Deccan Education Society's

FERGUSSON COLLEGE, PUNE (AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

SECOND YEAR M.Sc. (Botany)
SEMESTER – III

SYLLABUS M.Sc. (Botany)
w.e.f. Academic Year 2020-2021

Course Outcome (COs)		
S. Y. M. Sc. Semester III		
Title of the Course and Course Code	**Plant Systematics & Developmental Botany (BOT5301)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Outline the position of different taxa using different classification systems. Define the basic concepts of Developmental Botany and Systematics.	
CO2	Discuss the vegetative and reproductive development of higher plants and rules of nomenclature.	
CO3	Examine taxonomic characters, systematic position, phylogeny and economic importance and identify the plant specimens. Interpret the results of molecular development.	
CO4	Create floral diagrams and floral formulae. Relate the role of different genes with plant development.	
CO5	Compare the family characters, determine interrelation between different families and assess the role of hormones in the plant development.	
CO6	Integrate morphological, anatomical, molecular and biochemical data to design a complete picture of plant development.	

Units	Title and Contents
I	**Introduction to Systematics.** 1.1 Principles and methods in taxonomic research 1.2 Botanical survey of India 1.3 Conventional Tools 1.4 Modern Tools 1.5 Morphological features used in classification, identification. Taxonomic Keys and types
II	**International Code of Botanical Nomenclature**: 2.1 Salient Features-Principles 2.2 Important Rules and Recommendations 2.3 Provisions for the governance of the Code 2.4 Appendices.
III	**Classification systems** 3.1 Artificial - Linnaeus 3.2 Natural – Bentham and Hooker, Bessey 3.3 APG systems of classification 3.4 Robert Thorne's classification system

IV	**Morphological variations, systematic position, interrelationship, phylogeny** and **economic importance of following families:** 4.1 Polypetalae- Nympheaceae, Papavaraceae, Ranunculaceae, Tiliaceae, Rosaceae, Sapindaceae, Rutaceae(Any 4) 4.2 Gamopetalae- Malphigiaceae, Sapotaceae, Oliaceae, Boraginaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae (Any 4) 4.3 Apetalae- Polygonaceae, Phyllanthaceae, Euphorbiaceae, Loranthaceae, Urticaceae, Moraceae, Casurinaceae (Any 4) 4.4 Monocotyledonae- Musaceae, Commelinaceae, Liliaceae, Cyperaceae, Poaceae, Orchidaceae (Any 4)
V	**Processes basic to plant development** 5.1 Competence, determination, commitment, specification, induction, differentiation, dedifferentiation and redifferentiation. 5.2 Polarity and symmetry, cell- cell interaction. 5.3 Juvenility and transition to adult phase 5.4 Programmed cell death, aging and senescence.
VI	**Vegetative development** 6.1 Meristem types and activities of meristem. Organization of shoot and root apical meristems. 6.2 Leaf development, development of stomata
VII	**Transition from vegetative to reproductive phase** Morphological and histochemical changes in shoot apex, Floral meristems and floral development.
VIII	**Sporogenesis and fertilization** 8.1 Development of stamen, anther, sporogenous tissue, tapetum, microsporogenesis, pollen and male gametophyte. 8.2 Development of carpel, ovule, placenta, sporogenous tissue, integuments, megasporogenesis, female gametophyte 8.3 Interaction between pollen and pistil, pollen tube guidance, self-incompatibility. 8.4 Double fertilization and triple fusion, role of synergids, endosperm development
IX	**Embryogenesis** 9.1 Stages of embryogenesis, structure and organization of embryo. Suspensor. 9.2 Fruit development, structure of seed, germination.
X	**Molecular genetics of Development** 10.1 Embryogenesis mutants, establishment of body plan 10.2 Root, shoot and leaf development 10.3 Transition to flowering and flower development-ABCE Model
XI	**Light mediated regulation** 11.1 Photoreceptors- Phytochromes, Cryptochromes, Phototropins 11.2 Circadian rhythms
XII	**Hormonal regulation**

	12.1 Perception, signalling and regulation of gene expression by hormones 12.2 Role of hormones in germination, growth and flowering.

