MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL - 624 101
Tamil Nadu.

UGC-Non-SAP, DST-CURIE and DST-FIST Assisted

DEPARTMENT OF BIOTECHNOLOGY

Curriculum Framework and Syllabus for

M.PHIL BIOTECHNOLOGY

(For the candidates to be admitted from the academic year 2021-2022 onwards)

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL
Department of Biotechnology

M.Phil. Biotechnology

Eligibility : Master degree in the relevant discipline with 55% marks
Common Entrance Exam : University conduct a Common Entrance Test (CET) for M.Phil admission

M.Phil. Biotechnology syllabus 2021-2022

No	Paper Code	Course Title	Hours	Credits	Continuous Internal Assessment (CIS)	End Semester Exam (ESE)	Total
Semester I							
1.	M21BTT11	Core I -Research Methodology	10	4	40	60	100
2.	M21BTT12	Core II - Advances in Applied Biotechnology	10	4	40	60	100
3.	M21PST13	Core III - Professional Skills	10	4	40	60	100
		Total	**30**	**12**			**300**
Semester II							
4.	M21BTT21	Core IV -Special Paper	10	4	40	60	100
5.	M21BTD21	Dissertation & Viva-voce	20	14	-	-	200
		Total	**30**	**18**			**300**
Total			**60**	**30**			**600**

Special Papers related to Project

S.No	Course
1.	Special Paper I – Nanotechnology
2.	Special Paper II - Animal Biotechnology
3.	Special Paper III- Plant Biotechnology
4.	Special Paper IV – Environmental Biotechnology
5.	Special Paper V – Applied Microbiology
6.	Special Paper VI- Fungal Biotechnology
7.	Directed Study[#]
8.	Any UGC approved online course related to research (equal credit)

[#] Any new course can be added as special paper by getting permission from BoS and Academic council.

The M.Phil course consists of four theory papers. Paper III is common for all the programmes. Special Paper (IV) is pertaining to the area of specialization chosen by the candidate with the approval of guide.

Each candidate will submit a dissertation on a topic in the relevant discipline after carrying out the project work under the supervision of a guide. The duration of the project work will be for six months.

The dissertation will be evaluated by an external examiner and viva voce will be conducted for the candidate.

The examination will be for 100 marks in each of the theory papers. The question paper will cover the entire syllabus. The duration of the examination is 3 hours.

PROGRAMME EDUCTION OUTCOMES (PEO)

PEO 1: To equip the students to be competent in the field of biotechnology and its allied areas

PEO 2 : To inculcate the capability to work as entrepreneurs, techno-managers and researchers with strong ethics and communication skills

PEO 3: To encourage the students to pursue research in reputed institutes at national and international level

PEO 4: To cultivate working knowledge in students to develop biotechnology products, processes and designs.

PEO 5: To encourage the students to work as research associates under government funded projects to contribute scientifically to the society

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Enhance the knowledge in the advanced techniques in Biotechnology.

PSO2: Develop theoretic and hands-on knowledge inmolecular biology, genetic engineering and bioinformatics for gaining a successful career

PSO3: Translate the knowledge obtained from the programme to work as women entrepreneurs and identify novel solutions for scientific problems

PSO4: Effectively use computational techniques for all activities related to biotechnology and other life science fields

PSO5: Laboratory skills and hands on training in advanced and recent techniques along with knowledge in research methodology in biotechnology perceived will aid in research.

PRAGRAMME OUTCOMES (PO)

PO1: Apply the knowledge of molecular biology, genetic engineering, bioinformatics, food technology and computational biology to solve complex scientific problems.

PO2: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO3: Create, select, and apply appropriate techniques, resources, and modern biotechnology and bioinformatics tools including structure prediction and modelling to complex activities with an understanding of the limitations.

PO4: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO5: Apply ethical principles and commit to professional ethics and responsibilities and norms of the scientific practice.

PO6: Communicate effectively with the scientific community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions

PO7: Demonstrate knowledge and understanding of biotechnology and research principles and apply these to one's own work, as a member and leader in a team.

