FACULTY OF LIFE SCIENCES

SYLLABUS

For

Bridge Course in BOTANY

(Under Credit Based Continuous Evaluation Grading System)
(Semester: III–IV)

Session: 2015-16

GURU NANAK DEV UNIVERSITY AMRITSAR

Bridge Course in Botany (Semester System)
(Under Credit Based Continuous Evaluation Grading System)

SCHEME OF COURSE

Semester-III

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL501	C	Spermatophytes	3	-	-	3
BSL502	C	Plant Morphogenesis and Embryology	3	-	-	3
BSL503	C	Plant Molecular Biology and Genetic Engineering	3	-	-	3
BSL504	C	Genome Structure, Function and Dynamics	3	-	-	3
BSL505	C	Plant Anatomy	3	-	-	3
ESL506	C	Ecological Modelling	3	-	-	3
BSP521	C	Botany Lab VII (based on BSL501 and BSL502)	-	-	2	2
BSP522	C	Botany Lab VIII (based on BSL503 and BSL504)	-	-	2	2
BSP523	C	Botany Lab IX (based on BSL505 and ESL506)	-	-	2	2
		Total Credits	18	-	6	**24**

Semester-IV

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL551	C	Applied and Industrial Botany	3	-	-	3
BSL552	C	Plant Tissue Culture	3	-	-	3
BSL553	C	Evolutionary Biology	3	-	-	3
BSL554	C	Population Biology and Biodiversity	3	-	-	3
BSL555	C	Plant Breeding and Intellectual Property Rights	3	-	-	3
BSL556	C	Plant Metabolism	3	-	-	3
BSP571	C	Botany Lab X (based on BSL551 and BSL552)	-	-	2	2
BSP572	C	Botany Lab XI (based on BSL553 and BSL554)	-	-	2	2
BSP573	C	Botany Lab XII (based on BSL555 and BSL556)	-	-	2	2
		Total Credits	18	-	6	24

Bridge Course in Botany (Semester-III)
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BSL501 – Spermatophytes

Credits: 3-0-0

1. Classification of gymnosperms and their distribution in time and space with particular reference to Indian members. Classification of rocks according to chronostratigraphy, lithology and biostratigraphy. Important geological formations in India. A general account of structure reproduction and evolutionary relationships of progymnosperms, Cyacadofilicales, Cycadeoidales, Glossopteridales, Pentoxylales, Cycadales, Cordaitales, Coniferales Ginkgoales, Taxales, Ephedrales, Welwitschiales, Gnetales.
2. Origin and evolution of gymnosperms, tendencies in organographic and organ evolution: male and female sporophylls, cones, ovules, seeds and archegonia, pollination mechanisms; chromosome numbers and karyotypes.
3. Historical perspective of plant classification, comparative study of phylogenetic systems after Engler and Prantl, Bessey, Hutchinson, Cronquist, Takhtajan, Dahlgren and Thorne and Stebbins, treatment of Ranales, Apetalae, Centrospermae, Tubiflorae and Helobiales in the above mentioned systems of classification.
4. Historical perspective and main provisions of the International Code of Botanical Nomenclature. Elementary study of Latin language in light of the provisions of the code. Etymology, connotation and grammatical structure of generic names and epithets for species, sub divisions of genera and infraspecific categories.
5. Principles and methods of taxonomy: Taxonomic evidence and choice of characters, alpha versus omega taxonomy, role of anatomy, palynology, embryology, cytology and phytochemistry in plant classification. Floral anatomy in relation to morphological nature of floral parts, phylogenetic considerations.
6. Phenetic method in plant taxonomy; patterns and causes of variation, inter- and intra-population variations, numerical methods in plant taxonomy, statistical analysis in deriving taxonomic relationships, figurative representation of taxonomic affinities, cladistics, indices of taxonomic diversity.
7. Biosystematic methods in taxonomy, transplant experiments, non hierarchical and hierarchical categories, study of agamic, hybrid and polyploid complexes.
8. Taxonomic tools: herbaria; floras; serology; electrophoresis; nucleic acid hybridization; computers, computer-aided keys for identification of taxa, role of GIS

References:

1. Arnold, C.A. (1947) An Introduction to Palaeobotany. McGraw Hill Book Company, New York.
2. Bhatnagar, S.P., and Moitra, A. (1996). Gymnosperms. New age International, Private Limited.
3. Biswas, C., and Johri, B.M. (1997). Gymnosperms. Narosa Publishing House, New Delhi.
4. Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun.
5. Chamberlain C.J. (1935) Gymnosperms: Structure and Evolution CBS Publishers and Distributors, N. Delhi.
6. Cole, A.J. 1969. Numerical Taxonomy,Academic Press, London
7. Coulter, J.M., and Chamberlain, C.J. (1917) Morphology of Gymnosperms (Reprinted) Central Book Dept. Allahabad.

