

SCHEME & SYLLABUS
M.Sc. (Hons.) Botany



Department of Natural Sciences

UISH

Sant Baba Bhag Singh University
2018

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Course Scheme of M. Sc. (Hons.) Botany (Semester-I-IV)

SEMESTER I

I. Theory Subjects

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BOT501-18	Biology and Diversity of Fungi and Plant Pathology	4:0:0	4:0:0	4	4
2	BOT503-18	Biology and Diversity of algae, Bryophytes and Lichens	4:0:0	4:0:0	4	4
3	BOT505-18	Water relationship, Growth and Development	4:0:0	4:0:0	4	4
4	BOT507-18	Plant Biochemistry and Metabolism	4:0:0	4:0:0	4	4
5	MAT515-18	Biostatistical methods	4:0:0	4:0:0	4	4

II. Practical Subjects

1	BOT509-18	Seminar-I	0:0:2	0:0:1	2	1
2	BOT511-18	Practical Course on Fungi, Pathology, Algae and Bryophytes	0:0:4	0:0:2	4	2
3	BOT513-18	Practical Course on Plant Physiology and Biochemistry	0:0:4	0:0:2	4	2
Total					30	25

Total Contact hrs: 30
Total Credit Hours: 25

Semester-II

I. Theory Subjects (including Non- Credit Courses)

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BOT504-18	Biology and Diversity of Pteridophytes and Gymnosperms	4:0:0	4:0:0	4	4
2	BOT506-18	Reproductive and developmental biology of angiosperms	4:0:0	4:0:0	4	4
3	BOT508-18	Metabolic integration	4:0:0	4:0:0	4	4
4	BOT510-18	Genetics, Plant Breeding and Evolution	4:0:0	4:0:0	4	4
5	CSE554-18	Basic Concepts of Computer Technology	4:0:0	4:0:0	4	4

II. Practical Subjects

1	BOT512-18	Seminar-II	0:0:2	0:0:1	2	1
2	BOT514-18	Practical Course on Pteridophytes, Gymnosperms and Reproductive Biology	0:0:4	0:0:2	4	2
3	BOT516-18	Practical Course on Plant Metabolism and Genetics	0:0:4	0:0:2	4	2
Total					30	25

Total Contact hrs: 30

Total Credit Hours: 25

SEMESTER III

I Theory Subjects

S. No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BOT601-18	Angiosperm morphology and taxonomy	4:0:0	4:0:0	4	4
2	BOT603-18	Ecology	4:0:0	4:0:0	4	4
3	BOT605-18	Cytology and Molecular Biology of Plants	4:0:0	4:0:0	4	4
4	BOT607-18	Plant Tissue Culture and Genetic Engineering	4:0:0	4:0:0	4	4

II. Practical Subjects

1	BOT609-18	Project Work-I	0:0:10	0:0:5	10	5
2	BOT611-18	Practical Course on Angiosperm Morphology, Taxonomy and Ecology	0:0:4	0:0:2	4	2
3	BOT613-18	Practical Course on Cytology, Tissue Culture and Genetic Engineering	0:0:4	0:0:2	4	2
Total					34	25

Total Contact hrs: 34

Total Credit Hours: 25

Semester-IV

I Theory Subjects (including Non- Credit Courses)

S. No.	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	BOT602-18	Advanced Cell Biology	4:0:0	4:0:0	4	4
2	BOT604-18	Molecular Genetics	4:0:0	4:0:0	4	4
3	BOT606-18	Stress Physiology	4:0:0	4:0:0	4	4
4	BOT608-18	Advanced Plant Biochemistry	4:0:0	4:0:0	4	4

II. Practical Subjects

1	BOT610-18	Project Work-I	0:0:10	0:0:5	10	5
2	BOT612-18	Practical Course on Cell Biology and Molecular Genetics	0:0:4	0:0:2	4	2
3	BOT614-18	Practical Course on Stress Physiology and Biochemistry	0:0:4	0:0:2	4	2
Total					34	25

Total Contact hrs: 24

Total Credit Hours: 24

Course Scheme Summary

Semester	L	T	P	Contact hrs/Wk	Credits
1	20	0	10	30	25
2	20	0	10	30	25
3	16	0	18	34	25
4	16	0	18	34	25
Total	72	0	56	128	100