PO8: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE I - RESEARCH METHODOLOGY - M21BTT11</td></tr>
<tr><td>Semester</td><td colspan="2">Semester-I</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1: Recall
K2:Understand
K3:Apply
K4:Compare</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To gain familiarity with research and its types.
• To learn the appropriate methods of literature collection and analysis
• To understand data validation and interpretation
• To apply suitable statistical analysis and tools in research.
• To inculcate interest in students to pursue research.</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">know types of research and its importance, research ethics, research proposal writing</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td colspan="2">apply the Statistics in Research using different statistical tools</td><td>K3</td></tr>
<tr><td>CO3</td><td colspan="2">understand the principles and procedures of bioinstruments foranalysis of biomolecules</td><td>K2,K3</td></tr>
<tr><td>CO4</td><td colspan="2">understand the different types of PCRElectrophoresis:</td><td>K3</td></tr>
<tr><td>CO5</td><td colspan="2">compare the Database similarity searching tools for nucleicacid and proteins</td><td>K4</td></tr>
<tr><td>Unit I</td><td colspan="4">Research : Types of research, Role of literature review in research, Importance of formulating a research problem. Collection and displaying of data. Writing a research report. Importance and need for research ethics and scientific research. Writing Thesis, publication, Writing article, Plagiarism, Research Proposal writing.</td></tr>
<tr><td>Unit II</td><td colspan="4">Statistics in Research: Measures of central tendency: arithmetic mean, median, mode, geometric mean, Harmonic mean. Measures of dispersion: range, interquartile range, standard deviation, variance. Simple linear regression and correlation. Analysis of variance. Hypothesis testing - Idea of two types of errors and level of significance. Tests of significance: Parametric (F & t test); Non parametric: Chisquare tests</td></tr>
<tr><td>Unit III</td><td colspan="4">Principle of biophysical method and used for analysis of biopolymer structure: UVvisible, FTIR,XRD, SEM and TEM, TLC,HPTLC,HPLC, GC-MS, Atomic absorption and plasma emission spectroscopy, Nuclear Magnetic Resonance Spectroscopy. MALDI-TOF-TOF.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Electrophoresis: Principle and applications of Native, SDS, and 2D- gel electrophoresis. Polymerase Chain reaction(PCR) - Principles and Types - Real-Time PCR (quantitative PCR or qPCR) Reverse-Transcriptase (RT-PCR),Multiplex PCR, Nested PCR, Hot Start PCR,GC-Rich PCR, Long-range PCR and Arbitrary Primed PCR. Applications of PCR.</td></tr>
</table>

Unit V	**Database similarity searching** - BLAST – BLASTN and BLASTP, Gene sequence submission format - FASTA, multiple sequence alignment (CLUSTAL W), Phylogenetic analysis tools- Phylip, ClustalW, Online phylogenetic analysis. Visualisation of protein structure – (Ras Mol, Cn3d, SWISS – PDB viewer).
References	**Text Books** 1. Akash Ved. Biostatistics & Research Methodology. Publisher Thaukur Publication,2019. 2. Selzer, Paul M., Marhofer, Richard J., Koch, Oliver. An Introduction Applied Bioinformatics,Springer, 2018. 3. L. Veerakumari. Bioinstrumentation. MJP Publishers. 2011.
	References Books 1. Dubey Diwedi, Usman, Srivastava. Biostatistics and Research Methodology.Publisher S VikaS and Company, 2019 2. MJ Reily. Bioinstrumentation. CBS Publishers & Distributors,2019. 3. B Annadurai. A Textbook of Biostatistics. Publisher New Age International Private Limited,2017. 4. Selzer, Applied Bioinformatics: An Introduction, Publisher Springer, 2018. 5. Norman T.S. Bailey, Statistical Methods in Biology. Cambridge University Press, UK. . 2012
E-reference links:	1. https://www.allassignmenthelp.com/blog/types-of-research/ 2. https://www.bioinformatics.org/ 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/ 4. https://www.csulb.edu/~msaintg/ppa696/696stsig.htm 5. https://www.enago.com/academy/importance-of-research-ethics/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	M	M	M	M	M
CO2	S	S	S	S	S	S	S	S	M	M	M	M	S
CO3	S	S	S	M	M	S	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S	S	S	S
CO5	S	S	S	M	M	S	S	S	S	S	S	S	S

Strongly Correlating (S) - 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="3">CORE II- ADVANCES IN APPLIED BIOTECHNOLOGY- M21BTT12-M21BTT11</td></tr>
<tr><td>Semester</td><td>Semester-I</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="3">K1: Recall K2:Understand K3:Apply</td></tr>
<tr><td>Learning Objective</td><td colspan="3">• To introduce the students to advanced and modern techniques in biotechnology
• To gain knowledge on cutting edge technologies for future research.
• To learn the principles and mechanisms behind the new trends in biotechnology.
• To assure that the students will know up-to-date technological advancements on the completion of the course.</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="3">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td>gain knowledge modern techniques in plant and animal technology</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td>learn about the advanced tools in molecular biology and genetic engineering</td><td>K2</td></tr>
<tr><td>CO3</td><td>acquire knowledge on nano-formulations and their applications in cancer theranostics</td><td>K2</td></tr>
<tr><td>CO4</td><td>illustrate the methods to develop biomaterials and bio-products</td><td>K2, K3</td></tr>
<tr><td>CO5</td><td>gain knowledge on next generation sequencing and computational biology</td><td>K2</td></tr>
<tr><td>Unit I</td><td colspan="3">Plant and Animal Biotechnology: Introduction to Modern plant and animal biotechnology. CRISPR/Cas genome editing, regulations, techniques, applications in plant and animals systems. Development of climate smart and mineral enhanced aerobic crop varieties. Stem cells- research, controversy and future applications. 3D printed organs, Brian signals to audible speech and nerve regeneration. Trends in the use of tissue and animal culture, applications and future prospects.</td></tr>
<tr><td>Unit II</td><td colspan="3">Molecular biology and Genetic manipulation: Molecular biology tools for engineering biosynthetic gene clusters, enzymes and host genomes. Cellular mechanosensing and peizo proteins. Multiplex automated genome engineering (MAGE), promoter engineering and synthetic small regulatory RNA (sRNA)-based knockdown. Advanced molecular markers, promoter engineering and metabolic engineering. Genetic modification of animals for food and medicine. 3D genome folding and programmable RNA editing in microbes.</td></tr>
<tr><td>Unit III</td><td colspan="3">Nanobiotechnology and Cancer theranostics: Introduction to nanobiotechnology and Oncology. Current conventional diagnosis and therapeutics in cancer. Nanoparticles in targeted theranostics. Liposomal nanoparticles, Micelles, Dendrimers, Carbon nano-systems, Polymeric nanoparticles, DNA nanostructures and metal nanoparticles in cancer theranostics. Nano-formulations and their uses in cancer theranostics. Future applications and challenges of nanobiotechnology in cancer diagnosis and treatment.</td></tr>
</table>