8. Cutter, E.G. (1971). Plant Anatomy: Experiment and Interpretation. Part II. Organs. Edward Arnold, London.
9. Davis P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Kreiger Pub. Co., New York.
10. Esau, K. (1977). Anatomy of Seed Plants, 2nd edition. John Wiley and Sons, New York. Fahn, A. 1974. Plant Anatomy, 2nd edition. Pergamon Press, Oxford.
11. Grant W.E. (Ed.) (1984) Plant Biosystematics Academic Press, Toronto.
12. Haywood, V.H., and Moore, D.M. (1984). Current Concepts in Plant Taxonomy. Academic Press, London.
13. Heslop- Harrison, J. 1967. Plant Taxonomy. English Language Book Society & Edward Arnold Pub. Ltd., U.K.
14. Jeffery, C (1982) An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge.
15. Jones, S.B. and Luchsinger, A.E. (1986), Plant Systematics. McGraw Hill Book Company, New York.
16. Krishnan, M.S. (1982). Geology of India and Burma. CBS Publishers and Distributors, New Delhi.
17. Lawrence, D.H. (1969). Taxonomy of Vascular Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
18. Nair, P.K.K. (1970). Pollen Morphology of Angiosperms, Vikas Publishing House, New Delhi.
19. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper & Row Publicatons, USA.
20. Raghvan, V. (2000). Developmental Biology of Flowering Plants. Springer-Verlag, New York.
21. Saklani, P.S. (1991). Elementary Geology. Today's & Tomorrow's Printers and Publishers, New Delhi.
22. Singh, H. (1978). Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
23. Solbrig O.T., and Solbrig D.J. (1979). Population Biology and Evolution. Addison – Wesley Publishing Co. Inc., USA.
24. Solbrig, O.T. (1970). Principles and methods of plant Biosystematics. MacMillan Company, Collier MacMillan Limited, London.
25. Sporne, K.R. (1965). The Morphology of Gymnosperms, B.I. Publications, New Delhi.
26. Stace, C.A. (1980). Plant Taxonomy and Biosystematics, Arnold Publications limited, London.
27. Takhtajan, A.L. (1997). Diversity and Classification of Flowering Plants. Columbia University Press, New York.
28. Trotter, H. (1982). The Common Commercial Timbers of India and their Uses (Reprint). Govt. of India Press, Nasik.

Bridge Course in Botany (Semester-III)
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BSL502 - Plant Morphogenesis and Embryology

Credits: 3-0-0

1. **Basic concepts of development:** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.
2. **Correlation, Polarity and Differentiation:** Physiological and genetic correlations. Polarity as expressed in external and internal structures, polarity in isolated cells, polarity in plasmodia and coenocytes. Growth and differentiation, differentiation as expressed in structure, external and internal differentiation, differentiation during ontogeny, differentiation in relation to environment, physiological differentiation, differentiation without growth.
3. **Introduction to Morphogenetic factors**: light, water, temperature, physical factors like tension, compression, balancing and swaying, ultrasonics, gravity, bioelectical effects, genetic factors, chemical factors.
4. **Microsporogenesis:** Historical perspective of the development of our knowledge of embryology.
   Structure and function of walls layers, ultra – structural changes in tapetum and meiocytes during microsporogenesis, role of callose, role of tapetum in pollen development, anther culture and haploid plants. Pollen mitosis, division of generative cell, cell heterogeneity in sperms, pollen fertility and sterility, pollen storage, viability and germination.
5. **Megasporogenesis:** Subcellular profiles of archesporial and megaspore mother cells, megaspore tetrad, dyad and coenomegaspore (Polarity of nuclei) determination of functional megaspore/ dyad. Ovules: Ontogeny; types of evolution, reduction, nutrition, post pollination changes, ovule culture.
6. **Embryo sac types:** Ultrastructure of components, synergid and antipodal haustoria, nutrition of embryo sac.
7. **Pollination** Ultrastructural and histochemical details of style and stigma, self and interspecific incompatibility, significance of pollen-pistil interaction, role of pollen pistil interaction, role of pollen wall proteins and stigma surface proteins, barriers to fertilization, methods of over coming incompatibilities, intra-ovarian pollination, in-vitro pollination.
8. **Fertilization:** Heterospermy, differential behaviour of male gametes, discharge and movement of sperms, syngamy and triple fusion, post fertilization, metabolic and structural changes in embryo sac.
9. **Embryo:** Polarization of zygote, embryogenic types, histology and organogenesis of dicot embryos, organless (undifferentiated) embryos, delayed differentiation of embryo, structure, cytology and function of suspensor, physiological and morphogenetical relationship of endosperm and embryo, embryo culture for rescue of hybrid embryo. Polyembryony: Types, genetic and somatic, pollen embryos.

