

Approved Syllabus for UG Botany (VIIth- Xth Semester)

and

Approved Syllabus for PG Botany (Ist- IVth Semester)

(To be effective from the academic session 2012-2013)

**Department of Botany
School of Life Sciences
Guru Ghasidas Vishwavidyalaya
Koni, Bilaspur (C.G.)-495009**

Semester- VII/ I

Code	Title	End semester marks	Internal marks	Marks allotted
LBC 701/ LBT101	Diversity and Biology of Bacteria, Fungi and Viruses	60	40	100
LBC 702/ LBT102	Algae, Bryophytes and Pteridophytes	60	40	100
LBC 703/ LBT103	Diversity and Biology of Gymnosperms and Anatomy of Angiosperms	60	40	100
LBC 704/ LBT104	Angiosperm Taxonomy and Phytogeography	60	40	100
LBCL 705/ LBL105	Lab exercise based on LBT101 and LBT102	60	40	100
LBCL 706/ LBL106	Lab. exercise based on LBT103 and LBT104	60	40	100
			Total = 600	

Semester- VIII/ II

Code	Title	End semester marks	Internal marks	Marks allotted
LBC 801/ LBT201	Computational Biology	60	40	100
LBC 802/ LBT202	Ecology and Environment	60	40	100
LBC 803/ LBT203	Plant Physiology and Metabolism	60	40	100
LBC 804/ LBT204	Floral Morphology and Embryology of Angiosperm	60	40	100
LBCL 805/ LBL205	Lab. exercise based on LBT201 and LBT202	60	40	100
LBCL 806/ LBL206	Lab. exercise based on LBT203 and LBT204	60	40	100
			Total = 600	

Semester- IX/ III

Code	Title	End semester marks	Internal marks	Marks allotted
LBC 901/ LBT301	Cell Biology and Biochemistry	60	40	100
LBC 902/ LBT302	Genetics and Breeding	60	40	100
LBC 903/ LBT303	Plant Pathology	60	40	100
LBC 904/ LBT304	Plant Biotechnology and Genetic Engineering	60	40	100
LBCL 905/LBL305	Lab. exercise based on LBT301 andLBT302	60	40	100
LBCL906/ LBL306	Lab. exercise based on LBT303 andLBT304	60	40	100
			Total =	600

Semester- X/IV

Code	Title	End semester marks	Internal marks	Marks allotted
LBC1001/ LBT 401	Tool and techniques in plant biology	60	40	100
Specialization 1: Environmental Biology				
LBC1002/ LBT 402(i)	Air Pollution and Climate Change	60	40	100
LBC1002/ LBT 402(ii)	Water Pollution Management	60	40	100
Specialization 2: Functional Plant Biology				
LBC1003/ LBT 403 (i)	Plant Metabolism	60	40	100
LBC1003/ LBT 403(ii)	Stress Physiology of Plants	60	40	100
Specialization 3: Ethno-botany and Plant Resource Utilization				
LBC1004/ LBT 404(i)	Ethnobotany and Pharmacognosy	60	40	100
LBC1004/ LBT 404(ii)	Plant Resource Utilization and Conservation	60	40	100
Specialization 4: Plant Molecular Biology				
LBC1005/ LBT 405(i)	Genetic Engineering	60	40	100
LBC1005/ LBT 405(ii)	Bioinformatics and Genome Analysis	60	40	100
LBCL1006/ LBL 406	Practical based on special papers	60	40	100
LBCL 1007/ LBL 407	Dissertation	120	80	200
			Total = 600	

Note: Students may opt one of the specializations comprised of two theory papers

Semester-I

LBC 701/LBT 101- Diversity and Biology of Bacteria, Fungi and Viruses,	
Unit I	General characters: Mycoplasma; Actinomycetes: <i>Halobacteria</i> , <i>Thermoplama</i> ; Photosynthesis in bacteria: Anoxygenic photosynthesis in purple bacteria, chemosynthetic bacteria; methanogens and methanotrophs; Sexuality and Genetic recombination in Bacteria.
Unit II	General account and classification of viruses, Bacteriophages: T4, Lambda, Mu, lytic and lysogenic cycle, regulation of lysis and lysogeny in lambda phage, Cyanophages and Mycoviruses; Viroids and Prions.
Unit III	General characteristics of fungi: Distribution, Mode of nutrition, Reproduction: Vegetative, Asexual and Sexual reproduction and general principles of classification of fungi. Heterothallism and parasexuality; economic importance of fungi.
Unit IV	General characteristics features of orders Plasmodiophorales, Chytridiales Peronosporales, Mucorales, Protomycetales, Erysiphales, and Pezizales
Unit V	Uredinales, Ustilaginales, Agaricales and, Melanconiales, Moniliales; Mycorrhiza

Suggested Readings:

1.	Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 1996 - Introductory Mycology. John Wiley Publications. UK.
2.	Madigan M. et al. 2001. Brocks biology of Microorganisms. Pearson. USA.
3.	Mehrotra R.S. and Aneja K.R. An Introduction to Mycology. New Age International Publishers. New Delhi.
4.	Prescott, Harley and Kleins. 2001. Microbiology, McGraw-Hill Education. USA.
5.	Webster, J. 2007. An Introduction to Fungi. Cambridge Univ. Press. New Delhi.

LBC 701/LBT 101 Practical

1. Isolation, purification and maintenance of microbial culture from soil sample
2. Study of the growth behavior and determination of generation time
3. Antibiotic resistance pattern in microbial culture
4. Staining of bacteria by gram's stain method
5. Total cell counting of a microbial culture
6. Isolation of fungi from the rhizospheric soil
7. Preparation of slides and study of specimens of important fungi
8. Collection and study of aero mycoflora
9. Preparation of PDA media in the laboratory
10. Isolation and cultivation of fungus on PDA medium

LBC 702/LBT 102 - Algae, Bryophytes and Pteridophytes	
Unit I	General characters, classification and current trends in classification of algae, habitats, habit and thallus organization, reproduction and life cycle in algae, evolutionary trends in algae, economic importance algae.
Unit II	Comparative account of cell structure, thallus organization, reproduction and life cycle of Cyanophyta, Chlorophyta, Phaeophyta, Rhodophyta, Bacillariophyta
Unit III	General characters, classification, origin of Bryophytes, Comparative account of gametophyte and sporophyte of Hepaticopsida, Bryopsida and Anthocerotopsida, Fossil bryophytes, economic importance of bryophytes.
Unit IV	General characters and classification of Pteridophytes, Heterospory and seed habit, Evolution of sorus, Economic importance of Pteridophytes.
Unit V	Comparative morphology and anatomy of vegetative and reproductive structure of sporophyte and gametophyte of Psilopsida, Lycopsida, Sphenopsida, Filicopsida.