Unit IV	**Food and Bioprocess technology:** Recent trends in food processing: High hydrostatic pressure, Dielectric heating, Pulsed light, Bacteriocins, Microwave and Ultrasound assisted extractions, Super critical fluid extraction. Development of biomaterials and bioproducts: Biopolymers and biopackaging. Bioprocess designing: Operational fermentation strategies, intracellular products, extracellular products, Process analysis. Applications of synthetic biology and Bioinformatics in foods and bioprocess industries
Unit V	**Bioinformatics and Computational Biology:** Introduction to Next generation sequencing and sequence analysis, data mining biological and medical ontology. Latest bioinformatics tools in proteomics, genomics, transcriptomics and metabolomics analysis. Algorithmic approaches for molecular biology problems, Biclustering algorithms for microarray data, Genotype tagging, In silico simulation approach. Computational methods for understanding bacterial and archaea genomes. Application of fuzzy logic in bioinformatics. Future of bioinformatics and computational biology in modern medicine.
References	**Text Books** 1. Suresh Kumar Gahlawat, Joginder Singh Duhan, Raj Kumar Salar, Priyanka Siwach ,Suresh Kumar, Pawan Kaur, Advances in Animal biotechnology and its applications, Springer Singapore. 2018 2. Gautam B.Singh, Fundamentals of Bioinformatics and Computational biology, Springer International publishing,2015
	References Books 1. Y. B. Blume, Research advances in Plant biotechnology Nova Science publishers Inc. 2020 2. Bernard R. Glick, Cheryl L. Patten. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 2017 3. Anshu Mathur, Nanotechnology in cancer, Elsevier,2016 4. Monica Lizeth Chavez-Gonzalez, Nagamani Balagurusamy, Christobal N. Aguilar, Advances in Food bioproducts and bioprocessing technologies, CRC Press. 2019
E-reference links:	1. https://www.nature.com/articles/s41392-019-0089-y 2. https://www.tandfonline.com/doi/pdf/10.1080/02648725.1989.10647858 3. https://www.genscript.com/applications-of-synthetic-biology-in-food-industry-and-agriculture.html 4. https://www.cbd.int/doc/publications/cbd-ts-82-en.pdf

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	M	S	S
CO3	S	S	S	M	S	S	S	S	S	S	M	S	S
CO4	S	S	S	M	S	S	S	S	S	S	M	S	S
CO5	S	S	S	M	S	S	S	S	S	S	M	S	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE III – Professional Skills- M21MBT13</td></tr>
<tr><td>Semester</td><td colspan="2">Semester- I</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1: Recall
K2: Understand
K3: Apply
K4:Analyze</td></tr>
<tr><td>Learning Objective</td><td colspan="4">● Develop skills to ICT and apply them in teaching, learning contexts and research.
● Acquire the knowledge of communication skills with special reference to its elements, types, development and styles.
● Understand the terms: Communication technology, Computer Mediated Teaching and develop Multimedia/E-contents in their respective subjects.
● Develop different teaching skills for putting the content across to targeted audience.</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">Upon completion of this course the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">Learn the computer basics and its application in science field.</td><td>K1</td></tr>
<tr><td>CO2</td><td colspan="2">Develop the communication skills in both English and tamil.c</td><td>K2</td></tr>
<tr><td>CO3</td><td colspan="2">Impart knowledge on computer mediated teaching.</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">Understand the basic concepts of micro teaching skills.</td><td>K2</td></tr>
<tr><td>CO5</td><td colspan="2">Get familiar with basics of industrial technology</td><td>K2</td></tr>
<tr><td>Unit I</td><td colspan="4">Computer Application Skills: Fundamentals of Computers and windows, Operating System – MS – Office Components; Word: Equation editor, Table Manipulation – Formatting Features – organizational Chart. MS – EXCEL: Statistical Functions – Number Manipulation – Chart Preparation with various types of graphs. MS Powerpoint: Powerpoint presentation with multimedia features. Internet and its applications: E-mail and attachments – working with search engines.</td></tr>
<tr><td>Unit II</td><td colspan="4">Communication Skills (English/Tamil/Both): English: Skills of Communication: Listening, Speaking, reading and Writing – Writing Synopsis, Abstract and proposals. Developing good language asbilities – Public speaking – Writing Skills. Tamil: gapw;Wtpf;Fk; jpwd; - Ngr;Rj;jpwd; - ntspg;ghl;Lj; jpwd; - Ma;Tj;jpl;lk; - Ma;Tr;R&f;fk; jahhpj;jy;.</td></tr>
<tr><td>Unit III</td><td colspan="4">Communication technology: Computer Mediated Teaching: Multimedia, E – Content, Satellite Based Communication – EDUSAT and ETV channels. Web: Internet I Education.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Pedagogical Skills: Micro teaching Skills: Skill of Induction, Skill of Stimulus Variation. Skill of Explaining, Skill of Probing Questions, Skill of Blackboard, Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills – Research Extension and Consultancy.</td></tr>
<tr><td>Unit V</td><td colspan="4">Industrial Technology: Lecture Techniques: Steps, Planning of a lecture, Lecture Notes, Updating, Delivery of Lecture. Teaching – Learning Techniques: Team</td></tr>
</table>

