Karmaveer Bhaurao Patil University, Satara

Syllabus for

M. Sc. II (Biotechnology)

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2025-2026

Preamble:

As per the NEP 2020 guidelines this updated syllabus is prepared for first year undergraduate students of Biotechnology. At this level, to develop their interest towards Biotechnology as applied science and also to prepare them for academic and industrial exposure simultaneously. Introduction of life science subjects will help to form a basic foundation of concepts for students. The interdisciplinary approach with vigor and depth is compatible with the syllabi of other universities, and at the same time is not rigid for the students in the first year of their graduation. The Modules in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance.

GENERAL OBJECTIVES OF THE COURSE:

1. The students are expected to understand the knowledge about core areas of biotechnology
2. The practical course is framed in relevance with theory courses to improve understanding of various concepts in biotechnology
3. The students are expected to acquire knowledge, critical thinking skill and experience in conducting cutting edge research
4. It is expected to instill the ability for research and entrepreneurship in the students along with strong ethics and communication skills
5. The students are expected to get equipped and motivated to pursue higher education and research in reputed institutes at national and international level in biotechnology.

PROGRAM OUTCOMES:

1. Graduate with proficiency in the biotechnology.
2. Eligible to continue higher studies in the subject.
3. Eligible to peruse higher education in abroad.
4. Enable graduate to pursue research career in industry and academia.
5. Eligible for jobs in industry, research institutes, government sector, NGOs. Etc.
6. Able to do advanced scientific research and entrepreneurship

PROGRAM SPECIFIC OUTCOMES

1. Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom.
2. Develop the ability to apply the knowledge acquired in classroom and laboratories to specific problems in theoretical and experimental biotechnology.
3. Empower the students to acquire technological knowledge by connecting disciplinary and interdisciplinary aspects of biotechnology.
4. Identify the area of interest in the academic research and development.
5. Perform job in various fields like food, pharmaceutical, agriculture, healthcare, public services and business etc.
6. Be an entrepreneur with precision, analytical mind, innovative thinking, and clarity of thought, expression and systematic approach.

- TITLE: **Biotechnology**
- YEAR OF IMPLEMENTATION: **2025-2026**
- DURATION: **01 year**
- PATTERN: **Semester examination**
- MEDIUM OF INSTRUCTION: **English**
- EVALUATION STRUCTURE: **M.Sc. II NEP 2.0**

Semester III

Course	Course Category	Course Code	Internal Evaluation				ESE	Total Marks	Credits
			CCE-I	Mid-Semester	CCE-II	Activity			
DSC	T	MBTT 531	10	10	10	10	60	100	04
	T	MBTT 532	10	10	10	10	60	100	04
	T	MBTT 533	10	10	10	10	60	100	04
	P	MBTP 535	--	--	--	--	50	50	02
DSE (1 Theory Papers Out of Two)	T	MBTT 534	05	05	05	05	30	50	02
	T	MBTT 534	05	05	05	05	30	50	02
RP	P	MBTP 536	--	--	--	--	150	150	06

Semester IV

Course	Cours4e Category	Course Code	Internal Evaluation				ESE	Total Marks	Credits
			CCE-I	Mid-Semester	CCE-II	Activity			
DSC	T	MBTT 541	10	10	10	10	60	100	04
	T	MBTT 542	10	10	10	10	60	100	04
	T	MBTT 543	10	10	10	10	60	100	04
	P	MBTP 545	--	--	--	--	50	50	02
DSE (1 Theory Papers Out of Two)	T	MBTT 544	05	05	05	05	30	50	02
	T	MBTT 544	05	05	05	05	30	50	02
	P	MBTP 546	--	--	--	--	50	50	02
	P	MBTP 546	--	--	--	--	50	50	02
OJT	P	MBTP 547	--	--	--	--	100	100	04
Total								**550**	**22**

DSC: Discipline Specific Course; DSE: Discipline Specific Elective RM: Research Methodology; OJT: On Job Training; RP: Research Project; T: Theory; P: Practical

➢ STRUCTURE OF COURSE: **M. Sc. II**

Level	Sem.	Major				RM	OJT	RP	Total
		DSC		DSE					
		T	P	T	P				
6.5	III	12 (3 Courses)	2	2 (1 course out of two)	--	---	---	6	22
	IV	12 (3 Courses)	2	2 (1 course out of two)	2	---	4	---	22
Total		24	4	4	2	--	4	6	44
		34				4		6	

➢ Course Title**: Semester – III**

Level	Semester	Course Code	Name of the Course	No. of Hours per week	Credits
6.5	III	MBTT 531	Bioprocesses & Fermentation Technology	4	4
		MBTT 532	Bioinformatics	4	4
		MBTT 533	Genetic Engineering	4	4
		MBTT 534 E-I MBTT 534 E-II DSE(Elective any one among two)	E-I) Nano-biotechnology E-II) Artificial Intelligence in Biotechnology	2	2
		MBTT 535	Practical V: LAB V	4	2
		MBTP 536	Research project	4	6
				Total	22

Structure of Course: M.Sc. – II Semester –IV

Level	Semester	Course Code	Name of the Course	No. of Hours per week	Credits
6.5	IV	MBTT 541	Environmental biotechnology	4	4
		MBTT 542	Bio entrepreneurship & IPR	4	4
		MBTT 543	Biostatistics & Clinical research	4	4
		MBTT 544 E-I MBTT 544 E-II DSE (Elective any one among two)	E-I) Genomics and Proteomics E-II) Agriculture Biotechnology	2	2
		MBTP 545	Practical VI: LAB VI	4	2
		MBTP 546	Practical VII: LAB VII	4	2
		MBTP 547	On job Training	8	4
				Total	**22**

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: M.Sc. II	**Semester- III**
Type: Major	**Marks:** 100
Credits:4	**From:** A.Y.2025-26

Name of the Course: MBTT531 (DSC I): Bioprocesses & fermentation Technology

Course Objectives: The students should be able to…

1) learn concept of bioreactor
2) study digital monitoring in fermentation
3) understand concept upstream and downstream processing
4) aware the lab fermentation to scale up procedures

Course Outcomes: Students will be able to…

1) differentiate various types of design of fermenters/ bioreactors
2) gain knowledge of fermentation media , sterilization strain improvement
3) implement knowledge in industrial production, upstream and downstream processes
4) utilize the knowledge to learn various production processes.

Module	Title and Contents	Hrs
Module-1:	**Fermentation and its types** **1.1** Introduction to fermentation **1.2** Type of fermentation–Batch, Fed Batch and Continuous processes. **1.3** Basic Design of fermenter **1.4** Design aspect of Stirred tank reactor and non-mechanically agitated bioreactors **1.5** Airlift and Bubble column **1.6** Design and operation of immobilized cell reactors. Mass transfer, Aeration and agitation of fermentation broth.	15
Module-2:	**Fermentation media and monitoring of process variables** **2.1** Media components - C, N, P **2.2** Optimization and sterilization of media **2.3** Kinetics of destruction of microorganisms, indicator organism, Del factor. **2.4** Designs of batch and continuous sterilization **2.5** Equipment used. Filter sterilization. Monitoring of process variables **2.6** Types of sensors, Measurement and control of various parameters (pH, Temperature, dissolved oxygen, microbial biomass, inlet and exit gases, fluid flow, Pressure, Foam).	15
Module-3:	**Production and downstream processing** **3.1** Concept of primary (growth associated) and secondary metabolites (Non-growth associated) metabolites **3.2** Kinetics of growth and product formation, yield and efficiency. **3.3** Downstream processing and module operations. **3.4** General strategy of downstream processing, production, recovery (with principles of techniques involved) **3.5** fermentation economics.	15
Module-4:	**Fermentative products** **4.1** Antibiotics-penicillin **4.2** Biotransformation product (steroid) **4.3** Wine **4.4** Beer **4.5** Xanthan gum **4.6** Lactic acid **4.8** Citric acid by SSF **4.9** Vitamins (Vitamin C) **4.10** Amino acids	15