References:

1. Atwell, B.J. Kriederusann, P.E. and Jumbull, C.G.N. (Eds.) 1999. Plant in action: Adaptation in nature, Performance in cultivation, MacMillan Education, Sydney.
2. Beck, C.B. 2005. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. Cambridge University Press.
3. Bewley,J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press, New York.
4. Bhojwani, S.S. and Bhatnagar, S.P. 1975. The Embryology of Angiosperms. Vikas Publishing House, Delhi.
5. Eames, A.J. 1961. Morphology of the Angilosperms. Tata McGraw Hill Publishing Co., Bombay.
6. Fosket, D.E. 1994. Plant Growth and Development – A Molecular approach, Academic Press, Oxford.
7. Lyndon, R.F. 1990. Plant Development – The Cellular basis, Unnin Hyman, London.
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9. Raghavan, V. 1999. Developmental Biology of Flowering Plants, SpringerVerlag, New York.
10. Sinnot, E.W. 1960. Plant Morphogenesis, McGraw Hill Book Company, New York.
11. Steeve, T.A. and Sussex, I.M. 1989. Patterns in Plant Development (2nd Ed.), Cambridge University Press, Cambridge.
12. Bhojwani, S.S. and Bhatnagar, S.P. 2003. The Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd., Delhi.
13. Maheshwari, P. 1980, An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Company Ltd., Bombay – New Delhi.
14. Eames, A.J. 1961 Morphology of the Angiosperms. Tata McGraw Hill Publishing Co. Ltd. Bombay.
15. Johri. B.M. 1980. The Embryology of Angiosperms. McGraw Hill Publishing Co. Ltd. Bombay.

BSL503 - Plant Molecular Biology and Genetic Engineering

Credits: 3-0-0

1. Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels.
2. Cloning vehicles-plasmids (Natural plasmids, pBR322 pUC118 and pUC119), bacteriophages, phagmids, viruses, cosmids, BAC and YAC vectors.
3. Recombinant DNA technology: Use of restriction endonucleases, DNA ligases.
4. Agarose gel electrophoresis, Southern/Northern/ Western blotting. RFLP, RAPD and AFLP techniques.
5. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Generation of genomic and cDNA libraries.
6. Expression of recombinant proteins using bacterial, animal and plant vectors.
7. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.
8. Protein sequencing methods, detection of post-translation modification of proteins.
9. DNA sequencing methods, strategies for genome sequencing. Isolation of specific nucleic acid sequences. Genomics and its application to health and agriculture, including gene therapy.
10. Methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques.

References:

1. Draper, J.R., Scott, P., Armitage, R. Walden (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.
2. Grierson, D., and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York
3. Gupta, P.K. (1990). An Introduction to Biotechnology, Rastogi Publications, Meerut.
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7. Shaw C.H. (1988). Plant Molecular Biology – A Practical Approach. IRL Press Oxford.
8. Mount, D.W. (2001). Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbour Laboratory Press. New York.
9. Hartl, D. L. and Ruvolo, M. (2012). Genetics, Analysis of Genes and Genomes. 8th Edition. Jones and Bartlet, Ontario.

Bridge Course in Botany (Semester-III)
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BSL504 - Genome Structure, Function and Dynamics

Credits: 3-0-0

1. **Genetic fine structure:** Classical versus molecular concepts of the gene, cis-trans test, limitation of cis-trans test, introns and their significance, RNA splicing.
2. **Chromatin organization:** Chromosome structure and packaging of DNA, molecular organization at centromere and telomere, euchromatin and heterochromatin, banding patterns.
3. **DNA replication, repair and recombination:** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.
4. **RNA synthesis and processing:** Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.
5. **Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.
6. **Control of gene expression at transcription and translation level:** Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.
7. **Transposable genetic elements:** Transposable elements in prokaryotes and eukaryotes, significance of transposable elements.
8. **Quantitative aspects of evolution:** Hardy Weinberg law; Gene frequencies and equilibrium, genetic drift, genetic load. Effects of selection, mutation and migration.
9. **Molecular evolution:** Origin of genomes; acquisition of new genes, gene duplication and genetic redundancy, non coding DNA and genome evolution, transposable element of genome evolution.