	teaching, Group Discussion. Seminar, Workshops, Symposium and Panel Discussion – Games and Simulations – Web Based Instructions.
Text Books	1. Micael D. and William (2000). Integrating Technology into Teachnig and Learning: Concepts and Applications, Prentice Hasll, New York. 2. Information and Communication Technology in Education: A Curriuculum for Schools and Programme of Teacher development. Jonathan Anderson 3. Pandey S.K.(2005). Teaching communication. Commonwealth publisher, Delhi 4. Sharma. R.A.(2006), Fundamentals of education technology, Surya publication, Meerut
References	1. Kum Babu A. and Dandapani S. (2006), Microteaching, Neelkamal Publications, Hyderabad 2. Vanaja M and Rajasekhar S. (2006), Computer Education, Neelkamal Publications, Hyderabad

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	M	S	M	S	S	S	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	M	S	S	S
CO3	S	S	S	M	M	S	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE IV-SPECIAL PAPER I
NANOTECHNOLOGY- M21BTT21</td></tr>
<tr><td>Semester</td><td colspan="2">Semester-II</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1:Recall
K2:Understand</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To understand the fundamentals of nanotechnology
• To know scope and importance of green nanoparticles
• To know the applications of nanotechnology in biology
• To gain knowledge in molecular devices and nanotribology
• To learn the theranostic applications of nanomedicines</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">understand the mechanism behind the synthesis of nanoparticles</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td colspan="2">learn about different methods used in the characterization of nanoparticles</td><td>K1,K2</td></tr>
<tr><td>CO3</td><td colspan="2">gain knowledge on the different applications of nanoparticles</td><td>K2</td></tr>
<tr><td>CO4</td><td colspan="2">understand the development nanomedicines and nanosystems</td><td>K1,K2</td></tr>
<tr><td>CO5</td><td colspan="2">acquire knowledge on molecular nano-devices and nanotribology</td><td>K2</td></tr>
<tr><td>Unit I</td><td colspan="4">Synthesis of Nanoparticles: Use of bacteria, fungi, actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticle, Mechanism of formation, Virus as a components for the formation of nanostructured materials. Synthesis of silver and gold nanoparticles. Role of plants in nanoparticle synthesis.</td></tr>
<tr><td>Unit II</td><td colspan="4">Analysis of Nanoparticles: Nanoscience in Nano materials preparation silver, gold, iron and copper. Characterization – UV-Visible Spectrophotometer, X-RD, FTIR, SEM-EDAX, TEM.</td></tr>
<tr><td>Unit III</td><td colspan="4">NanoBiology: DNA based computation, DNA based nanomechanical devices, Interaction between biomolecules and nanoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano bio assemblies, Application of nano in biology, Nanoprobes for analytical application.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Nanomedicines : Developing of Nanomedicines. Nanosystems in use. Protocol for nanodrug administration. Nanotechnology in diagnostic applications, materials used in diagnostic and therapeutic applications- Molecular Nanomechanics.</td></tr>
<tr><td>Unit V</td><td colspan="4">Nanotribiology: studying tribiology at nanoscale, Nanotribiology applications. Current status of Nano Biotechnology, Future perspectives of Nanobiology. Nanosensors.</td></tr>
<tr><td>References</td><td colspan="4">Text Books
1. Kulkarni, Sulabha K.Nanotechnology: Principles and Practices,Springer,2015
2. Thomas Varghese & K.M. Balakrishna, nanotechnology: An introduction to synthesis, properties and applications of nanomaterials, Publisher</td></tr>
</table>

