**Course Name: Master of Science**
**Discipline: Botany**
**(For those who join in 2023 and after)**
**Course Scheme:**

## II year M.Sc. BOTANY

| Semester | Part | Subject Name | Hours | Credit | Int + Ext =Total | Local | Regional | National | Global | Professional Ethics | Gender | Human Values | Environment & Sustainability | Employability | Entrepreneurship | Skill Development | Subject Code | Revised / New / No Change / Interchanged & Percentage of Revision |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| III | Core 11 | Microbiology, Fungi and Plant Pathology | 6 | 4 | 25+75=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | **P24BYC31** | **Mark Change** |
| | Core 12 | Biotechnology | 5 | 4 | 25+75=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | **P24BYC32** | **Mark Change** |
| | Core 13 | Biochemistry | 6 | 4 | 25+75=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | **P24BYC33** | **Mark Change** |
| | Core 14 | **LAB - V**: Microbiology, Fungi and Plant Pathology & Biotechnology | 4 | 3 | 40+60=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | P22BYP31/ **P24BYCP31** | No Change |
| | Core 15 | **LAB - VI**: Biochemistry | 4 | 3 | 40+60=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | P22BYP32/ **P24BYCP32** | No Change |
| | Elective II | Biodiversity and Conservation | 5 | 5 | 25+75=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | **P24BYE31** | **Mark Change** |
| | **Total** | | **30** | **23** | | | | | | | | | | | | | | |
| | **Internship Programme (Extra Credit)** | | **60** | **2** | | | | | | | | | | | | | **P24IP31** | **New** |
| IV | Core 16 | Plant Physiology | 5 | 4 | 25+75=100 | | | | ✔ | | | | | ✔ | | ✔ | **P24BYC41** | **Mark Change** |
| | Core 17 | Bioinformatics and Biostatistics | 5 | 4 | 25+75=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | **P24BYC42** | **Mark Change** |
| | Core 18 | Developmental Botany | 5 | 4 | 25+75=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | **P24BYC43** | **Mark Change** |
| | Core 19 | **LAB – VII**: Plant Physiology | 4 | 3 | 40+60=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | P22BYP41/ **P24BYCP41** | No Change |
| | Core 20 | **LAB -VIII**: Bioinformatics and Biostatistics & Developmental Botany | 5 | 3 | 40+60=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | P22BYP42/ **P24BYCP42** | No Change |
| | Elective III | **Project** | 6 | 5 | 50+50=100 | | | | ✔ | | | | | ✔ | ✔ | ✔ | P22BY4PV/ **P24BY4PV** | No Change |
| | **Total** | | **30** | **23** | | | | | | | | | | | | | | |

## SEMESTER – III

| **Core 11 - MICROBIOLOGY, FUNGI AND PLANT PATHOLOGY** | **Total Hours :90** |
|---|---|
| **Course Code: P24BYC31** | **Total Credits : 4** |

**Course Outcomes:**

| COs | CO Statement |
|---|---|
| **CO1** | Know the contributions of microbiologists |
| **CO2** | Learn about the Classification, structure and growth of bacteria and bacterial culture techniques |
| **CO3** | Study the Classification of fungi, morphology and reproduction of major classes of fungi and Types and importance of Lichens and Mycorrhiza |
| **CO4** | Acquire knowledge on the general characteristics of viruses and Classification based on the morphology of viruses |
| **CO5** | Know the etiology of selected fungal, bacterial and viral diseases and its control measures. |

.

**Unit - I** **18 hours**

Early development of microbiology; Contributions of Anton Van Leeuwenhoek, Louis Pasteur, Joseph Lister, Robert Koch, Edward Jenner & Alexander Fleming; General characteristics of bacteria – morphological, cultural and serological characteristics; Ultra structure of Bacterial cell;Cell wall chemistry; structure of capsule, flagella, pili, fimbriae, mesosome, and plasmids; Endospore – structure,Formation and its significance.

**Unit – II** **18 hours**

Classification of Bacteria according to Bergey's Manual of systematic Bacteriology; Growth of bacteria, generation time, growth curve, measurement of bacterial growth, effect of pH and temperature on bacterial growth; Nutritional types of bacteria; Bacterial metabolism – EMP pathway, ED pathway and Pentose Phosphate pathway.

**Unit – III** **18 hours**

General characteristics of fungi; Contributions of Heinrich, Anton De Bary, Miles Joseph Berkeley and Edwin John Butler; Classification of fungi based on C.J Alexopoulos and C.W Mims (1979); Study of somatic and reproductive structures of the following classes: Zygomycetes, Ascomycetes, Basidiomycetes & Deuteromycetes; Nutritional and medicinal Importance of Ganoderma sp and Agaricus sp; Lichens types and importance, Mycorrhizatypes and importance.

**Unit – IV** **18 hours**

Structure and physical properties of Plant viruses; Classification based on the morphology; Structure of Cauliflower mosaic virus (CaMV) and Tobacco Mosaic Virus

(TMV);Virus vector relationship, Transmission & control measures of plant viruses; Bacteriophages - Structure, Lytic and Lysogenic cycles.

**Unit - V** **18 hours**

Classification and symptoms of plant diseases; Mechanism of infection; Defence mechanism - structural and biochemical changes; Epidemiology and Disease forecasting; Principles of plant disease control;Etiology and control measures of the following plant diseases: Downy mildew of Grapes, Banana leaf spot, Black rust of Wheat, Blast disease of Rice, Citrus canker, Yellow mosaic of Bhendi. Wilt disease of Cotton.