References:

1. Brown, T.A. (1999). Genomes. BIOS Scientific Publishers limited, UK.
2. Gardener, E.J., Simsons, M.J., and Sinustad, D.P. (1991). Principles of Genetics. John Wiley Sons Inc., New York.
3. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., and Gelbart, W.M. (1993). An Introduction to Genetic Analysis. Freeman and Comapany, USA.
4. Hawley R.S. and Walker, M. Y. (2003) Advanced Genetics analysis-Finding meaning in Genome. Blackwell Publishing, USA.

5. Klug W. S. and Cummings, M. R. (1997). Concepts of Genetics. Printice Hall International, Inc.
6. Lewin, B. (2000). Gene VII. Oxford University Press, New York.
7. Schulz-Schaeffer, J. (1980). Cytogenetics of Plants Animals and Human. Spinger-Verlag, New York.
8. Smith, J. M. (1998). Evolutionary Genetics. Oxford University Press, New York.
9. Snustab, D. P., Simmons, M. J. and Jenkins, J. B. (1997). Principles of Genetics, John Wiley and Sons, Inc., New York.
10. Strickberger, M.W. (2001). Genetics. Prentice-Hall, Inc., Englewood Cliffs, N. Jersey.

Bridge Course in Botany (Semester-III)
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BSL505 - Plant Anatomy

Credits: 3-0-0

1. **The shoot and root system:** primary structure and basic vasculature, the root-stem transition, secondary growth in stems and roots , the origin of cambium and its activity, anamalous secondary growth, polycyclic vasculature, secondary meristems, origin and function , the role of pericycle, phellogen., phellem, phelloderm, distribution of sclerenchyma in leaves, stem and roots.
2. **Nodal anatomy:** types of nodes in dicots and monocots, the node-internode transition, formation of leaf and branch traces.
3. **Histology of wood** : growth rings, types and ultrastructure of tracheids , vessels and wood rays , longitudinal parenchyma and its arrangement , grain and texture , knots, formation of resin cavities and tyloses, anatomy and chemistry of lignification , physical and anatomical features of common hard and soft woods of India , importance of density and weight in commercial utilization of woods, keys for identification of common Indian woods and their economic importance , techniques and methods in wood technology .
4. **Floral anatomy:** the anatomy of floral axis and the whorls, the leaf origin of carpel, evidences from anatomy of essential and accessory whorls,
5. **Fruit and seed anatomy**: gross and ultrastructural surface features of the fruits and seeds, role in taxonomy, internal anatomy of dicot and monocot seeds, organ and cellular anatomy of typical monocot and dicot seeds.
6. **Laticifers and lenticels**: types and distribution , anatomy in relation to physiological roles,
7. **Functional anatomy**: Anatomy of leaf in relation to photosynthesis and transpiration, modification of the root stem and leaf anatomy in relation to habit and habitat with special reference to aquatics , nitrogen fixers, xerophytes parasites and mycorhizas

References:

1. Cutter, E.G., 1969, Part 1 Cells and Tissues, Edward Arnold, London.
2. Cutter, E.G., 1971, Plant anatomy: Experiment and Interpretation, Part II, Organs Edward Arnold, London.
3. Esdu, K., 1977, Anatomy of Seed Plants, 3rd Edition. John Wiley and Sons, New York.
4. Hartman, H.T. and Kestler, D.E., 1976. Propagation: Principles and practices, 3rd Edition, Prentice Hall of India Pvt.Ltd., New Delhi.
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6. Brown, H.P. 1989. An Elementary Manual on Indian Wood Technology. R. P.S Publishers.
7. Trotter, H. 1982. The Common Commercial Timbers of India and their uses. Controller of Publications Delhi.