	Atlantic,2012
	References Books 1. Ashutosh Tiwarianthony P.F. Turner,Biosensors Nanotechnology,Wiley,2014 2. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, Publisher Springer nature,2014 3. Sulabha K. Kulkarni,Nanotechnology: Principles and Practices,Springer,2015
E-reference links:	1. https://www.tandfonline.com/doi/full/10.1080/24701556.2020.1835978 2. https://www.tribonet.org/wiki/nanotribology/ 3. https://royalsocietypublishing.org/doi/10.1098/rsta.2007.2170 4. https://pubs.acs.org/doi/abs/10.1021/nn2031319

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	M	S	S	S	S	M	S	S
CO2	S	S	S	S	M	M	S	S	S	S	M	S	S
CO3	S	S	S	M	M	M	S	S	S	M	M	M	M
CO4	S	S	S	M	M	M	S	S	S	M	M	M	M
CO5	S	S	S	M	M	M	S	S	S	M	M	M	M

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="3">CORE IV-SPECIAL PAPER II
ANIMAL BIOTECHNOLOGY- M21BTT21</td></tr>
<tr><td>Semester</td><td>Semester-II</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="3">K1:Recall
K2:Understand
K3: Apply
K4: Analyze</td></tr>
<tr><td>Learning Objective</td><td colspan="3">• To acquire knowledge on the fundamentals of animal biotechnology
• To learn about animal cell culture techniques
• To gain knowledge on the development and maintenance of animal cell lines
• To understand the principles of transgenics and stem cell biology
• To know the various applications of animal biotechnology</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">At the end of the course, the student will be able to
CO1 know the basics of cell culture laboratory and its equipment — K1
CO2 gain knowledge on the preparation of cell culture media and reagents — K2,K3
CO3 understand the techniques in developing and maintain cell cultures — K2
CO4 acquire knowledge on the different application of animal biotechnology — K1
CO5 compare the methods and strategies in transgenics and stem cell biology — K4</td></tr>
<tr><td>Unit I</td><td colspan="3">Cell culture Laboratory design & Equipments: Planning, construction and services; Layout; Sterile handling area; Incubation; Hot room; Air circulation; Service bench; Laminar flow; Sterilizer; Incubator; CO_2 incubator; Refrigerators and freezers; Centrifuge; Inverted stage microscope; Magnetic stirrer; Liquid nitrogen freezers; Slow cooling system for cell freezing; Water bath; Autoclaves and hot air oven; Pipette washers; Water purification system; Fluid handling systems and other equipments; Washing, packing and sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Cell culture vessels.</td></tr>
<tr><td>Unit II</td><td colspan="3">Cell culture Media and reagents: Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics, growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.</td></tr>
<tr><td>Unit III</td><td colspan="3">Different types of cell cultures: History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants.</td></tr>
</table>

Unit IV	**Cell culture Applications:** Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for *in vitro* testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins
Unit V	**Transgenesis and Stem cell biology:** Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell lineages and developmental control genes in drosophila and mice; Differentiation of germ layers; Cellular polarity; Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of proto-oncogenes; Stem cell markers; Methods of stem cell production in farm animals; Using stem cells for SCNT; Transgenesis and Xenotransplants.
References	**Text Books** 1.A.K. Srivastava, RK. Singh. Animal Biotechnology, CBS Publishers & Distributors Pvt Ltd, India,2018. 2.M .M. Ranga..Animal Biotechnology,3rd Edition, Agrobios, India. 2017. 3.B. Singh, S.K. Gautam, Textbook of Animal Biotechnology, Publisher The Energy and Resources Institute, TERI,2013
	References Books 1. Birbal Singh, Gorakh Mal, Sanjeev K. Gautam, Manishi Mukesh. Advances in Animal Biotechnology. Springer, 2019. 2. Singh, B., Mal, G., Gautam, S.K., Mukesh, M. Advances in Animal Biotechnology.Publisher Springer,2019. 3. Rodrigues, Gabriela, Roelen, Bernard A. J, Concepts and Applications of Stem Cell Biology, Publisher Springer,2020.
E-reference links:	1. https://www.microscopemaster.com/cell-culture.html 2. https://www.labome.com/method/Cell-Culture-Media-A-Review.html 3. https://pubmed.ncbi.nlm.nih.gov/7711194/ 4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2777739/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S	S	M	
CO2	S	S	S	M	S	M	S	S	S	S	S	M	
CO3	S	S	S	M	S	M	S	S	S	S	M	M	
CO4	S	S	S	M	S	M	S	S	S	S	M	M	
CO5	S	S	S	M	S	M	S	S	S	M	M	M	