Suggested Readings:	
1.	Bold and Wynne. 1985. Introduction to the Algae. Prentice-Hall Publication. Mumbai.
2.	Chapman, V.J. and Chapman D.J. 1973. The Algae. Macmillon and Company, New York.
3.	Hoek, Christian et al. 1995. Algae: An Introduction to Phycology. Cambridge University Press. New Delhi.
4.	Lee, R. E. 2009. Phycology. Cambridge University Press. New Delhi.
5.	Parihar N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
6.	Parihar N.S. 1959. An Introduction to Pteridophyta. Central Book Depot, Allahabad.
7.	Rashid A. 2011. An Introduction to Pteridophyta. Vikas Publishing House. New Delhi.
8.	Rashid A. 2009. An Introduction to Bryophyta. Vikas Publishing house. New Delhi.
9.	Round F.E. 1984. The Ecology of algae. Cambridge University Press. New Delhi.
10.	Sharma, O.P. 2006. Pteridophyta. Macmillan India Limited. New Delhi.
11.	Vashistha, B.R. Sinha, A.K. Kumar, A. 2012. Pteridophyta. Botany for Degree Students. S. Chand. New Delhi.
12.	Vashistha, B.R. Sinha, A.K. Singh, N.P. 2013. Algae. Botany for Degree Students. S. Chand. New Delhi.
13.	Sharma, O.P. 2006. Textbook of Algae. Tata McGraw Hill, New Delhi.

LBC 703/LBT103: Diversity and Biology of Gymnosperms and Anatomy of Angiosperms	
Unit I	Classification of Gymnosperms, Types of fossils and the Process of Fossilization, techniques for studying plant fossils, Brief account of the order Pteridospermales, general account of Cordaitales and Pentoxylatles
Unit II	General characteristics of gymnosperms, general account of structure, reproduction and affinities of order Ephedrales, Gnetales and Welwitschiales and Genetales, Distribution of living Gymnosperms in India, Economic importance of Gymnosperms.
Unit III	Shoot apical meristem, Root apical meristem, Control of cell and tissue differentiation especially xylem and phloem, secretory ducts and laticifers, wood development in relation to environmental factors.
Unit IV	Types and phylogeny of stomata, types of nodal anatomy, phylogenetic and evolutionary consideration of nodal anatomy, types of cambium, factors influencing the growth of cambium, experimental control of cambial activity.
Unit V	Seed anatomy of Monocotyledonous and Dicotyledonous, special features of seeds or seed appendages, seed germination seedling growth, hormonal control of seedling growth.

Suggested Readings:	
1.	Andrews, H.N. 1961. Studies in Palaeobotany. John Wiley. UK.
2.	Arnold, C.A. 1974. An introduction to paleobotany. MC Graw Hill. UK.
3.	Bhatnagar, S.P. and Moitra A.1996 - The Gymnosperms. New Age International Pvt. Ltd. New Delhi
4.	Biswas C. and Johri B.M. 1997. The Gymnosperms. Narosa Publishing House, New Delhi
5.	Buvat, R. 1988. Ontogeny, Cell differentiation and structure of vascular plants. Springer-vrelag. USA.
6.	Chamberlain, C.J. 1935. Gymnosperms- Structure and Evölation. Univ. of Chicago Press. USA.
7.	Essau, K. 1972. Plant Anatomy. John Willey. UK.
8.	Fahn, A. 1997. Plant anatomy. IV th Edition, Aditya book Ltd. New Delhi
9.	Iqbal. M. 1990. The vascular Cambium. John Wiley. New Delhi.
10.	Larsen, P.R. 1994. The vascular Cambium. Springer –Verlag. New Delhi.
11.	Lyndon, R.F. 1990. Plant Development .The cellular basis, Unnin Human, London
12.	Mauseth,J.D. 1988. Plant anatomy, The Benjamin Cummings Publication. USA.
13.	Raghavan. V. 1999. Developmental Biology of flowering plants. Springer. Verlag. New Delhi.
14.	Sporne, K.R. 1965. The morphology of Angiosperms. Hutchinson and Co.
15.	Sporne, K.R. 1965. The morphology of Gymnosperms. Hutchinson Publications. London.
16.	Stevens, W.C. 1995. Text books of Plant anatomy. Saujanya Publications. Jaipur
17.	Stewart, W.N. and Rothwell, G.W. 1993. Palaeobotany and the evolution of plants 2 nd Edition, Cambridge Univ. Press, New York.
18.	Waisel, Y. et al. 1996. Plant roots: The hidden hall. 2 nd edition. Marcel Dekker. New York

LBC 704/LBT104: Angiosperms Taxonomy and Phyto geography	
Unit I	Taxonomic hierarchy, delimitation of taxa and attribution of rank. Typification, International Code of Botanical Nomenclature Salient features-Principles, Important Rules and Recommendations, Provisions for the governance of the Code. Biosystematics.
Unit II	Herbarium, flora, histological, cytological, serological, morphology, anatomy, palynology, embryology, phytochemistry, numerical taxonomy, DNA bar coding
Unit III	Phenetic versus phylogenetic systems, cladistics in taxonomy, relative merits and demerits of major systems of classification, relevance of taxonomy to conservation, Angiosperm phylogeny group (AGP), ancestors of Angiosperms, Interrelationship among the major groups of Angiosperms.
Unit IV	Ranunculaceae, Capparidaceae, Malvaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Asclepiadaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Moraceae, Cyperaceae, Arecaceae, Poaceae, Nymphaeaceae.
Unit V	A brief idea of Phyto geography, Phyto-geographical regions of the world with special reference to the Indian sub-continent, Endemism, Major vegetation, forest types of India and their distribution, Grassland types and their distribution in India.

Suggested Readings:	
1.	Davis, P. H. and V. H. Heywood. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi
2.	Eames, A.J. 1961. Morphology of Angiosperms. McGraw Hill, NY.
3.	Naik, V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com
4.	Pandey, B.P. 2007. Taxonomy of Angiosperms. S. Chand and Company Limited. New Delhi.
5.	Sharma, O.P. 2009. Plant Taxonomy. Tata McGraw-Hill. Mumbai.
6.	Singh Gurcharan. 2004. Plant Systematics : Theory and practice Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi
7.	Singh G. 2004. Plant Systematics. Science Publishers. New Delhi.
8.	Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.

LBCL 705/ LBL105: based on LBC 701 & 702/LBT 101 & 102

LBC 701/LBT 101 Practical

11. Isolation, purification and maintenance of microbial culture from soil sample
12. Study of the growth behavior and determination of generation time
13. Antibiotic resistance pattern in microbial culture
14. Staining of bacteria by gram's stain method
15. Total cell counting of a microbial culture
16. Isolation of fungi from the rhizospheric soil
17. Preparation of slides and study of specimens of important fungi
18. Collection and study of aero mycoflora
19. Preparation of PDA media in the laboratory
20. Isolation and cultivation of fungus on PDA medium

LBC 702/LBT 102 Practical

1. Preparation of temporary slide of algal specimen and their identification
2. Isolation and identification of local algal flora.
3. Micro-preparation of different members of Bryophytes.
4. Study of Bryophytes in their natural habitats.
5. Study of habit, anatomy and reproductive structures of Pteridophytes.

