MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL

DEPARTMENT OF BIOTECHNOLOGY

M.PHIL BOTANY

SYLLABUS TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2021-2022

(CHOICE BASED CREDIT SYSTEM)

SYLLABUS, REGULATION AND SCHEME OF EVALUATION

Name of M.Phil Programme : **Botany**
Eligibility : Masters degree in Botany discipline with 55% marks
Common Entrance Exam : University conduct a Common Entrance Test (CET) for M.Phil admission

Sl. No	Paper Code	Course Title	Hours	Credits	Continuous Internal Assessment (CIS)	End Semester Exam (ESE)	Total
Semester I							
1.	M21BOT11	Core I (Theory)- Research Methodology	10	4	40	60	100
2.	M21BOT12	Core II (Theory)	10	4	40	60	100
3.	M21PST13	Core III (Theory)- Common Paper Professional Skills	10	4	40	60	100
		Total	**30**	**12**			**300**
Semester II							
4.	M21BOT21	Core IV (Theory)- Special Paper	10	4	40	60	100
5.	M21BOD22	Dissertation + Viva-voce	20	14	-	-	200
		Total	**30**	**18**			**300**
Total			**60**	**30**			**600**

Special Paper related to Project

Sl.no	Course
1.	Special Paper I -Advances In Plant Science
2.	Special Paper II - Nanotechnology
3.	Special Paper III- Plant Biotechnology
4.	Special Paper IV- Mycology
5.	Directed Study[#]
6.	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 EDUCATIONAL OBJECTIVES (PEO)

On completion of this program, students will be able to

PEO1: enable students to be competent in the field of plant science and its allied areas

PEO2: encourage the students develop teaching skills and their academic skills.

PEO3: provide necessary theoretical and practical experience in all divisions of Botany to become an expert in the subject.

PEO4: write and formulate research data/ Projects and further to publicize

PEO5: develop technical tools to formulate plant drugs to fulfill the needs of the humanity and to respect the environment

PROGRAMME OUTCOME (PO)

On completion of M.Phil Botany, graduates will be able to

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PO1: apply the obtained scientific knowledge to provide solutions to lead a healthy life and to protect the environment

PO2: acquire basic knowledge of research such as data collection, processing and presentation of data and also learn the application of various research tools.

PO3: write research articles, review articles, chapters and books.

PO4: apply their skills and techniques to improve cultivation of various food crops

PO5: demonstrate the basic and advanced techniques which used in plant breeding.

PO6: demonstrate various instruments used for the analysis and isolation of phytocompounds

PO7: understand the importance of biodiversity and the problems related to its conservation

PO8: acquire first-hand experience in working on projects at individual and knowledge on various research institutes

PROGRAMME SPECIFIC OUTCOME (PSO)

On completion of M. Phil. Botany program,

PSO1: Problem Solving Skills: Students will be able to explain various applications in the field of plant science.

PSO2: Research Skills: Students will developed their research thought and ideas for various innovative projects.

PSO3: Successful career: Students will be able to take up a suitable position in various research institutes and pursue a career in research field.

PSO4: Entrepreneurship: Students will be aware of the importance of entrepreneurship opportunities available in the society.

PSO5: Sustainable Development: Students will be able to design and execute experiments related any field of plant science