** A field study/trip to research institute/universities/industrial visit should be carried out for at least two days.*

**Text Books:**


- O.P Sharma, 1998 - Text book of Fungi Tata McGrew Hill Publishing Co. New Delhi.
- B P Pandey, 2001 - Plant Pathology - S. Chand & Company. P.D Sharma, 2006 - Plant Pathology - Narosa publication, New Delhi.
- R. C. Dubey, D.K. Maheshwari, 2008 - Text Book of Microbiology- S. Chand & Company Limited, New Delhi.
- Vashishta, P.C and Gill, P.C. 1998 - Plant Pathology. Pradeep Publications, Jalandhar.
- Alexopoulos, C.J., Mims, C.W., Blackwell, M.1996 - Introductory mycology. John Wiley & sons. Newyork


**Reference Books:**


- Atlas, M. and Bartha, R.2000. Microbial Ecology. Addison Wesley Longman, Inc,
- New York.
- Pelezar, M.J Chan, E.C.S and Krieg, N.R.1993. Microbiology-concepts and
- Applictions. McGrew Hill, Inc. Newyork.
- Mehrotra, R.S. 2000. Plant Pathology. Tata McGrew Hill Publishing Co. New Delhi.
- Rangaswamy, G. 1992. Disease of crop plants in India. Prentice Hall of India, New
- Delhi.
- Wheeler, B.E 1972. An Introduction to Plant Disease. John Wiley & sons. Newyork
- Introductory Mycology - C.J Alexopoulos, Charles W. Mims, M.Blackwell,2002. 4th
- Edition. Wiley India Pvt. Ltd. New Delhi.
- Plant Pathology - George, N Agrios, 2005. Academic Press California, USA.
- Plant Pathology - R.S Mehrotra, 2nd Edition, 2003. Tata McGrew Hill Publishing Co.
- New Delhi.


**e-Resources:**

1. https://uou.ac.in/sites/default/files/slm/BSCBO-101.pdf
2. https://agri-bsc.kkwagh.edu.in/uploads/department_syllabus/2018-08-011533119323Path%20all%20syllabus,%20lesson%20plan,%20books.1533119323.pDf
3. http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf

---

| **CORE 12 - BIOTECHNOLOGY** | **Total Hours :75** |
|---|---|
| **Course Code: P24BYC32** | **Total Credits : 4** |

**Course Outcomes**

| **COs** | **CO Statement** |
|---|---|
| **CO1** | Understand the tools used in Genetic engineering |
| **CO2** | Apply the principles of bioprocess engineering in the design, analysis, optimization and Downstream processing. |
| **CO3** | Attain sufficient Knowledge about the applications of modern biotechnology for the industrial production with waste minimization and reduced energy consumption. |
| **CO4** | Understand the meristem culture and clonal propagation of plants on a commercial scale |
| **CO5** | Apply principles of basic science concepts in understanding and prediction of matter at nano scale. |

**Unit – I** **18 hours**

Scope - multidisciplinary approach of biotechnology. Recombinant DNA technology and its applications - molecular tools - nomenclature and characteristics of Restriction enzymes - ligases and DNA modifying enzymes. Plasmid vectors - properties and classification - pBR 322, M13 phage vectors,Shuttle vector, cassette vector, cosmids (pJB 8), Construction of Genomic library and cDNA library . DNA finger printing.

**Unit – II** **18 hours**

Direct gene transfer using PEG, Electroporation, biolistics, microinjection and liposome mediated methods of gene delivery. *Agrobacterium* and CaMV mediated gene transfer- Ti plasmid (Octopine and Nopaline) - Disarmed Ti plasmid, Ri plasmid - Hairy root culture. PCR, RAPD, AFLP and RFLP - applications.

**Unit – III** **18 hours**

Industrially important microorganisms - Primary screening, crowded plate technique, enrichment culture technique. Fermentation-submerged fermentation (SM) and Solid state fermentation (SSF). Types of fermentor. Industrial production of penicillin, citric acid, glutamic acid, vitamin $B_{12}$ and SCP.

**Unit – IV** **18 hours**

Micropropagation – Types of media, organ culture (Protoplast, Embryo, Anther, Ovary) somatic hybridization, cybrids, artificial seeds and somaclonal variation. Transgenic plants -Bt Brinjal, Golden rice, Flavr Savr Tomato. Biosafety aspects of GMOs and GM foods. Agricultural biotechnology - Cultivation and Mass Production of Biofertilizers - BGA, Mycorrhiza, *Rhizobium,* Bioinsecticides - viral, bacterial and fungal sources.

**Unit – V** **18 hours**

Nanotechnology – phytomediated synthesis of silver Nano particles and their properties (surface effect, size, shape). Advances made with plant Nanobionics – bomb detection, glowing plants, augumented photosynthesis. Biosensor - types and applications. Bioleaching methods & advantages; Phytoremediation; DNA vaccines - Plant as edible vaccines- Enzyme immobilization; conservation of germplasm *in vitro* strategies.