LBCL 706/ LBL106: based on LBC 703 & 704/LBT 103 & 104

LBC 703/LBT 103 Practical

1. Comparative study of the anatomy of vegetative and reproductive parts of locally available (wild and cultivated) gymnosperms viz. Cycas, Pinus, Thuja and Cupressus
2. Study of various types of fossils viz. Impression, compression and Petrifications
3. Study of fossil Gymnosperms from permanent slides
4. Learning techniques of making temporary and permanent double stained microscopic preparations for monocot and dicot roots and stem and their characteristic feature.
5. Study of anomalous secondary growth by preparing the permanent double stained slides as well as available permanent slides.

LBC 704/LBT 104 Practical

1. Study of locally available families of flowering plants
2. Identification of genus and species of locally available wild plants
3. Micro-preparation of permanent slides of woody plants to study xylem and phloem

Semester-II

LBC 801/LBT201: Computational Biology	
Unit I	Scope of Biostatistics, variables in biology, collection, classification, tabulation of data. Frequency distribution, Diagrammatic and graphical presentation of statistical data, Sampling techniques. Measures of central location and dispersion, Simple measure of skewness and Kurtosi, Probability, conditional probability.
Unit II	Binomial, Poisson and Normal Distribution Correlation and Regression, Least Square method of fitting, Standard error of estimate, Correlation and regression coefficient. Basic idea of significance testing, level of significance, students 't' test, χ^2 (chi-square) test and F-test, Analysis of variance.
Unit III	Biological databases, EMBL, DDBJ, TAIR, KEGG, Swis-prot, Optimal Pairwise Alignment- Biological Sequences and the Exact String Matching Problem-Fast Alignments: Genome Comparisons and Database Searches.
Unit IV	Multiple Sequence Alignment-Sequence Profiles and Hidden Markov Models.- Gene Prediction-Phylogeny-Sequence Variation and Molecular Evolution
Unit V	Testing Evolutionary Hypotheses, In silico analysis of phylogeny, construction of phylogenetic tree, dendrogram, Computational phylogenetics, Construction of QTL mapping, Microarray data analysis.

Suggested Readings:	
1.	Arthur, M. 2002. Introduction to Bioinformatics. Oxford University Press. New Delhi.
2.	Bernard, A. Rosner, 2006. Fundamentals of Biostatics. Thompson Publication. Canada.
3.	Khan and Khanam. 2003. Fundamental of Biostatistics. Ukaaz Publications. Hyderabad.
4.	Krawetz. 2003. Introduction to Bioinformatics: A theoretical and Practical Approach. Humana Press. USA.
5.	Miguel and Rade. 2003. Bioinformatics and Genome. Horizon Scientific Press.Utah. USA.

LBC 802/LBT 202 - Ecology and Environment	
Unit I	Principles of Ecology, Physical environment; biotic environment; biotic and abiotic interactions, Concept of habitat and niche; fundamental and realized niche; resource partitioning; character displacement.
Unit II	Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); Community: structure and attributes; edges and ecotones; Succession: Types; mechanisms; changes involved in succession; concept of climax
Unit III	Ecosystem Organization: Structure and Functions, Primary Production (methods of measurement, controlling factors), Energy Dynamics (trophic organization, energy flow pathways, ecological efficiencies)
Unit IV	Biological diversity: Concept and levels; distribution and global patterns; terrestrial biodiversity, hot spots; IUCN categories of threat; inventory; conservation.
Unit V	Environmental pollution: Kinds, sources, effects on plants and ecosystems, greenhouse gases, consequences of climate change; Ozone layer depletion: causes and consequences; Xenobiotics and its impact

Suggested Readings:	
1.	Kormondy E. J., 2000. Concept of Ecology. 4 th Edition. Benzamin Cummings. UK
2.	Odum E.P., 1996. Fundamentals of Ecology, Natraj Publishers, Dehradun.
3.	Patrick L. 2000. Tropical Ecosystems and Ecological Concepts. Cambridge University Press. UK.
4.	Sharma P.D. 2007. Ecology and Environment. Rastogi Publication, Meerut.
5.	Singh J.S., S.P. Singh and S.R. Gupta 2006. Ecology, Environment and Resource Conservation, Anamya Publication, New Delhi.

LBC 803/LBT 203: PLANT PHYSIOLOGY and METABOLISM	
Unit I	Plant Water relations: Osmotic phenomena, Water and osmotic potential, Absorption of water, Mineral salt absorption, Ascent of Sap, Translocation of organic solutes, passive and active transports; Transpiration: Mechanism and Theories of Stomatal movement, Factors affecting transpiration
Unit II	Metabolism: Photosynthesis and Respiration: Light (Hill's) reaction, excitation energy transfer, mechanism of electron and proton transport in chloroplast, photophosphorylation, photoprotective mechanisms, carbon fixation in C3 and C4 plants, CAM, Glycolysis and Kreb's Cycle
Unit III	Plant nutrition, Mineral nutrition and acquisition in plants, Mineral deficiency and toxicity in plants, Nitrogen metabolism, nitrate uptake and assimilation, biological nitrogen fixation, biology of nodule formation in legumes, Phosphate uptake and assimilation, Sulphur uptake and assimilation
Unit IV	Stress physiology: Water deficit and drought resistance, Chilling and Freezing, Heat stress and heat shock, Salinity and salt stress, Oxygen deficiency, Metal toxicity and tolerance in plants, Oxidative Stress and Anti-oxidative defense system, Stress induced gene expression.
Unit V	Sensory photobiology: Phytochromes and cryptochromes, Photoperiodism and its significance, Plant growth regulators: Physiological effects and mechanism of action of plant growth hormones (Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid).

Suggested Readings:	
1.	Devlin Robert M. 1983. Plant Physiology, Prindle Weber and Schmidt Publisher; 4 th edition. UK.
2.	Fitter Alastair H. 2001. Environmental Physiology of Plants. Academic Press Publisher, 3 rd Edition. UK.
3.	Hans Lambers et al. 2008. Plant Physiological Ecology. Springer. Germany.
4.	Hopkins and Hunner. 2010. Introduction to Plant Physiology. John Wiley. UK.
5.	Salisbury Frank and Cleon Ross 1991. Plant Physiology. Brooks Cole Publishers; 4 th edition. USA.
6.	Taiz Lincoln and Zeiger Eduardo 2010. Plant Physiology. Sinauer Associates, Inc. Publishers, 5 th edition. UK.