<table>
<tr><td>Course Title & Code</td><td colspan="4">CORE I - RESEARCH METHODOLOGY - M21BOT11</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).
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	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="4">COREII (THEORY) - ADVANCES IN BOTANY – M21BOT12</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">K3: Apply K4:Evaluate K5:Analyse K6:Create</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To introduce the students to advanced and modern taxonomic tools in Botany
• To gain knowledge on cutting edge technologies for future research.
• To learn the principles and mechanisms behind recent trends in Botany
• To assure that the students will know up-to-date technological advancements on the completion of this course.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">Upon completion of this course the students will be able to</td></tr>
<tr><td></td><td>CO1</td><td colspan="2">classify the plants and analyse the use of secondary metabolites extracted from plants</td><td>K3, K5</td></tr>
<tr><td></td><td>CO2</td><td colspan="2">perform and evaluate various plant breeding techniques</td><td>K3,K4</td></tr>
<tr><td></td><td>CO3</td><td colspan="2">apply plant techniques for biodiversity conservation</td><td>K3</td></tr>
<tr><td></td><td>CO4</td><td colspan="2">practice micropropagation techniques</td><td>K3</td></tr>
<tr><td></td><td>CO5</td><td colspan="2">produce new transgenic plant for the wellbeing of society and its needs</td><td>K6</td></tr>
<tr><td>Unit I</td><td colspan="4">Angiosperm Taxonomy
Plant systematic: The integration of taxonomy (identification, nomenclature, classification emphasizing flowering plants), phylogenetics (phenetics,cladistics, morphology and molecules). Taxonomic tools: Herbarium, floras, Botanical gardens, Computers. Systems of Angiosperm Classification, Chemotaxonomy:History, general chemical and chemotaxonomic characters, types of data, methods of gathering data. Identification of the major classes of the pharmaceutically important secondary metabolites from natural sources (phenolics, steroids, terpenoids, glycosides and alkaloids). Applications: Phytochemicals in cosmetics, aromatherapy, disease prevention.</td></tr>
<tr><td>Unit II</td><td colspan="4">Plant Breeding: History of Plant Breeding, High yield, improved quality, disease and pestresistance, earlymaturity, photosensitivity, varieties for new seasons and resistant varieties. Creation of new varieties, selection, evaluation, multiplication and distribution. Molecular trends in Reproductive Biology: Apomixis – Types, cytogenetic basis and induction of apomixes, applications; Biochemistry and</td></tr>
</table>

	genetics of incompatibility, methods to overcome incompatibility, pollen viability tests, molecular basis of incompatibility; Sterility – Male sterility, temperature sensitive and photosensitive male sterility, transgenic male sterility, female sterility and zygotic sterility.
Unit III	**Plant Biodiversity:** Genetic diversity in plants, Importance of genetic diversity in crop improvement and it serosion, Concepts of biodiversity conservation and regulation. Applications of molecular markers in Biodiversity. Plant biodiversity databases-molecular docking
Unit IV	**Plant Tissue culture technology:** Tissue culture techniques - callus culture-suspension culture-culture of single cells- somatic embryogenesis - anther culture-ovary culture- meristem culture, somatic hybridization, Embryo culture *in vitro* pollination, Micropropagation, Protoplastisolation fusion and culture, Somaclonal variation: Somoclonal and gametoclonal variations andimportance. Technique for detection and isolation of somaclonal variants. Factors controlling somo clonal variation and its application in plant breeding, Transformation techniques: Agrobacter iummediated genetransfer.
Unit V	**Transgenic Plants:** Transgenic plants for crop improvement (dicots and monocots), Insect resistance, insecticide, Resistancetovirus, Transgenics for male sterility, Transgenics for terminator seed, Transgenics plants as bioreactors, Transgenics plants to study regulated gene expression, Commercial transgenics crops, Uses and applications of transgenic plants. Germplasm Storage and Cryop reservation: Conservation of germplasm, *In vitro* strategies, Short, medium and long term (cryopreservation) preservation application, Techniques of cryopreservation, Determination of survival and viability, Plant growth and regeneration, Application of cryopreservation
Text Books	1. Gurcharan Singh, Plant Systematics: An Integrated Approach, Science Publishers, 2004. 2. Satyanarayana, U. Biotechnology. Books & Allied (P) Ltd, Kolkata. 2005.
References	1. Chawla, H.S. Introduction to Plant Biotechnology. 2nd Ed. Oxford University Press and IBH. 2002. 3. Chawla, H.S. Introduction to Plant Biotechnology. 2 nd Ed. Oxford University Press and IBH. 2002.