***A field study/trip to research institute/universities/industrial visit should be carried out for atleast two days.***

**Text Books:**


- Rev Fr Dr. S. Ignacimuthu, S.J., 1995, Basic Biotechnology - Tata Mc Graw Hill Publishing Company Ltd. New Delhi.
- S. Ignacimuthu, 1997, Plant Biotechnology -. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
- S.S. Purohit 2003 - Biotechnology fundamentals and applications, - Published by Agrobios India.
- R.C. Duby, 2006 - A text Book of Biotechnology , S. Chand & Company Ltd, Ram Nagar, New Delhi.
- Kalyan Kumar De., 1992 - Plant tissue culture, New central book Agency P .Ltd, Calcutta.
- M.K Razdan., 2002 - Introduction to plant Tissue Culture, Oxford & IBH Publishing Co.Ltd. New Delhi.


**Reference Books:**


- Chawla, H.S. 2000. Introduction to plant biotechnology. Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi.Dixon, R.A and Gonzales, R.A (Eds.) 1994. Plant Cell Culture- A Practical Approach. Oxford University Press.
- Gamborg, O.L and Phillips, G.C. 1998. Plant Cell, Tissue and Organ culture. Narosa Publishing House, New Delhi.
- Griffiths et al., 1999. Modern genetic Analysis. W.H. Freeman & Co. Newdork.
- Gupta, P.K, 1999. Elements of Biotechnology. Rastogi Publications, Meerut.
- Jefrey, M, Backer et al., 1996. Biotechnology - A Laboratory Course. Academic Press, Newyork.


**e-Resources:**

- https://www.mlsu.ac.in › 119_
- https://www.frontiersin.org/articles/10.3389/fpls.2014.00730/full
- https://byjus.com/biology/tissue-culture/
- https://byjus.com/free-ias-prep/genetically-modified-crops-upsc-notes/

---

| **Core – 13 - BIOCHEMISTRY** | **Total Hours : 90** |
|---|---|
| **Course Code: P24BYC33** | **Credit: 4** |

**Course Outcomes:**

| COs | CO statement |
|---|---|
| **CO1** | Understand the structure, properties and biosynthesis of amino acids and proteins |
| **CO2** | Gain knowledge on overview of enzymes, Mechanism of enzyme action and applications of enzymes |
| **CO3** | Appreciate the role and importance of carbohydrates metabolism and its regulation |
| **CO4** | Gain knowledge about lipid metabolism and its importance |
| **CO5** | Acquire knowledge about nucleic acid biosynthesis and |

**UNIT-I** **18hours**

Structure and Properties of Carbohydrates; Glycolysis, HMP Pathway. Gluconeogenesis, TCA cycle, Electron transport and Oxidative Phosphorylation.

**UNIT-II** **18hours**

Biosynthesis of amino acids; properties and chemical reaction concerned with amino acids; proteins: primary, secondary, tertiary structure of protein, 3D structure and protein folding, physiochemical properties of proteins.

**UNIT - III** **18 hours**

Classification and nomenclature of enzymes; IUB, isolation and purification of enzymes; concept of active site, mechanism of enzyme action; Michaelis – Menton equation and Km value; Enzyme modifier-activator, inhibitors, allosteric enzymes; regulation of enzyme action; Isozymes and its applications.

**UNIT-IV** **18hours**

Biosynthesis and oxidation of palmitic acid and its bioenergetics, oxidation of unsaturated fatty acids, biosynthesis of cholesterol, importance of cholesterol and plant lipids; Glyoxylate Metabolism.

**UNIT-V** **18hours**

Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids – Biosynthesis of Nucleotide – *De novo* synthesis and salvage pathway – Nucleotide degradation. Vitamins – types and biological function- vitamins as coenzymes. Intermediary metabolism; integration of metabolic pathways.

****A field study/trip to research institute/universities/industrial visit should be carried out for atleast two days.***

**Text Books:**

- Conn, E.E. and Stump P.K.etal., 1999.Biochemistry.John Wileyand Sons. New Delhi.
- Jain,J.L. 2000.Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
- Plummer, D.T. 1996.An Introduction to Practical Biochemistry.McGraw Hill.

**Reference Books:**

- Voet.D and Voet.G.etal, 2016 – Fundamentals of Biochemistry, JohnWileyandSons.USA.
- Lehninger,A.L., Nelson,d.L, and Cox.M.M(2008).Lehninger Principles of Biochemistry(5$^{th}$ed), Palgrave Macmillan, NewYork.
- Jeremy M. Berg, John. L. Tymoczko, Gregory J.Gatto,Jr. Lubert Stryer(2015)Biochemistry– WH. Freeman.USA.
- Buchanan, B.B., Grissem, W. and Jones, R.L. (2000). Biochemistry and Molecular biology of plants, 5th edition, Wiley-Blackwell.
- Heldt, H.W. (2005). Plant Biochemistry. 3rd edition, Elsevier Academic Press.

**e-Resources:**

- Biochemistry Free and Easy | Biochemistry and Biophysics | Oregon State University
- Atoms, Isotopes, Ions, and Molecules | Boundless Biology | | Course Hero
- Potential, Kinetic, Free, and Activation Energy | Boundless Biology | | Course Hero
- ATP: Adenosine Triphosphate | Boundless Biology | | Course Hero
- Synthesis of Biological Macromolecules | Boundless Biology | | Course Hero
- Connections of Carbohydrate, Protein, and Lipid Metabolic Pathways | Boundless Biology | | Course Hero
- Regulation of Cellular Respiration | Boundless Biology | | Course Hero
- Energy in Living Systems | Boundless Biology | | Course Hero
- Glycolysis | Boundless Biology | | Course Hero
- Oxidation of Pyruvate and the Citric Acid Cycle | Boundless Biology | | Course Hero
- Oxidative Phosphorylation | Boundless Biology | | Course Hero
- Metabolism without Oxygen | Boundless Biology | | Course Hero

**Interactive animations:**

- Interactive Concepts in Biochemistry - Interactive Animations (wiley.com)
- BioInteractive Resources
- https://www.biointeractive.org/classroom-resources?keyword=&topics=23&resource_type=9&level=100&sort_bef_combine=search_api_relevance_DESC&f%5B0%5D=grade_levels%3A100&f%5B1%5D=resource_type%3A9&f%5B2%5D=topics%3A23

---

| **Core-14-Lab V – LAB: MICROBIOLOGY, FUNGI, PLANT PATHOLOGY & BIOTECHNOLOGY** | **Total Hours : 60** |
|---|---|
| **Subject Code:** P22BYP31/ **P24BYCP31** | **Credit: 3** |

**Course Outcomes:**

| COs | CO Statement |
|---|---|
| **CO1** | Know about the microbes, media preparation and different types of culture techniques. |
| **CO2** | Learn about the gram staining and Hanging drop techniques |
| **CO3** | Know the etiology of selected fungal species. |
| **CO4** | Acquire knowledge on the Agarose gel electrophoresis and PCR. |
| **CO5** | Learn about the different blotting techniques |

**Practical syllabus**

**Microbiology, Fungi and Plant Pathology**

- Sterilization method.
- Preparation of culture Media - Nutrient Agar (NA) and Potato Dextrose Agar (PDA)
- Isolation of microbes from soil and water using serial dilution technique.
- Staining of Bacteria - simple and gram staining.
- Hanging drop technique.
- Micro preparation and observation of the following fungi:
  *Mucor, Rhizopus, Pilobolus, Aspergillus, Penicillium, Xylaria, Peziza, Puccinia, Polyporus, Lycoperdon, Agaricus and Alternaria, Cercospora* .
- Observation of infected plant specimens mentioned in the syllabus.

**Biotechnology**

• Isolation of plant chromosomal DNA- CTAB method
• Agarose gel electrophoresis and visualization of DNA.
• Restriction endonucleases
• Amplification of DNA using PCR - demonstration.
• Spotters - vectors, blotting techniques, transgenic plants, fermentor, biogas, methods of gene transfer.
• Demonstration of Artificial seed synthesis.

---

| **Core-14-LAB VI – LAB: BIOCHEMISTRY** | **Total Hours : 60** |
|---|---|
| **Subject Code:** P22BYP32/ **P24BYCP31** | **Credit: 3** |

| **CO statement** | |
|---|---|
| **CO1** | Student gain confidence on preparing various expression of concentration of solutions |
| **CO2** | Obtain knowledge on qualitative test for various biomoleules |
| **CO3** | Gain knowledge on quantitative estimation of various biomolecules |
| **CO4** | Acquaint with Acid- Base chemistry |
| **CO5** | Acquire knowledge Enzyme assay |

**Practical Syllabus**

1. Preparation of molal, molar, normal and percentage solutions and their dilutions
2. Qualitative tests for Carbohydrates(reducing sugar, Starch),Protein- amino acid (Tryptophan), Lipid (cholesterol)
3. Estimation of Sugar, Starch, Protein and free amino acid by Colorimetric method
4. Estimation of Lipids by Gravimetric method.
5. Determination of pKa value for acetic acid
6. Estimation of total phenolics.
7. Enzyme assay (amylase)
   a) Determination of Km value
   b) Effect of pH on enzyme activity.
   c) Effect of inhibitor on Enzyme activity

---

| **Course Title : BIODIVERSITY AND CONSERVATION** | **Total Hours :75** |
|---|---|
| **Course Code : P24BYE31** | **Total Credits : 5** |

**Course Outcomes:**

| **COs** | **CO Statement** |
|---|---|
| **CO1** | Gain knowledge on the biodiversity and understand the levels and types of biodiversity |
| **CO2** | Acquire technical knowledge on the comprehensive methods for inventorying the biodiversity and its assessment |
| **CO3** | Familiarize an overview about the various threats to biodiversity and international agencies in conservation |
| **CO4** | To get an idea about the biodiversity conservation strategies |

| | |
|---|---|
| **CO5** | Acquire knowledge about Biodiversity act, various issues and rights related to biodiversity |

**UNIT - I** **18-hours**

Biodiversity: definition, concept, scope; Levels of biodiversity: Genetic, species and ecosystem diversity; Magnitude of biodiversity; Global pattern of biodiversity (abiotic and biotic theories); Measures of biodiversity: alpha; beta and gamma diversity; Key stone species and their significance in an ecosystem function; Concept of Hot Spots; Distribution of hotspots in India and the world; Values of biodiversity: economic; ecological and societal.

**UNIT - II** **18-hours**

Methods of sampling: quadrat method, transect method, plot less method, pitfall method, sweep net method and all out searches; Types of Diversity indices: i) Dominance indices- Berger and Parker & Simpson; ii) Information-Statistic Indices- Brillouin and Shannon; Community similarity- Jaccard coefficient and Sorenson coefficient.