LBC 804/LBT 204 - Floral Morphology and Embryology of Angiosperms	
Unit I	Morphology of flowers, types of gynoecium, primitive and advanced structure of stamen and carpel, evolutionary trends in placentation
Unit II	Microsporangium (Anther), Structure and function of anther wall layers, microsporogenesis, role of callose and tapetum in pollen development pollen wall morphogenesis, microspore/pollen mitosis, division of generative cells, pollen fertility and male sterility, pollen storage and pollen viability
Unit III	Megasporangium (ovule) structure and types, megasporogenesis, megaspore tetrad, dyad and coenomegaspore (polarity of nuclei) Embryosac types, ultrastructure of mature embryosac, synergid and antipodal haustoria
Unit IV	Pollination, significance of pollen pistil interaction, incompatibility types and methods of overcoming incompatibilities, fertilization, syngamy and triple fusion, Post-fertilization metabolic and structural changes in embryosac.
Unit V	Endosperm, types and their development, endosperm haustoria and their function, embryogenesis in monocot and dicot angiosperms, suspensor structure , cytology and functions, physiological and morphological relationship of endosperm and embryo, role of embryology in plant breeding

Suggested Readings:	
1.	Bhojwani and Bhatnagar. 2000. The Embryology of Angiosperms. Vikas Publishing House. New Delhi.
2.	Chaturvedi, S.K. and Chaturvedi, S. 2001. Biology of reproduction in angiosperms. Bioved research Society, Allahabad.
3.	Eames, A.J: 1961. Morphology of Angiosperms. McGraw Hill, New York. USA.
4.	Endress, P.K. and Frus, F.M. 1994. Early evolution of flowers. Springer Verlag. Germany.
5.	Faegri, K. and Van der Pijl, L. 1969. The principles of pollination ecology. Pergamon Press. Toronto.
6.	Johri, B.M. 1982. Experimental embryology of vascular plants. Narosa Publishing House, New Delhi
7.	Maheshwari, P. 1950. An introduction to the embryology of angiosperms. Mcgraw Hill Book Company. Mumbai.
8.	Meeuse, A.D.J. 1966. Fundamentals of phytomorphology. Ronald Press Company. New York. USA.
9.	Pandey, A.K. 1997. Embryology of angiosperms. CBS Publishers, New Delhi.
10.	Proctor, M. and Yeo, P. 1973. The pollination of flowers. Collins, St. J. Place. London
11.	Raghavan, V. 1999. Developmental biology of flowering plants. Springer-verlag, New Delhi.
12.	Raven, P.H., Evert, R.F. and Eichhom, S.E. 1992. Biology of flowering plants. Springer – Verlag, Germany.
13.	Sattler, R. (Edt.) 1978. Theoretical plant morphology. Leiden Univ. Press. Hague. The Netherlands.
14.	Sporne, K.R. 1974. The morphology of angiosperms. Hutchinsons Univ. Lib. London.
15.	Swami, B.G.L. and Krishnamurhti, K.V. 1980. From flower to fruit: Embryology of flowering plants. Tata Mcgraw Hill. Mumbai.

LBCL 805/ LBL 205: based on LBC 801 & 802/LBT 201 & 202

LBC 801/LBT 201 Practical

1. Determine the mean, median and mode from the given sample
2. Calculate the t values of the given data and determine the its significance
3. Calculation of analysis of variance from the given sample
4. Study the sequence homology of the given sequences
5. Testing the BLAST
6. Phylogenetic analysis using various bioinformatics methods

LBC 802/LBT 202 Practical

1. To determine the frequency, density, dominance of plant species in different terrestrial ecosystems.
2. To estimate IVI of the species in a woodland ecosystem.
3. To study the life form of a woodland ecosystem.
4. To compare protected and unprotected grassland ecosystems using community coefficients (similarity indices).
5. To determine diversity indices (Shannon-Wiener, Concentration of Dominance, Species richness, Equitability and B-diversity) of protected and unprotected ecosystems.
6. Estimation of biomass estimation using harvest method.
7. To determine the water holding capacity of soils collected from different ecosystems.
8. To determine the percent organic carbon and organic matter in the soils of cropland, grassland and forest.
9. To study environmental impact of a given developmental activity on an ecosystem using checklist as EIA method.
10. Field visits to different ecosystems

LBCCL 806/ LBL 206: based on LBC 803 & 804/LBT 203 & 204

LBC 803/LBT 203 Practical

1. To measure the rate of transpiration by using Ganong's Potometer
2. To demonstrate the liberation of oxygen in Photosynthesis
3. To demonstrate transpiration by cobalt chloride method
4. Separation of chloroplast pigments by solvent extraction process
5. To determine the respiratory quotient (R.Q.) of different respiratory substrates
6. Demonstrate that energy is released during respiration
7. Demonstration of anaerobic respiration
8. Demonstration of the effect of abiotic stresses on plant growth

LBC 804/LBT 204 Practical

1. Study from permanent slides, anther wall layers, pollen, types of ovules, megasporogenesis, embryo sac development, endosperm and embryo, Pollinia of orchids and Asclepiads.
2. Preparation of temporary mount of TS of anthers (locally available) to study the anther wall layers.
3. Preparation of temporary mount of TS of ovary to study the types of placentation.

Semester III

LBC 901/LBT301: Cell Biology and Biochemistry	
Unit 1	Structural organization of typical plant cell. Plant Cell wall biogenesis and structure, Plasma membrane, Structure and function of different cell organelles in cell, Structural organization of chloroplast and mitochondria. Nuclear envelope, nuclear pore complex, their ultra-structural model, Nucleolus: structure and function.
Unit 2	Central dogma: replication of DNA, semi-conservative mode of replication, DNA polymerases and DNA synthesis in vitro, transcription and translation in prokaryotic and eukaryotic cells, regulation of gene expression in prokaryotes.
Unit 3	Cell-Cell Interaction and signalling: Signalling molecules and mechanism of signalling, secondary messenger, Ca ²⁺ , c-AMP, MAP kinase, Basic concepts of Cell division and cell cycle and Regulation
Unit 4	Structure and function of carbohydrates, Amino acid, Classification of amino acid, chemical and physical properties of amino acids, reactions of amino acids, peptides and peptide bond, Proteins types and functions, structural features of proteins including primary, secondary and tertiary structure; Lipids: synthesis of saturated and unsaturated fatty acids, oxidation of fatty acids
Unit 5	Enzyme definition and characteristics, Enzyme specificity, Enzyme inhibition, Nomenclature of enzymes, coenzyme and cofactors, factors affecting enzyme action, enzyme kinetics, Concepts of Km and Vmax, Michaelis-Menten equation of enzyme kinetics, Ribozyme

Suggested Readings:	
1.	Alberts B. Johnson, A. Lewis, J. Raff, M. Roberts, K. Walter, P. 2008. Molecular Biology of the Cell. Garland Science Publisher. USA.
2.	Berg, J M; Stryer L. 2010. Biochemistry, W. H. Freeman; Seventh Edition edition
3.	De Robertis and De Robertis. 2010. Cell and Molecular Biology: Saunders College Publisher. UK.
4.	Lewin Benjamin 2011. Gene X: Jones and Bartlett Learning Publisher. USA.
5.	Lodish and Baltimore.2005. Molecular Cell Biology: WH Freeman Publisher. UK.
6.	Nelson and Cox. 2002. Lehninger Principle of Biochemistry: 3rd Edition: WH Freeman Publisher. UK.