	4. Khan, T.I. and Shishoda, Y.S. Biodiversity conservation and sustainable development.,Pointer Publ., Jaipur . 1998. 5. Trivedi, P.R. and Gurudeep Raj. Environmental Wildlife and Plant conservation. Akashdeep Publ. House, New Delhi. 1992. 6. Thomas J. Orton. Horticultural plant breeding, Academic press. 2019. 7.Gamborg, O.L., Phillips, G.C. 1998. Plant Cell, Tissue & Organ Culture. Fundamendal Methods. Narosa Publishing House, New Delhi.
E-References	1. https://ebooks.schandpublishing.com/detail/a-textbook-botany-angiosperms/9788121904049 2. https://www.researchgate.net/publication/274018210_Taxonomy_and_Classification 3. http://faunaofindia.nic.in/PDFVolumes/spb/041/index.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	M	M	S	S	S	S	S	S	S	S	S
CO2	S	S	M	M	S	S	S	S	S	S	S	M	S
CO3	S	S	M	M	S	S	S	S	S	S	S	M	S
CO4	S	S	M	M	S	S	S	S	S	S	S	M	S
CO5	S	S	M	M	S	S	S	S	S	S	S	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 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 teaching, Group Discussion. Seminar, Workshops, Symposium and Panel Discussion – Games and Simulations – Web Based Instructions.</td></tr>
</table>

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
TRENDS IN PLANT SCIENCE–M21BOT21</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">K2: Understand K3: Apply K6: Create</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To gain knowledge on the pollination mechanism
• To learn advanced techniques which used in plant taxonomy
• To gain knowledge on preparation and preservation of drugs
• To learn the production of transgenic plants</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">understand various bioresources and its importance</td><td>K2</td></tr>
<tr><td>CO2</td><td colspan="2">identify the plants</td><td>K3</td></tr>
<tr><td>CO3</td><td colspan="2">apply the methods used for plant drug preparation</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">Produce new transgenic plants</td><td>K6</td></tr>
<tr><td>CO5</td><td colspan="2">apply learned techniques for plant conservation</td><td>K3</td></tr>
<tr><td>Unit I</td><td colspan="4">Plant – animal interaction: Pollination and dispersal (Air, Water and Soil) Its impact on plant, control measures. Bioremediation, Bioresourses – SCP, biomass energy, biofuel, bioinoculants and biosensors.</td></tr>
<tr><td>Unit II</td><td colspan="4">Taxonomy: Chemo, numerical, sero and digital. IUCN classification – Red data book. DNA Barcoding in plants. Species identification using software (Linneaus version), Digital herbarium.</td></tr>
<tr><td>Unit III</td><td colspan="4">Medicine: Plant in relation to human welfare: Elementary knowledge of crude drugs – Preparation, drug administration, absorption and distribution and preservation. Pre clinical and clinical phases of drug evaluation.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Genetics: Gene isolation (Direct and indirect gene transfer) methods, gene silencing, gene function editing. Production of transgenics for resistance to abiotic (temperature, salt and herbicide) and biotic (pests and diseases). Quality improvement – Vitamin enrichment, improvement in shelf life.</td></tr>
<tr><td>Unit V</td><td colspan="4">Plant Conservation: Plant Conservation strategies for plant genetic resources (ex-situ and in-situ), IPR: Outline and patenting of Biological products. Nanobiology – Introduction, approaches, green synthesis, characterization and applications</td></tr>
<tr><td>Text Books</td><td colspan="4">1. Gurcharan Singh, Plant Systematics: An Integrated Approach, Science</td></tr>
</table>