References:

1. Cook T (1903). The Flora of Presidency of Bombay, Vol. I (Indian Reprint) Bishen Singh, Mahendra Pal Singh, Dehradun.
2. Cronquist A J (1988). Evolution and Classification of Flowering Plants, 2nd edn, N Y Botanical Garden.
3. Davis P H and Heywood V H (1963). Principles of Angiosperm Taxonomy, Oliver and Boyd.
4. Eames A J (1961). Morphology of Angiosperms, McGraw Hill Book Co.
5. Erdtman G (1966). Pollen Morphology and Plant Taxonomy of Angiosperms (An introduction to Palynology I), Hafner Pub. Co. London.
6. Hickey M and King C (2000). The Cambridge Illustrated Glossary of Botanical Terms. Cambridge University Press, UK.
7. Jain S. K. and Rao R. R. Handbook of Field and Herbarium Methods, Today and Tomorrow Publishers, New Delhi.
8. Jones S B and LuchingerA E (1986). Plant Systematics 2nd edn, McGraw Hill BookJudd et al. (2007) 10. Plant Systematics – A phylogenetic approach. Sinauer Pub. 3rd edition
9. Kubitzki K (1977). Flowering Plants Evolution and Classification of Higher Categories. Plant Systematics – Evolution Supplement I.
10. Lawrence G H M (1951). Taxonomy of Vascular Plants, Macmillan.
11. Mabberly T J (1997). The Plant Book 2nd edn Cambridge University Press, Cambridge.
12. Naik V N (1984). Taxonomy of Angiosperms, TMH, New Delhi.
13. Radford A E (1986). Fundamentals of Plant Systematics, Harper and Row N Y.

14. Simpson M. Plant Systematics Academic Press, 2nd edition.
15. Singh G (2004). Plant Systematics, 2nd edn, Oxford and IBH, New Delhi.
16. Sivrajan V V (1984). Introduction to Principles of Plant Taxonomy, Oxford and IBH, New Delhi.
17. Smith P M (1976). The Chemotaxonomy of Plants, Edward Arnold Pub. Ltd.
18. Sporne K R (1974). Morphology of Angiosperms, Hutchinson University Library, London.
19. Stace C A (1989). Plant Taxonomy and Biosystematics. Bhojwani S. S. and Bhatnagar S. P. (1999). The embryology of angiosperms. Vikas Pub. House.
20. Bhojwani S.S. and Soh W.Y. (2001). Current Trends in Embryology of Angiosperms Kluwer Academic Publishers.
21. Fahn A. (1989) Plant anatomy (Third edn) Pergamon Press
22. Gilbert (2006). Developmental biology (8th Edition). Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
23. Graham C.F. and Wareing P.F. (1984). Developmental Controls in Animals and Plants
24. Blackwell Scientific Publications.
25. Jermy Burgess (1985) An Introduction to Plant Cell Development. Cambridge University Press.
26. Johri B. M. and Srivastava P. S. (2001). Reproductive biology of plants. Narosa Pub. House, New Delhi.
27. Krishnamurthy K.V. (1988) Methods in Plant Histochemistry
28. Lewis Wolpert (2002), Principles of Development (2nd edition). Oxford University Press.
29. Lyndon R.F. (1990) Plant Development- The Cellular Basis. UNWIN HYMAN
30. Raghavan V. (2000) Developmental Biology of Flowering Plants. Springer Verlag.
31. Razdan M.K. (2003) Plant Tissue Culture, Oxford IBH.

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areing P. F. and Philips I. D. J. (1981) Growth and Differentiation in plants. Pergamon Press
33. W
ada M., Shimazaki K., Iino M. (2005). Light sensing in plants. Springer.
34. D
avies P. J. (2004) Plant hormones. Kluwer.
35. Buchanan B. B., Gruissem W. and Jones R. L. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Physiology, Maryland

Title of the Course and Course Code	Plant Biotechnology(BOT5302)	Number of Credits : 04
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	List the advanced techniques of plant biotechnology.	
CO2	Summarize the different methods of biotechnology.	
CO3	Apply the basics of molecular biology for better understanding of the techniques.	
CO4	Compare different techniques of biotechnology on the basis of principles.	
CO5	Evaluate the different techniques in the specified area of biotechnology.	
CO6	Integrate the knowledge of techniques of biotechnology to find solutions to different problems of society.	