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE IV-SPECIAL PAPER III
PLANT BIOTECHNOLOGY- M21BTT21</td></tr>
<tr><td>Semester</td><td colspan="2">Semester-II</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1:Recall
K2:Understand</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To learn the fundamentals of plant biotechnology
• To acquire knowledge on gene transfer techniques
• To understand the techniques in maintain and preserving plant tissue culture
• To learn the Biosafety issues and bioethics in plant genetic engineering
• To gain knowledge in Intellectual property rights</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">know about the principles of culture techniques, micropropogation and cryopreservation</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td colspan="2">gain knowledge on gene transfer technique and their applications</td><td>K2</td></tr>
<tr><td>CO3</td><td colspan="2">understand the processes in the development of pharmaceutically important plant products</td><td>K1,K2</td></tr>
<tr><td>CO4</td><td colspan="2">learn about the biosafety issues and bioethics in plant engineering</td><td>K2</td></tr>
<tr><td>CO5</td><td colspan="2">acquire knowledge on Intellectual property rights and patenting of biological material</td><td>K1,K2</td></tr>
<tr><td>Unit I</td><td colspan="4">Plant Tissue Culture: Historical perspective, tissue culture lab. Organization, sterilization techniques, nutrient media, culture techniques- callus cultures, cell cultures and protoplast cultures, role of phytohormones, organogenesis and somatic embryogenesis. Artificial seed production; Micropropagation; Mutation, somaclonal variation, Germplasm conservation and cryopreservation.</td></tr>
<tr><td>Unit II</td><td colspan="4">Agrobacterium-plant interaction: Ti and Ri plasmids. Gene transfer techniques - vector mediated and vector less gene transfer. Agrobacterium-mediated gene transfer; Cointegrate and binary vectors and their utility; Screenable and selectable markers; Chloroplast transformation; Marker-free methodologies. Stress Resistance/Tolerance – Bacterial resistance; Viral resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity and thermal stress.</td></tr>
<tr><td>Unit III</td><td colspan="4">Plants as Biofactories: Fermentation and production of industrial enzymes, vitamins and antibiotics and other biomolecules; secondary metabolite production; Production of pharmaceutically important compounds; Bioenergy generation.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Biosafety issues and containment practices: Testing of transgenics, regulatory procedures for commercial approval. Bioethics of plant genetic engineering.</td></tr>
<tr><td>Unit V</td><td colspan="4">Intellectual property rights (IPR): Patents, trade secrets, copyright, trademarks; Plant genetic resources; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights.</td></tr>
<tr><td>References</td><td colspan="4">Text Books
1. S. Umesha, Plant Biotechnology. Publisher CRC Press.2019.
2. Hiru Ranabhatt , Renu Kapor. Plant Biotechnology. 1st Edition, Publiser</td></tr>
</table>

	WPI Publishing. 2018. 3. Chawla H S. Introduction To Plant Biotechnology. Publisher Oxford & IBH publishing.2020.
	References Books 1. Gresshoff Peter M. Plant Biotechnology and Development. Publisher: Taylor & Francis Inc. 2020. 2. Abdin**,** M.Z., Kiran, U., Kamaluddin, M., Ali, A. Plant Biotechnology: Principles and Applications,Publisher Springer. 2017.
E-reference links:	1. https://www.onlinebiologynotes.com/types-of-plant-tissue-culture/ 2. https://www.vedantu.com/biology/micropropagation 3. https://microbenotes.com/micropropagation-stages-types-applications-advantages-limitations/ 4. https://pubmed.ncbi.nlm.nih.gov/15310911/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	S	S	S	S	S	M	S
CO2	S	S	S	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	M	M	S	S	S	S	S	M	M	S
CO4	S	S	S	S	S	S	S	S	S	S	M	M	M
CO5	S	S	S	M	S	S	S	S	S	S	M	M	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE IV-SPECIAL PAPER IV
ENVIRONMENTAL BIOTECHNOLOGY - M21BTT21</td></tr>
<tr><td>Semester</td><td colspan="2">Semester-II</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1:Recall
K2:Understand
K3: Apply</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To gain awareness about the global environmental problems
• To know about the water pollution and the ways to control it
• To acquire knowledge on solid waste management and its implementations
• To obtain knowledge on Biofertilizers, bioenergy and biogas production
• To know about the application of biotechnology in solving global problems</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">gain knowledge on the different global environmental problems and their risks</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td colspan="2">understand the cause of water pollution and the ways to control it</td><td>K2</td></tr>
<tr><td>CO3</td><td colspan="2">learn about solid waste management and the production of biofertilizers and biogas</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">gain knowledge on bioremediation techniques and its importance</td><td>K2</td></tr>
<tr><td>CO5</td><td colspan="2">know about the different biotechnology applications such as biopesticides and bioplastics</td><td>K2</td></tr>
<tr><td>Unit I</td><td colspan="4">Environmental issues: Environment – Basic Concepts and Issues. Environmental Pollution – types of pollution; sources and effect, Global environmental problems: Ozone depletion, UV-B, Green House Effect and Acid rain</td></tr>
<tr><td>Unit II</td><td colspan="4">Water Pollution and its control: Sources of water pollution, Physico chemical and biological characteristics of water, National and international standards for Drinking water, standards for waste water disposal, Water and waste water treatment, primary, secondary and tertiary treatment, need for water management, measurement of water pollution, waste water collection and biotechnological approach for waste water treatment process.</td></tr>
<tr><td>Unit III</td><td colspan="4">Solid waste management: Sources, collection and disposal techniques. Composting, vermicomposting, incineration etc., Organic farming, Renewable energy sources, Bioenergy, Biogas production, biodiesel.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Bioremediation: Types of bioremediation, Bioventing, microbes in biodegradation, Microbial degradation of Xenobiotics in Environment –oil pollution, pesticides Bioremediation of contaminated soils and waste land. Phytoremediation and its mechanism.</td></tr>
<tr><td>Unit V</td><td colspan="4">Application of Biotechnology: Biopesticides in Integrated pest management, Biofertilisers, mycorrhizae, Bioplastics, biomineralization, Biodiversity conservation. Gene Bank.</td></tr>
</table>