ESL506 - Ecological Modeling

Credits: 3-0-0

1. **Exponential population growth:** Finite rate of increase, population doubling time, life tables, life expectancy, net reproduction rate, generation time, intrinsic rate of natural increase, stable age distribution.
2. **Matrix model for population growth:** Matrix operations, addition, subtraction, multiplication, inversion, latent roots of a matrix, Leslies matrix model for population growth in unlimited environment, finite rate of increase with stable age distribution.
3. **Logistic population growth:** Differential and matrix models for population growth in limited environment.
4. **Dispersal:** Empirical models, random walk model.
5. **Dispersion:** Poisson, random, uniform and aggregate patterns, Morisita's index of aggregation.
6. **Interaction between two species:** Competition – Differential equations, Leslie-Gower Model, Lotka-Volterra model for predator – prey interaction, Leslie model, deterministic models for simple and general epidemics.
7. **Association analysis and community classification:** Chisquare, Cole's measures and point correlation coefficient for association, information analysis, ordination, continuum concept.
8. **Species diversity:** Species area relationships, species abundance relationships – Log normal distribution, information measures of diversity. Brillouin's measure, Shannon-Wiener measure, Simpson's measure. Extinction and formation of single populations, McArthur – Wilson theory of biogeography.
9. **Production and energy flow:** Production efficiency. Bertalanffy's growth equation, measurement of production in plants, litter decomposition – differential equations, Gompertz curve – differential equations, Energy flow. Ecological energetic.

References:

1. Barbour, M.G., Burk, J.H. and Pitts, W.D. (1987). Terrestrial Plant Ecology. Benjamin/Cummings Publication Company, California.
2. Batschelet, E. (1971). Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin.
3. Begon, M., Harper, J.L. and Townsend, C.R. (1996). Ecology. Blackwell Science, Cambridge.
4. Chapman, J.L. and Reiss, M.J. (1988). Ecology: Principles and Applications. Cambridge University Press, Cambridge.
5. Curran, P.J. (1988). Principles of Remote Sensing. E.L.B.S., Longman Scientific and Technical, Harlow.
6. Heywood, V.H. and Watson, R.T. (1995). Global Biodiversity Assessment. Cambridge University Press, Cambridge.
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15. Muller-Dombois, D. and Ellenberg, H. (1974). Aims and Methods of Vegetation Ecology, Wiley, New York.
16. Odum, E.P. (1971). Fundamentals of Ecology. Saunders, Philadelphia..
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19. Poole, R.W. (1974). An Introduction to Quantitative Ecology. McGraw Hill Book Co., New York.
20. Sabbins Jr, F.F. (1986) Remote Sensing: Principles and Intrepretation. WH Freeman & Co., New York.
21. Smith, R.L. (1996). Ecology and Field Biology. Harper Collins, New York.
22. Sokal, R.R. and Rohlf, F.J. (1995). Biometry. W.H. Freeman & Co. San Francisco.

Bridge Course in Botany (Semester-IV)
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BSL551 – Applied and Industrial Botany

Credits: 3-0-0

1. Physical characteristics of Indian woods, methods of seasoning and chemical treatment of specialized use, fire proofing of the wood. Industrial manufacturing of packing material and plywood and the classifications of plywoods according to their use. Some important commercial woods: *Dalbergia* spp., *Shorea robusta*, *Tectona grandis*, *Cedrus deodara*, Bamboo-the 'green gold' of India
2. Manufacturing of paper and board from raw plant material. Manufacturing of crude and high quality paper, recycled paper.
3. Extraction of sugar from sugar cane. Flow diagram of the process with a critical study of the steps involved, problems faced by the sugar industry in India. Bye-products of sugar industry, distillation of alcohol and other products with special reference to distilleries in Punjab.
4. The rubber plants of India, extraction of raw rubber and its chemical processing for the manufacturing of finished rubber.
5. Fibres: Classification of fibres, physical and chemical processes involved in the manufacuring of fibres from different types of fibre yielding plants.
6. Sources and methods of extraction of vegetable oils and fats and their utilization
7. Sources of gums and resins and their classifications according to their chemical nature. Extraction of the raw resin and down the line processing for terpentine and other products.
8. Essential oil yielding plants of India, their use in perfumary
9. Sources of natural dyes in India and their extraction methods, merits and limitations of plant based dyes.
10. An introduction to pharmaceutical industry in India, extraction of antibiotics from microorganisms. Medicines extracted from higher plants, Industrial manufacturing of quinine, the concept of nutraceuticals, their availability, uses & problems.
11. Agro industries in India with particular reference to Punjab. The manufacturing and packing of milk and milk products, pickles, jams, jellies, juices, pastes, sauces etc. Problems of storage and marketing .

References:

1. Kochhar S. L. (1998). Economic Botany in the Tropics. MacMillan India Limited, Delhi.
2. Pandey B P (1984). Economic Botany (3rd Ed.). S. Chand & Company Ltd. New Delhi.
3. Trotter H (1982). The Common Commercial Timbers of India and their Uses. The Controller of Publications, Delhi.
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6. Ambasta S P (1994). The Useful Plants of India. (3rd Ed.). Publications & Information Directorate, New Delhi.