	4.11 Enzymes (hydrolase).	

Reference Books:-

1. *L. E. Casida* Industrial Microbiology, Wiley Easterbs, New Delhi, 1984
2. *A. H. Patel.* , Industrial Microbiology, Macmillan India Ltd. 1985.
3. *P. Doran,* Bioprocess Engineering, Principles - Academic Press. 1995
4. Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann. 1992
5. *W. Crueger* and *A.* A *Crueger,* TextBook of Industrial Biotechnology, Panima, New Delhi. 2005
6. *R. Harrison, P. Todd* Bioseparations science and Engineering, Oxford University Press 2006
7. *S. Lydersen,* Bioprocess Engineering : Systems, Equipment & Facilities Ed. B. N.A. Delia & K.M. Nelson, John Wiley & Sons Inc. 1993
8. *S. C. Prescott* and *C. G. Dunn,* Industrial Microbiology, Reed G. AVI tech books. 1983
9. *U. Satyanarayan* Biotechnology, Arunabha Sen Books allied Publishers. 2000
10. *P. F. Stanbury and A. Whittaker* Principles of Fermentation technology, Pergamon press. 1984.

Evaluation Pattern:60/40

Total Marks:100

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 10 marks • Mid semester: 10 marks • CCE II: 10 marks • Activity: 10 marks	• Question-1: 12 marks • Question-2: 12 marks • Question-3: 12 marks • Question-4: 12 marks • Question-5: 12 marks • Question-6: 12 marks • Question-7: 12 marks

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Programme: M.Sc. II	**Semester- III**
Type: Major	**Marks:** 100
Credits: 4	**From:** A. Y.2025-26

Name of the Course: MBTT 532 (DSC II): Bioinformatics

Course Objectives: The students should be able to…

1) learn various bioinformatics tools and techniques.
2) understand concepts of various databases and various methods.
3) study bioinformatics tools for the analysis of the biological experimental data.
4) implement sequencing techniques and gene annotation.

Course Outcomes: Students will be able to…

1) apply various bioinformatics tools and techniques for the analysis of the biological experimental data.
2) implement *in-silico* approach for the protein modeling and drug discovery process.
3) understand the concepts of DNA mutation, gene expression, protein synthesis.
4) perform various sequencing techniques and gene annotation.

Module	Title and Contents	Hrs
Module-1:	**Basics of bioinformatics** **1.1** Bioinformatics: Introduction and definition, Scope and Applications. **1.2** Introduction to Biological Databases: Types of databases, Biological databases, Information retrieval from Biological databases. **1.3** Types of protein sequence databases **1.4** Primary protein sequence databases: SWISS- PROT, PIR, TrEMBL. **1.5** Secondary protein sequence databases: PROSITE, PROFILE, PRINT. **1.6** Literature database: PubMed, PubMed Central. **1.7** Structural databases: PDB, MMDB, CATH, SCOP, PdbSum	15
Module-2:	**Structural bioinformatics** **2.1** Protein Structure Basics: Amino acids, Peptide bond formation, Secondary structures, Tertiary structures **2.2** Determination of Protein Three-Dimensional Structure. **2.3** Protein Structure Visualization, Comparison and Classification, CATH & SCOP **2.4** Protein Secondary Structure Prediction Protein Tertiary Structure Prediction: Homology Modeling	15
Module-3:	**Gene and promoter prediction** **3.1** Gene Prediction **3.2** Gene Prediction in Prokaryotes: Promoter and regulatory element prediction **3.3** Gene Prediction in Eukaryotes: Promoter and regulatory elements prediction	15
Module-4:	**Sequence alignment and molecular phylogenetic** **4.1** Sequence alignment: Significance of Sequence alignment, Global Alignment and local sequence alignment. **4.2** Multiple Sequence Alignment **4.3** Pair wise Sequence Alignment: Dot matrix, the dynamic programming (or DP) algorithm, Word or k-tuple methods, Database Similarity Searching: FASTA and BLAST. **4.4** Primer designing software, Software study: Mega4, Clustar Omega. **4.5** Phylogenetic analysis, Relationship of phylogenetic analysis to sequence alignment, Genome complexity and phylogenetic analysis, Concept of evolutionary trees.	15

Reference Books:-

1. *Mount D. W.*, Bioinformatics-Sequence and Genome Analysis Cold Spring Harbor Laboratory Press; 2nd edition, 2004
2. Thomas Langauer (editor) Bioinformatics - From Gen omes to Drugs Wiley-VCH; 1st edition, 2001
3. Mount D. W, Bioinformatics-Sequence and Genome Analysis Cold Spring Harbor Laboratory Press; 2nd edition, 2004.
4. Graham D.R. M.Broad-based Proteomics strategies: a practical guide to proteomics and functional screening et al J.Physiol 2005,
5. Miller W. Comparative Genomics et al Annu.Rev. Genomics Hum.Genet 2004
6. Malcoln A. Campbell, Laurie J. Discovering genomics, Proteomics and Bioinformatics 2006
7. Peter Y. V. Trends in Bioinformatics Research, Published by Nova Science Publishers, Incorporated, Mishawaka, IN, U.S.A., 2006.
8. Baldi P, G W Hatfield DNA microarrays and gene expression Cambridge University Press, 2002.
9. Xiong J.Essential Bioinformatics Cambridge University Press; 1st edition, 2006
10. Campbell A. M, L. J. Heyer Discovering genomics, proteomics, and bioinformatics, 2nd edition, CSHL Press : Pearson/Benjamin Cummings, San Francisco, 2007.

Evaluation Pattern: 60/40

Total Marks: 100

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 10 marks • Mid semester: 10 marks • CCE II: 10 marks • Activity: 10 marks	• Question-1: 12 marks • Question-2: 12 marks • Question-3: 12 marks • Question-4: 12 marks • Question-5: 12 marks • Question-6: 12 marks • Question-7: 12 marks

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Programme: M.Sc.	**Semester- III**
Type: Major	**Marks:** 100
Credits: 4	**From:** A. Y.2025-26

Name of the Course: MBTT 533 (DSC III): Genetic Engineering

Course Objectives: The students should be able to…

1) know basic tools of genetic engineering
2) study various vectors in genetic engineering
3) learn methodologies of gene cloning
4) understand the applications of genetic engineering

Course Outcomes: Students will be able to…

1) describe basic tools of genetic engineering
2) discuss various vectors in genetic engineering
3) elaborate methodologies of gene cloning
4) discuss the applications of genetic engineering