References	**Text Books** 1. B.K.Sharma. Environmental Chemistry, Krishna Prakashan Media (P)Limited. 2019. 2. Pramod Kumar,Vipin Kumar, Pravin Kumar Sachan,Environmental Biotechnology, Publisher WPI Publishing,2019 3. Daniel Vallero, Environmental Biotechnology: A Biosystems Approach,Publisher Elvesier,2015.
	References Books 1. Pramod Kumar, Vipin Kumar, Environmental Biotechnology, Publisher Woodhead Publishing India,2018 2. S.V.S Rana,Environmental Biotechnology, Publisher Rastogi Publications,2014
E-reference links:	1. https://www.eartheclipse.com/energy/bioremediation-types-uses-techniques.html 2. https://www.aftermath.com/content/types-of-bioremediation/ 3. https://www.vedantu.com/chemistry/effects-of-ozone-layer-depletion 4. https://www.conserve-energy-future.com/organic-farming-benefits.php 5. https://agritech.tnau.ac.in/org_farm/orgfarm_introduction.html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	S	S	S	S	M	M	S
CO2	S	S	S	S	M	S	S	S	S	S	M	M	S
CO3	S	S	S	S	M	S	S	S	S	S	M	M	S
CO4	S	S	S	S	M	S	S	S	S	S	M	M	S
CO5	S	S	S	S	M	S	S	S	S	S	M	M	S

Strongly Correlating (S) - 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE IV-SPECIAL PAPER V
APPLIED MICROBIOLOGY - M21BTT21</td></tr>
<tr><td>Semester</td><td colspan="2">Semester-II</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1:Recall
K2:Understand
K3: Apply</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To know about the scope and importance of Microbial biotechnology
• To understand the techniques in the production of proteins and enzymes from microbes
• To gain knowledge in microbial biomass production for different applications
• To understand the applications of microbes in environmental applications
• To learn the use of microbes in metabolic engineering</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">learn the isolation and preservation of industrially important microorganisms</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td colspan="2">gain knowledge on protein and enzyme production from pathogenic microorganism</td><td>K2</td></tr>
<tr><td>CO3</td><td colspan="2">know about utilization of microbial biomass for the production of commercially important bio-products</td><td>K2</td></tr>
<tr><td>CO4</td><td colspan="2">acquire knowledge on preparation of inoculants and composting</td><td>K2,K3</td></tr>
<tr><td>CO5</td><td colspan="2">know about the application of microbes in biotechnology and in environmental applications</td><td>K1,K2</td></tr>
<tr><td>Unit I</td><td colspan="4">Microbial biotechnology: scope and techniques, Bioprospecting of microbial diversity, Isolation and preservation of industrially important microorganisms. Genomics, Proteomics, Metabolomics, metagenomics.</td></tr>
<tr><td>Unit II</td><td colspan="4">Medical microbiology: methods of isolation of pathogenic organisms; Insulin production. Production of proteins and enzymes in bacteria, yeast and fungus, recombinant and synthetic vaccines. Microbial polysaccharides and polyesters.</td></tr>
<tr><td>Unit III</td><td colspan="4">Microbial biomass production: utilization of plant biomass by microorganisms (lignocellulose biodegradation), ethanol production, amino acids, antibiotics. Biotransformation of steroid and non steroid compounds, metabolic engineering</td></tr>
<tr><td>Unit IV</td><td colspan="4">Nitrogen fixation: Biology of nitrogen fixation,preparation of different, Types of inoculants (nitrogen fixers phosphate solubilizers, plant growth promoting rhizobacteria, PGPR, composting.</td></tr>
<tr><td>Unit V</td><td colspan="4">Microbes and its Environmental Applications: Introduction to the use of microbes in environmental applications, Bioremediation, bioaugemntation, Bioemulsifiers, biosurfactants, Microbial Enhanced Oil Recovery (MEOR), leaching of ores. Microbial fuels (Methane, Hydrogen)</td></tr>
</table>

