measures about its protection 3. Basic concept of Bio-Geo Chemical Cycle 4. Energy Flow in an ecosystem	**07**
II	**Alterations in Environment:** 1. Concept and components of the pond ecosystem 2. Air pollution and measures for its control 3. Water pollution and measures for its control 4. Global warming, Climate change, and possible measures	**07**
III	**Measurements of Environmental Components** 1. Soil composition and methods of its analysis 2. Water analysis methods for DO, BOD, COD 3. Water analysis methods for pH, TDS, Turbidity, Salinity, and Alkalinity 4. Information about environmental factors—PM-10, PM-2.5, NO2, O3	**08**
IV	**Application Measures** 1. Useful microbes to control water pollution 2. Useful microbes to control soil pollution 3. Concept of Biodegradation 4. Concept of Phytoremediation	**08**
Key Words	**Ecosystem, Pollution, Climate Change, Biodegradation**	

Name and Signature of Convener and Members of CBOS

Dr. Ujjwala Sayde

Dr. Shubha Diwan 11/6/24

(Dr. Anuj Kr. Kanojia)

(Keshav Kant Shahi)

Dr. Pramod Maurya

Sanjaan 11/06/24

(Dr. Sanjaan Bhagat)

Neha Behar (11/6/24)

(Dr. Neha Behar)

Shivani

11/6/24

Dr. Shivani Sha

Amrita Panda 11/6/2024

(Dr. Amrita Panda)

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PART–C: Learning Resources

Text Books, Reference Books, and Others

Text Books Recommended –

1. *Ecology and Environment, 8th Edition, P.D.Sharma, Rastogi Publication, Meerut.*
2. *Environmental Biology, 2nd Edition, P,D.Sharma, Rastogi Publication, Meerut.*
3. *Environmental Biology and Toxicology, 2nd Edition, P.D.Sharma, Rastogi Publication, Meerut.*
4. *Environmental Studies, 1st Edition, S.V.S.Rana, Rastogi Publication, Meerut.*
5. *Environmental Biotechnology, 1st Edition, S. V. S. Rana, Rastogi Publication, Meerut.*

Online Resources–

- **e-Resources / e-books and e-learning portals**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Two sections – A & B** Section **A**: **Q1**. Objective – **05 x1= 05** Mark; **Q2**. Short answer type- **5x2 =10 Marks** Section **B**: Descriptive answer type qts.,**1out of 2** from each unit- **4x05 =20 Marks**	

Name and Signature of Convener & Members of CBoS:

Sanjay 11/06/24
(Dr. Sanjay Bhagat)

Shivani Sharma 11/6/24
(Dr. Shivani Sharma)

11.6.24
Dr. Vijaya Lakshmi

11/06/24
(Dr. Shubha Diwan)

Neha Behar 11/6/24
(Dr. Neha Behar)

Amita Panda
(Dr. Amita Panda)
11.6.2024

Dr. Pramod Kumar Malviya

(Dr. Anil Kumar Kanaujia)

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