Bridge Course in Botany (Semester-IV)
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BSL552 – Plant Tissue Culture

Credits: 3-0-0

1. Basic techniques of plant tissue culture, culture media, tissue and organ culture, cell culture, growth, differentiation and organogenesis in cell and organ culture.
2. Protoplast isolation, culture, somatic hybridization, selection systems for somatic hybrids, cell modification by DNA uptake, chloroplast uptake and genetic complementation.
3. Haploid production and its significance, anther and microspore cultures, monoploid production through chromosome elimination, production of triploids through endosperm culture.
4. Cytogenetics and differentiation in cell and tissue culture, plant regeneration from callus, shoot apex culture and anthers.
5. Micropropagation : Stages, somatic embryogenesis,usefulness, hardening of micropropagated plantlets, advantages and disadvantages, application of the technique in crop improvement.
6. Somaclonal variations and isolation of useful mutants at cellular level, disease resistance, herbicide resistance and salt tolerance. Transgenic plants, molecular approaches to diagnosis and strain identification.
7. Production of pathogen free plants through tissue culture.
8. Production of artificial seeds, their use and application.
9. Techniques for the production of transgenic plants : concept, vectorless transgenosis, gene targeting tools, crop improvement through transgenics, benefits and risk of producing transgenic plants, commercialization of transgenics.
10. In vitro cell culture and secondary metabolites production techniques.
11. Cryobiology of plant cell cultures and establishment of plant banks, freeze preservation technology, factors influencing revival of frozen cells and future prospects.
12. Terminator technology, apprehensions and challenges.
13. Role of plant tissue culture and biotechnology in agriculture, medicine and human welfare, prospects of genetic engineering of plants.

References:

1. Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990). Hand Book of Plant Cell Culture, Vols. 1 – 5. McGraw Hill Publishing Company, New York.
2. Bhojwani, S.S. and M.K. Razdan (1983), Plant Tissue Culture. Theory Practice Elsevier science publications Amsterdam.
3. Draper J.R. Scott, P. Armitage, R. Walden, (1988). Plant Genetic Transformation and Gene Expression – A Laboratory Manual. Blackwell Scientific Publications, Oxford.
4. Grierson, D. and Covey, S.N. (1984). Plant Molecular Biology, Black Publishers, New York
5. Gupta P.K., (1990), An Introduction to Biotechnology, Rastogi Publications, Meerut.
6. Kung, Shain – Dow and Arntzen, C.J. (1989). Plant Biotechnology, ButterWorths, London.

7. Old, R.W. and Primrose S.B. (1991). Principles of Gene Manipulation: An Introduction to Genetic Engineering, Blackwell Scientific Publications, Oxford.
8. Reinert, J. and Bajaj, Y.P.S. (1977). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer Verlang, Berlin.
9. Shaw C.H. (1988), Plant Molecular Biology – A Practical Approach IRL Press Oxford.

Bridge Course in Botany (Semester-IV)
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BSL553 - Evolutionary Biology

Credits: 3-0-0

1. Historical perspective of evolutionary biology, fundamental concepts in cosmology and geology, origin of life and evolutionary changes in the early life forms. origin of unicellular and multicelluar organism and major groups of plants, animals, human evolution. Pre-Darwinian and Darwinian theories of organic evolution.

2. Paleontology, geological time table, eras, the evolutionary synthesis, periods and epochs, major evolutionary events in the geological time scale.

3. The environmental context, dynamics of the geological and climatic changes, response of biotas, Pleistocene glaciations, the fossil evidence, carbon and oxygen dating.

4. The taxonomic and biological concept of species, barriers to gene flow, pre-zygotic and post-zygotic, the genetics of reproductive isolation, the role of hybridization, the deviant forms, the hybrid. agamic and polyploid complexes.

5. Allopatric speciation, evidences and genetic models, the role of genetic drift, peripetric speciation,. Role of dispersal and distribution, disjunct distributions, dispersalism versus extensionism, pattern of geographic variation, the theory of island biogeography.

6. Sympatric speciation: concepts of genetic variation, population as the unit of evolutionary change, mechanisms of genic and genotypic diversity, the role of genetic drift and gene flow in evolution, models of genetic drift, extinction and recolonalization, mutualism and coevolution.