Module	Title and Contents	Hrs
Module-1:	**DNA & basics of recombinant DNA technology** **1.1** Enzymes used in rDNA technology, Modification systems, type II restriction endonucleases and properties **1.2** Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing. **1.3** Labeling of DNA: Nick translation, random priming, radioactive and non-radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase, ligase, nuclease. Revers transcriptase. **1.4** Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization, **1.5** Restriction maps and mapping techniques, DNA fingerprinting, Chromosome walking & chromosome jumping	15
Module-2:	**Cloning Vectors** **2.1** Gene Cloning Vectors: Plasmids, bacteriophages, Cloning in M13 mp vectors, phagemids, Lambda vectors; insertion and replacement vectors, Cosmid vectors. **2.2** Artificial chromosome vectors (YACs, BACs) **2.3** Animal Virus derived vectors- SV- 40, vaccinia / bacculo & retroviral vectors. **2.4** Expression vectors: pMal, GST, pET-based vectors. Viral vectors	15
Module-3:	**Cloning Methodologies** **3.1** Insertion of Foreign DNA into Host Cells: Transformation, Transfection: Chemical and physical methods, liposomes, microinjection, macro injection, electroporation, biolistics, somatic cell fusion. **3.2** Cloning and expression in yeasts (Saccharomyces), animal and plants cells, methods of selection and screening, cDNA and genomic cloning, expression cloning, jumping and hopping libraries. **3.3** Construction of cDNA and genomic DNA libraries. **3.4** Screening of libraries	15
Module-4:	**PCR and Its Applications** **4.1** Primer design, Fidelity of thermostable enzymes, DNA polymerases, multiplex, nested, reverse transcriptase. **4.2** Real time PCR, hot start PCR, colony PCR, cloning of PCR products, PCR in molecular diagnostics **4.3** PCR based mutagenesis and its applications **4.4** Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, principle of automated DNA sequencing **4.5** Gene silencing techniques: Introduction to siRNA, micro RNA, principle and application of gene silencing, Crisper technology.	15

Reference Books:-

1) Glover D.M and D.B. Hames DNA Cloning : A practical approach, RL Press, Oxford, 1995
2) Mickloss D. A. and G. A Freyer, DNA Science: A First Course in Recombinant Technology, Cold Spring Harbor Laboratory Press, New York, 1990.l
3) Kingsman S. M. Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, Blackwell Scientific Publications, Oxford, 1998.
4) Goedel V., Methods in Enzymology Gene Expression Technology, Vol. 185D. Academic Press Inc, San Diego, 1990.
5) Berger S. L. and A. R. Kimmel, Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 Academic Press Inc, San Diego, 1996.
6) Davis J. A. and W. S. Reznikof Milestones in Biotechnology, Classic Papers on Genetic Engineering, Butterworth-Heinemann Ltd, 1993.
7) Sambrook J. E. F. Fritsch and Maniatis, Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York. 1989.
8) Kim Donghern, Peter B. Kaufman, Leland J. Cseke, William Wu, Molecular and cellular methods in Biology and Medicine, CRC Press; 1st edition, 1995.
9) OldR.W and S. B. Primrose, Principles of Gene Manipulation, Blackwell Science Ltd, 1980.
10) Walke M. R, and R. Rapley, Route Maps in Gene Technology, Blakwell Science, 1997

Evaluation Pattern:60/40

Total Marks:100

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 10 marks • Mid semester: 10 marks • CCE II: 10 marks • Activity: 10 marks	• Question-1: 12 marks • Question-2: 12 marks • Question-3: 12 marks • Question-4: 12 marks • Question-5: 12 marks • Question-6: 12 marks • Question-7: 12 marks

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Programme: M.Sc.	**Semester- III**
Type: Minor	**Marks:** 50
Credits: 2	**From:** A. Y.2025-26

Name of the Course: MBTT534 (DSE I): Nano-biotechnology

Course Objectives: The students should be able to…

1) study the basic knowledge of nanoscience and technology.
2) understand biological nanostructure and various methods of nanomaterials synthesis

Course Outcomes: Students will be able to…

1) apply knowledge regarding nanomedicine for various diseases
2) describe and identify nanoscopic structure present in natural materials.

Module	Title and Contents	Hrs
Module-1:	**Biosynthesis of Nanoparticles** **1.1** Introduction to Nanoscale, Nanomaterials, Nanoscience and Nanotechnology. Its significance **1.2** Biosynthesis of nanoparticles from plants, fungi & microorganisms and their application. **1.3** Biological Sensors and Detectors and their applications**.** **1.4** Future aspects and importance of Nanotechnology in environmental conservation	07
Module-2:	**Nanomedicine application** **2.1** Applications of nano in biology. Concept of disease, **2.2** Cause and molecular/cellular progression of key diseases including infectious, **2.3** Inherited diseases, immunological diseases and cancer.	08
Module-3:	**Protein based nanostructure** **3.1**Nanoparticles for electrochemical bioassays, **3.2** Luminescent semiconductor quantum dots, and **3.3** Applications of nanotechnology in tissue engineering and regenerative medicine	08
Module-4:	**Nanomedicine and Nanosensing** **4.1** Liposomes in nanomedicine, therapeutic applications, nano-sized carriers for drug delivery, **4.2** Design of bionanosensor. **4.3** Approach to developing nanomedicine	07

Reference Books:-

1. Greco RS, FB. Prinz, RL Smith (Editors), Nanoscale Technology In Biological Systems. CRCPress, 2004.
2. MalschNH., Biomedical Nanotechnology. Taylor and Francis. CRC press, 2005.
3. Freitas RA Jr., Nanomedicine, Vol. I:Basic Capabilities, 1st edition, 2003
4. Boisseau P, M Lahmani. Nanoscience: Nanobiotechnology and Nanobiology, Springer Publishers. 2009.
5. Hornyak G., H. Tibbals, J. data, J. Moore. Introduction to Nanoscience and Nanotechnology, CRC Press, 2008.
6. Kulkarni S.K. Nanotechnology: Principles and Practices , Capital publish, 3 rd, edition, 2014
7. Pokropivny V., R. Lohmus, I. Hussainova, A. Pokropivny and S. Vlassov, Introduction to Nanomaterials and Nanotechnology by Tartu University Press, 2007.
8. Murty B. S, P. Shankar, B Raj, B. B. Rath, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Berlin, Heidelberg, 2013.
9. Gazit E. Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology, Imperial college Press, 2007.
10. Challa S., S. R. Kumar, J. H. Carola Nanofabrication towards biomedical application: Techniques, tools, application and impact, John Wiley and sons. 2006.

Evaluation Pattern:30/20	
Total Marks: 50	
Internal Continuous Evaluation: • CCE I : 05 marks • Mid semester: 05 marks • CCE II: 05 marks • Activity: 05 marks	**End Semester Examination:** • Question-1: 10 marks • Question-2: 10 marks • Question-3: 10 marks • Question-4: 10 marks

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Programme: M.Sc.	**Semester- III**
Type: Minor	**Marks:** 50
Credits: 2	**From:** A. Y.2025-26

Name of the Course: MBTT534 (DSEII): Artificial Intelligence in Biotechnology

Course Objectives: The students should be able to…

1) understand the principles involved in the artificial intelligence
2) know the applications of AI in biotechnology.

Course Outcomes:: Students will be able……

1) explain history and scope of AI.
2) analyze role of AI applications in biotechnology.