Unit No.	Title of Unit and Contents
I	**Advanced Techniques in Biotechnology** 1.1 Polymerase chain reaction (PCR), methods of PCR, applications of PCR Genomic and cDNA libraries 1.2 Screening of libraries by Southern, Northern, Western, Blotting techniques and applications 1.3 DNA sequencing and genome sequencing techniques
II	**Molecular markers and their applications** 2.1 Molecular markers: Different types of molecular markers, Genic and random markers, Hybridization-based techniques-RFLP and PCR based techniques – RAPD, AFLP, SSR polymorphism, microsatellite-primed PCR, single nucleotide polymorphism (SNP) 2.2 Applications of molecular markers: Diversity studies, DNA fingerprinting, population structure studies, phylogenetic relationships
III	**Techniques in gene expression at transcription level** Northern hybridization, subtractive hybridization, differential display of mRNA, SAGE, cDNA-AFLP, DNA microarrays, Gene-tagging and plasmid

	rescue, promoter and enhancer traps
IV	**Alterations in gene expression** Site-directed mutagenesis, insertional mutagenesis, knock out mutants, targeting induced local lesions in genomes (TILLING)
V	**Gene silencing** Gene inhibition at RNA level - antisense, co-suppression, miRNAs and siRNAs, silencing mechanisms
VI	**Basics of Plant Tissue Culture** 6.1 Major landmarks in the development of Plant Tissue Culture Nutritional requirements of the explants in PTC, role of PGRs and additives. 6.2 Micropropagation – Stages, pathways. 6.3 Organogenesis and Embryogenesis – Direct and indirect, zygotic and somatic 6.4 Protoplast Culture & Somatic hybridization - Isolation, culture, fusion, selection. Somatic hybrids (symmetric and asymmetric), cybrids, chimeric hybrids 6.5 Somaclonal variation – introduction, types, causes, selection methods
VII	**Applications** 7.1 Production of disease/virus free plants, production of useful mutants/somaclonal variants, production of haploids and triploids, synthetic seeds, embryo rescue, production of secondary metabolites, Micropropagation. 7.2 Germplasm conservation (Slow growth storage, cryopreservation) 7.3 Advantages of tissue culture technique over conventional methods of crop Improvement.
VIII	**Case studies for stress tolerant transgenics** 8.1 Transgenics for Abiotic stress tolerance (Salt and drought stress resistance) 8.2 Transgenics for Biotic stress resistance (fungal, insect, nematode and viral diseases) 8.3 Transgenics for Herbicide resistance
IX	**Case studies for applications of transgenics** 9.1 Transgenics for production of biopharmaceuticals and other useful products –Plant derived vaccines, plantibodies, and pharmaceutical proteins, etc. 9.2 Transgenics for biofortification& quality improvement of proteins, lipids, carbohydrates, & vitamins 9.3 Transgenics for lignin modification 9.4 Concerns related to GMOs

References:

1. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)

2. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14 (Blackwell Publ)
3. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture.Prospects for the 21st century (Academic press).
4. Bhojwani SS. &Razdan MK (1996). - Plant Tissue Culture: Theory & Practice (Elsevier)
5. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology (CRC Press)
6. Slater A, Scott NW, Fowler MR (2008) – Plant Biotechnology: the genetic manipulation of plants (Oxford Press)
7. Rai M (2009) – Fungal Biotechnology (IK International)
8. Vasil IK, Thorpe TA (1994) – Plant cell and tissue culture (Springer)
9. H K Das, Textbook of Biotechnology, 4th Edition

Title of the Course and Course Code	**Plant Ecology(BOT5303)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Outline principles of conservation and state importance of EIA. Recall basic concepts related to ecosystems, energy flow and productivity.	
CO2	Compute parameters of demographic study and exemplify different life strategies. Discuss succession and categorize diversity types.	
CO3	Classify biomes and apply this knowledge to study habitat ecology.	
CO4	Analyze relationships between plants, plants and animals, plants and microbes in ecological settings.	
CO5	Appraise pollution and justify its role in global warming. Assess biodiversity and management.	
CO6	Propose adaptive responses of plants to variation in abiotic factors.	