LBC 902/LBT 302 - Genetics and Breeding	
Unit I	Classical genetics: Mendelian principles, Segregation, Independent Assortment; incomplete dominance, Co-dominance, Gene interactions, Epistasis, Chromosomal theory of inheritance, sex chromosomes and determination, dosage compensation, Extra nuclear inheritance
Unit II	Arrangement of genetic material: linkage and recombination, genetic and cytological crossing over, genetic and chromosome mapping, Change and structure of genetic material: Chromosome variation in number, Euploidy, Aneuploidy, polyploids. Changes in chromosome structure: deficiencies, duplications, translocations, Gene mutation
Unit III	Population Genetics: Population models, probability and distributions, Genotypic and phenotypic variation, Hardy-Weinberg, measures of genetic variation Gene frequencies and equilibrium, optimum phenotype and selection pressure, kinds of selection; Fisher's fundamental theorem of Natural selection.
Unit IV	Genomics and Molecular Genetics: Maps of Chromosomes, Map position-based cloning of genes: Chromosome walks, chromosome jumps, Expressed sequences, Comparative genomics: Mitochondrial and Chloroplast genomes, genome evolution in plants
Unit V	Plant breeding: objectives and scope, hybridization in self-pollinated crops and cross-pollinated crops, inbreeding depression and heterosis, polyploid breeding; breeding for disease resistance plants, molecular markers and plant breeding

Suggested Readings:	
1.	Alberts B. Johnson, A. Lewis, J. Raff, M. Roberts, K. Walter, P. 2008. Molecular Biology of the Cell. Garland Science Publisher. USA.
2.	Benzamin Lewin. 2011. Gene X. Jones and Batlett. Learning Publisher. USA.
3.	Clugg and Cummings. 2011. Concepts of Genetics. Benzamin Cumming Publishing Company. UK.
4.	Russel, P.J. 2010. Genetics. Benzamin Cumming Publishing Company. UK.
5.	Singh, B.D. 2007. Plant Breeding. Kalyani Publications. New Delhi.
6.	Snustad and Simmons. 2008. Principle of Genetics. 5 th Edition. Willey Publication. UK.
7.	Tamarin. 2001. Genetics. McGraw Hill. New Delhi.

LBC 903/LBT 303: Plant Pathology	
Unit I	History of plant pathology, identification of symptoms and signs, observation of symptoms, isolation, growth and identification of causal agents, losses caused by plant diseases, basic procedure in diagnosis of plant diseases.
Unit II	Parasitism and pathogenecity, development of plant diseases, inoculations, penetration, infection, dissemination of pathogen, oxidative burst, PR proteins, SAR, phytoalexins, factors affecting distribution of disease.
Unit III	Pathogenesis, Chemical weapons of pathogens, microbial toxins, growth regulators and detoxification of antimicrobial molecules in disease development Pre-existing defense structures, pre-existing chemical defense, induced structural and biochemical defense.
Unit IV	Nature and properties of pathogenic bacteria, viruses, mycoplasma and nematodes, symptoms, transmission, characterization. Study of plant disease caused by Bacteria, Viruses, Mycoplasma and Nematodes and their control measures.
Unit V	Study of fungal diseases, symptoms caused by fungi on plants, mechanisms of infection, penetration, colonization and their control measures. General account of some important fungal diseases of economically important crops of central India and their control measures.

Suggested Readings:	
1.	Aggrawal Ashok and Mehrotra R S. 2002. Plant Pathology. Tata Mcgraw Hill, 2 nd edition. Mumbai.
2.	Agrios George N. 2005. Plant Pathology, Academic Press, 5 th Edition. UK.
3.	Robert B. 2008. Plant Pathology: Techniques and Protocols (Methods in Molecular Biology), Humana Press. USA.
4.	Gail L. Schumann and Cleora J. D'Arcy 2009. Essential Plant Pathology, 2 nd Edition. American Phytopathological Society. USA.
5.	Sharma P. 2006. Plant Pathology, Alpha Science International Ltd. New Delhi.
6.	Trigiano Robert N. 2007. Plant Pathology Concepts and Laboratory Exercises. 2 nd Edition, CRC Press. U.K.

LBC 904/LBT304 Plant Biotechnology and Genetic Engineering	
Unit 1	Basic concepts of Biotechnology, biotechnology and its components, need of R and D and pilot scale production using biotechnology, current global scenario, university-industry collaboration, fermentation technology, environmental biotechnologies, biosensors, phytoremediation, biotechnology and information technology (BT and IT) interdependence, management of biotech related industries
Unit 2	Introduction of plant tissue culture and cell suspension culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media nutrient and hormone requirement, single cell culture, somaclonal variation, protoplast isolation and hybridization; concept of artificial seeds.
Unit 3	Methods for the plant genetic transformation, particle bombardment method, electroporation, microinjection, mechanism of Agrobacterium mediated gene transformation
Unit 4	Promoters and genetic markers, transgenic plant analysis, biosafety related issues to transgenics, field trials and risk management, intellectual property rights.
Unit 5	GMO case study, GM crops, Transgenics plant resistant to biotic and abiotic stresses, molecular techniques for marker free transgenics.

Suggested Readings:	
1.	Brown T.A. 2007. Genomes 3. Garland Science Publication. USA.
2.	Brown.T.A.2011. Gene Cloning and DNA Analysis. Taylor and Francis. UK.
3.	Karp, G. 2009. Cell and Molecular Biology Concepts and Experiments. Willey Publication. UK.
4.	Primrose and Twyman, 2009. Principles of Gene manipulation and Genomics, Wiley-Blackwell. UK.
5.	Sambrook and Russell. 2001. Molecular Cloning. 3 rd Edn. CSHL Press. USA.
6.	Senger, Gupta and Sharma. 2010. Laboratory manual on Biotechnology. WH Publishers. USA.
7.	Singh, B.D. 2008. Biotechnology. Narosa Publishing House. New Delhi.

LBCL 905/ LBL 305: based on LBC 901 & 902/LBT 301 & 302

LBC 901/LBT 301 Practical

1. Microscopic study of plant cell
2. Estimation of proteins by spectrophotometric methods
3. Estimation of carbohydrates by spectrophotometric method
4. Isolation of plasmid from the bacteria
5. Isolation of DNA from plant sample and their spectrophotometric quantification
6. Restriction digestion of the plasmid
7. Amplification of plant DNA using Polymerase Chain Reaction
8. Electrophoretic separation and visualization of the DNA/PCR product
9. Isolation of RNA from Plant sample
10. c-DNA synthesis

LBC 902/LBT 302 Practical

1. Demonstration of special chromosomes of plants
2. To study the spontaneous mutation by replica plating method
3. To study the induced mutation in the selected organism
4. Isolation of antibiotic resistant mutant by gradient plate technique
5. Theoretical problems based on genetics
6. Determination of χ^2
7. Demonstration various plant breeding techniques
8. Study of molecular markers
9. Construction of genetic maps

LBCL 906/ LBL 306: based on LBC 903 & 904/LBT 303 & 304

LBC 903/LBT 303 Practical

1. Study of the specimens of the plant diseases caused by fungal pathogens
2. Study of the specimens of the plant diseases caused by bacterial pathogens
3. Study of the specimens of the plant diseases caused by viral pathogens
4. Techniques of isolation and pure culture of pathogen locally available

LBC 904/LBT 304 Practical

1. Demonstration of gene transfer methods in plants.
2. Isolation of RNA of plants.
3. Analysis of differential expression of different gene by Real Time PCR technique
4. Preparation of MS medium and organ culture with suitable explants
5. Experimental demonstration of liquid culture
6. Experimental demonstration of carrot callus induction
7. Experimental demonstration of artificial seeds synthesis