Module	Title and Contents	Hrs
Module-1:	**Artificial Intelligence** **1.1** Definition and scope of AI Historical overview and key milestones **1.2** Differentiating AI from human intelligence – Future of Artificial Intelligence – Characteristic of Intelligent Agents – Typical Intelligent Agents –Problem Solving Approach to Typical AI problems. **1.3** Biological Sensors and Detectors and their applications. **1.4** Future aspects and importance of Nanotechnology in environmental conservation	08
Module-2:	**Applications of AI in Biotechnology** **2.1** Artificial Intelligence (AI) Technologies and Advanced Robotics in the Food Industry. **2.2** Technology available for AI relevant to Agro-Industry and Food Supply - AI in decision making for agricultural professionals and farmers.	07
Module-3:	**Protein based nanostructure** **3.1** Impact and Benefits of AI for a sustainable future Agri-Business and Food Industry **3.2** AI technologies in Systems Biology towards Pharmacogenomics. **3.3** AI in diagnosis of Genetic Diseases, Cancer Diabetes, Diagnosis of Syndrom, diagnosis of Psychiatric Disorders, **3.4** AI in Systems Biology for medicine and Cancer Cure. Role of artificial intelligence in Human life, ethical considerations of AI, current initiatives in AI and ethics	08
Module-4:	**AI technologies** **4.1** Machine learning basics, Deep Learning AI applications: Natural Language **4.2** Processing - Language Models – Machine Translation; Speech Recognition; Computer Vision - Image classification.	07

Reference Books:-

1) Kaliraj P., T. & Devi, (Eds.) Artificial Intelligence Theory, Models, and Applications (1st ed.). CRC Press, Taylor & Francis Group, Boca Raton, ebook 2021.
2) Russell S and P Norvig "Artificial Intelligence: A Modern Approach", Prentice Hall, 3rd Edition. 2010.
3) Wang, P. Z Fuzzy sets and its applications. Shanghai Science and Technology Press, Shanghai, 55-58. 1983.
4) Chen S. L, J. G. Li, & X. G. Wang Fuzzy set theory and its application. Beijing, Science publish company. 2005.
5) Rank A A, A. Asuncion UCI machine learning repository 2010,
6) Russell S. and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall,. 2008.
7) Tim M. Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; 1stEdition, 2008.
8) Nilsson N. J., "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
9) Jones M. T., "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; 1stt Edition, 2008.

Evaluation Pattern: 30/20	
Total Marks :50	
Internal Continuous Evaluation: • CCE I : 05 marks • Mid semester: 05 marks • CCE II: 05 marks • Activity: 05 marks	**End Semester Examination:** • Question-1: 10 marks • Question-2: 10 marks • Question-3: 10 marks • Question-4: 10 marks

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Programme: M.Sc.	**Semester** – III
Type : DSC-P	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course- MBTP 535: Practical –V (LAB V)

(Based on MBTT 531, 532, 533)

Course Objectives: Student should be able to…

1) understand screening, maintaining and Inoculum buildup of the isolated organism
2) know the skill for handling of genetic material
3) impart skill of measuring the microscopic objects
4) implement the practical skills of protein extraction, purification and characterization

Course Outcomes: Students will be able to…

1) apply skill & techniques in isolation, identification & screening of microbial strains from different soil samples
2) perform multiple and local sequence alignment for their experiment.
3) do practically ligation, transformation of DNA, Blotting techniques
4) handle genetic material skillfully for their applications

Sr. No.	Title and content	Hrs
1.	Screening and identification (Genus Level) of a production strain (enzyme/antibiotic) from soil samples	60
2.	Maintenance of the isolated production organism (Agar slants/ glycerol stocks /soil culture/ lyophilization) at least two methods.	
3.	Inoculum buildup of the isolated organism for use in bench top fermentation	
4.	Study of different parts and assembly of the bench top fermenter.	
5.	Study of Working of lab bench fermenter (with production of enzyme or antibiotic using screened organism),	
6.	Solid state fermentation: Lab scale production of a product	
7.	Demonstration of working of industrial fermenters by visiting fermentation industry	
8.	Retrieval of amino acid sequence and nucleotide sequence from NCBI database and perform BLAST.	
9.	Visualize and analyze the 3-D protein structure using RasMol	
10.	Perform homology modeling	
11.	Perform multiple sequence alignment	
12.	Perform primer designing	
13.	Perform phylogenetic studies	
14.	Perform isolation of plasmid DNA	
15.	Perform *In vitro* DNA ligation	
16.	Perform transformation of E.coli	
17.	Perform restriction mapping	
18.	Perform bacterial conjugation	
19.	Perform southern blotting and hybridization	
20.	Perform dot Blotting	

Reference Books:-

1) Stanbury P. F., and Whittaker, A. Principles of Fermentation technology, Pergamon press. 1984.
2) Sadashivam and Manikam, practical book of biochemistry springer. 2000.
3) Patel A. H. Industrial Microbiology, Macmillan India Ltd. C. 1985.
4) David W Mount, Bioinformatics-Sequence and Genome Analysis Cold Spring Harbor Laboratory Press; 2nd edition, 2004.
5) Xiong J., Essential Bioinformatics, Cambridge University Press; 1st edition, 2006.
6) Malcoln. A Campbell, Laurie J. Discovering genomics, Proteomics and Bioinformatics 2006.
7) Berger S. L. and A. R. Kimmel, Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 Academic Press Inc, San Diego, 1996.
8) Sambrook J, E. F. Fritsch and Maniatis. Molecular cloning, vol. I, II, III,th edition, Cold spring harbor laboratory press, New York. 1989.
9) Old R.W. and S. B. Primrose, Principles of Gene Manipulation, Blackwell Science Ltd. 1980.
10) Mount DW, Bioinformatics-Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press; 2nd edition, 2004.

Evaluation Pattern: 50

Total Marks: 50

Internal Continuous Evaluation:	**End Semester Examination:**
	• Question -1: 10 Marks • Question -2: 05 Marks • Question -3: 10 Marks • Question -4: 05 Marks • Question -5 : 05 Marks • Question -6 : 05 Marks • Question -7 : 05 Marks • Question -8 : 05 Marks

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: M.Sc.	**Semester** – III
Type : RP	**Marks: 150**
Credits :6	**From:** A. Y. 2025-26

Name of the Course -MBTP 536: Research Project

Module	Title and Content	Hrs
Module 1:	Students will undertake research in specific areas of his Major/Core with an advisory supported by a teacher/Faculty member. Students are required to take 6 credit Research Projects for semester III under the guidance of faculty members.	**180**

Evaluation Pattern: 150

Total Marks: 150

Internal Continuous Evaluation:	End Semester Examination:
	• Question -1: 30 marks • Question -2: 30 marks • Question -3: 30 marks • Question -4: 30 marks • Question -5: 30 marks

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Board of Studies in Biotechnology

Programme: M.Sc.	**Semester- IV**
Type: Major	**Marks:**100
Credits:4	**From:**A. Y.2025-26

Name of the Course: MBTT 541 (DSC I): Environmental Biotechnology

Course Objectives: The students should be able to…

1)gain knowledge of global and regional threats to the environment.
2)know the role of biotechnology in air pollution & management
3)aware the role of biotechnology in water pollution & management
4)understand the environmental laws

Course Outcomes: Students will be able to…

1)apply knowledge of global and regional threats to the environment; air, water and soil pollution
2)gain knowledge of role of biotechnology in effluent treatment,
3) implement knowledge in biodegradation, bioremediation, bio augmentation with examples.
4) understand the concepts of eia and environmental laws.