References	**Text Books** 1. R.C.Dubey,A Textbook Of Microbiology, Publisher SChand 2011 2. Madigan Michael T, Martinko John M., Bender Kelly S. 2017.Biology of Microorganisms. 14th Edition, Publisher Pearson Educatio, 2017. 3. Sarafaraz Ahmad, A Textbook of Applied Microbiology, PublisherAnmol Publications Pvt Ltd,2011
	References Books 1.V.S. Randhawa, Textbook Of Microbiology,Peepee Publishers and Distributors,2019 2.Jeffrey C. Pommerville, Fundamentals of Microbiology.15th Edition, Publisher Jones and Bartlette. 2018. 3.Gerald J.Tortora, Microbiology,11th Edition, Publisher Pearson Education. 2016.
E-reference links:	1.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC309047/ 2.https://www.scientificpub.com/upload/pdf/758.pdf 3.https://www.britannica.com/science/nitrogen-fixation 4.https://www.degruyter.com/document/doi/10.1515/biol-2020-0099/html

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S	M	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	M	S
CO3	S	S	S	S	M	S	S	S	S	S	M	M	S
CO4	S	S	S	S	M	S	S	S	S	S	S	M	S
CO5	S	S	S	M	M	S	S	S	S	S	M	M	S

Strongly Correlating (S) - 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE IV-SPECIAL PAPER VI
FUNGAL BIOTECHNOLOGY - M21BTT21</td></tr>
<tr><td>Semester</td><td colspan="2">Semester-II</td><td>Credits:4</td><td>Hours/weeks: 10</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K1:Recall
K2:Understand
K3: Apply</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To know about the morphology, ecology and genetics of fungi
• To learn about mycotoxins and fungal diseases
• To acquire knowledge on handling and maintenance of fungi
• To know about the methods to diagnose fungal diseases
• To gain knowledge on fungal metabolites and their applications</td></tr>
<tr><td rowspan="6">Course Outcomes</td><td colspan="4">At the end of the course, the student will be able to</td></tr>
<tr><td>CO1</td><td colspan="2">learn about the morphology, ecology, genetics and cultivation of edible fungi</td><td>K1,K2</td></tr>
<tr><td>CO2</td><td colspan="2">understand the principles of systemic mycology and fungal diseases in man and animals</td><td>K2</td></tr>
<tr><td>CO3</td><td colspan="2">gain knowledge on the handling, maintenance and storage of fungal cultures</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">know the methods to gain immunity against fungal infections</td><td>K2</td></tr>
<tr><td>CO5</td><td colspan="2">acquire knowledge on the techniques to produce commercially important fungal metabolites</td><td>K1,K2</td></tr>
<tr><td>Unit I</td><td colspan="4">Introduction to Mycology or fungi: Life cycle – classification – Morphology.Ecology of Fungi – Replication – Genetics of Fungi - Fungal organelles and functions. Mushroom – edible, poisonous , Cultivation. Antifungal Agents.</td></tr>
<tr><td>Unit II</td><td colspan="4">Mycotoxin: Introduction to Systemic Mycology, Superficial, cutaneous, Sub-Cutaneous. Fungal Disease in man and Animals.</td></tr>
<tr><td>Unit III</td><td colspan="4">Fungal Guidelines: Handling of Fungal Strains – Maintenance – Subculture – Storage – Sterilization of different materials used in animal cell culture, Aseptic concepts – Safety Measures – Ethical issues.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Fungal Immunity: Immunity to fungal infection – Yeast of Medicinal Importance – Newer methods in Diagnostic Mycology.</td></tr>
<tr><td>Unit V</td><td colspan="4">Fungal Metabolites: Novel Fungal Products – Secondary Metabolites – Pigments-Types – Extraction – Somatic Hybridization – Protoplast Fusion in Fungi. Mutation in Fungi.</td></tr>
<tr><td>References</td><td colspan="4">Text Books
1. Petersen, Jens, The Kingdom of Fungi, Princeton University Press, Princeton, NJ. 2012.
2. Errol Reiss ,Fundamental Medical Mycology,Wiley,2011
3. B.R. Vashista. Fungi, Chand & Co, New Delhi. 2016.</td></tr>
</table>

	References Books 1.D. R. Arora, Medical Mycology, Publisher CBS Publishers & Distributors,2014 2.Sarwat Parvez, Morphological Guide of Human and Animal Pathogenic Fungi & Medical Mycology Lab Manual, 2019 3.Kee Peng Ng, A Guide to the Study of Basic Medical Mycology, Publisher Partridge,2014
E-reference links:	1.https://www.sciencedirect.com/science/article/pii/S1198743X14630767 2.https://www.nature.com/articles/s41579-018-0121-1 3.https://www.microscopemaster.com/fungi.html 4.http://www.mycotoxins.info/mycotoxins/mycotoxins-definition/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	S	S	S	M	M	S
CO5	S	S	S	M	S	S	S	S	S	S	M	M	S

Strongly Correlating (S) - 3 marks; Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark; No Correlation (N) - 0 mark

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