	Publishers, 2004. 2. Ignacimuthu, S.J. Applied Biotechnology. Tata Mc Graw – Hill Publishing Co. Ltd. New Delhi.1996
References	1. Mukherjee P. K.. Quality Control of Herbal Drugs, Business Horizons Pharmaceutical Publisher, Delhi, Ist edn. 2002. 2. Harborne J.B. Phytochemical Methods - A guide to modern technique of plant analysis, 3rd edn, Champan & Hall, UK. 1998. 3. Chawla, H.S. Introduction to Plant Biotechnology. 2nd Ed. Oxford University Press and IBH. 2002. 4. Drug Discovery and Evaluation –Pharmacological assays. Ed.Vogel HG & Vogel WH. Springer- New York. 1997. 5. Chawla, H.S. Introduction to Plant Biotechnology. 2 nd Ed. Oxford University Press and IBH. 2002. 6. Khan, T.I. and Shishoda, Y.S.. Biodiversity conservation and sustainable development.,Pointer Publ., Jaipur .1998. 7. Trivedi, P.R. and Gurudeep Raj. Environmental Wildlife and Plant conservation. Akashdeep Publ. Hojuse, New Delhi. 1992. 8. Finar, I. L. *Organic Chemistry, Stereochemistry and the Chemistry of Natural Products*, ELBS, Longman Singapore Publication (P) Ltd., Singapore, 5th edn. 1975.
E-References	1. https://www.researchgate.net/publication/274018210_Taxonomy_and_Classification 2. https://www.pdfdrive.com/plant-cell-and-tissue-culture-a-tool-in-biotechnology-e20389188.html 3. https://www.pdfdrive.com/principles-of-plant-biotechnology-e33514134.html 4. https://www.pdfdrive.com/plant-genomics-e28703875.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	S	S	S
CO2	S	S	S	M	S	M	S	S	S	S	S	S	S
CO3	S	S	S	M	S	M	S	S	S	S	M	S	S
CO4	S	S	S	M	S	M	S	S	S	S	M	S	S
CO5	S	S	S	M	S	M	S	S	S	M	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 IV-SPECIAL PAPER II
NANOTECHNOLOGY - M21BOT21</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">K2: Understand K3: Apply K6: Create</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To gain knowledge on principles of nanotechnology and synthesis process
• To understand different methods used for characterization of nanoparticle
• To acquire knowledge on nanostructure
• To understand the importance of nanoparticle</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">synthesise nano particle for application</td><td>K6</td></tr>
<tr><td>CO2</td><td colspan="2">characterize the nanoparticle</td><td>K3</td></tr>
<tr><td>CO3</td><td colspan="2">synthesize the microbial production of nanoparticle</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">understand the DNA based nanoparticles</td><td>K2</td></tr>
<tr><td>CO5</td><td colspan="2">use the nanoparticle in different pharmaceutical activities</td><td>K3</td></tr>
<tr><td>Unit I</td><td colspan="4">Principles of Nanobiotechnology: Nanoparticles-definition and historical background. Principles and properties of nanoparticles and nanomaterials. Biological synthesis, Microbial nanoparticle production, Magnetosomes, Bacteriorhodopsins, Nanoproteomics, Role of biomolecules, reducing and/or capping agents: proteins, viruses and carbohydrates. Nanomaterials and their applications.</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">Protein and Peptide based Nanostructures: S-layers-Chemistry and structure, Assembly, recrystalisation, diagnosis- Engineered Nanopores- Methods of production, Supported bilayers and membrane arrays- Genetic Approaches- Microbial nanoparticles production- Magnetosomes- Bacteriorhodopsins- Nanoproteomics.</td></tr>
<tr><td>Unit IV</td><td colspan="4">DNA based Nanostructures: DNA-protein nanostructures-Methods- Self</td></tr>
</table>

	assembled DNA nanotubes—Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties.
Unit V	**Pharmaceutical Nanotechnology:** Pharmaceutically important nanomaterials Drug Nanoparticles- Structure and Preparation, Liposomes, Cubosomes and Hexosomes, Lipid based Nanoparticles-Liquid nanodispersions- Solid Lipid Nanoparticles (SLP)- Biofunctionalsiation of SLP, Characterisation- Nanoparticles for crossing biological membranes. Fundamentals- Physicochemical Principles of Nanosized Drug Delivery Systems-Nanotubes, Nanorods, Nanofibers, and Fullerenes for Nanoscale Drug Delivery, Carbon nanotubes biocompatibility and drug delivery
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 Atlantic,2012
References	1. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte.Ltd, 2009. 2. C.M. Niemeyer and C.A. Mirkin, Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag Gmb H&Co, 2004. 3. S. David Goodsell, Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc, 2004. 4. Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press 2009. 5. Robert A. Freitas Jr. Nanomedicine, Volume I:Basic Capabilities, Landes Bioscience,1999
E-References	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	S	S	S	S	S	S	S	M	S
CO2	S	S	S	M	S	M	S	S	S	S	S	M	S
CO3	S	S	S	M	S	M	S	S	S	S	S	M	S
CO4	S	S	S	M	S	M	S	S	S	S	S	M	S
CO5	S	S	S	M	S	M	S	S	S	M	S	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 III
PLANT BIOTECHNOLOGY - M21BOT21</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">K2: Understand K3: Apply K5: Analyse K6: Create</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To acquire knowledge on plant tissue culture technique
• To understand different methods used for gene transfer
• To gain basic knowledge on genetic engineering
• To acquire knowledge on the importance of biotechnology</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">perform mass multiplication of plants through tissue culture</td><td>K3</td></tr>
<tr><td>CO2</td><td colspan="2">understand vectors which used for gene transfer to produce new variety</td><td>K2,K6</td></tr>
<tr><td>CO3</td><td colspan="2">apply the techniques learned for the production of edible vaccine and apply for the production of</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">analyse the production of enzymes, antibiotics and vitamins</td><td>K5</td></tr>
<tr><td>CO5</td><td colspan="2">explain on intellectual property rights and use for their future research</td><td>K3</td></tr>
<tr><td>Unit I</td><td colspan="4">Plant Tissue Culture: Types of cultures – Cell, protoplast, callus, embryo and organ; Germplasm storage and conservation in-vitro, somaclonal variation, haploid production with reference to Rice and Cotton</td></tr>
<tr><td>Unit II</td><td colspan="4">Agrobacterium and crown gall tumors; Mechanism of T-DNA transfer; Disarmed Ti Plasmid vectors (Co-integrate and Binary vectors); plant viral vectors; Direct gene transformation methods (Particle gun bombardment, Electroporation, $CaCl_2$, PEG and Liposome mediated transformation).</td></tr>
<tr><td>Unit III</td><td colspan="4">Markers: Selectable markers and promoters used in plant genetic engineering, transgenic plants for virus resistance, Pathogen resistance, salt and drought tolerance, Cytoplasmic male sterility, antisense RNA technology; Edible vaccines, Golden rice, Plastic potato; High lysine corn, Bt cotton.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Pharmaceutical products: Fermentation and production of industrial enzymes, vitamins and Antibiotics - Penicillin and Streptomycin. Proteins- Insulin and Vaccines. Biodegradable plastics, Stain improvement of microorganisms and Design of fermentor (STR). Biosafety and Bioethics.</td></tr>
</table>

Unit V	**Biotechnology and Society:** Benefits, ethical, legal and social implications (ELSI) aspects. Genetic modification and food consumption. (GMOs patenting-patent, Intellectual Property Rights (IPRs), Plant breeders Rights (PBR), TRIPS, WTO and Farmer's rights. Patenting research, International guidelines and regulations. Biotechnology and the developing countries.
Text Books	1. Elements of Biotechnology – P.K Gupta. Rastogi Publication (First Edition 2003-2004). 2. Satyanarayana, U. Biotechnology. Books & Allied (P) Ltd, Kolkata.2005.
References	1. M.K.Razdan, An Introduction to Plant Tissue Culture-Oxford and IBH Publishing. 2003. 2. J.Hammond, P.Mc. Garvy and V.Yusibov, Plant Biotechnology, Springer Verlag. 2000. 3. H.S.Chawla, Introduction to Plant Biotechnology-Oxford and IBH Publishing Co. Pvt. Ltd. 2002. 4. A Laboratory Manual Plant Biotechnology – S.S.Purohit, Agrobios (India), Jodhpur. 2006. 5. Plant Biotechnology Practical Manual- C.C.Giri and Archana Giri (2007), I.K. International Publishing House Pvt. Ltd. New Delhi. 6. Enzyme- P. Asokan, (Second edition, 2006), Chinnaa Publication, Vellore. 7. Elements of Biotechnology – P. K. Gupta, Rastogi publications, Meerut 8. Biotechnology – Sathyanararayana, NCB, Calcutta. 9. Kalyankumar De,. Plant tissue culture. New Central Book Agency, Calcutta. 2008. 10. Kumar H.D.. Molecular Biology and Biotechnology. Vikas Publishers, New Delhi. 1993.
E-References	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	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	M	M	S	S	S	S	S	S
CO3	S	S	M	S	S	M	M	S	S	S	S	S	S
CO4	S	S	S	S	S	M	M	S	S	S	M	S	S
CO5	S	S	S	S	S	M	M	S	S	M	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 IV-SPECIAL PAPER IV
MYCOLOGY- M21BOT21</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">K2: Understand K3: Apply K4: Evaluate K5:Analyse</td></tr>
<tr><td>Learning Objective</td><td colspan="4">• To understand importance of fungi
• To acquire knowledge on structure and reproduction in different classes of fungi
• To gain knowledge on lichens
• To understand the commercial importance of fungal metabolites</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">evaluate the various types of fungal spores and mode of dispersal</td><td>K4</td></tr>
<tr><td>CO2</td><td colspan="2">analyse the distribution and reproduction of different classes of fungi for extracting useful compounds</td><td>K5</td></tr>
<tr><td>CO3</td><td colspan="2">explain the importance of fungi</td><td>K3</td></tr>
<tr><td>CO4</td><td colspan="2">understand the importance of mycorrhizae in agriculture</td><td>K2</td></tr>
<tr><td>CO5</td><td colspan="2">explain various plant diseases caused by fungi</td><td>K3</td></tr>
<tr><td>Unit I</td><td colspan="4">Fungi: Introduction & Historical overview of mycology, General characteristics of fungi; Classification of Fungi (Ainsworth, 1973); Reproduction (Vegetative, Asexual and Sexual); Heterothallism; Heterokaryosis; Parasexuality; Types of fungal spores and mode of dispersal; Economic importance of fungi.</td></tr>
<tr><td>Unit II</td><td colspan="4">Fungi Reproduction: Occurrence, somatic structure, distribution and modes of reproduction with special reference to sexuality in Myxomycetes, plasmodiophoromycetes, Chytridiomycetes, oomycetes, Zygomycetes.</td></tr>
<tr><td>Unit III</td><td colspan="4">Fungi Lifecycle & Economic importance: Detailed study of Occurrence, Morphology, Reproduction, Life cycle and Economic importance of the following genera: Albugo, Saccharomyces, Aspergillus, Neurospora, Peziza and Puccinia.</td></tr>
<tr><td>Unit IV</td><td colspan="4">Lichen: A general account of lichens - Structure, nutrition; reproduction, classification and economic importance of lichens. Mycorrhizae: Role of mycorrhizae in ecosystems - AM in agriculture and horticulture - Mycorrhizas in managed environment: forest production, interactions with other microorganisms and pollutants</td></tr>
<tr><td>Unit V</td><td colspan="4">Fungal Biotechnology: Industrial uses of fungi in fermentation technology,</td></tr>
</table>

	enzyme production, citric acid production. Commercial exploitation of fungal metabolites. A general account of plant disease caused by fungi, causes, symptoms and identification of plant disease. Host – parasite interaction. Defense mechanism in plants
Text Books	1. Sharma, P.D. Microbiology (2nd edition). Rastogi Publication, Meerut. 2007 2. Burnett, J.H. The fundamentals of Mycology. ELBS Publication, London . 1971.
References	1. Aneja, K. K. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Cultivation, Wishwa Prakashan, New Delhi. 1996 . 2. Purohit, S. S. Microbiology Fundamentals and Applications, (6th Edition). Agrobios (India), Jodhpur. 1999. 3. Bessey, E.A. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.1979. 4. Mehrotra, RS, Aneja KR.An Introduction to Mycology, New Age International Pub, New Delhi. 1990. 5. Smith J.E, Berry D.R, Kristiansen B, The filamentous fungi–Vol. IV – fungal technology, Edward Arnold, London, UK. 1983. 6. Cochrane V.W, Physiology of fungi, John Wiley & Sons, Incorporated, New York. 1958. 7. Burnett J.H, Fundamentals of Mycology 2nd ed., Edward Arnold, London, and Crane Russak, New York. 1976. 8. Singh. R.S. Introduction to Principles of Plant Pathology. III - Edition. Oxford IBM. Publishing Co. Pvt. Ltd, New Delhi. 1980.
E-References	1. https://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html 2. http://herba.msu.ru/shipunov/school/biol_154/textbook/intro_botany.pdf 3. Fungi YouTube Videos: https://www.youtube.com/watch?v=vcYPI6y-Udo 4. Lichen YouTube-Videoshttps://www.youtube.com/watch?v=XQ_ZY57MY64

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	M	M	S	S	S	S	M	S
CO3	S	S	S	M	M	M	M	S	S	S	M	M	S
CO4	S	S	S	M	M	M	M	S	S	S	M	M	S
CO5	S	S	S	M	M	M	M	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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