Semester-IV

Common Paper

LBC 1001/LBT 401: Tools and techniques in plant biology	
Unit I	Concept of electrolytes, buffers and pH, Laboratory ethics, basic techniques of centrifugation, preparative and analytical centrifugation, Microscopy: Phase contrast , confocal, fluorescence, scanning and transmission electron microscopy.
Unit II	Spectroscopic techniques: Principle of spectroscopy (emission and absorbance), Visible, UV and X-ray spectroscopy, Spectrofluometry, atomic absorption and fluorescence spectroscopy, NMR and ESR spectroscopy.
Unit III	Chromatography: Basic principles (Retardation coefficient (R_f), stationary and mobile phases, planar and column chromatography), paper chromatography, TLC, HPLC, GC-MS, LC-MS, MALDI-TOF.
Unit IV	Electrophoresis: Polyacrylamide gel electrophoresis (PAGE), agarose gel electrophoresis, native PAGE, 2D electrophoresis, Isoelectric focusing (IEF).
Unit V	Isolation and purification of plasmid, DNA, RNA, proteins; Blotting: Principles, types of blotting techniques, Southern, Northern, Western, Immunoblotting and Dot blots. FISH, microarray, DNA sequencing

Suggested Readings:	
1.	Karp, G. 2009. Cell and Molecular Biology Concepts and Experiments. Willey Publication. UK.
2.	Nelson and Cox. 2002. Lehninger Principle of Biochemistry: 3rd Edition: WH Freeman Publisher. UK.
3.	Primrose and Twyman, 2009. Principles of Gene manipulation and Genomics, Wiley-Blackwell Publishing. UK.
4.	Sambrook and Russell. 2001. Molecular Cloning. 3 rd Edn. CSHL Press. USA.
5.	Senger, Gupta and Sharma. 2010. Laboratory manual on Biotechnology. WH Publishers. UK.
6.	Singh, B.D. 2008. Biotechnology. Narosa Publishing. New Delhi.
7.	Wilson and Walker. 2006. Principles and techniques of biochemistry and molecular biology Cambridge University Press. New Delhi.

Specialization-I: Environmental Biology

LBC 1002/LBT 402(i): AIR POLLUTION and CLIMATE CHANGE	
Unit I	Gaseous and particulate pollutants, indoor air pollution, Effects of important air pollutants on plants, human health and ecosystems.
Unit II	Photochemical smog, stratospheric ozone depletion; effects of enhanced UV-B on plants, microbes and human health. Acid rain: Formation, dispersion and deposition; consequences on soil fertility, rivers, lakes and plants
Unit III	Greenhouse effects: consequences, global warming, sea level rise, albedo, oceanic influences; effects of increased CO ₂ on plants; human implications. Surface cooling
Unit IV	Biomonitoring of air pollution: Concept, active and passive monitoring; bio-indicator parameters; air pollution tolerance indices; control of air pollution by plants.
Unit V	Plant atmosphere exchange of trace gases: Biogenic volatile organic compounds (BVOCs) and their importance in global climate change. Impact of eco-physiological factors on the exchange of trace gases.

Suggested Readings:	
1.	Adger, W. N. 2005. Adapting to climate change. Wiley Publication. UK.
2.	Arthur, C. Stern. 1997. Fundamentals of air pollution, Wiley Publishers, UK.
3.	Arya Arun. 2009. Eco-degradation due to air pollution. Narosa Publishers. New Delhi
4.	Bell and Treshow 2002. Air Pollution and Plant Life. Willey Publication. UK.
5.	Kenneth, Wark. 1997. Air Pollution its origin and control, Prentice Hall publication. UK
6.	Pepper, Ian. 2003. Environmental chemistry. Wiley Publication. UK.
7.	Sharma, P. D. 2006. Ecology and Environment. Rastogi Publication, Meerut.
8.	Singh, J.S. Singh, S.P. and Gupta, S.R. 2008. Ecology Environment and Resource Conservation. Anamaya Publishers. New Delhi.

LBC 1002/LBT 402(ii): WATER POLLUTION MANAGEMENT

Unit I	Sources of water pollution, Physico-chemical and biological properties of sewage, industrial effluents produced from textile, leather, thermal power, chemical, and mining industries and their effects on water quality, bio-indicators of water pollution.
Unit II	Domestic wastewater treatment: Various stages of treatment of sewage with special reference to advanced wastewater treatments; biological treatment of wastewater.
Unit III	Industrial wastewater treatment: Treatment of industrial effluents released from textile, leather, thermal power, chemical, and mining industries.
Unit IV	Disinfection of treated water: Ozonization of secondary treated wastewater; chemical and other methods for disinfection, recycling of industrial effluents after treatment.
Unit V	Water pollution monitoring and management bodies: Important organizations involved in water pollution monitoring in India.

Suggested Readings:

1.	Agrawal S.K., 2009. Water Pollution. APH Publishing House. New Delhi.
2.	Goel P.K., 2006. Water Pollution. New Age International. New Delhi.
3.	Henze M., Harremoës P., Jansen, and Arvin, E., 2002. Wastewater Treatment: Biological and Chemical processes, Springer Publication. Germany.
4.	Marcos von Sperling, 2007. Basic Principles of Wastewater Treatment: IWA Publishing Company. UK.
5.	Wang Lawrence. 2009. Handbook of advanced industrial and hazardous wastes treatment. CRC Press. UK.
6.	Wun Jern Ng. 2006. Industrial Waste water Treatment. Imperial College Press. UK.

Specialization 2
Functional Plant Biology

LBC 1003/LBT 403(i) : Plant Metabolism	
Unit I	Plant metabolism and water relation, solute transport: Water absorption by root, transport through xylem, soil-plant-atmosphere continuum, transport of ions across a membrane barrier, membrane transport process, ion transport in root. transport proteins, water channels, symport, antiport, cotransport, membrane transporters families.
Unit II	Energy production in plant cell: ATP synthesis, photosynthetic formation of energy molecules, glycolysis and oxidative pentose phosphate pathway, gluconeogenesis, control of energy production, bioenergetics,
Unit III	Mineral acquisition and assimilation in plants: Nutrients (N, P, S) assimilation, biochemistry and various components involved, energetics of mineral uptake and assimilation, cation assimilation, strategies of iron uptake by plants, mineral deficiencies and toxicities.
Unit IV	Growth and Development: Embryogenesis, meristem in plant development, leaf, root development, Cell differentiation, regulation of developmental pathways, gene regulation in plant development, floral development, fruit development and ripening, Homeotic genes and their molecular analyses.
Unit V	Secondary metabolism: Cutin, waxes, suberin, secondary metabolites, terpenes, phenolics, nitrogen-containing, functional importance of secondary metabolites in plants, biosynthesis of secondary metabolites, relation of secondary metabolites with plant defense

Suggested Readings:	
1.	Buchanan, Greessam and Jones. 2002. Biochemistry and Molecular Biology of plants. American society of plant biology. USA.
2.	Hopkins and Hunner. 2011. Introduction to plant physiology. Willey Publication. UK
3.	Taiz and Zeigar 2010. Plant Physiology. Sinauer Publishers. USA.