Module	Title and Contents	Hrs
Module-1:	**Global warming & greenhouse gasses** **1.1**Global and regional threats to the environment:, **1.2** Greenhouse effect &Global warming, **1.3** Sources of greenhouse gases, **1.4** Effect Measurement & control of greenhouse effect, **1.5** problem of ozone, ozone hole, effect of ozone depletion, measurement & control, **1.6** Development of acid rain, effects ,measurement	15
Module-2:	**Environmental pollution** **2.1** Environmental pollution, general, source and nature, **2.2** Air pollution, water and soil Pollution, **2.3** Types, sources and impacts, **2.4** Solid waste :Sources and types, **2.5**Impact on land of solid waste disposal, cycle Reuse and Recovery. **2.6** Biotechnology and environmental pollution control Re (waste water and air), **2.7** Biotechnology in control of Industrial pollution and safe disposal of industrial effluents (with 2-3 examples of Industrial effluenttypes and treatment), **2.8** Activated sludge process, Hospital waste management	15
Module-3:	**Biotechnological methods for management of pollution** **3.1**Management of pollution, **3.2** Atmospheric CO2 reduction, **3.3** management of metal pollution, **3.4** immobilized cells in management of pollution, **3.5** Biodegradation :Biodegradation of xenobiotic compounds: **3.6** Microbial basis of biodegradation Biopesticides, **3.7** Bioremediation: Meaning, Types, Process with examples, **3.8** bioremediation of wastewater(MSW,BSW,ISW), **3.9** Phytoremediation Metal remediation **3.10** Biofiltration, Bioaugmentation, Biostimulation. **3.11** Agricultural bioremediation: Microbial composting, biogas	15
Module-4:	**Environmental management** **4.1**ProblemsandneoEnvironmentalmanagementPlan scope, **4.2** EMP preparation, **4.3** Need of EMP Environmental Impact Assessment: **4.4** Objectives of EIA, EIA and International organizations, Stages of EIA process.	15

	4.5 EIA in India: Process Stages of Environmental clearance process, **4.6** ISO14000Environmentalauditsandethics Environmental Laws and Policies	

Reference Books:-

1) Indu Shekhar Thakur Environmental Biotechnology: Basic Concepts and Applications, I. K. International Pvt Ltd, 2006.
2) Gareth M. Evans and Judith C. Furlong. Environmental Biotechnology Theory and Application, John Wiley & Sons Inc. 2003.
3) Alan H. Scragg. Environmental Biotechnology, Oxford University Press. 1st edition 2006.
4) AgarwalS.K.. Environmental Biotechnology, APH Publishing Co-operation, New Delhi, 2007.
5) Murugesan A.G. and C. Rajakumari Environmental Science and Biotechnology Theory and techniques. MJP Publishers, Chennai, 2006.
6) Holmes, G; Singh, B R; Theodore, L. Handbook of Environmental management and technology, USA: Wiley Intersciences Publishers, 2000.
7) Suchandra Choudhury. An Introduction To Geographic Information Technology. IK International Pvt Ltd., New Delhi, 2009.
8) Levin M.V and Gealt, M.A. Biotreatment of Industrial & Hazardous Waste. McGraw Hill. Inc, New York, 1993
9) Albert C.P.L. and K.W. Yeung. Concepts and Techniques of Geographic Information Systems. Prentice Hall, Inc., New Jersey. 2nd edition, 2009.
10) Asthana & Asthana. Environment Problems & Solutions. S. Chand Limited, New Delhi,

Evaluation Pattern:60/40

Total Marks:100

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 10 marks • Mid semester: 10 marks • CCE II: 10 marks • Activity: 10 marks	• Question-1: 12 marks • Question-2: 12 marks • Question-3: 12 marks • Question-4: 12 marks • Question-5: 12 marks • Question-6: 12 marks • Question-7: 12 marks

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Board of Studies in Biotechnology

Programme: M.Sc.	**Semester- IV**
Type: Major	**Marks:**100
Credits:4	**From:**A. Y.2025-26

Name of the Course: MBTT 542 (DSC II): Bio entrepreneurship & IPR

Course Objectives: The students should be able to…

1) understand the dynamic role of entrepreneurship and small businesses.
2) learn to organize and manage a small business.
3) learn IPR and patent laws.
4) understand IPR regulations with special reference GMO

Course Outcomes: Students will be able to…

1)develop the business plan.
2)apply knowledge of fundamentals of management and administration.
3) identify legal forms of the business for registration of the small scale industries, agencies for the registration of the companies.
4) gain knowledge of IPR and patent rules and copyright act.

Module	Title and Contents	Hrs
Module-1:	**Entrepreneurship** **1.1** An Overview of Entrepreneurs and Entrepreneurship: definition, **1.2** Basic principles and practices of management- Definition, concepts and application; **1.3** Organization types ,coordination, control and decision making in management **1.4** Characteristics for being an entrepreneurin biotechnology, **1.5** Case studies of successful and unsuccessful bio-entrepreneurs **1.6** Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors. Marketing, Marketing research-concept and techniques	15
Module-2:	**Enterprises Classification and various promotion schemes** **2.1**Types of Enterprises and Owner ship Structure:small scale ,medium scale and large scale enterprises **2.2** role of small enterprises in economic development **2.3** proprietor ship, partnership, Ltd. Companies and co-operatives: their formation, capital structure and source of finance. **2.4** Projects: identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method. **2.5** Role of government and schemes, financial institutions in fostering bio-entrepreneurship **2.6** Factors affecting biotech business: (finance, infrastructure, equip	15
Module-3:	**Intellectual Property Rights** **3.1**Characteristics and Types of Intellectual Properties **3.2** Tools of IPR- Introduction and types, Treaties, Conventions, Laws, Acts, agreements pertaining to Biotechnology, **3.3** Tools of IPRs-1.Patents-prerequisites for patenting, **3.4** Biological Patents–, Biological Patents –a. Plant b. Animal c. Microbial patents **3.5.** Process patents and Product patents with one case study each. **3.6** Indian and International scenario **3.7** Protection of Plant varieties and Plant breeders rights, **3.8** Industrial Designs-Designs of gadgets used in Biotechnology	15

Module-4:	**Biosafety, rules and regulations regarding GMO** **4.1** Biosafety and Societal Concern, Public debate and concern on genetically modified microorganisms, plants and animals **4.2** scientific analyses of the concern, Biosafety regulation **4.3** guideline on developing and using the genetically modified organisms. **4.4** Patenting of Biological Materials: International conventions. International cooperation, obligations with patent applications, **4.5** Canliveformbe patented-with special reference to Factor VIII, Erythropoietin, tissue plasminogen, hybridoma technology etc. Patenting of higher plants, animals, genes, DNA sequences, transgenic organisms.	15

Reference Books:-

1) Entrepreneurship And Business of Biotechnology, Prof S N Jogdand, Himalaya Publisher. 2009.
2) Anil S. Kumar, Entrepreneurship Development, New Age International (P) Ltd. Publishers. 2003
3) Robert Mellor, Entrepreneurship for Everyone: A Student Textbook, Sage Publication Ltd. 2009.
4) Richard Blundel & Nigel Lockett , Exploring Entrepreneurship: Practices and Perspective, Oxford University Press. 2011.
5) Entrepreneurial Development: Text and Cases, Entrepreneurship Sultan Chand & Sons. 1992.
6) Shreefal S. Mehta, Commercializing Successful Biomedical Technologies, Cambridge University Press. 2008.
7) Handbook Of Bioentrepreneurship, Patzelt, Holger; Brenner, Thomas, Springer. 2008.
8) Wadehra Dr. B.L., Law Relating To Intellectual Property, Fifth Edition, Universal Law Publishing Co.Pvt. Ltd. 2011
9) Das H K Textbook of Biotechnology,4th edition, Wiley India Pvt. Ltd, New Delhi. 2010.
10) Ganguli P., Intellectual Property Rights, Tata McGraw-Hill Publishing Company Ltd.7. World Intellectual Property Rights (WIPO). 2001.