7. Molecular and genomic evolution, aims and methods of study, phylogenetic insights, evolution of DNA sequences, molecular phylogenetics, divergence and molecular clocks, ,evolution of novel genes and proteins, gene duplication and divergence, genome and chromosomal evolution in prokaryotes and eukaryotes.

References:

1. Graur Dan and Li Wen-Hsiuung. Fundamentals of Molecular Evolution (Second edition). Sinauer Publications.
2. Avers Charlotte J. Process & Pattern in Evolution. Oxford Publications.
3. Douglas J. Futuyma. Evolutionary Biology (Third Edition) Sinauer Publications.
4. Minkoff, J.C. 1983. Evolutionary Biology. Addision Wesley Publishing Company.
5. Dobzhansky, T. 1972. Evolutionary Biology . Appleton – Century – Crofts , Educational Division/ Meredith Corpoartion, New York. Ayala, F.J. & Valentine , J.W. !979. Evolving the theory of organic evolution. The Benjamin cumming Publishing Company, Melno Park, California. Lull, R.S. 1976. Organic Evolution. Light and Life Publishers, New Delhi
6. Smith, J.M. 1998. Evolutionary Genetics . Oxford University Press.
7. Stebbins, G.L. 1973. Prentice Hall of India Pvt. Ltd.

Bridge Course in Botany (Semester-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL554 - Population Biology and Biodiversity

Credits: 3-0-0

1. Concept of population biology, behaviour and properties of population, life equation and key factor analysis. Principles of demography, mathematical techniques and models for the projection of population growth.
2. Genetic structure of population, the concept of gene pool, effect of mating systems on the population structure, models of study, ideal population, Hardy-Weinberg law, effect of selection, the basic selection model, fundamental theorem of natural selection, models of selection, multiple alleles, other types of selection, multi-locus selection; genetic drift, effective population size, Founders effect and bottleneck effects, inbreeding coefficient; inbreeding and selection.
3. Mutation as a factor in change of allele frequencies, mutation-selection balance, mutation in a finite population, effect of migration on allele frequencies, genetic variations, point and chromosomal mutations, genetic polymorphism, speciation as genetic phenomenon.
4. Gene flow and population structure, general model, Wahlund's effect, estimation of genetic distance, F coefficient, other differentiation measures, sex differences in gene flow, genetic drift
5. Ecological causes and background rates of plant extinctions, mass extinctions in the geological past. A study of anthropogenic factors in the loss of biodiversity, historical phases and recent escalations.
6. Biodiversity, concept, definition and scope, its relation to biogeography, genetic, specific and ecosystem diversity with particular reference to India. Levels of species diversity (alpha, beta & gamma) and indices of their measurement, species-area relationships and models.
7. Ecological and practical uses of biodiversity; distribution and conservation status of plants with particular reference to economically important species, red data book categories, strategies and practices for *in situ* and *ex situ* conservation of biodiversity, role of botanical gardens.
8. Recent concerns for biodiversity beginning with Rio summit, National and International conventions and regulations on biodiversity with detailed study of CBD, major agencies involved and their activity profiles.

References:

1. Boughey, A.S. (1973). Ecology of Population (2nd Ed.). The Macmillon Company Ltd., New York.
2. McNaughton, S.J. & Wolf, L.L. (1973). General Ecology (Ist Ed.). Holt, Rinehart & Winston Inc. New York.
3. Dawson P.S. & King C.E. (Eds.) (1971). Readings in Population Biology. Prentice-Hall Inc. Englewood Cliffs, New Jersey.
4. Benton, A.H. & Werner(Jr.). W.E. (1974). Field Biology and Ecology (3rd Ed.) MacGraw Hill-Book Company, New York.

Bridge Course in Botany (Semester-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL555 - Plant Breeding and Intellectual Property Rights