**UNIT - III** **18-hours**

Threats to Biodiversity - Habitat loss and fragmentation, Introduction of alien invasive species, Disturbance and pollution, Harvesting and exploitations; GMOs and biodiversity; Extinction of species and causes for species extinction; IUCN Red list categories; International efforts for conserving biodiversity - CITES, WTO, CBD and International treaty on Plant Genetic Resources; Ethnobiology, biodiversity and traditional knowledge.

**Unit - IV** **18-hours**

Conservation of biodiversity: need for conservation, type – *In-situ* conservation (sanctuaries, national parks and biosphere reserves) and *Ex-situ* conservation (Gene banks, seed banks, Pollen banks and Cryopreservation); Role of indigenous people in conservation of sacred species, sacred groves; Human and animal conflicts in Biodiversity conservation.

**UNIT - V** **18-hours**

Bioprospecting, Indigenous knowledge, Biopiracy, Impact of new technologies; Biotechnology and genetic engineering, Intellectual property rights; Contribution of NBA, Biodiversity act-2002, Wild Life Protection Act-1972 and PPVFR Act-2001.

***A field study/trip to research institute/universities/industrial visit should be carried out for atleast two days.***

**Text Books:**


- Krishnamurthy, K.V. An advanced Book on Biodiversity-Principles and Practice. Oxford and IBH publishing company, New Delhi, 2003.
- Singh, J.S., Singh, S.P. and Gupta, S.R. 2010. Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi, 2010.
- Biodiversity- CPR Environmental Education Center, Chennai


**Reference Books:**


- Peter Stiling. Ecology- Theories and Application. Prentice- Hall of India, New Delhi, 2002.

- Miller. T, Environmental Science. Cengage Learning India Pvt. LTD, New Delhi, 2010.


**e-Resources:**

- https://eco-intelligent.com/2016/10/14/alpha-beta-gamma-diversity/#:~:text=Alpha%20diversity%20is%20the%20species,range%20of%20the%20mountain%20slope.
- https://www.britannica.com/study/4-different-ways-to-measure-biodiversity
- https://education.nationalgeographic.org/resource/role-keystone-species-ecosystem
- https://www.biologydiscussion.com/plant-ecology/methods-of-sampling-plant-communities/57189
- https://www.statisticshowto.com/jaccard-index/
- https://bio.libretexts.org/Courses/Gettysburg_College/01%3A_Ecology_for_All/22%3A_Biodiversity/22.02%3A_Diversity_Indices
- https://www.bioexplorer.net/threats-to-biodiversity.html/
- https://byjus.com/free-ias-prep/iucn-red-list/#:~:text=Critically%20endangered%20(CR)%20%E2%80%93%20Extremely,Likely%20to%20become%20endangered%20soon.
- https://cites.org/eng/disc/what.php
- https://byjus.com/biology/biodiversity-conservation/
- https://www.drishtiias.com/to-the-points/paper3/intellectual-property-rights
- https://byjus.com/free-ias-prep/biological-diversity-act-2002/
- https://byjus.com/biology/biopiracy/#:~:text=Biopiracy%20is%20the%20practice%20of,from%20one%20generation%20to%20another.

---

**SEMESTER - IV**

| **Course : CORE 16 - PLANT PHYSIOLOGY** | **Total Hours : 75** |
|---|---|
| **Subject Code: P24BYC41** | **Credit: 4** |

| **COs** | **CO Statement** |
|---|---|
| **CO1** | Understand how water and ions are transported in plants. |
| **CO2** | Gain knowledge on Mineral salt absorption and its mechanism |
| **CO3** | Understand plant strategies in the capture of light and carbon fixation |
| **CO4** | Attain sufficient knowledge on plant respiration and $N_2$ fixation |
| **CO5** | Understand the various plant adaptations to different environments their impacts on plant physiology |

**UNIT I** **18 hours**

Water relations - physico chemical properties of water; theories on membrane permeability; diffusion, osmosis and imbibition; plasmolysis and deplasmolysis- significance; water potential - definition, water potential gradient, soil-plant-air-continuum. Absorption of water: types of soil water, water absorbing parts of plants. Mechanism of water absorption, active and passive absorption, significance. Ascent of sap- Transpirational pull theory.

**UNIT II** **18 hours**

Mineral salt absorption: mechanism of mineral salt absorption- theory, passive absorption theory, apoplastic, mass flow theory, Donnan's equilibrium, active absorption theory - symplast, Carrier concept theory, protein lecithin and cytochrome pump hypothesis. Transpiration: types, significance, Mechanism of stomatal movement. Theories - starch, glycolate, K+ ions. and guttation.

**UNIT III** **18 hours**

Photosynthesis - excitement and ground state, electromagnetic spectrum, photosynthetic apparatus. PSI and PSII reaction centres, components of cyclic and non cyclic reactions. "Z" scheme, Emerson's enhancement and Red drop. CO2 assimilatory pathways, C3, C4. CAM pathway - interrelation and differences. Factors affecting photosynthesis.

**UNIT IV** **18 hours**

Respiration - Aerobic, Anaerobic respiration, RQ. ETP complexes, cyanide resistant pathway. Biochemical control of respiration, Factors affecting respiration - Photorespiration - Dual action of Rubisco - Glycolate pathway (C2 pathway), nitrogen metabolism - Diazotrophs, symbiotic, mechanism of N2 fixation and nitrogen cycle

**UNIT V** **18 hours**

Growth - Bioassay, chemistry and physiological applications of phytohormones - auxin, gibberellins, cytokinins, ABA, ethylene and brassinosteroids. Role of light - photoperiodism, its type and significance. Vernalization, senescence and ageing mechanism (brief account). Phytochromes - properties, mechanism of action and functions. – Flowering hormones and Inhibitors - Stress physiology - drought, salt, heat and radiation stress. Biological clock - Circadian rhythm in plants (brief account).

***A field study/trip to research institute/universities/industrial visit should be carried out for atleast two days.***

**Text Books**:


- S.K.Verma and Mohit Verma, 2008, Plant Physiology, S.Chand Limited, New Delhi.
- R.K.Sinha, 2004, Modern Plant Physiology, Alpha Science International Ltd, England.
- S.N.Pandey and B.k.Sinha,2009, Plant Physiology, Vikas Publishing House Pvt


**Reference Books:**


- Devlin and Witham, 1997. Plant Physiology. CBS Publishers and Distributers, New Delhi.

- Lincoln Taiz and Eduardo Zeiger, 1991. Plant Physiology. The Benjamin/ Cummings publishing Company, Inc.
- Noggle and Fritz, 1999. Introductory Plant Physiology. Prentice hall, London.
- Salisbury, F.B. and Ross. C. 2000. Plant Physiology. John Wiley & Sons, New Delhi.
- Wilkins, MB. (Ed) 1984. Advanced Plant Physiology. Pitman Publishing Co. New York.


**e-Resources:**

- https://www.onlinebiologynotes.com/plant-water-relations-and-water-potential-diffusion-osmosis-and-imbibition/
- https://www.biologydiscussion.com/plants/absorption-of-water/absorption-of-water-in-plants-with-diagram/22718
- https://www.biologydiscussion.com/plants/absorption-of-mineral/absorption-of-mineral-salts-from-soil-by-plants-with-diagram/22774
- https://www.khanacademy.org/science/ap-biology/cellular-energetics/photosynthesis/v/photosynthesis
- https://www.biologydiscussion.com/difference/difference-between-photorespiration-and-normal-respiration/52205
- https://en.wikipedia.org/wiki/Plant_hormone

---

| **Course Title : Core 17 - BIOINFORMATICS AND BIOSTATISTICS** | **Total Hours :75** |
|---|---|
| **Course Code : P24BYC42** | **Total Credits : 4** |

**Course Outcomes**

| COs | CO STATEMENT |
|---|---|
| **CO1** | Understand the various measures of central tendancy and learn the methodologies of Biostatistics and its application in selection of the Biological samples. |
| **CO2** | Identify appropriate tests to perform hypothesis testing, and interpret the outputs adequately |
| **CO3** | Ascertain the Knowledge about Protein and Genome Databases. and also about the Data Retrieval tools and its Utilization. |
| **CO4** | Insight in Drug discovery and drug targeting in various fields |
| **CO5** | Able to perform and interpret statistical analysis with real molecular biology data. |

**Unit - I** **18 hours**

Introduction to Bioinformatics: Definition, objectives. Introduction to Triple letter and single letter code for amino acids, Symbols used in nucleotides, Biological data formats. Retrieval and visualization of Sequence (Nucleotide and protein). Applications of Bioinformatics in various fields.

**Unit - II** **18 hours**

Biological Databases-Primary, secondary and specialized databases. Nucleic acid databases-NCBI, DDBJ, and EMBL: Protein databases-PDB, PIR, and SWISSPROT. Structure elucidation -SCOPE and CATH. Sequence retrieval method from different databases. Sequence analysis - Local vs Global : Multple sequence alignment: Dynamic Programming- Smith Waterman/Needle man wunsch algorithm, Online search Tools-BLAST/FASTA

**Unit - III** **18 hours**

Genome and proteome analysis: genomics - structural, functional and comparative genomics, isolation of genes, Genome sequencing - Sanger method. Genome mapping, Genome analysis - Microarray, proteomics - structural and functional proteomics: tools - proteomic analysis - 2D PAGE,MS MALDI - TOF. Molecular visualization – Drug discovery – Ligand based – Structure based – Drug designing

**Unit - IV** **18 hours**

Biostatistics: Definition and scope-Descriptive and inferential statistics, Populations, Samples, Variables, Parameters, Collection of data, Sampling methods, organizing the data into summary tables and graphing the data.

**Unit -V** **18 hours**

Measures of central tendency-arithmetic mean mode and median, measures of dispersion- Mean deviation and standard deviation and standard error. Probability-addition and Multiplication theorems-normal distribution and binomial distribution. ANOVA (one way and two way), correlation and regression-Tests of Significance (t,f) - X test and its applications.

***A visit to research institute/universities/industries should be carried out for atleast two days.***

**Text Books:**


- Khan and Khan.1994. **Biostatistics.** Vikas Publishing House Pvt. Ltd. New Delhi.
- Shanmugavel.P.2006. Trends **in Bioinformatics,** Pointer Publishers, Jaipur, India
- Ignacimuthu. S, 1995. Basic Biotechnology, Tata McGraw Hill Publishing Co., New Delhi,


**References Books:**


- Daniel WW, 1995.Biostastics.7th edition, John wiley and Sons, Newyork,USA
- Bliss CI,1970.Statistics in Biology.Vol I and II, Mc Graw-Hill Inc.USA
- Lehinger,A.L.Principles of Biochemistry.CBS Publishers and distributors,New Delhi,India
- Attwood T.K. and Parry-Smith .1999.Introduction to bioinformatics.A W Longman Ltd.UK.
- R.M.Twyman.2008.Principles of Proteomics.Taylor and francis.UK

- David W Mount 2005.Bioinformatics sequence and genome analysis(2 nd edition) CBS Publishers.Newdelhi
- Jean Michel Claveria and Cedric Notre dome 2006.Bioinformatics-A beginners guide -Wiley Dream tech-Newdelhi
- Orpita Bosu and Simminder Kaur Thukral 2007. Bioinformatics Databases, Tool and Algorithms. Oxford University Press.


**e-Resources:**

- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBB1609.pdf
- https://www.studocu.com/row/document/kenyatta-university/economics101/biostatistics-lecture-notes-2/21626424
- https://www.teachmint.com/tfile/studymaterial/b-sc/biostatistics/biostatunit2pdf/98b8aaca-ddd4-48e9-8619-1aab88381a3e

---

| **Course Title : Core 18 - DEVELOPMENTAL BOTANY** | **Total Hours :75** |
|---|---|
| **Course Code : P24BYC43** | **Total Credits : 4** |

**Course outcomes**

| CO | COs STATEMENT |
|---|---|
| **CO1** | Comprehend the contributions by the national and international embryologists to the subject and to evaluate the application of the subject knowledge to other branches and industries |
| **CO2** | Examine the development of microspore and megaspore |
| **CO3** | Depict the fertilization and post-fertilization processes, incompatibility and demonstrate the methods of overcoming self incompatibility |
| **CO4** | Demonstrate Embryogenesis, development of fruit, polyembryony, apomixis |
| **CO5** | Comprehend the tissue differentiation, plant galls, crown gall tumours and biological significance |

**Unit – I** **18 hours**

Historical account – Contributions of Indian Plant Embryologists – Maheswari, P, Johri BM, Swamy, BGL; International Plant Embryologists – Amici, G.B., Wihalm Hofmeister, Edward Strasburger, SergiusNawaschin, Wunderlich; Scope on plant embryology to other branches of botany – taxonomy, cell biology, plant tissue culture, molecular biology and industries – plant breeding, secondary plant metabolites

**Unit – II** **18 hours**

Microsporogenesis - Microsporangium – Morphology and development of Male gametophyte; wall layers, tapetum, MMC and microspores – Megasporogenesis -

Megasporangium – structure and organization of embryo sac; positional variation and development

**Unit – III** **18 hours**

Fertilization and post – fertilization – Pollination - Pollen germination, pollen tube growth and cellular, biochemical changes; Self-incompatibility, Genetic basis of self incompatibility, Barriers to fertilization, Significance of Incompatibility, Methods to overcome incompatibility; Syngamy and types; Double fertilization- Definition, importance; Triple fusion; Endosperm - cellular, nuclear and helobial types, endosperm haustoria types and functions

**Unit -IV** **18 hours**

Embryogenesis - Embryo Development stages - cell lineages during late embryo development – Dicot embryo and monocot embryo development - Agamospermy and Polyembryony and Apomixis – types -. Fruit – and Seed development – Seed coats, Aril structure, parthenocarpy – types and significance

**Unit -V** **18 hours**

Morphogenesis – Definition, scope and importance; Concepts - differentiation, dedifferentiation, re-differentiation, polarity, symmetry - Morphogenetic factors - Physical, mechanical, chemical and genetic factors – Plant Galls – types, causal organisms – phytocecdion, zoocecidion, Development process and crown gall plant tumours – Biological significance

**Text Books:**


- Mani, M.S. 1964. Ecology of Plant Galls, Springer Sciences Business Media, Dordrecht, UK.
- Swamy B.G.L and Krishnamurthy K.V 1990 From flower to fruits ,Tata – McGraw Hill publishing CoLtd , New Delhi
- Maheswari.P 1991. An Introduction to Embryology of Angiosperms. Tata- McGraw hill Publishing Co .Ltd. New Delhi
- Raghavan,V. 1997. Molecular embryology of flowering plants. Cambridge University Press. UK.
- Pullaiah, T., Lakshminarayanan, K. and Hanumantha Rao, B. 2001. Text book of embryology of angiosperms, Regency Publications, New Delhi.
- Lersten, N.R. 2004. Flowering Plant Embryology. Blackwell Publishing, Australia.
- Bhojwani, S.S. Bhatnagar, S.P. and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.


**References:**


- Burgess, J. 1985 An Introduction to Plant Cell Development. Cambridge University Press, Cambridge, London
- Leins, P., TucKer, S.C. and Endress, P.K. (1988) Aspects of Floral Development, J. Cramer, Germany, 1988.
- Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego, USA.

- Howell, S.H. 1998. Molecular Genetics of Plant Development. Cambridge University press, Cambridge, London
- Bhojwani, S.S. and Soh, W.Y. 2001. Current Trends in the embryology of angiosperms. Kluwer Academic Publishers. The Netherlands.
- P. Maheswari (1963). An Introduction to embryology of Angiosperm: Mc Craw-Hill., New York
- Pullaiah, T., Lakshminarayanan, K. and Hanumantha Rao, B. (2001). Text book of embryology of angiosperms, Regency Publications, New Delhi.


**e-Resources:**

- Comparative Embryology of Angio sperms. Johri, B. M., Ambegaokar, BOOK REVIEWS in early embryogenesis. His work was Alismataceae
- https://link.springer.com/content/pdf/10.1007/978-3-662-12051-4_2.pdf
- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/embryogenesis
- https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/endosperm
- https://www.researchgate.net/figure/Morphological-types-of-galls-based-on-position-of-galling-herbivores-and-gall-development_fig5_263010118

---

| **Course: Core 19 - LAB: PLANT PHYSIOLOGY** | **Total Hours :60** |
|---|---|
| **Course Code :** P22BYP41/ **P24BYCP41** | **Total Credits : 3** |

| **CO** | **COs STATEMENT** |
|---|---|
| **CO1** | Attain knowledge on membrane permeability |
| **CO2** | Acquire knowledge on determination of Anthocyanin and Chlorophyll pigments |
| **CO3** | Understand the mechanism of Stress Physiology |

**Practical Syllabus**

1. Determination of Osmotic potential of Rhoeo cell sap by plasmolytic method
2. Determination of Water Potential of Potato tuber by Gravimetric method
3. Determination of Water Potential of Potato tuber by falling drop method
4. Effect of Detergent on membrane permeability.
5. Effect of Organic solvent (acetone) on membrane permeability
6. Determination of Anthocyanin
7. Determination of Stomatal Frequency and stomatal Index.
8. Effect of Leaf age on chlorophyll content
9. Effect of Leaf age on the soluble protein content
10. Effect of shade and direct sunlight on chlorophyll content.
11. Effect of Cytokinin on the delay of senescence in terms of chlorophyll content
12. Determination of proline from normal and water stressed plant

---

| **Course: Core 20- LAB: BIOINFORMATICS AND BIOSTATISTICS & DEVELOPMENTAL BOTANY** | **Total Hours :75** |
|---|---|
| **Course Code :** P22BYP42/**P24BYCP42** | **Total Credits : 3** |

| **CO** | **COs STATEMENT** |
|---|---|
| **CO1** | Identify appropriate tests to perform hypothesis testing, and interpret the outputs adequately |
| **CO2** | Ascertain the Knowledge about Protein and Genome Databases. and also about the Data Retrieval tools and its Utilization. |
| **CO3** | Examine the development of microspore and megaspore |
| **CO4** | Depict the fertilization and post-fertilization processes, incompartibity and demonstrate the methods of overcoming self incompatibility |
| **CO5** | Demonstrate Embryogenesis, development of fruit, polyembryony, apomixis |

## Practical Syllabus

### BIOINFORMATICS AND BIOSTATISTICS

Biological Databanks-Sequence databases, structure databases, specialized databases; Data retrieval tools and methods; Database file formats
Molecular visualization -Rasmol, Swiss PDB viewer.
Database similarity searching and dynamic programming algorithms
Sequence similarity searching-NCBI BLAST, FASTA
Pairwise and Multiple sequence alignment -Clustal W
Analysis of protein and nucleic acid sequences- Dot matrix, Substitution matrix
Protein sequence analysis-ExPASY proteomic tools.
Computation of mean, median, mode, standard deviation. Frequency distribution, Histogram, frequency polygon, frequency curves and cumulative frequency curves, Graphic location of median and mode
Bar and pie Diagrams
Pearson co-efficient of correlation and Spearman rank correlation
Regression equations of X or Y on X estimation of X and Y values
Problems connected with probability rules
X2 test problems-a) Test of Goodness of fit b) Test of independence
Calculation of probability using Binomial and normal distribution
t-test for significance of mean of a random sample b) testing significance between means of two samples (independent and period samples)

### DEVELOPMENTAL BOTANY

Anatomical structure of Anther and Pistil
Embryo Dissection using the ovary of Tridax procumbens – identification of embryonic stages (globular, heart shaped, torpedo shaped)

Analysis of pollen tube growth using pollen grains of *Cassia*/*Datura* in different sugar concentration
Endosperm haustoria separation from the endosperm tissue of *Cucumis sativus*
Demonstration of Embryogenesis
Demonstration of hairy root culture using *Agrobacterium tumifaciens*
Leaf galls – *Syzygium jambolanum, Pongamia glabra*
Plant specimens, permanent slides observation, Models portraying the structural details on the syllabus components
Training in paraffin wax method for preparation of serial sections.
Submission of permanent slides
Submission of Record for external valuation

---

| **Course Title: PROJECT** | **Total Hours : 90** |
|---|---|
| **Course Code :** P22BY4PV/ **P24BY4PV** | **Total Credits : 5** |

**Objectives:**

The aim of project work (field/ lab work) is to inculcate students to learn adequate knowledge on research methodology in the subject and prepare them for pursuing research in experimental or computational areas of the Botany. Students allotment by lot system. The lab work or Field Study is to be undertaken under the guidance of a Teacher of the Department. The guiding teacher will make continuous internal assessment of the Project Work/ Field Study. The project work will be evaluated by the external examiner.

• Project will be done by the final year students in the fourth semester under the guidance of respective guides.

• For projects, internal marks (max 50) will be awarded by the respective guide and external marks (max 50) will be awarded by the external examiners.

• Minimum number of Pages for M.Sc. Project should be 40.

---