Total contact hours for I-IV semester= 128

Total credit hours for I-IV semester= 100

SEMESTER I

BIOLOGY AND DIVERSITY OF FUNGI AND PLANT PATHOLOGY

Course Code	BOT501-18
Course Title	Biology and Diversity of Fungi and Plant Pathology
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc. Medical with Botany as one main subject
Course Objective	The main objective of Biology and Diversity and Plant pathology is to study the concepts of fungal diversity and comparative study of the different fungal genera. In plant pathology focus is to study the commonly occurring disease, their etiology and control mechanisms.

UNIT: I

Recent trends on the classification of fungi with reference to morphological and paramorphological criteria, Comparative study of the following sub division:

Mastigomycotina: *Albugo*, *Peronospora*, *Plasmopora*

UNIT: II

Comparative study of the following sub-division:

Zygomycotina: *Mucor*, *Rhizopus*, *Syncephalastrum*, Ascomycotina: *Tapharina*, *Emericella*, *Penicillium*, *Chaetamium*, *Morchella*

UNIT: III

Comparative study of the following sub-divisions:

Basidiomycotina: *Puccinia*, *Melampsora*, *Ustilago*, *Polyporus*, *Cyathus*, *Deuteromycotina*: *Fusarium*, *Cercospora*, *Colletotrichum*

Mushroom cultivation: Mycorrhizal application in agriculture and forestry, Fungal cytology and genetics: Heterothallism, Heterokaryosis, parasexual cycle, mutation

UNIT: IV

Symptomatology in fungal, bacterial and viral infection of plants

Etiology and control of the following crop diseases

Paddy: Paddy blast, paddy blight, Wheat: Black stem rust, Bunt of Wheat, Bajara: green ear and Ergot, Sugar cane: Red rot disease of sugar cane, Ground nut: Tikka disease, Maize smut

Role of enzymes and toxins in pathogenesis, Disease control by physical, chemical and biological methods, resistant varieties, Crop rotation, plant quarantines, seed certification

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Introductory Mycology	Alexopoulos, C.J., Mims, C.W. and Blackwell, M.	John Wiley and sons, INC, New York.
2	Plant Pathology	Mehrotra, R.S.	Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3	Botany for degree students-Fungi.	Vashista, B.R. and Sinha, A.K.	S. Chand and Company Ltd, New Delhi-pp 1-752.
4	An Introduction to Mycology.	Mehrotra, R.S. and Aneja, K.R.	New Age International
5	Stereochemistry of carbon compounds	Ernest Eliel	McGraw Hill, New York (1962).

BIOLOGY AND DIVERSITY ALGAE, BRYOPHYTA AND LICHENS

Course Code	BOT 503-18
Course Title	BIOLOGY AND DIVERSITY ALGAE, BRYOPHYTA AND LICHENS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of Biology and diversity of algae, Bryophytes and lichens. In this focus is the comparative study of different genera of algae and bryophytes.

UNIT: I

Algae: diverse habitats (terrestrial, freshwater, marine); thallus organization; evolutionary relationships; cell ultrastructure; reproduction (vegetative, asexual, sexual); criteria for classification of algae (pigments, reserve food, flagella). Classification and salient features: Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

UNIT: II

Algal blooms: causal factors and dynamics of freshwater algal blooms; physical and chemical means and bio-manipulation (top- down and bottom-up) for controlling nuisance blooms; role of phycoviruses in algal bloom control; algal bio-fouling of ships and its control.

UNIT: III

Origin of Bryophytes- evolution of gametophyte and sporophyte; economic, ecological and microbial importance of bryophytes, symbiotic associations of bryophytes Liverwort and Hornworts: classification, morphology, anatomy and reproduction of Marchantiales, Metageniales, Jungermanniales and Anthocerotales.

UNIT: IV

Mosses: classification, morphology, anatomy and reproduction of Funariales, Sphagnales and Polytrichales, Bryophytes in bioindication: direct and indirect biomonitoring.

Spore germination, Protonemal differentiation, bud germination

Parthenogenesis, apogamy, apospory and regeneration

Lichens: General account, structure, structure and reproduction

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	An Introduction to Pteridophytes.	Rashid, A. (1991).	Vikas Publishing House Pvt. Ltd. New Delhi.
2	The Biology and Morphology of Pteridophytes,	Parihar, N.S. (1987).	Central Book Distributors, Allahabad.
3	Cryptogamic Botany. Vol. II,	Smith, G.M. (1955).	Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4	Botany for Degree Students-Bryophytes	B.R. Vashishta	S. Chand Limited, 2001
6	Morphology, Growth and Differentiation	PremPuri	Atma Ram & Sons, 1981
7	A text Book of Algae	Bilgrami, K.S., & L.C. Saha	CBS Publishers & Distributors (P) Ltd., New Delhi - 260 pp.,
8	Botany for degree students-Algae.	Vashista,B.R.	S. Chand & Co., (P) Ltd., New Delhi – 567pp.,

WATER RELATIONSHIP, GROWTH AND DEVELOPMENT

Course Code	BOT505-18
Course Title	WATER RELATIONSHIP, GROWTH AND DEVELOPMENT
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc. Medical with Botany as one main subject
Course Objective	The main objective of this branch is to study concept of water relations in plants, photosynthesis and growth and development in plants

UNIT: I

Water relationships in plants: Unique physio-chemical properties of water, Chemical potential, water potential, Apparent free space, bulk movement of water, soil plant atmosphere continuum (SPAC), Stomatal regulation of transpiration, hormonal and energy dependent hypothesis.

Inorganic nutrition, physicochemical aspects of solute transport, diffusion and facilitated diffusion, passive and active transport.

Nernst equation and Donnan's potential. Role of ATPase as a carrier, Co-transport (Symport) and counter transport (antiport), Ion channels, role of calmodulin, Importance of foliar nutrition and use of chelates.

UNIT: II

Photosynthesis: Energy pathway in photosynthesis, chloroplast as an energy transducing organelle. Composition and characterization of photo systems I and II, electron flow through cyclic, non cyclic and pseudo cyclic photophosphorylation. Pathways of CO₂ fixation, Difference between C₃ and C₄ fixation and different kinds of C₄ pathways

UNIT: III

CAM pathway: Occurrence, biological events and adaptive advantage

Photorespiration: Mechanism and regulation of photorespiration

Enzymes: Classification, mode of action, km value, Industrial application, immobilized enzymes, their preparation and application, Enzyme regulation: Competative and non-competitive, allosteric enzymes

UNIT: IV

Chemical control of growth and morphogenesis

Hormonal effect on growth and development

Bioassay of plant growth regulators and mode of action with reference to auxins, Gibberellins, cytokinins, abscisic acid and ethylene

Phytochrome: Chemistry and photo morphogenetic effects and role in flowering

Dormancy: Seed and bud dormancy; hormonal regulation

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of Plants.	Buchanan, B.B., Grissem, W., and Jones, R.L. (2000).	American Society of Plant Physiologists, Maryland.
2	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.
3	Plant Physiology,	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.
4	Plant Physiology	Mukherji, S & Ghosh, A.K.	New Central Book Agency (P) Limited, 2009-

PLANT BIOCHEMISTRY AND METABOLISM

Course Code	BOT507-18
Course Title	PLANT BIOCHEMISTRY AND METABOLISM
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To study the classification, occurrence and structure of biomolecules and their metabolism. To study the general concept of nitrogen fixation and its role in plant growth and development.

UNIT: I

Carbohydrates: Classification, occurrence and structure of monosaccharides, oligosaccharides and polysaccharides (Starch, cellulose and pectin)

Proteins: Amino acids, structure and characteristics, peptides and protein structure, functions of proteins, Conjugate proteins, Accounts of lactins and their function

UNIT: II

Lipids: Classification, occurrence, structure and importance of acyl lipids and phosphates

Concept of free energy and entropy, high energy compounds, Gibb's free energy concept in biochemical reaction

Synthesis of ATP through oxidative electron transport chain, Chemiosmotic regeneration of ATP

UNIT: III

Gluconeogenesis vs glycolysis

Biosynthesis of fatty acids

Degradation of fatty acids

Lipid as high energy molecule

Role of Kreb's cycle

UNIT: IV

Nitrogen fixation by free living and symbiotic organisms, mechanism of nitrogen fixation, Soil nitrogen sources, nitrogen uptake by plants and assimilation

Nitrate reductase system, substrate controlled induction, interrelation between photosynthesis and nitrogen metabolism

Brief account of amino acid synthesis by reductive amination, GS-GOGAT system, transamination

Basic structure of important phenolics and alkaloids: a general view of their synthesis

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of Plants.	Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000).	American Society of Plant Physiologists, Maryland.
2	Lehninger Principles of Biochemistry: 6th Edition	Nelson, D. L., Cox, M.M	Macmillan Learning, 2012
3	Plant Physiology,	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.
4	Plant Physiology	Mukherji, S & Ghosh, A.K.	New Central Book Agency (P) Limited, 2009-
5	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.

BIOSTATISTICAL METHODS

Course Code	MAT515-18
Course Title	BIOSTATISTICAL METHODS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc. Medical
Course Objective	To aware students about the use and significance of statistical techniques in biological science.

UNIT I

Data collection, tabulation, Frequency distribution and its graphical representation

Measures of Central tendency: mean, mode, median

Measures of Dispersion: range, variance, Standard deviation and Standard error

UNIT I

Mathematical definition of a probability event

Conditional probability

Additive and Multiple law of Probability

Theoretical Distributions: Binomial, Poisson and Normal

UNIT III

Null Hypothesis and Level of Significance

Confidence limit and confidence interval

Skewness and Kurtosis moments.

Student's t- test (Paired and Unpaired)

Chi Square test

UNIT IV

Correlation: Covariance, Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient

Regression: Least square technique for regression lines, regression coefficient

Relation between Correlation and Regression

Analysis of variance (one way and two way ANOVA)

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Introduction to Mathematics for Life Scientists	Batschelet, E	Springer-Verlag, Berlin
2	Mathematical Biology	Murray, J.D.	Springer-Verlag, Berlin
3	Statistical Methods	Snedecor & Cochran	Affiliated East-West Press
4	Biostatistics	P. Ramakrishnan	Saras Publications
5	Biostatistics: Basic Concepts and Methodology for the Health Sciences	Wayne W. Daniel	Wiley Publication

PRACTICAL COURSE ON FUNGI, PATHOLOGY, ALGAE AND BRYOPHYTES

Course Code	BOT511-18
Course Title	PRACTICAL COURSE ON FUNGI, PATHOLOGY, ALGAE AND BRYOPHYTES
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B. Sc. Medical with Botany as one main subject.
Course Objective	To understand the different commonly occurring diseases and study the specimens.

LIST OF EXPERIMENTS

1. Study of morphological characters and reproductive structures of the genera mentioned in the theory.
2. Study of diseased specimens of plants with reference to symptomatology
3. Isolation, purification and single spore culture of pathogens
4. Demonstration of biological control of pathogenic fungi in vitro.
5. Collection and study of algae mentioned in theory, identification up to generic level using algal monographs
6. Staining techniques of cytological studies
7. Morphological and structural study of representative member of the following group using cleared whole amount preparation, dissection and section: *Pellia*, *Porella*, *Marchantia*, *Mumortiera*, *Weisnerella*, *Sphagnum*
8. Experiments to study spore germination, formation of protonema and bud development

Text and Reference books:

S. No.	Name/Title	Author	Publisher
1	Practical Plant Pathology	Vijay Yadav	NEW INDIA PUBLISHING COMPANY
2	Fungi & Plant Pathology	Annie Ragland , V. Kumaresan , N. Arumugam	Saras Publication
3	Practical Manual of Algae	<u>Rajan S. Sundara</u>	Anmol Publisher
4	Practical Manual for and Pteridophytes	Mohammed Gufran Khan	Lambert Academic Publishing

PRACTICAL COURSE ON PLANT PHYSIOLOGY AND BIOCHEMISTRY

Course Code	BOT513-18
Course Title	PRACTICAL COURSE ON PLANT PHYSIOLOGY AND BIOCHEMISTRY
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	To learn the basic instrumentation used in plant physiology and biochemistry and different quantitative as well quantitative methods for determination of biomolecules and activity of enzymes.