Evaluation Pattern: 60/40

Total Marks: 100

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 10 marks • Mid semester: 10 marks • CCE II: 10 marks • Activity: 10 marks	• Question-1: 12 marks • Question-2: 12 marks • Question-3: 12 marks • Question-4: 12 marks • Question-5: 12 marks • Question-6: 12 marks • Question-7: 12 marks

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Board of Studies in Biotechnology

Programme: M.Sc.	**Semester- IV**
Type: Major	**Marks:**100
Credits:4	**From:**A. Y.2025-26

Name of the Course: MBTT 543 (DSC III): Biostatistics & Clinical research

Course Objectives: The students should be able to…

1) know the mathematical applications in the biology
2) understand basic techniques, correlation and regression in statistics
3) study the principles involved in the ethical, legal, and regulatory issues
4) familiar with the basic methods involved in conducting clinical research

Course Outcomes: Students will be able to…

1) apply principles involved in the ethical, legal, and regulatory issues in clinical human subject's research, including the role of irb.
2) analyze the infrastructure required in performing clinical research
3) determine steps involved in developing and funding research studies.
4) explain data management system

Module	Title and Contents	Hrs
Module-1:	**Introduction to statistics and correlation and regression** **1.1** Introduction to Statistics: Measures of central tendency–mean, mode, median and their properties **1.2** Measures of dispersion–variance, standard deviation, coefficient of variance symmetry and skewness, measures of skewness **1.3** Correlation and regression: Bivariate correlation, positive correlation, negative correlation, Measures of correlation, Regression analysis	15
Module-2:	**Experimental statistics** **2.1** Design of experiments, Principles of design–randomization, replication, local control, treatment group and control group. **2.2** Level of significance, p-value, normal distribution, **2.3** T-test: t-test for mean, equality of two means, paired t-test, unpaired t test, chi-square test: chi square test for goodness of fit **2.4** Analysis of variance table (ANOVA)	15
Module-3:	**Introduction to clinical research** **3.1** Brief History of Clinical Research: Sulfanilamide Tragedy, 3 Thalidomide disaster, Nazi experiments, Tuskegee study, Belmont report, Nuremberg code, Declaration of Helsinki. **3.2** Clinical Research: An Overview, guidelines in Clinical Research, Different types of Clinical Research. **3.3** Clinical Pharmacology: Pharmacokinetics, Pharmacodynamics, Bioavailability, Bioequivalence, Terminologies and definition in Clinical Research. **3.4** Drug Development Process: Preclinical trial, Human pharmacology (Phase-I), Therapeutic exploratory trial (Phase-II), Therapeutic confirmatory Trial (Phase-III) and Post marketing surveillance (PhaseIV). Pharmacovigilance. **3.5** Guidelines in Clinical Research: International conference on harmonization(ICH), Guidelines for good clinical practices, ICMR guidelines for biomedical research on human subjects	15
Module-4:	**Regulation and ethics in clinical research** **4.1** Regulation in Clinical Research: Drug and cosmetic act, FDA, Schedule Ethics committee and their responsibilities. **4.2** Ethics committee submission, adverse event and safety reporting. **4.3** Role of sponsors. Study preparation, Study feasibility, Vendors/Service provider	15

	selection, Investigator selection, Budgeting in Clinical trial, Agreement (CTA) **4.4** Regulatory submission and approval, Sponsors obligation in Good Clinical Practice. **4.5** Clinical Research Operation: Monitoring and Clinical Evaluation: Protocol in Clinical Research, Informed Consent, Case Report Form, Investigator's Brochure (IB), Inclusion and exclusion criteria, Randomization, Blinding, Ethics and Regulatory submission. **4.6** Clinical Research Regulatory Submission & approval Process: IND, NDA and ANDA submission Procedure. **4.7** DCGI submission procedure. Other Regulatory authorities- EMEA, MHRA, PhRMA	

Reference Books:-

1) Kubben P., Dumontier M., Dekker A., Fundamentals of Clinical Data Science, Springer International Publishing, 2018.

2) Mark E, A Guide to GCP for Clinical Data Management, Canary Publications, 2017.

3) Lawrence M. Friedman, Curt D. Furberg David L. DeMets, Fundamentals of Clinical Trials, Springer; Kindle Edition 5th edition, 2015.

4) Stephen B Hulley MD MPH, Steven R Cummings MD. Designing Clinical Research Paperback, 2013.

5) Frederick P Ognibene, John I. Gallin Principles and Practice of Clinical Research 2nd Edition Elsevier Science, 2011.

6) Richard K. Rondel, Sheila A. Varley, Colin F. Webb, Clinical Data Management 2nd Edition, Wiley, 2000.

7) Rosner, B. Fundamentals of Biostatistics. Boston, MA:Duxbury Press, 2000.

8) Daniel W. W. Biostatistics: a Foundation for Analysis in the Health Sciences. New York: Wiley. 1987. 9.

9) Sunderrao P. S. and J. Richards. An introduction to Biostatistics, Prentice Hall Pvt. Ltd. India, 2000.

10) Campbell R. C., Statistics for Biologists, Cambridge University Press, Cambridge. 1989.

Evaluation Pattern: 60/40

Total Marks: 100

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 10 marks • Mid semester: 10 marks • CCE II: 10 marks • Activity: 10 marks	• Question-1: 12 marks • Question-2: 12 marks • Question-3: 12 marks • Question-4: 12 marks • Question-5: 12 marks • Question-6: 12 marks • Question-7: 12 marks

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Faculty of Science and Technology

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Board of Studies in Biotechnology

Programme: M.Sc.	**Semester**–IV
Type: Minor	**Marks:** 50
Credits:2	**From:** A.Y. 2025-26

Name of the Course: MBTT 544 (DSE-I): Genomics and Proteomics

Course Objectives: The students should be able to…

1) aware of omics era
2) understand different advanced tools and techniques used in omics research
3) learn concept and application s of gene expression studies
4) know various techniques of genomics and proteomics

Course Outcomes: Students will be able to…

1) apply principles involved in the ethical, legal, and regulatory issues in clinical human subject's research including the role of irb.
2) analyze the infrastructure required in performing clinical research
3) determine steps involved in developing and funding research studies.
4) explain data management system

Module	Title and Contents	Hrs
Module-1:	**Genomics** **1.1** Genomics overview, concepts and applications **1.2** Strategies for large scale DNA sequencing-Whole genome analysis techniques, Next generation sequencing methods **1.3** Structural & Functional genomics–Goals, methods, applications	07
Module-2:	**Transcriptomic and Microarray and Applications** **2.1** Introduction to transcriptomic and expression profiling **2.2** DNA and RNA Microarray –preparation, working and analysis. **2.3** Investigative techniques–EST, SAGE, SNP	08
Module-3:	**Proteomics and its applications** **3.1**Proteomics–Introduction, concept, application **3.2** Advantages and limitations of expressional proteomics, functional proteomics, structural proteomics **3.3** Applications in drug discovery, toxico proteomics, biomarkers in disease diagnosis	07
Module-4:	**Techniques in Proteomics** **4.1**Protein separation techniques, Strategies in protein identification, **4.2** 2D Gel electrophoresis, Isoelectric Focusing (IEF) **4.3** Mass spectrometry in proteomics – Principle, techniques, components and variations and analysis, applications **4.4** Protein Microarray-Preparation, working and analysis.	08

Reference Books:-

1) Thomas Langauer (editor) (2001) Bioinformatics - From Genomes to Drugs WileyVCH; 1st edition
2) Mount D W (2004) Bioinformatics-Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press; 2nd edition
3) Malcoln A. Campbell, laurie J. Heyer, Benjamin Cummings; (2006) Discovering genomics, Proteomics and Bioinformatics, 2nd edition
4) Xiong J (2006) Essential Bioinformatics. Cambridge University Press; 1st edition
5) Baldi P and G W Hatfield (2002) DNA microarrays and gene expression Cambridge University Press
6) Brownstein M J, A B Khodursky (2003) Functional Genomics : Methods and Protocols Humana Press
7) Griffiths A., Wessler S., Lewantin R., Carroll S (2008) Introduction to genetic analysis, 9th edition
8) Pennington SR, Dunn MJ., Stephen R BIOS (2001) Proteomics from protein sequence to function
9) GomaseV (2003) Transcriptomics VDM Publishing
10) Twyman R (2004) Principles of proteomics. Taylor & Francis

Evaluation Pattern: 30/20

Total Marks: 50

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 05 marks • Mid semester: 05 marks • CCE II: 05 marks • Activity: 05 marks	• Question-1: 10 marks • Question-2: 10 marks • Question-3: 10 marks • Question-4: 10 marks

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Programme: M.Sc.	**Semester**–IV
Type: Minor	**Marks:** 50
Credits:2	**From:** A. Y.2025-26

Name of the Course: MBTT 544 (DSE-II): Agriculture Biotechnology

Course Objectives: The students should be able to…

1) understand the basic and advanced knowledge of agriculture biotechnology.
2) apply the crop improvement techniques basic and advanced.
3) imbibe the knowledge about bioreactors and genetic markers.
4) aware the information about biopesticides, post harvesting protection and quality improvement

Course Outcomes: Students will be able to…

1) improve the crop quality and yield.
2) explain the scientific knowledge of bioreactors and markers.
3) describethe transgenic technique for crop improvement.
4) analyzethe biopesticides, post harvest protection and quality improvement & set up an agro business.

Module	Title and Contents	Hrs
Module-1:	**Crop improvement** **1.1** Advantages of biotechnological methods over conventional methods of crop improvement. **1.2** Homozygous plant production through anther & pollen culture **1.3** Embryo rescue & embryo culture inrearing viable hybrid embryos **1.4** Endosperm culture & production of triploids **1.5** Apomixis **1.6** Induced Poly embryony **1.7** Somaclonal and gametoclonal variations and their applications in crop improvement **1.8** genome annotation gene pyramid Mass breeding Allele mining	15
Module-2:	**Bioreactors and markers** **2.1** Use of bioreactor inplant production **2.2** Scale –up Marker assisted selection **2.3** Introduction to markers (RFLP, AFLP, microsatellites, RAPD, QTL) **2.4** Generation of maps using markers **2.5** Case studies of MAS **2.6** Virus indexing	15
Module-3:	**Transgenic in crop improvement** **3.1** Stress tolerance, **3.2** Risk assessment with respect to high and low impact crops. **3.3** Plants as biofactories for molecular farming: edible vaccines, planti bodies,	15
Module-4:	**Biopesticides, postharvest protection and quality improvement** **4.1** Baculo virus pesticides, **4.2** Myco pesticides. **4.4** Post harvest protection- Antisense RNA technology for 15 extending shelf life of fruits and flowers. Genetic Engineering for quality improvement–Seeds to rage proteins **4.5** Flavours- Capsaicin, Vanillinetc	15

Reference Books:-

1) Ahindra Nag A textbook of Biotechnology, Oxford book Co, IInd Edition. 2004.
2) Kumar H. D. Agricultural biotechnology, DayaPubl House, India, 2005.
3) Bhojwani S S, Soh WY,Agro biotechnology and plant tissue culture, Oxford & IBH Publ, India. 2006.
4) Rawat H. H, Agricultural biotechnology, Oxford Book Co, India.1st edition , 2008.
5) Newbury H. J, Plant molecular breeding, John Wiley and Sons., USA. 2009.
6) BhojwaniS.S. and S.P. Bhatnagar Embryology of Angiosperms, Vikas Publ House, India. 2009.
7) Ashwani Kumar, Shekhawat NS Plant tissue culture and molecular markers: the or role in improving crop productivity (IK International) 2009.
8) Hou CT, Shaw JF Biocatalysis and agricultural biotechnology, CRC Press, USA, 2009.
9) Das H K, Biotechnology,Wiley India Pvt. Limited, India ,4th edition, 2010.
10) Thakur S. and Ajay Kumar Agriculture Biotechnology at a glance, Sharma Publishers and distributors, 2nd edition. 2019.

Evaluation Pattern: 30/20

Total Marks: 50

Internal Continuous Evaluation:	**End Semester Examination:**
• CCE I : 05 marks • Mid semester: 05 marks • CCE II: 05 marks • Activity: 05 marks	• Question-1: 10 marks • Question-2: 10 marks • Question-3: 10 marks • Question-4: 10 marks

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Programme: M.Sc.	**Semester** - IV
Type : DSC- P	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course-MBTT 545: Practical VI (LAB VI)

(Based on MBTT 541 & 542)

Course Objectives: Student should be able to…

1) gain experimental knowledge of bioremediation of heavy metals & quantitation of TSS, DO, BOD, COD
2) acquire practical knowledge of Business plan writing and Project report writing
3) acquire skill & knowledge in analysis of mean mode and median for given data
4) gain skill & techniques in performing ANOVA and correlation

Course Outcomes: Students will be able to…

1) apply skills & techniques in isolation, identification & screening of microbial strains from different soil samples & in determination of TSS, TDS BOD & COD
2) implement skills & techniques in preparation of case study reports & clinical Data Management.
3) apply experimental knowledge about various environmental aspect
4) implement knowledge to environmental issues.

Sr. No.	Content	Hrs
1.	Isolation and purification of pathogenic microorganisms from polluted soil	60
2.	Biochemical tests of isolated pathogenic microorganisms from polluted soil	
3.	Microbial bioremediation of heavy metals	
4.	Estimation of Total Soluble Solid & Total Dissolved solid of waste water	
5.	Quantitative estimation of BOD of waste water	
6.	Quantitative estimation of COD of waste water	
7.	Detection of Coliforms in Water (MPN Test)	
8.	Analysis of Chloride Content in Water	
9.	Biodegradation Assay of Organic Pollutants (e.g., Dyes, Pesticides)	
10.	Preparation of Environmental Management Plans (EMP)	
11.	Study of market research and its analysis	
12.	Business plan writing and Project report writing for funding	
13.	Marketing and Sales in Bioentrepreneur ship	
14.	Case study biotech industrial projects	
15.	Basic financial calculations (Ex. Calculation of interest)	
16.	Strategies for solving the business problems	
17.	Patent Search Exercise	
18.	Case Study Analysis on Intellectual Property Types	
19.	Study of procedure for filling patent	
20.	Study of various components during patent writing	

Reference Books:-

1) Thatoi H, Dash S. Practical Biochemistry (Principle and protocols) – Dreamtech Press, 2nd edition 2020.
2) SwarajyaG. Lakshmi. Environmental Science A practical Manual – BS Publications 2018.
3) PatraJK, G Das , SK Das, H Thatoi A Practical Guide to Environmental Biotechnology, Springer, 2020.
4) Asthana & Asthana. Environment Problems & Solutions. S. Chand Limited, New Delhi, 2001.
5) VikasDhikav, Textbook of Clinical Research by 1st Edition Sold By: atithibooks, 2017
6) Mohanta GP, Textbook On Clinical Research A Guide For Aspiring Professionals And Professionals, Pharmamed Press, Sold By: Meripustak, 2000.
7) Entrepreneurial Development: Text and Cases, Entrepreneurship Sultan Chand & Sons. 1992.
8) Patzelt, Holger; Brenner, Thomas, Handbook of Bioentrepreneurship, Springer. 2008.
9) Wadehra B. L, Law Relating To Intellectual Property, Fifth Edition, Universal Law Publishing Co. Pvt. Ltd. 2011.
10) Das H. K, Textbook of Biotechnology,4th edition, Wiley India Pvt. Ltd, New Delhi. 2010

Evaluation Pattern: 30/20

Total Marks: 50

Internal Continuous Evaluation:	**End Semester Examination:**
	• Question -1: 10 Marks • Question -2: 05 Marks • Question -3: 10 Marks • Question -4: 05 Marks • Question -5 : 05 Marks • Question -6 : 05 Marks • Question -7 : 05 Marks • Question -8 : 05 Marks

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Programme: M.Sc.	**Semester** – IV
Type : DSE I-P	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course-**MBTP 546:** Practical VII (LAB VII)

(Based on MBTT 543, and 544)

Course Objectives: Student should be able to…

1) apply experimental knowledge about various statistical analysis
2) apply One-way and Two-way ANOV to various statistical problem
3) to write a research proposal based on the genomics and proteomics.
4) Implement knowledge of DMP, DQA & case study in clinical settings.

Course Outcomes: Students will be able to…

1) apply experimental knowledge about various statistical analysis
2) acquire skill & knowledge in analysis of mean mode and median for given data
3) isolation and characterization of agriculturally important microbes.
4) to study the various Bio fertilizer

Sr. No.	Content	Hrs
1.	Analysis of mean mode and median for given data	60
2.	Perform t test for given data	
3.	Perform ANOVA and correlation for given data	
4.	Perform One-way	
5.	Perform Two-way ANOV	

6.	Case Report Form in clinical research.	
7.	Clinical Case Study Report	
8.	Data Management Plan (DMP) in clinical trials.	
9.	Clinical Data Quality Assessment (DQA) in clinical trials	
10.	Study visit to Biotechnology industry	
11.	Extraction of genomic DNA	
12.	Separation and quantification of Genomic DNA	
13.	Isolation of protein	
14.	Separation and quantification of protein	
15.	Perform purification of isolated protein	
16.	Evaluate the activity of isolated enzymes	
17.	Evaluate the enzyme activity	
18.	Extraction of RNA from plant	
19.	Extraction of plasmid	
20.	Isolation of mitochondria	

Reference Books:-

1) Purohit S. S. Fundamentals of agriculture biotechnology –2nd edition.
2) R. C. Chaudhary 1st edition Introduction to plant breeding –
3) Thomas L. (editor) (2001) Bioinformatics - From Genomes to Drugs Wiley- VCH; 1st edition
4) Mount D. W.(2004) Bioinformatics-Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press; 2nd edition.
5) Malcoln A. C., laurie J. Benjamin C.; (2006) Discovering genomics, Proteomics and Bioinformatics, 2nd edition
6) Griffiths A., Wessler S., Lewantin R., Carroll S. (2008) Introduction to genetic analysis, 9 th edition
7) Pennington S.R., Dunn M.J., Stephen R. BIOS (2001) Proteomics from protein sequence to function
8) TwymanR. (2004) Principles of proteomics. Taylor & Francis
9) Introduction to wine laboratory practices and procedures: Jean L. Jacobson 2006- Springer Science.
10) Hutkins R. W. Microbiology and technology of fermented foods: Blackwell publishing

Evaluation Pattern: 50

Total Marks: 50

Internal Continuous Evaluation:	**End Semester Examination:**
	• Question -1: 10 Marks • Question -2: 05 Marks • Question -3: 10 Marks • Question -4: 05 Marks • Question -5 : 05 Marks • Question -6 : 05 Marks • Question -7 : 05 Marks • Question -8 : 05 Marks

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(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science Satara, Satara

Board of Studies in Biotechnology

Programme: M.Sc.	**Semester** – IV
Type : DSE II-P	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course-MBTP 546: Practical VII (LAB VII)

(Based on MBTT 543, & 544)

Course Objectives: Student should be able to…

1) apply experimental knowledge about various statistical analysis
2) apply one-way and two-way ANOVA to various statistical problem
3) to write a research proposal based on the genomics and proteomics.
4) implement knowledge of DMP, DQA & case study in clinical settings.

Course Outcomes: Students will be able to…

1) apply skills & techniques in isolation, identification & screening of dna
2) implement skills & techniques in isolation of protein
3) apply the knowledge in raising the bio fertilizers
4) implement skill & techniques in artificial seed formation

Sr. No.	Content	Hrs
1.	Analysis of mean mode and median for given data	60
2.	Perform t test for given data	
3.	Perform ANOVA and correlation for given data	
4.	Perform One-way	
5.	Perform Two-way ANOV	
6.	Case Report Form in clinical research.	
7.	Clinical Case Study Report	
8.	Data Management Plan (DMP) in clinical trials.	
9.	Clinical Data Quality Assessment (DQA) in clinical trials.	
10.	Study visit to Biotechnology industry	
11.	Isolation of Azotobacter	
12.	Isolation of Rhizobium from root nodules	
13.	Isolation of PSB from soil.	
14.	Production of Biofertilizer- Azotobacter	
15.	Production of Biofertilizer- PSB	
16.	Isolation of *Trichoderma* / *Bacillus thuringenisis*	
17.	Production of Biopesticide – *Trichoderma*	
18.	Production of Biopesticide –*Bacillus thuringenisis*	
19.	Production of Artificial seed	
20.	Visit to Bio-fertilizer unit	

Reference Books:-

1) Purohit S. S. Fundamentals of agriculture biotechnology –2nd edition.
2) R. C. Chaudhary 1st edition Introduction to plant breeding –
3) Thomas L. (editor) (2001) Bioinformatics - From Genomes to Drugs Wiley- VCH; 1st edition
4) Mount D. W.(2004) Bioinformatics-Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press; 2nd edition.
5) Malcoln A. C., laurie J. Benjamin C.; (2006) Discovering genomics, Proteomics and Bioinformatics, 2nd edition
6) Griffiths A., Wessler S., Lewantin R., Carroll S. (2008) Introduction to genetic analysis, 9 th edition
7) Pennington S.R., Dunn M.J., Stephen R. BIOS (2001) Proteomics from protein sequence to function
8) TwymanR. (2004) Principles of proteomics. Taylor & Francis
9) Introduction to wine laboratory practices and procedures: Jean L. Jacobson 2006- Springer Science.
10) Hutkins R. W. Microbiology and technology of fermented foods: Blackwell pubshing

Evaluation Pattern: 50

Total Marks: 50

Internal Continuous Evaluation:	**End Semester Examination:**
	• Question -1: 10 Marks • Question -2: 05 Marks • Question -3: 10 Marks • Question -4: 05 Marks • Question -5 : 05 Marks • Question -6 : 05 Marks • Question -7 : 05 Marks • Question -8 : 05 Marks

Karmaveer Bhaurao Patil University, Satara

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Programme: M.Sc.	**Semester** - IV
Type : OJT	**Marks: 100**
Credits :4	**From:** A. Y. 2025-26

Name of the Course -MBTP 547: On Job Training (OJT)

Module 1	**Title and content**	**Hrs**
	OJT will provide the opportunity Moduleies for internship with local/regional industries, business organization, health and allied areas, local government, etc. so that students may actively engage with the employability opportunity Moduleies. Students will undergo 4 credit work based learning/OJT/internship	**120**

Evaluation Pattern: 60/40

Total Marks: 100

Internal Continuous Evaluation:	**End Semester Examination:**
	• Question-1: 20 marks • Question-2: 20 marks • Question-3: 20 marks • Question-4: 40 marks