Credits: 3-0-0

1. **Origin of agriculture, world centres of primary diversity of domesticated plants:** Centres of origin of crop species and routes of their spread under cultivation, secondary centres of origin. Plant introduction and domestication, history, nature and objections of plant breeding.
2. **Breeding systems of crop species:** Breeding in plants, including marker– assisted selection, Systems of mating in sexually reproducing species and their genetic consequences, breeding methods for self and cross pollinated crops, pure line, pedigree and mass selection, male sterility and self incompatibility.
3. **Inbreeding depression and hybrid vigour (heterosis):** Hybridization in self and cross pollinated crops, genetic and physiological basis of heterosis, hybrid varieties, multiline synthetic and composite varieties, role of interspecific and intergeneric hybrids, barriers and techniques for production of distant hybrids.
4. **Breeding for disease resistance:** Classification of resistance, responses of the host to pathogens, variability systems of pathogenic fungi, breeding disease resistant varieties.
5. **Mutations and polyploidy Types:** causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis, protocols of point mutations and polyploidy in plant breeding, inheritance in polyploids, Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
6. **Seed biotechnology:** Seed quality concept and general principles of seed production, synthetic seeds. Modern techniques in variety identification: Various biochemical methods like electrophoresis, DNA, profiling techniques. Use of machine vision. Applications of variety identifications and future trends.
7. **Intellectual property rights:** concept and administration, national and international laws and conventions related to intellectual property rights with particular reference to CITES, Dunkel's proposals, WIPO, GATT, TRIPS etc. publications on IPR, trade secrecy and material transfer agreements, biosafety and product labelling considerations.
8. The national and international patenting syatem, procedures to apply and secure patents, formats of application and background information, patenting of plant materials and breeders's rights, role of TIFAC and IP management division of CSIR, Patent facilitation centres.

References:

1. Conway, G. (1999). The Doubly Green Revolution: Food for All in the *21st Century*. Penguin Books.
2. Conway, G., and Barbier, E. (1990). After the Green Revolution. Earthscan Press, London.
3. Cristi, B.R. (ed.) (1999). CRC Handbook of Plant Sciences and Agriculture. Vol. I. *In-situ* Conservation. CRC Press, Boca Raton, Florida.
4. Haye, H.K., Immer, F.R., and Smith, D.C. (1955). Methods of Plant Breeding. McGraw Hill Book Co., New York.
5. Khush G.S. (1973). Cytogenetics of Aneuploids. Academic Press, New York.

6. Kohli, R., Arya, K.S., Singh, P,H., and Dhillon, H.S. (1994). Tree Directory of Chandigarh. Lovedale Educational, New Delhi.
7. Simmonds, N.W. (1979) Principles of Crop Improvement. Longman, London.
8. Singh B.D.(2005), Plant Breeding- Principles and Methods, Kalyani Publishers, Ludhiana.
9. Swaminathan, M.S., and Kochhar, S.l. (Eds) (1989). Plants and Society. Macmillan Publication Ltd., London.
10. Agarwal, K.C. (2000) Biodiversity. Agrobios, Jodhpur (India).
11. Kumar,U. and Asija, M.J (2002). Biodiversity, Principles and Conservation. Agrobios, Jodhpur (India).

BSL556 – Plant Metabolism

Credits: 3-0-0

1. **Nitrogen Metabolism**: Introduction, Overview of nitrogen in the biosphere and in plants, overview of nitrogen fixation, enzymology of nitrogen fixation, symbiotic nitrogen fixation, ammonia uptake and transport, overview of nitrate and nitrite reduction, interaction between nitrate assimilation and carbon metabolism,
2. **Sulphur Metabolism**: Overview of sulfate assimilation, sulfur chemistry and function, sulfur uptake and transport, the reductive sulfate assimilation pathway, synthesis and function of glutathione and its derivatives.
3. **Lipid Metabolism**: Biosynthesis of fats, fatty acids and glycerol, condensation of fatty acids and glycerol; Fat oxidation - hydrolysis of triglycerides by lipase; metabolism of glycerol; Oxidation of Fatty Acids – β-oxidation, α- oxidation, ω- oxidation; conversion of fat into carbohydrates (glyoxylate cycle).
4. **Carbohydrate Metabolism**: Biosynthesis of carbohydrates; catabolism of carbohydrates; direct oxidation pathway; inter-conversions of monosaccharides; gluconeogenesis.
5. **Secondary Metabolites and Plant Defence**: Role of secondary metabolites in plants, biosynthetic pathways and functions of terpenes, phenolic compounds and nitrogen containing compounds; induced plant defences against insect herbivores, plant defences against pathogens.

References:

1. Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. (eds) (1997). Plant Metabolism. Longman, Essex.
3. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley & Sons, Inc., New York
4. Nobel, P.S. (2009). Physiochemical and Environmental Plant Physiology. Academic Press, San Diego.
5. Salisbury, F.B., and Ross, C.W. (1992). Plant Physiology, Wadsworth Publishing Co., California.
6. Scott, P. (2008). Physiology and Behaviour of Plants. John Wiley and Sons Ltd. England.
7. Stewart, S. and Globig, S. (2011). Plant Physiology. Apple Academic Press Inc., Canada
8. Taiz, L., and Zeiger, E. (2010). Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts.