B.Sc 3rd Year (Semester 5) Botany Paper 1

Plant Physiology, Metabolism & Biochemistry (Theory)

Programme/Class: Degree	Year: 3	Semester: 5
Subject: Botany		
Course Code: B040501T	Course Title: **Plant Physiology, Metabolism & Biochemistry (Theory)**	

Course outcomes: After the completion of the course the students will be able to:	**Bloom's Taxonomy**
CO1- Understand the role of Physiological and metabolic processes for plant growth and development.	K1, K3
CO2-. Learn the symptoms of Mineral Deficiency in crops and their management.	K2, K4
CO3-Assimilate Knowledge about Biochemical constitution of plant diversity.	K3, K4
CO4-Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants	K2, K5

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 33

Total No. of lectures= 60

Unit	Topics	No. of Lectures
I	**Plant water relation, Mineral Nutrition, Transpiration and translocation in phloem** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Criteria of essentiality of elements; Role of essential elements; Symptoms of mineral deficiency in major crops, Transport of ions across cell membrane, active and passive transport, Composition of phloem sap, girdling experiment; Pressure flow model.	7
II	**Carbon Oxidation** Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Kerbs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP- Synthetase, Chemiosmotic mechanism, P/O ratio , cyanide-resistant respiration, factors affecting respiration.	7

III	**Nitrogen Metabolism** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	8
IV	**Lipid Metabolism & Photosynthesis** Lipid Metabolism : Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation.; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM-Reaction and Significance	7
V	**Plant Development, Movements, Dormancy & Responses** Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.) autonomic & paratonic movements, Control and Coordination in plants, Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization & Senescence	**8**
VI	**Biomolecules** *Carbohydrates:* Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin). *Lipids*: Storage lipids: Fatty acids structure and functions, Structural lipids: Phosphoglycerides; Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers	**8**
VII	**Proteins**: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, Ramchandran plot,tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins **Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleic acids, Nucleic acid denaturation & Re-naturation, MiRNA	**7**
VIII	**Enzymes:** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced -fit theory), enzyme inhibition and factors affecting enzyme activity,Allosteric enzymes & Abzymes. Phytonutrients, Nutraceuticals, dietary supplements and antioxidants.	**8**

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. पादप शिीि फिया तवज्ञान ि्था जैव ि्सायन लेखक :डॉ एच एस श्रीवास्ि्व प्रकाशन: ि्स्ि्ोगी प्रकाशन ,र्े्ठ
2. पादप शिीि फिया तवज्ञान एवं जैव ि्सायन लेखक ससंह ,पांडे ि्था जैन प्रकाशन :ि्स्ि्ोगी प्रकाशन ,र्े्ठ
3. पादप कार्यणकी एवं जनन तवज्ञान. Madan Kumar. 2020.
4. Plant Physiology and BiochemistryISBN #:81-301-0035-5Sunil D Purohit, K. Ahmed & Gotam K Kukda Edition: 2013Pages: 368 + VIII Text Book (Hindi)
5. पादप कार्यणकी एवं जैव ि्सायन Dhankar - Sharma – Trivedi RBD Publishing
1. Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
2. A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISBN : 9788177543377Edition : 01Year : 2011Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN , Sathyamoorthi K , Babu CR , Babu RC , Boopathi PNPublisher : Agrobios (India)
3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
5. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New Central Book. Agencies.
8. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
9. Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
10. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
12. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.
14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and their potential toxic effects. 2016. Elsevier.
15. Harborne,J.B.1973 .Phytochemical Methods. John Wiley & Sons, New York.
16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
17. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017

This course can be opted as an elective by the students of following subjects: Open for all

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Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Subjective long questions
- Attendance.

At the End of the whole syllabus any remarks/ suggestions:

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B.Sc. 3 Year (Semester 5) Botany Paper 2

Molecular Biology & Bioinformatics

Programme/Class: Degree	Year: 3	Semester: 5
Subject: Botany		
Course Code: B040502T	Course Title: **Molecular Biology & Bioinformatics**	

Course outcomes: After the completion of the course the students will be able to:	**Bloom's Taxonomy**
CO1- Understand nucleic acids, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.	K1, K3
CO2-Know about Processing and modification of RNA and translation process, function and regulation of expression.	K2, K4
CO3- Gain working knowledge of the practical and theoretical concepts of bioinformatics	K3, K4

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 33

Total No. of Lecture= 60

Unit	Topics	No. of Lectures
I	**Genetic material** Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase, bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): semi- conservative. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ǿ (theta) mode of replication, replication of linear, dsDNA, replicating the 5′end of linear chromosome including replication enzymes.	07
II	**Transcription & Regulation of gene expression** Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation, (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression in Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes	07
	Principles &Techniques of genetic engineering Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP,	08

III	SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Antibody Engineering.	
IV	**Applications of Genetic engineering** Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products, Biosafety concerns.	07
V	**Bioinformatics & its applications** Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.	08
VI	**Biological databases :** Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss- Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem,)	08
VII	**Data Generation and Data Retrieval** Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)	07
VIII	**Phylogenetic analysis** Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.	08

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. Dr Pooja Rai. आतण्वक जीव तवज्ञान एवं जैव िकनीकी**,Bhopal**

2. Sharma - Trivedi Molecular Biology And Biotechnology (आतण्वक जीव तवज्ञान एवं जैव प्रौधोतगफक**) by RBD Publisher**

3. Plant Physiology and Biochemistry ISBN #: 81-301-0035-5Author: Sunil D Purohit, K. Ahmed & Gotam K KukdaEdition: 2013Pages: 368 + VIIIType: Text Book (Hindi)

4. Molecular Biology Biotechnology ISBN #: 81-301-0033-9Author: Sunil D Purohit & Gotam K Kukda Edition: 2013Pages: 366 + XType: Text Book (Hindi) Apex Publishing House, Udaipur, Rajasthan

5. Bioinformatics Paperback – 1 January 2015 by Dr Archana Pandeya (Author), Santosh Choubey (Editor), & 2 More Hindi AISECT Ltd.

6. BIOTECHNOLOGY AND GENETIC ENGINEERING (Hindi, Hardcover, Dr. Archna Nigam)

1. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK..
2. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York.
3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th
edition. Cold Spring Harbour Lab. Press, Pearson Pub.
4. Freifelder - Molecular Biology.
5. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017.
6. Ghosh, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
7. Baxevanis, A.D. and Ouellette, B.F., John (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
8. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
9. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
10. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey,U.S.: Wiley Blackwell.
11. Xiong J. (2006). Essential Bioinformatics,1st edition. Cambridge, U.K.: Cambridge University Press
12. A Textbook Of Basic And Molecular Genetics (pb)ISBN : 9788188826193Edition : 01Year : 2018Author : Dr. Parihar P

This course can be opted as an elective by the students of following subjects: Open for all
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Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Further Suggestions:

At the End of the whole syllabus any remarks/ suggestions:
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B.Sc. 3 Year (Semester 5) Botany Paper 3

Experiments in Physiology, Biochemistry & Molecular Biology (Practical)

Programme/Class: Degree	Year: 3	Semester: 5
Subject: Botany		
Course Code: B040503P	Course Title: **Experiments in Physiology, Biochemistry & Molecular Biology**	
Course outcomes: After the completion of the course the students will be able to:		**Bloom's Taxonomy**

CO1- Know and authentic the physiological processes undergoing in plants along with their metabolism	K1, K3
CO2-Identify Mineral deficiencies based on visual symptoms	K2, K4
CO3-Understand and develop skill for conducting molecular experiments for genetic engineering	K3, K4
Credits: 2	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40 %
Total No. of Lab.Periods 30(60 hours)	

Units	Topic	No of Lab. Periods
I	**Plant water relation, Mineral Nutrition and translocation in phloem** **1**. Determination of osmotic potential of plant cell sap by plasmolytic method using leaves of Rhoeo / Tradescantia. 2. Osmosis – by potato osmoscope experiment 3. Effect of temperature on absorption of water by storage tissue and determination of Q10. 4. Experiment to demonstrate the transpiration phenomenon with the bell jar method 5. Experiment for demonstration of Transpiration by Four-Leaf Experiment: 6. Structure of stomata (dicot & monocot) 7. Determination of rate of transpiration using cobalt chloride method. 8. Experiment to measure the rate of transpiration by using Farmer's Potometer 9. Experiment to measure the rate of transpiration by using Ganong's potometer 10. Effect of Temperature on membrane permeability by colorimetric method. 11. Study of mineral deficiency symptoms using plant material/photographs.	08
II	**Nitrogen Metabolism, Photo Synthesis & Respiration** 1. A basic idea of chromatography: Principle, paper chromatography and column chromatography; demonstration of column chromatography. 2. Separation of plastidial pigments by solvent and paper chromatography. 3. Estimation of total chlorophyll content from different chronologically aged leaves (young, mature and senescence) by Arnon method. 4. Effect of HCO3 concentration on oxygen evolution during photosynthesis in an aquatic plant and to find out the optimum and toxic concentration (either by volume measurement or bubble counting). 5. Measurement of oxygen uptake by respiring tissue (per g/hr.) 6. Determination of the RQ of germinating seeds. 7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubble	08

III	**Plant Development, Movements, Dormancy & Responses** 1. Geotropism and phototropism — Klinostàt 2. Hydrotropism - a. Measurement of growth — Arc and Liver Auxonometer 3. To study the phenomenon of seed germination (effect of light). 4. To study the induction of amylase activity in germinating grains. 5. Test of seed viability by TTC method. 6. To study the effect of different concentrations of IAA on *Avena* coleoptile elongation (IAA bioassay)	08
IV	**Techniques for biochemical analysis** 1. Weighing and Preparation of solutions -percentage, molar & normal solutions, dilution from stock solution etc. 2. Separation of amino acids by paper chromatography. 3. Detection of organic acids: citric, tartaric, oxalic and malic from laboratory samples. 4. Qualitative Analysis of carbohydrates, 5. Estimation of reducing sugar by anthrone method, 6. Qualitative Analysis of Lipids 7. Qualitative analysis of Amino acids and Proteins 8. Quantitative Analysis of Nucleic Acids, 9. Analysis of dietary supplements, nutraceuticals & antioxidants 10. Testing of adulterants in food items.	08
V	**Genetic material** 1. Instruments and equipments used in molecular biology. 2. Preparation of LB medium and cultivating E.coli on it. 3. Isolation of Genomic DNA 4. Isolation of DNA from plants 5. Examination of the purity of DNA by agarose gel electrophoresis. 6. Quantification of DNA by UV-spectrophotometer 7. Estimation of DNA by diphenylamine method.	**07**
VI	**Preparation of models/ charts:** 1. Study of experiments establishing nucleic acid as genetic material (Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments) through photographs 2. Numericals based on DNA re-association kinetics (melting	**07**

	profiles and Cot curves) 3. Study of DNA replication through photographs: Modes of replication – Rolling circle, Theta and semi-discontinuous ; Semiconservative model of replication (Messelson and Stahl's experiment); Telomerase assisted end-replication of linear DNA 4. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs 5. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozymes and Alternative splicing 6. Understanding the regulation of lactose (lac) operon (positive & negative regulation) and tryptophan (trp) operon (Repression and De-repression & Attenuation) through photographs. 7. Understanding the mechanism of RNAi by photographs	
VII	**Genetic Engineering** 1. Isolation of protoplasts. 2. Construction of restriction map of circular and linear DNA from the data provided. 3. Isolation of plasmid DNA. 4. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/ photograph). 5. Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results. 6. Agarose gel analysis of plasmid DNA 7. Restriction digestion of plasmid DNA -Demonstration of PCR	**07**
VIII	**Applications of Genetic engineering** 1. ELISA Test, 2.. Viability tests of cells 3. Study of methods of gene transfer through photographs: Agrobacterium mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 4. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.	**07**

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. प्रयोगात्क वनस्पति तवज्ञान भाग 3 लेखक अशोक बेंद्रे िथा अशोक कुर्ाि प्रकाशन िस्िोगी प्रकाशन र्ेठ

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

2. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN : 9788177544589Edition : 01Year : 2012Author : Akhtar InamPublisher : Agrobios (India)

3. Advanced Methods In Physiology And Biochemistry (pb)ISBN : 9789381191132Edition : 01Year : 2016Author : Padmanaban G , Chandrasekaran CN , Thangavelu AU , Dr. Sivakumar R , Kalimuthu N , Dr. Boominathan P , Dr. Anbarasan P,Agrobios.

4. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRC Press.

5. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge University

Press.U.K.
6. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers.
7. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London

B.Sc. 3 Year (Semester 5) Botany Paper 1V

Project in Botany for Pre-graduation

Programme/Class: Degree	Year: 3	Semester: 5
Subject: Botany		
Course Code: B040504R	Course Title: **Project in Botany for Pre-graduation**	

Course outcomes: After the completion of the course the students will be able to:	**Bloom's Taxonomy**
CO1-Project work will supplement field experimental learning and deviations from classroom and laboratory transactions.	K1, K3
CO-2 Project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes.	K2, K4
CO3-It will promote creativity and the spirit of enquiry in learners.	K3, K4
CO4-They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions,	K2, K5
CO5-Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing.	K2,K4
CO6-It will enhance their abilities, enthusiasm, and interest.	K2,K4

Credits: 3	Compulsory
Max. Marks: 25+75	Min. Passing Marks: 33

Suggestive List Of PROJECTS

1. Rural Areas: Flora of a city/ village, Biodiversity of Village, Soil & seed testing service provision to farmers,
2. Industrial waste management
3. water pollution status of rural water & promotion of WASH in villages
4. Plant Disease identification in farms, nurseries and orchards.
5. Digital portal for plants: Campus, city or particular area
6. Rare and endangered plants & their conservation & domestication
7. Air pollution tolerance index (APTI) : Screening of sensitive/tolerant plant species at various locations in particular area
8.Science Communication by Creating science documentaries of innovators , Internet Science (Social media, Websites, Blogs, Youtube, Podcast etc.)
9.Science Outreach Talks and Public Sensitization for plant biodiversity conservation sensitization of public.
10. Phytochemistry of medicinal plants & their antimicrobial, nutraceutical and antioxidant properties
11. Study of pollen grains in different flowers
12.Study of stomata in different plants
13.Study of various types of secretory and special tissues in plants.

Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.

This course can be opted as an elective by the students of following subjects: **Open to all**

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment Marks
Class Interaction 5
Seminar 10
Thesis/dissertation 10
Total= 25

This course can be opted as an elective by the students of following subjects: Open for all
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Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

At the End of the whole syllabus any remarks/ suggestions

Suggested Continuous Evaluation Methods

- Assessment of Audio-visual Aids and their use.
- Assessment of techniques and communication skills.
- Assessment of Educational Plan and Visits Record.
- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Course prerequisites: To study this course, a student must have had the subject ALL inclass12th.
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At the End of the whole syllabus any remarks/ suggestions:
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B.Sc. 3 Year (Semester 6) Botany Paper 1

Cytogenetics, Plant Breeding & Nanotechnology

Programme/Class: Degree	Year: 3	Semester: 6
Subject: Botany		
Course Code: B040601T	Course Title: **Cytogenetics, Plant Breeding & Nanotechnology**	

Course outcomes: After the completion of the course the students will be able:	**Bloom's Taxonomy**
CO1-Acquire knowledge on ultrastructure of cell.	K1, K3
CO2-Understand the structure and chemical composition of chromatin and concept of cell division.	K2, K4
CO3-Interpret the Mendel's principles, acquire knowledge on cytoplasmic inheritance and sex linked inheritance.	K3, K4
CO4-Understand the concept of 'one gene one enzyme hypothesis' along with molecular mechanism of mutation.	K2, K5
CO5-Interpret the concept of Lemarkism, Neo Lamarkism, Darwinism and also understand the concept of natural selection.	K2,K4

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:33
Total No. of Lectures-Tutorials- 60	

Unit	Topic	No of Lectures
I	**Cell biology** Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus. Chromosomal nomenclature- chromatids, centromere, telomere, satellite, secondary constriction.Organization of chromosomes- Nucleic acid and histones- types and classification. Lampbrush chromosomes and polytene chromosomes- Karyotype and idiogram.Cell cycle: G0, G1, S and G2 phases – mitosis: open and closed mitosis – amitosis - meiosis. Variation in Chromosome number (Numerical aberrations)- anueploidy and Euploidy-haploidy , polyploidy- significance (Structural aberrations) - deletion, duplication, inversion and translocation.	08
II	**Genetics** **Ch**romosome theory of inheritance, crossing over and linkage; Incomplete dominance and codominance;	07

	Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Polygenic inheritance; Extra-nuclear Inheritance, Linkage, crossing over , Concept of sex determination and Sex chromosomes; Patterns of Sex determination in plants	
III	**Plant breeding** Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization– Achievements, Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods , Hybridization: Procedure of hybridization, inter generic, inter specific, inter varietal hybridization with examples. Composite and synthetic varieties, Male sterility , Heterosis and its exploitation in plant breeding, Mutation, Molecular Breeding (use of DNA markers in plant breeding) , achievements in India, Breeding for pest, pathogenic diseases and stress resistance.	08
IV	**Biostatistics:** Definition, statistical methods, basic principles, variables-measurements, functions, limitations and uses of statistics. Biometry: Data, Sample, Population, random sampling, Frequency distribution- definition only, Central tendency– Arithmetic Mean, Mode and Median; Measurement of dispersion–Coefficient of variation, Standard Deviation, Standard error of Mean; Test of significance: chi- square test for goodness of fit. Computer application in biostatistics - MS Excel and SPSS	07
V	**Plant tissue culture** Principles, components and techniques of in vitro plant cultures, Callus cultures, Cell culture, cell suspension cultures, Embryogenesis and organogenesis , Protoplast-isolation and culturing of protoplast- principle and application, regeneration of protoplasts, protoplast fusion and somatic hybridization- selection of hybrid cells, Somaclonal variation, , Plant secondary metabolites production.	08
VI	**Nanotechnology** Fundamentals of nanoscale self-assembly process involved in important functional biomolecules such as Nucleic acid (DNA and RNA), Proteins, Enzymes. Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes). Nanoscale assembly of microorganisms (virus). Nano-particles synthesis, Biological synthesis of Nanoparticles, Advantages and applications of biologically synthesized nanomaterials. Introduction to biological nanomaterials.,Biomineralization, Magnetosomes, nano-pesticides, nano-fertilizers, nano-sensors.	07
VII	**Artificial Intelligence in Plant Sciences** Big Data Analytics, Blockchain Technology, 3-D Printing, Machine learning, Algorithms of Machine Learning, Expert systems and Fuzzy logic , Artificial Neural Networks and Genetic algorithms, Predictive Analytics, Agents and Robotics, IoT Sensors, Object Image capture & analysis; Applications of Artificial Neural Networks in Plant Science.	08

VIII	**Introduction to use of Digital technologies – AI, IoT & ICT in Botany** Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repositorygoogle scholar, science direct. resource management, weather forecasting. IoT Database management ,IoT platforms , IoT Graphical user interface • IoT application development for Android Mobile phones, ICT Applications for different crops and horticulture	07

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. कोतशका तवज्ञान अनुवांतशकी ,तवकास एवं पारितस्थतिकी लेखक :पीके गुप्ता प्रकाशन :ि स्ि ोगी प्रकाशन र्े ठ

2. कोतशका जैतवकी **,** आनुवंतशकी**,** जैव प्रौधोतगकी **Sharma and Trivedi by RBD Publisher**

3. Cell Biology And Genetics (Hindi) 2/e PB....Gupta P K (Hindi) rastogi Publications

4. PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas University

5. Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 9788177544732Edition : 03Year : 2018Author : Dr. Purohit SS , Mathur S

6. Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani Pubishers ISBN: 9789327246070, 9327246071

7. Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1Sunil D Purohit & Gotam K Kukda, Apex Publishing House

8. Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House

9. Padap Prajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shukl (Author) Pointer Publishers, Jaipur

10. PLANT BREEDING : PRINCIPLE AND METHODS B D SINGH - IN HINDI

11. कोतशका ि था अर् ु जैतवकी शलद-संग्रह **Commission for Scientific and Technical Terminology (CSTT)**

12. पादप आनुवंतशकी परिभाषा कोश **Commission for Scientific and Technical Terminology (CSTT)**

1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
2. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company
7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
8. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
9. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8th edition.Pearson Education Inc. U.S.A.)
10. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th e
11. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th edition.
12. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A..
13. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
14. M K Raxdan An Introduction to Plant Tissue Culture –; Oxfird & IBH Publishing Co.Pvt. Ltd.,New Delhi
15. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
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22. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
23. Gerald Karp (1985) Cell biology, Mc Graw Hill company..
24. Lewin, B, (1994) Genes, Oxford University Press, New York.
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26. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
27. Roy S.C. and Kalayan kumar De (1997) Cell biology. New central Boos Calcutta
28. Sandhya Mitra,(1998) Elements of molecular biology. Macmillan, India Ltd.

29. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
30. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
31. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork.
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34. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
35. A. J. Nair . Basics of Biotechnology- Laxmi Publications, New Delhi.
36. S S Purohit and S K Mathur; Biotechnology-Fundamentals and Application- Agrobotanica, India.
37. A. J. Nair Introduction to Genetic Engineering & Biotechnology.Jones & Bartlett Publishers, Boston,USA.
38. H S Chawla Introduction to Plant Biotechnology-; Oxford & IBH publishing Co.Pvt.Ltd., New Delhi.
39. H D Kumar Modern concept of Biotechnology, Vikas Publishing House, Pvt. Ltd., New Delhi.
40. P C Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
41. Du, C., and S. A. Jackson. 2019. Machine learning and complex biological data. Genome Biology 20: 76. https://doi.org/10.1186/s13059- 019- 1689- 0
42. Alexis and Mathew Leon.,Fundamentals of Information Technology Leon Vikas
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45. Lucci S., Kopec D. (2013). Artificial intelligence in the 21st century. 22841 Quicksilver Drive Dulles, VA 20166.
46. V.Rajaraman Introduction to Information Technology,., Prentice Hll.
47. Ramesh Bangia Learning Computer Fundamentals., Khanna Book Publishers
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49. R. Rangaswami (2009) A Text book of Agriculture Statistics .New Age International (P) Limited, Hyderabad.
50. Nageshwar Rao G.(2007)Statistics for Agriculture Sciences BS Publications. New Delhi
51. NigamA.K. andGupta,V.K.(1979)Hand book on Analysis of Agricultural Experiments.. IASRI Publication, New Delhi.
52. Panse V.G. Sukhatme P.V. (1985) Statistical methods for Agricultural workers . Indian Council of Agricultural Research, New Delhi
53. Snedecor GW. & Cochran WG. (1989) Statistical Methods . Iowa State University Press.
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59. Sulabha K. Kulkarni. 2014 Nanotechnology: Principles and Practices. CP publishing, New Delhi.
60. B S Murty, P Shankar, Baldev Raj, B B Rath, James Murday. 2012. Textbook of Nanoscience and Nanotechnology. Springer
61. K. K. Chattopadhyay and A. N. Banarjee. 2009. Introduction to Nanoscience and Nanotechnology. PHI Publication.
62. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
63. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
64. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.
65. David S. Goodshell. 2004. Bionanotechnology-Lessons from nature. John Wiley Publications.
66. R. Stephen Crespi, Tibtech, Patenting in Biotechnology - Part I, Vol. 9, 117-122, 1991.
67. Pattnaik, P.K., Kumar, R., Pal, S., Panda, S.N. (Eds.)IoT and Analytics for Agriculture,2020
68. https://www.springer.com/gp/book/9789811391767
69. https://www.springer.com/gp/book/9789811550720
70. Petersen Roger G. (1994) Agricultural Field Experiments Design and Analysis by Marcel Dekker, NewYork.

This course can be opted as an elective by the students of following subjects: Open for all
The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th.

- The eligibility for this paper is 10+2 with any subject

Further Suggestions:

It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:

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B.Sc. 3 Year (Semester 6) Botany Paper 2
Ecology & Environment

Programme/Class: Degree	Year: 3	Semester: 6
Subject: Botany		
Course Code: B040602T	Course Title: **Ecology & Environment**	

Course outcomes:	**Bloom's Taxonomy**
CO1-Acquaint the students with complex interrelationship between organisms and environment;	K1, K3
CO2-Make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.	K2, K4
CO3-This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.	K3, K4

Credits: 4	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:33
Total No. of Lectures-Tutorials- 60	

Unit	Topic	No of Lectures
I	**Natural resources & Sustainable utilization:** Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water , Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy , Contemporary practices in resource management : EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting.	07
II	**Ecology & Ecosystem** Definition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem – Concept of an ecosystem-structure and function of an ecosystem. Abiotic and biotic com-Energy flow in an ecosystem Ecological Succession-Definition &types. Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary & secondary), Hydrosere and Xerosere. Food chains and food webs , Ecological pyramids, production and productivity; And components. Types of ecosystems: Forest Ecosystem, Grass land ,Crop land, aquatic Ecosystems Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.	08
III	**Soil Formation, Properties & Conservation** Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, Soil Erosion, Biogeochemical cycles, Soil Conservation: Biological– Contour farming, Mulching, Strip cropping, Terracing and	07

	Crop rotation. Mechanical–Basin Listing, Construction of dams, Water Shed Management, Soil reclamation	
IV	**Biodiversity and its conservation:** Definition -genetic, species, and ecosystem diversity. Value of biodiversity: : social, ethical, aesthetic and option values hot spots of Biodiversity &threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, ecological indicators. ***Conservation of Biodiversity:*** Ex-situ and in-situ conservation, Red data book, botanical gardens, National park, Sanctuaries, hot & hottest spots and Bioreserves. Role of Seed Bank and Gene Bank Valuing plant resources,ecotourism, Role of NBPGR, FAO, BSI.	07
V	**Phytogeography:** Biogeographic regions of India & world, Agroecological & Floristic zones of India. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Phytogeographical regions of India, Vegetational types in Uttar Pradesh.	07
VI	**Environmental audit & Sustainability** Concept of environmental audit; Guidelines of environmental audit; Methodologies adopted along with some industrial case studies; Environmental standards: ISO 14000 series; Scheme of labelling of environment friendly products (Ecomark); Life cycle analysis; Concept of energy and green audit, Sustainability indices; Strategies and debates on sustainable development; Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards Sustainability; Sustainable development in practice; Urbanization; Concept and characteristics of smart city; Urban resources and environmental problems; Carrying capacity analysis; Concept of ecological footprints.	08
VII	**Pollution ,Waste management & Circular Economy** Environmental pollution, Environmental protection laws, Bioremediation, Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor, neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bioscrubbers, biotrickling filters; regulatory framework for pollution monitoring and control; case study: Ganga Action Plan; Yamuna Action Plan; implementation of CNG ;Waste- Types , collection and disposal, Recycling of solid wastes (hazardous & non-hazardous) classification, collection and segregation, Incineration, Pyrolysis and gasification , Sanitary landfilling ; composting, Biogas production, Circular Economy & sustainability.	08
VIII	**Environmental ethics, Carbon Credits &Role of GIS** Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.	08

	Wasteland reclamation. Consumerism and waste products. Clean development mechanism. Geographical Information Systems: definitions and components; spatial and non-spatial data; GIS software packages; GPS survey, data import, processing, and mapping. Applications and case studies of remote sensing and GIS in land use planning, forest resources & agriculture studies.	

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. Environmental Studies (Hindi)ISBN81-301-0004-5B. L. Chaudhary & Jitendra Pandey Edition: 2013Pages: 340 + XII Apex Publishing House
2. Soil and Water Conservation ISBN #: 978-81-301-0071-5S. C. Mahnot & P. K. Singh Apex Publishing House
3. Ecology And Environmental Biology (पारितस्थतिकी एवं पयाणवर् जैतवकी) by RBD Publisher Author: Bhatia - Jain – Kohli - Shrivastava - Singh – Verma
4. पयाणवर्ीय वनस्पति एवं पादप व्यातधकी लेखक :डॉ पी डी शर्ाण प्रकाशन: िस्िोगी प्रकाशन र्ेठ
5. Paryavaran Evam Paristhithiki 5e (Hindi) Paperback – 20 February 2020 Majid Husain
6. Environmental Biology and Phytogeography ISBN #: 978-81-301-0064-7B. L. Chaudhary, Gotam K Kukda & Jitendra Kumar Joshi
7. Ugc Unified: Environmental Sciences (hindi) (pb) ISBN : 9788177545814Edition : 01Year : 2015Author : Dr. Purohit SS , Dr. Deo PP , Dr. Agrawal Ashok KPublisher : Agrobios (India)
1. Chapman and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge University Press
2. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
3. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House
4. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
5. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company
6. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
7. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications
8. Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors
9. Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
10. Mackenzie et al. Ecology, Latest Ed., Viva Books.
11. Gurevitch, J. (et al.)., The Ecology of plants, 2002, Sinauer Associates.
12. Kimar, U. & Asija, M.J. Bio-diversity: Principles & Conservation, 2005, Student Edition, Agrobios (India)
13. Krishnamurthy, K.V. An Advanced Text Book on Biodiversity, 2003, Oxford & IBH Publishing Co. Ltd.
14. Mitra, D., Guha, J.K., Chowdhury, S.K. Studies in Botany, Vol. II (7th ed.) Moulik Library.
15. Primack, R.B. Essentials of Conservation Biology, 1993, Sinauer Associates.
16. Lo, C.P. & Yeung, A.K.W. Concepts and Techniques of Geographic Information Systems, 2002, Printice-Hall of India.
17. Cain, Bowman, Hacker. Ecology. 2014. 3rd Ed. Sinauer Associates
18. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
19. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
20. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
21. Abbasi, S. A. (1998). Environmental Pollution and its Control. Cogent International, Pondicherry.
22. Abbasi, S. A. and Ramasamy, E. V. (1999). Biotechnological Methods of Pollution Control. Universities Press (India) Limited, Hyderabad.
23. Peavy, H. S., Rowe, D. R. and Tchobanoglaus, G. (1985). Environmental Engineering, Mc Graw Hill Book Company, Singapore.
24. Rand, M. C., Greenberg, A. E. and Taras, M. J. (Ed.) (1995). Standard methods for the examination of water and wastewater: 19th edition, American Public Health association (APHA), Washington, D.C.
25. Scragg, A. (1999). Environmental Biotechnology, Addison Wesley Longman, Singapore.
26. Tchobanoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Ta ta Mc Graw Hill, New Delhi.
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28. George, T., Hilary, T. and Samuel, A. V. (1993). Integrated solid Waste Management, Engineering Principles and Management Issues, Mc Graw Hills.
29. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second dition). Mc Graw Hills.
30. Kanthi, L. S. (2000). Basics of Solids and hazardous waste management Technologies.Prentice Hall.
31. Anonymous . 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New York.

32. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries
33. with Policy and Science Considerations. Martinus Nijhoff Publishers.
34. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
35. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
36. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
37. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
38. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future.Columbia University Press.
39. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
40. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition).Sage Publications.
41. Demers, M.N. 2005. Fundamentals of Geographic Information System. Wiley & Sons.
42. Richards, J. A. & Jia, X. 1999. Remote Sensing and Digital Image Processing. Springer.
43. Sabins, F. F. 1996. Remote Sensing: Principles an Interpretation. W. H. Freeman.
44. Gaston, K J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London,
45. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.
46. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
47. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics.Wiley-Blackwell, Oxford, UK.

This course can be opted as an elective by the students of following subjects: Open for all
The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class12th.

- The eligibility for this paper is 10+2 with any subject

Further Suggestions:
It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:
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B.Sc. 3 Year (Semester 6) Botany Paper 3 Course
Lab on Cytogenetics, Conservation & Environment management

Programme/Class: Degree	Year: 3	Semester: 6
Subject: Botany		
Course Code: B040603P	Course Title: **Lab on Cytogenetics, Conservation & Environment management**	
Course outcomes: After the completion of the course the students will be able:		**Bloom's Taxonomy**
CO1-To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding on field, conserving and depolluting the environment.		K1, K3

CO2-Can be employed in environment impact assessment companies & start his own venture		K2, K4
Credits: 2	Core Compulsory	
Max. Marks: 25+75	Min. Passing Marks:40	
Total No. of Lab Periods- 30(60 hours)		

Unit	Topic	No of Lectures
I	**Cell biology** 1. Study of plant cell structure with the help of epidermal peal mount of Onion/Rhoeo/Crinum 2. Measurement of cell size by the technique of micrometry. 3. Counting cells per unit volume with the help of haemocytometer (Yeast/pollen grains) 4. Determination of mitotic index and frequency of different mitotic stages in pre-fixed root tips of Allium cepa.	07
II	**Genetics** 1. Monohybrid cross (Dominance and incomplete dominance) 2. Dihybrid cross (Dominance and incomplete dominance) 3. Gene interactions (All types of gene interactions mentioned in the syllabus) a. Recessive epistasis 9: 3: 1. b. Dominant epistasis 12: 3: I c. Complementary genes 9: 7 d. Duplicate genes with cumulative effect 9: 6: 1 e. Inhibitory genes 13: 3 4. Observe the genetic variations among inter and intra specific plants. 5. Demonstration of Breeding techniques-Hybridization, case studies of mutation, polyploidy , emasculation experiment	08
III	**Biostatistics:** 1.Univariate analysis of statistical data: Statistical tables, mean, mode, median, standard deviation and standard error (using seedling population / leaflet size). 2.Calculation of correlation coefficient values and finding out the probability. 3. Determination of goodness of fit in Mendellian and modified mono-and dihybrid ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1, 9:7, 13:3, 15:1) by Chi-square analysis and comment on the nature of inheritance. 3. Computer application in biostatistics - MS Excel and SPSS	07
IV	**Plant tissue culture** 1. Familiarization of instruments and special equipments used in the plant tissue culture experiments 2. Preparation of plant tissue culture medium, and sterilization, Preparation of stock solutions of nutrients for MS Media. 3. Surface sterilization of plant materials for inoculation (implantation in the medium) 4. Micropropagation of potato/tomato/ - Demonstration	08

	5. Protoplast isolation and culturing – Demonstration	
V	**Ecology & environment** 1. Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites 2. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each). 3. (b). Study of biotic interactions of: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants). 4. Observation and study of different ecosystems mentioned in the syllabus. 5. Field visit to familiarize students with ecology of different sites	08
VI	**Soil Formation, Properties & Conservation** 1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper) 2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests. 3. Determination of organic matter of different soil samples by Walkley & Black rapid titration method. 4. Soil Profile study 5. Soil types of India-Map	08
VII	**Biodiversity and Phytogeography:** 1. Study of community structure by quadrat method and determination of (i) Minimal size of the quadrat, (ii) Frequency, density and abundance of components (to be done during excursion/field visit). 2. Marking of vegetation types of India, World & Uttar Pradesh on maps 3. Phytogeographical areas of India	07
VIII	Pollution &Waste management 1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter 2. Estimation of chloride and dissolved oxygen content in water sample 3. Comparative anatomical studies of leaves form polluted and less polluted areas. 4. Measurement of dissolved O2 by azide modification of Winkler's method. 5. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. 6. Microbiological assessment of drinking water using MPN technique- water from well, river, water supply department and packaged drinking water 7. Making kitchen waste from compost/vermicompost by Enzymes/Bio decomposer/ Whey with dung. **Climate Change, Carbon Credits &Role of GIS**	07

	1. Conducting Waste Audit of your Institution -Demo 2. Green auditing of the College/University -Demo	

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. Practical Botany (Part III) Author: Sunil D Purohit, Anamika Singhvi & Kiran Tak 2013 Apex Publishing House,Raj.
2. Practical Botany (Part II) Author: N. C. Aery, Sunil D Purohit & Gotam K Kukda 2013 Apex Publishing House,Raj.
3. प्रयोगात्क वनस्पति तवज्ञान भाग 3 लेखक अशोक बेंद्रे िथा अशोक कुर्ाि प्रकाशन िस्िोगी प्रकाशन र्ेठ
4. A Handbook Of Soil, Fertilizer And Manure (2nd Ed.) (pb) ISBN : 9788177544152 Edition: 02Year : 2017Author : Gupta PKPublisher : Agrobios (India)
5. Green Technology: An Approach For Sustainable Environment ISBN : 9788177543438Edition: 01Year : 2021Author : Dr. Purohit SSPublisher : Agrobios (India)
6. Laboratory Manual Of Chemical And Bacterial Analysis Of Water And SewageISBN 9788177540802 Edition : 01Year : 2011Author : Theroux FR , Eldridge EF , Mallmann WLPublisher : Agrobios (India)
7. Methods In Environmental Analysis: Water Soil And Air (2nd Ed.) ISBN : 9788177543087 Edition : 02Year : 2021Author : Gupta PKPublisher : Agrobios (India)
8. Water Treatment And Purification Technology ISBN : 9788177540024Edition : 01Year : 2009 Author : Ryan WJPublisher : Agrobios (India

http://vidyamitra.inflibnet.ac.in/index.php/home/subjects?domain=Life+Science&subdomain=Botany
http://heecontent.upsdc.gov.in/Home.aspx

- ***(http://epathshala.nic.in/, http://epathshala.gov.in/)***

This course can be opted as an elective by the students of following subjects: Open for all

……

Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

Course prerequisites: To study this course, a student must have had the subject.....in class/12th/ certificate/diploma.

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At the End of the whole syllabus any remarks/ suggestions:

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B.Sc. 3 Year (Semester 6) Botany Paper 1V

Project in Botany for Graduation

Programme/Class: Degree	Year: 3	Semester: 5
Subject: Botany		
Course Code: B040604R	Course Title: **Project in Botany for Graduation**	
Course outcomes: After completing this course a student will have:		**Bloom's Taxonomy**
CO1-Project work will supplement field experimental learning and deviations from classroom and laboratory transactions.		K1, K3
CO2-Project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes		K2, K4
CO3-It will promote creativity and the spirit of enquiry in learners.		K3, K4
CO4-They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing		K2, K5
CO5-It will enhance their abilities, enthusiasm, and interest.		K2,K4
Credits: 3	Compulsory	
Max. Marks: 25+75	Min. Passing Marks: 33	

Suggestive List Of PROJECTS

Prepare beds for growing nursery for herbs, shrubs and trees.

Develop Green house facility in college and grow plants

Develop hydroponics facility in college and grow plants.

Develop botanical garden in the college with labelling

Vertical gardens, roof gardens.

Culture & art of making bonsai.

Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer

Aided Designing)

Phytochemical Analysis of Medicinal plants

Bio composting and Vermicomposting.

Performing Aromatherapy by essential Oils

Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museums, etc.

This course can be opted as an elective by the students of following subjects: **Open to all**

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment Marks
Class Interaction 5
Seminar 10
Thesis/dissertation 10
Total= 25

This course can be opted as an elective by the students of following subjects: Open for all
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Suggested Continuous Evaluation Methods:

- Seminar/ Presentation on any topic of the above syllabus
- Test with multiple choice questions/ short and long answer questions
- Attendance

At the End of the whole syllabus any remarks/ suggestions

Suggested equivalent online courses:

https://ndl.iitkgp.ac.in/
http://heecontent.upsdc.gov.in/Home.aspx
(http://epathshala.nic.in/, http://epathshala.gov.in/)
nptel.iitm.ac.in
https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5JQhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD_BwE
http://www.dli.ernet.in/, http://www.ulib.org/
http://www.tkdl.res.in/, http://www.vigyanprasar.gov.in/digilib
Directory of Open Access Repositories (DOAR)http://www.opendoar.org
Registry of Open Access Repositories (ROAR)http://roar.eprints.org/
http://www.iscnagpur.ac.in/knowledge_learning_files/5.7_General_Open_Access_e-Resources.pdf