LBC 1003/LBT 403(ii): Stress Physiology of Plants	
Unit I	Plant responses to abiotic stresses: stress concept, reception of stress and creation of signals, various types of abiotic stress, drought, salinity, flooding extreme temperature, metal and metalloids toxicity and UV-B, Stress-mediated modifications in plant metabolism, mechanism of action, sensitivity, tolerance, avoidance, resistance
Unit II	Plant responses to herbivory, allelopathy, and pathogen attack: Herbivory, causes and consequences, metabolic responses to herbivory, allelopathy: mode of action, invasiveness of plants, exotic invasive plants, allelochemicals, ecophysiological implications of herbivory and allelopathy. Pathogen attack: Compatible and incompatible host-pathogen interactions, biotic stress responses.
Unit III	Oxidative stress and redox metabolism: Reactive oxygen species (ROS), superoxide, hydrogen peroxide and hydroxyl, other free radicals in plant metabolism, site of generation of ROS and free radicals, Biological effect of ROS and free radicals, oxidative damage, indicators of oxidative damage, oxidation of lipids, proteins and nucleic acids.
Unit IV	Nutrient limitation, Aluminium stress: plant-nutrient relations, consequences of nutrient limitation, molecular changes in plant metabolism associated with N and P limitation, plant responses to deficiencies of essential alkaline earth metals (Ca, Mg, K), Strategies of plants to overcome nutrient limitation, Abundance of Al in soil, solubilization of Al in soil, factors affecting Al solubilization, entry of Al into plant cell, effect of Al on plant responses, mechanisms of Al toxicity, Al-resistance in plants.
Unit V	Gene expression during stress, protein expression during stress, metabolomics and its relation with stress, microRNA and stress metabolism of plants, Studying gene regulatory networks during stress, co-expression analyses, molecular analyses of stress responses of model and non-model plants.

Suggested Readings:	
1.	Buchanan, Greessam and Jones .2002. Biochemistry and Molecular Biology of plants. American society of plant biology. USA.
2.	Hopkins and Hunner. 2011. Introduction to plant physiology. Willey Publication. UK.
3.	Schulze, Beck and Mueller-Hohenstein. 2010. Plant Ecology. Springer, Germany
4.	Taiz and Zeigar 2010. Plant Physiology. Sinauer Publishers. USA.

Specialization-3
Ethnobotany and Plant Resource Utilization

LBC 1004/LBT404 (i): Ethnobotany and Pharmacognosy	
Unit I	Ethnobotany: Introduction, scope and relevance and interdisciplinary Science. Major ethnic groups of Chhattisgarh and their life styles dependence on the forests. The ethnobotanical data documentation; Traditional Botanical Knowledge (TBK)
Unit II	The centers of Ethnobotanical studies in the world. Scope of ethnobotanical research in Chhattisgarh. Plants in magico-religious beliefs, social customs and taboos.
Unit III	Ethnomedicine: Introduction and scope. Ethnoveterinary medicine and its significance. The important Indian ethnobotanical drugs. WHO and Ethno-directed drug discovery. Applied Ethnobotany. Ethnobotany and Employment opportunities.
Unit IV	Classification of crude drugs: Alphabetical, Taxonomical, Morphological, Clinical, Pharmacological and Chemotaxonomic. Study of crude drugs: Bark drug- <i>Cinchona</i> ; Leaf drug- <i>Digitalis</i> ; Flower drug: Clove; Seed drug: <i>Isaphaghula</i> ; Fruit drug: Poppy; Rhizome and root drug: <i>Glycyrrhiza</i> , Unorganized drug: <i>Butea</i> ; Gums: <i>Acacia</i> , Resin: <i>Ferula</i> ; Fixed oil: <i>Ricinus</i>
Unit V	Herbal drug adulteration. Methods of drug evaluation: Morphological, physical, chemical, biological, phytochemical investigations. Preliminary phytochemical tests for alkaloids, saponins, phenolic compounds, tannins, gums, mucilage, starch, carbohydrates and glycosides

Suggested Readings:	
1.	Brain K.R, and Turner T.D. 1976. The Practical evaluation of Phytopharmaceuticals. Bristol Wright-Scientehnica. Italy.
2.	Chopra, R.N., Nayar S.L. and Chopara I.C. 1956. Glossary of Indian Medicinal plants. CSIR. New Delhi.
3.	Das, A.P. and Pandey, A.K. 2007. Advances in Ethnobotany. Bishen Singh and Mahendra Pal Singh, Dehradun.
4.	Jain and Mudgal. 1996. Dictionary of Ethnobotany. Deep Publication, Delhi.
5.	Jain, S.K. 1990. Contributions of Indian Ethnobotany. Scientific publishers, Jodhpur.
6.	Jain, S.K. 1995. Manual of Ethnobotany, Scientific Publishers, Jodhpur.
7.	Kokate C. K., Purohit A. P. and Gokhale S. B. 2003. Pharmacognosy 22 nd Edition, Nirali Prakashan. Pune.
8.	Mukherjee P.K. 2002. Quality control of Herbal Drugs – An approach to Evaluation of Botanicals, Business Horizons, New Delhi, 1st Edition.
9.	Trease G. E. and Evans, W. C. 2006. Pharmacognosy. 10 th Edition, Williams and Wilkins, Baltimore. USA.

LBC 1004/LBT 404 (ii) Plant Resource Utilization and Conservation	
Unit I	General aspects on resource types: Renewable resources, non-renewable resources, Resource degradation, Resource conservation; Natural resources, biological resources, plants as natural resources.
Unit II	Utilization of plant resources, Bio-control- sources and advantages, Bio-control as agribusiness, Untapped potential plant resources, seaweeds as potential resources – food, fodder and bio-fertilizer; Plant resources used in cosmetics, aromatics and pharmaceuticals, fibers; forest as potential resources: vegetable oil yielding plants, bio-energy.
Unit III	Biodiversity, Levels and types of biodiversity, uses of biodiversity, Distribution of biodiversity, Regional pattern of biodiversity, Hot spots of biodiversity, Threats to biodiversity – Habitat loss and fragmentation, Alien invasive species, disturbance and pollution, harvesting and over-exploitation.
Unit IV	An overview of Indian biodiversity; Biogeographic regions (zone) of India; Hot spots of Indian biodiversity; Status of biodiversity conservation in India; Protected area network of India; The Biological Diversity Act 2002; Bio-prospecting – Biochemical resources from plants.
Unit V	Conservation of Biodiversity; IUCN red list categories, In situ conservation strategies – Protected areas, Biosphere reserves; Ex-situ conservation strategies – Restoration of endangered species, Sustainable use and public participation; International efforts for conserving biodiversity.

Suggested Readings:	
1.	Chandel K. P. S. Shukla G. and Sharma Neelam.1996. .Biodiversity in Medicinal and Aromatic Plants in India – Conservation and Utilization, Indian Bureau of Plant Genetic Resources, New Delhi,
2.	Kaufman Peter B. et al. 1999. Natural Products from Plants, CRC Press. UK.
3.	Primack R.B. 2000. A Primer of Conservation Biology, Sinauer Asso. Publ., Massachusetts. USA.
4.	Sahoo S. 2002. Plant Resource Utilization. Allied Publishers. Nagpur.
5.	Singh J.S. Singh S.P. and Gupta S.R., 2006, Ecology, Environment and Resource Conservation, Anamya Publication, New Delhi,
6.	Trivedi P.C. and Sharma N. 2010. Plant Resource Utilization and Conservation, Pointer Publishers. Jaipur.

Specialization 4
Plant Molecular Biology

LBC 1005/LBT 405 (i) Genetic Engineering	
Unit I	Basic concepts of DNA structure and properties, restriction enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Cohesive and blunt end ligation, Linkers, Adapters, Random priming, Radioactive and non-radioactive probes.
Unit II	Hybridization techniques, Northern, Southern and Colony Hybridization, Fluorescence in situ hybridization, Chromatin immunoprecipitation, footprinting, Isolation of Plasmid, DNA and Bacteriophage DNA. Isolation of total RNA and mRNA.
Unit III	Plasmids, Bacteriophages, pBR322 and pUC series of vectors, M13 and P2 phage based vectors, High capacity vectors: Cosmids, phagemid, phasemid, YAC, BAC, Animal and Plant virus based cloning vectors, Shuttle vectors, Expression vectors, pMal, GST, pET-based vectors, Insertion of foreign DNA into Host Cells, Transformation
Unit IV	Constructions of libraries, cDNA and genomic libraries, cDNA and genomic cloning, Expression cloning Protein-protein interactive cloning and Yeast two hybrid system, Phage display,
Unit V	Primer designing, Fidelity of thermostable enzymes, DNA polymerase, Types of PCR- multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, in situ PCR, cloning of PCR products, Introduction of DNA into plant cells, transfection techniques.

Suggested Readings:	
1.	Brown T.A. 2007. Genomes 3. Garland Science Publication. USA.
2.	Brown T.A. 2011. Gene Cloning and DNA Analysis. Taylor and Francis. UK.
3.	Primrose and Twyman, 2009. Principles of Gene manipulation and Genomics, Wiley-Blackwell Publishing. UK.

LBC 1005/LBT 405 (ii) Bioinformatics and Genome Analysis	
Unit I	Basic concepts about data and information, Representation of data in computers in binary, bits and bytes. Computer words coding (ASCII and EBCDIC), Number conversion system, Introduction to Internet, WWW, NICNET, ERNET, On-line publishing ventures eg. Biomed Central, BTIS Network in India.
Unit II	Biological Databases: Primary Sequence databases (Protein and DNA databases), Secondary databases, Composite databases. Online international database access
Unit III	Sequence Alignment and Databases searching: Evolutionary basis of sequence alignment, Optimal alignment methods; Dot Plot, Dynamic Programming Databases similarity searching: Algorithms of FASTA, BLAST.
Unit IV	Multiple Sequence alignment: CLUSTAL W. Phylogenetic analysis, UPGMA, Statistical significance of alignment, Substitution Scores and Gap penalties.
Unit V	Introduction to Microarray Technology and its applications, <i>In silico</i> prediction of regulatory networks in plants, Plant system biology: concept, procedure and importance.

Suggested Readings:	
1.	Brown T.A. 2011. Gene Cloning and DNA Analysis. Tailor and Francis. UK.
2.	Campbel. 2006. Discovering Genomics, Proteomics and Bioinformatics. Pearson Education. USA.
3.	Jonathan, P. 2009. Bioinformatics and Functional Genomics. Wiley Blackwell. UK.
4.	Rastogi S.C. 2012. Bioinformatics: Methods and Applications. Prentice Hall of India Private Limited. New Delhi
5.	Sharma, Munjal and Shanker. 2009. Text Book of Bioinformatics. Rastogi Publication. Meerut.

LBCL1007/ LBL 407 based on special paper Environmental Biology

LBC 1002/LBT 402(i) practical

1. To estimate dust holding capacity of different plant species
2. To monitor Total Suspended Particulate matter (TSPM) in ambient air
3. To monitor Respirable Suspended Particulate matter (RSPM) in ambient air
4. Estimation of particle bound trace metals based on AAS method
5. Biomonitoring of trace metals using plant leaves.

LBC 1002/LBT 402(ii) practical

1. To estimate dissolved oxygen (DO) content of water samples
2. To estimate Biological Oxygen Demand (BOD) of water samples
3. To estimate Alkalinity of water sample
4. To estimate Hardness of water sample
5. To estimate free CO₂ and acidity of water samples
6. Demonstration of Phytoremediation of heavy metals using aquatic macrophytes

LBC 1003/LBT 403(ii) practical

1. Determination of reactive oxygen species generated in plant cell
2. Quantitative measurement of antioxidant enzymes (SOD, APX, CAT)
3. Determination of efflux of organic acids from plant roots during stress condition
4. Determination of the accumulation of metal ions in plant tissues
5. Morphological determination of root-Aluminium interaction
6. Mapping of QTL associated with stress tolerance in plant
7. Determination of gene/protein expression of plant exposed to abiotic stress
8. Determination of lipid peroxidation of plant tissues

LBCL1007/ LBL 407 based on special paper Ethnobotany and Plant Resource Utilization

LBC 1004/LBT404 (i) practical

1. Determination of Stomatal number index, Frequency and Pore Area and Organoleptic studies.
2. Documentation of traditional and local patterns of plant use and Submission of Reports.
3. Phytochemical tests for alkaloids, saponins, phenolic compounds, tannins, gums, mucilage, starch, carbohydrates and glycosides.
4. Demonstration of Phytochemical screening methods: Paper Chromatography, TLC, HPLC, Spectrophotometry etc.
5. Field trips within and nearby areas, compilation of field notes and identification, field notes, visual and digital records and preparation of herbarium of important medicinal plants.

LBC 1004/LBT 404 (ii) practical

1. Study of fodder, food, fire, oil, fibre and oil of plants (five each)
2. Study of locally available medicinal and aromatic plants.
3. Study of Gums, resins, tannins, dyes yielding plants of Bilaspur, (CG).
4. Local Field study tour for plant wealth survey and report writing.

LBCL1007/ LBL 407 based on special paper Plant Molecular Biology

LBC 1005/LBT 405 (i) practical

1. Isolation of genomic DNA from plant cell.
2. Restriction digestion of plant DNA.
3. Isolation of total RNA from plant cell.
4. Preparation of competent cells using CaCl₂.
5. Synthesis of cDNA and analyses of mRNA expression using RT/Real-Time PCR.
6. Isolation of plasmid DNA from bacteria.
7. Transformation study in *E.coli*.
8. PCR amplification of the selected plant gene.

LBC 1005/LBT 405 (ii)

1. Designing of primers using online tools.
2. Phylogenetic analyses of the selected plant gene.
3. Multiple alignment of the plant gene for homology prediction.
4. Construction of phylogenetic trees using N-J method.
5. In-silico prediction of protein/gene structure and function.