Unit No.	**Title of Unit and Contents**
I	**Plant interaction with abiotic factors:** climatic, edaphic and topographic factors
II	**Plant-plant & Plant-animal interaction:** allelopathy, herbivory, carnivorous plants
III	**Plant- microbes interaction:** Mutualism, parasitism, Quorum Sensing
IV	**Population Ecology:** 4.1 Ecological limits and the size of population, factors affecting population size, Demes Life history strategies, r and k selection, C-S-R triangle 4.2 Concept of metapopulation, extinction events, population viability analysis
V	**Community Ecology:**

	5.1 Community structure and species diversity. Diversity types and levels (alpha, beta and gamma), ecotone and edge effect 5.2 Plant succession, Autogenic and allogenic, mechanism and phases Serial communities and climax communities: Hydroseres, xeroseres
VI	**Ecosystem:** 6.1 Components and organization 6.2 Energy flow and productivity
VII	**Habitat ecology and Ecosystem types** 7.1 Terrestrial: Forests, grasslands and deserts 7.2 Aquatic: Fresh water, marine and estuarine 7.3 Artificial: Agricultural
VIII	**Biomes:** Classification and components
IX	**Eco-physiology**: Adaptive responses of plants to variation in: 9.1 Light: Photo inhibition, protection against light-induced damage 9.2 Temperature: Winter hardness, vernalization, adaptation to high temperature 9.3 Water availability: Adaptation to light drought and flooding
X	**Applied Ecology:** 10.1 Environmental pollution; global environmental change 10.2 Biodiversity: Status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches, EIA
XI	**Conservation Biology:** 11.1 Principles of conservation, major approaches to management, 11.2 Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves) 11.3 Man and Biosphere Programme- Principles and strategies.

References:

1. Ambhast, R. S. (1998). A Text Book of Plant Ecology, 9th edition, Friend and Co.
2. Barbour, M. G., Pits, W. D. and Burk, J. H. (1967). Terrestrial Plant Ecology, Addison-Wesley Publisher.
3. Begon, M., Townsend, C. R., Harper, J. L. (2005). Ecology: From Individuals to Ecosystems, 4thedition, Wiley Blackwell.
4. Canter, L. (1996). Environmental Impact Assessment, 2nd edition, McGraw Hill Publishing Company.
5. Coleman, D. C., Crossley, D. A., Handrix, P. F. (2004). Fundamentals of Soil Ecology, 2nd edition, Elsevier academic press.

6. Coller, B. D., Cox, G. W. and Miller, P. C. (1973). Dynamic Ecology, Prentice-Hall, Inc. EnglewoodCliffs, New Jersey.
7. Crawley, M., Crawley, J. And Crawley, M. (1997). Plant Ecology, 2nd edition,Wiley Blackwell.
8. De, A. K. (1994). Environmental Chemistry, Wiley Eastern publication.
9. Gurevitch, J., Scheiner, S. M., Fox, G. A. (2006). The Ecology of Plants, Sinauer associates.
10. Hynes, H. B. N. (1978). Biology of Polluted Water, 1st edition, Liverpool University Press.
11. Kershaw, K. A. (1978). Quantitative and Dynamic Ecology, 2nd edition, Edward Arnold Publication.
12. Kumar H. D. (1981). Modern Concept of Ecology, 8th edition, Vikas Publication.
13. Mishra, R. (1968). The Ecology of Work Book, Oxford and IBH Pub. Co.Kolkata.
14. Mukherjee, B. (1996). Environmental Biology, 1st edition, Tata McGraw Hill.
15. Mukherjee, B. (2000). Environmental Management: Basic and Applied Aspects of Management ofEcological Environmental System, 1st edition, Vikas Publication.
16. Odum E. P. (2007). Fundamentals of Ecology, 5th edition, Thomson Books.
17. Yadav, P. R. and Mishra, S. R. (2004). Environmental Biology, Discovery Publication, New Delhi.

Title of the Course and Course Code	**Industrial Botany (BOT5305)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	List and get acquainted with different industrial facets of Botany.	
CO2	Summarize upcoming trends of industries in Botany. Discuss greenhouse technology.	
CO3	Outline case studies of micropropagation of commercially important medicinal plants and examine the ways of increasing the yield of secondary metabolites.	
CO4	Relate the floriculture aspects of Botany and integrate the knowledge to plan a startup and become an entrepreneur.	
CO5	Evaluate the resource potential of algae, fungi as pharmaceuticals and nutraceuticals in national and international markets.	
CO6	Specify different types of plant resources and their uses.	

Unit No.	Title of Unit and Contents
I	**Algal Technology:** 1.1 Resource potential of algae, commercial utility of algae- food and feed, pigments, Pharmaceuticals and neutraceuticals, fine chemicals, fuel and biofertilizers, seaweeds extract as biofertilizers, distribution of economically important algae in India 1.2 Seaweed farming, biodiesel from algae, advantages over other sources of biodiesel, cultivation and extraction methods, liquid seaweed fertilizers – method of preparation and applications.
II	**Biopesticide Technology:** 2.1 Concept and significance of bio-pesticides, types of biopesticides and their applications, 2.2 Herbal- Azadiractin, rotenone and pyrethrins 2.3 Insect predators/parasites- Lady bird beetle, Trichoderma 2.4 Fungal- Trichoderma- Isolation, mass multiplication and application
III	**Food Industry:** 3.1 Production of yeast biomass 3.2 Production of mycoproteins 3.3 Production of traditional fungal foods 3.4 Production of mushrooms.
IV	**Culture Systems:** 4.1 Scope and applications of in vitro secondary metabolite production. 4.2 Types of culture systems used for secondary metabolite production 4.3 Bioreactors- Types of bioreactors, growth, product analysis and scaling up
V	**Improving Secondary Metabolite Production:** 5.1 Regulation of secondary metabolite pathways and compartmentalization 5.2 Manipulation of nutrient media, precursor additions 5.3 Immobilization of cells 5.4 Elicitation using biotic and abiotic elicitors 5.5 Biotransformation 5.6 Screening and selection of high secondary metabolite producing cell lines.
VI	**Pathway engineering:** Enhancing secondary metabolite production through genetic manipulation of biosynthetic pathways
VII	**Case studies of micropropagation:** Micropropagation of banana, sugarcane, lily, orchids and gerbera with respect to: Selection of elite plants, Preparation of explants, Surface sterilization, Initiation of cultures, Subculture, In-vitro rooting/ In-vivo rooting, Acclimatization of tissue cultured raised plants, Market potential (National, International)

	Plant Resources: Plants as source of spices, beverages, edible oils, essential oils, narcotics, insecticides, timber, dyes, cellulose, starch.
VIII	**Micropropagation of Medicinal Plants:** Culture media, explants, incubation conditions, stages of micropropagation, acclimatization and field trials (Case study- *Vinca rosea, Adhathoda vasica* and *Withania somnifera*)
IX	**Green House Technology:** Selection of land, infrastructure, types, maintenance, medial used, Selection of propagules of crop, hardening, harvesting and postharvest processing, marketing,
X	**Floriculture:** significance, importance, scope, prospects and role of floriculture in developing country, its scope for domestic and export market, factors affecting flower production, production of cut flowers and maintaining its quality, prolonging of vase life, packaging of cut flowers, cultivation of Carnation, Gerbera, Gladiolus, Rosa, Gypsophilla, Orchids, starts ups, Government schemes and economics of cultivation

References:

1. Chawla HC (2004) – Introduction to plant biotechnology (Science Publ)
2. Davies K (Ed) (2004) – Plant pigments and their manipulation – Annual plant revies, vol 14 (Blackwell Publ)
3. Altman A, Hasegawa PM (Ed) (2012) – Plant Biotechnology and agriculture Prospects for the 21st century (Academic press).
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5. Practice (Elsevier)
6. Hou CT, Shaw JF (2009) – Biocatalysis and agricultural biotechnology (CRC Press) Slater A, Scott NW, Fowler MR (2008) – Plant Biotechnology: the genetic manipulation of plants (Oxford Press)
7. Rai M (2009) – Fungal Biotechnology (IK International)
8. Vasil IK, Thorpe TA (1994) – Plant cell and tissue culture (Springer)
9. Hand book of horticulture, ICAR, New Delhi
10. Floriculture in India, Randhawa and Mukhopaddhay
11. Gardening in India, Bose and Mukherjee, Oxford
12. Introductory ornamental horticulture, Arora, Kalyani publishers
13. Gardening in India, Bose and Mukherjee, Oxford
14. H K das Textbook of Biotechnology 4th edition
15. Razdan M.K. (2003) Plant Tissue Culture, Oxford IBH.

Title of the Course and Course Code	Botany Practical V(BOT5307) (Any 10 to 15 practicals of 3 Hours)	Number of Credits : 04
Course Outcome (CO) On completion of the course, the students will be able to:		
CO1	Recall and identify types of Inflorescence, Aestivation, adhesion and cohesion of Floral whorls.	
CO2	Outline the transition of different stages in development of higher plants.	
CO3	Employ artificial keys and Flora volumes for classification and identification of the plants. Demonstrate the dissections of embryo, endosperm and apical meristem.	
CO4	Identify and trace the vegetative and reproductive pathways of development of plant organs.	
CO5	Assess the morphology of reproductive parts of angiosperms to study families	
CO6	Write the tour report, collect the plant specimens or create digital herbarium, rearrange herbarium as per the classification system and compile the taxonomic data of given area.	

Unit No.	Title of Unit and Contents
	Angiosperms (Any 5 to 7P of 3Hrs)
1-2	Study of Inflorescence, Aestivation, adhesion and cohesion of Floral whorls.
3-8	Study of at least 12 locally available families of flowering plants
9	Identification of family of locally available plants.
10	Identification of genus and species of locally available wild plants using flora
11-12	
13	Preparation of artificial keys based on vegetative and reproductive characters
14	Case study of plant species from a particular family and their comparative account.
	Excursion to study the flora (Preferably out of Maharashtra)
	Developmental Botany (Any 5 to 7P of 3Hrs)
1	Isolation of shoot apical meristems from seedling, young and mature vegetative plant.
2	
3	Tracing the course of stomatal development and observations on stomatal types.

4 5 6 and 7 8	Study on Microsporogenesis, megasporogenesis and male and female gametophyte developmental stages. Dissection of haustorial endosperm Dissection of dicotyledonous embryo and developmental stages of embryogenesis. Histochemical analysis and comparison between vegetative SA and reproductively induced SA. Study of mutants (ABCE model and other mutants).

Title of the Course and Course Code	**Botany Practical VI (BOT5308)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe the procedures of basic biotechnology experiments.	
CO2	Predict the results of experiments.	
CO3	Use proper plant tissue culture method to fulfil the objective.	
CO4	Differentiate the plant tissue culture techniques.	
CO5	Assess the results of experiments with correct observations and calculations.	
CO6	Plan and perform the experiments, compile the observations, draw conclusion and interpret the result.	

Prac No.	**Title**
	Fundamental techniques of Biotechnology (Any 5 to 7P of 3Hrs)
1-4	Isolation of DNA and RNA from plant tissues and electrophoresis.
5-7	Restriction digestion and electrophoresis of plant genomic DNA, Southern blotting and Southern hybridization.
8-10	Separation and detection of specific proteins using Western blotting.
11-13	Technique of RT-PCR.
	Plant Tissue Culture (Any 5 to 7P of 3Hrs)
14-15	Preparation of sterilized medium.
16	Callus culture.
17	Organ/ Anther Culture.
18	Protoplast isolation and culture
19-20	Somatic Embryogenesis.
21	Presentation of research paper related to transgenics.
22-25	Transformation of E. coli & Blue White Screening

S. Y. M. Sc. Semester IV

Title of the Course and Course Code	**Biostatistics & Bioinformatics (BOT5401)**	**Number of Credits : 04**
CO1	List the applications of different biostatistics and bioinformatics tools. Recall basic concepts of biostatistics to solve problems	
CO2	Articulate different bioinformatics tools for in-silico analysis. Discuss principles and guidelines of designing the experiment.	
CO3	Compute given statistical problems with right hypotheses and calculations to propose solution.	
CO4	Identify the sampling processes and their role by using different bioinformatics tools and techniques for data analysis.	
CO5	Compare different statistical and bioinformatics tools and select proper methods. Explain correlation and regression concept.	
CO6	Justify solution to any given problem with application of correct statistical and bioinformatics tools.	

Unit No.	**Title of Unit and Contents**
I	**Introduction to Statistics** **7L** **1.1 Measures of central tendency – mean, mode, median and their properties** **1.2 Measures of dispersion – variance, standard deviation, coefficient of variance, Symmetry and skewness, measures of skewness, kurtosis.** **1.3 Sampling and sampling distributions – concept of sample and population**
II	**Sampling and sampling distribution** **2L** **Methods of sampling: Simple sampling, random sampling (SRSWR, SRSWOR), stratified sampling**
III	**Correlation and regression** 3.1 Concept of correlation, positive correlation, negative correlation, Graphical method of studying types and correlation – Scatter diagram 3.2 Karl-Pearson's coefficient of correlation, Spearman's rank correlation coefficient 3.3 Regression – Equations of regression line using least square method, regression estimate and its standard error
IV	**Design of experiments** 4.1 Principles of design – randomization, replication, local control, treatment group and control group 4.2 Guidelines for designing the experiments, size of plot, number of replications. 4.3 Completely randomized design (CDR), randomized block design (RBD)

V	**Analysis of variance** 5.1 Analysis of variance table (ANOVA), standard error, critical difference for pairs of treatments 5.2 Tukey's test for pairwise comparison of treatments, Introduction to R software.
VI	**Testing of hypothesis** 6.1 Hypothesis, statistical hypothesis, critical region, level of significance, p-value, normal distribution. 6.2 T-test: t-test for mean, equality of two means, paired t-test, unpaired t-test 6.3 Chi-square test: chi square test for goodness of fit, independence of attributes, non-parametric test, Mann–Whitney U test
VII	**Introduction to Bioinformatics** 7.1 Introduction and definition, history and scope, applications of bioinformatics in various fields. 7.2 Basic concepts of sequence similarity, identity and homology. Definitions of homologues, orthologues and paralogues.
VIII	**Databases** Nucleic acid sequence databases (NCBI, EMBL, DDBJ), protein sequence databases (SWISS-PROT, TrEMBL, PIR, Uniprot), Literature databases (PubMed, MEDLINE, BMC, PLOS), Metabolic pathway databases (KEGG, MetaCyc, EcoCyc), Structural Databases (PDB, NDB, PubChem)
IX	**Scoring Matrices** Basic concept of scoring matrix, Matrices for nucleic acid and protein sequences, PAM and BLOSUM series
X	**Sequence Analysis** 10.1 Pair wise comparison of DNA and protein sequences, dynamic programming algorithms, FASTA and BLAST. 10.2 Multiple sequence alignments, progressive methods, iterative methods, localized alignments.
XI	**Phylogenetic Relationships** Determining phylogenetic relationships using DNA and protein sequences (CLUSTAL, PHYLIP)
XII	**Protein structure prediction and drug discovery** 12.1 Use of Ramchandran Plot and protein folding in protein structure prediction, Molecular visualisation of protein, protein conformation and visualisation tool (RASMOL), Protein structure classification (SCOP, CATH). 12.2 Role of bioinformatics in drug discovery, target discovery, lead discovery, docking and prediction of drug quality

References:

1. Lab Math – Adams, D.S. I.K. Internations Pvt Ltd. New Delhi, 2004
2. Statistical Methods – Snedecor G.W. and Cochran W.G. Affiliated East-West Press Pvt. Ltd. 1989
3. Statistical methods in Agriculture and Experimental Biology – Mead, R. and Curnow, R.N. Chapman and Hall, 1983
4. Practical statistics and experimental design for plant and crop science – Clewer, A.G. and Scarisbrick, A.H., John Wiley, New York, 2001
5. Bioinformatics - Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003
6. Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, New Delhi, 2003
7. Bioinformatics and Molecular Evolution – Higgs PG and Attwood, TK

S. Y. M. Sc. Semester IV		
Title of the Course and Course Code	**Project (BOT5403)**	**Number of Credits : 04**
CO1	Identify the topic of research, its objectives and state its importance.	
CO2	Articulate the information to write a review of literature.	
CO3	Prepare the reagents and implement the experiment procedure with precision and accuracy.	
CO4	Arrange weekly progress reports of the work. Analyse the data statistically using tests of significance.	
CO5	Standardize the protocols of the experiments, test the hypothesis and compare the work with relevant national and international research papers.	
CO6	Design, perform the experiments, compile the observations, draw conclusions, interpret the results, write a thesis and integrate the work in form of presentation.	

The necessary details for Summer Training course are as follows:

A student can complete Training in any Biotech industry / Agro based Industry/ Research institute/ Academic institute / with a research project of a teacher / an expert funded by any funding agency for a minimum period of 4 weeks.

Student has to submit a training report at the beginning of third semester.

The student must include the project completion certificate issued by the respective industry/research institute/educational institute in the report. A student will submit three hard bound copies: Student Copy, Department copy, CoE copy of the work carried out during project work.

The Project Report should include followings:

- Introduction

- Review of Literature
- Aims and Objectives
- Material and Methods
- Observations
- Result and Conclusion
- Bibliography

Internal Assessment will be done by teacher co-ordinator for 25 marks as following:

Sr. No.	Criteria	Marks
1	**Project report**	**10**
2	**Analysis of Result & Conclusion**	**10**
3	**Viva**	**5**