LIST OF EXPERIMENTS

1. Determination of water potential in different tissues
2. Estimation of the Hill reaction activity
3. Estimation of total nitrogen by Kjeldahl method
4. Principle of colorimetry, spectrophotometry and fluorimetry
5. Determination of chlorophyll a and chlorophyll b , total chlorophyll (Arnon;s method)
6. Estimation of protein by Biuret and Lowry's method
7. Estimation of seed germination as affected by red and infrared radiation
8. Extraction and Estimation of starch
9. Determination of reducing sugars in fruits
10. Estimation of amino acids by ninhydrin
11. Separation and identification of sugars by paper chromatography
12. Separation of soluble protein by gel electrophoresis

Text and Reference books:

S. No.	Name/Title	Author	Publisher
1	Practical in Plant Physiology and Biochemistry	Sunita Gupta, N.K. Gupta & M.K. Sangha Manju Bala	Scientific Publishers.
2	A Practical Manual for Plant Physiology and Biochemistry	ShriramMirajkar, Prashant Kale, Prashant Shingote	Lambert Academic Publishing

SEMESTER II

BIOLOGY AND DIVERSITY OF PTERIDOPHYTES AND GYMNOSPERMS

Course Code	BOT504-18
Course Title	BIOLOGY AND DIVERSITY OF PTERIDOPHYTES AND GYMNOSPERMS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of biology and diversity of pteridophytes and gymnosperms and study their comparative morphology, anatomy and ontological studies of different generas.

UNIT: I

Pteridophytes: origin and evolution, telome theory; stelar evolution; classification; economic importance Fossil pteridophytes: structural features and evolutionary significance of Psilophytales Lepidodendrales, Calamitales

UNIT: II

Diversity, morphology, anatomy and reproduction in: Psilopsida (Psilotales), Lycopsidea (Lycopodiales, Selaginellales, Isoetales), Sphenopsida (Equisetales), Ophioglossales, Eusporangiate ferns (Marattiales), Leptosporangiate ferns (Filicales, Marsileales, Salviniales).

UNIT: III

Gymnosperms: origin and evolution, classification (Sporne, Christenhueze); economic importance; diversity and distribution in India. Fossil gymnosperms: structural features and evolutionary significance of Pteridospermales, Cycadeoidales, Cordiales

UNIT: IV

Diversity, morphology, anatomy and reproduction in: Cycadales, Ginkgoales, Coniferales, Taxales, Ephedrales, Gnetales, Welwitschiales

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Botany for degree students Pteridophytes	Vashista, B. R	S. Chand and Company limited.
2	Botany for degree students Gymnosperms	Vashista, P. C., Sinha, A.K., Kumar A.	S. Chand and Company limited
3	An Introduction to Pteridophytes.	Rashid, A. (1991).	Vikas Publishing House Pvt. Ltd. New Delhi..
4	Gymnosperms	Bhatnagar, S. P., Moitra. A.	New Age International Publisher
5	Gymnosperms	O.P. Sharma	Pragati Prakash-Meerut

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY OF ANGIOSPERMS

Course Code	BOT 506-18
Course Title	REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY OF ANGIOSPERMS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of reproductive and developmental biology of angiosperms

UNIT: I

Flower development: floral evocation, floral organ formation, flowering in perennials, seasonal flowering, polycarpy and biennial bearing. Male and female gametophyte: structure of anther, role of tapetum, micro-sporogenesis and development of pollen, regulation of asymmetric first pollen mitosis, control of second pollen mitosis and sperm cell differentiation, female gametophyte development: initiation, patterning, cell fate specification and maintenance of cell identities of female gametophyte.

UNIT: II

Pollination, pollen-pistil interactions and fertilization: pollination mechanisms, pollination syndromes, structure of pistil, pollen germination and compatible pollenstigma interactions, sporophytic and gametophytic self-incompatibility, pollen tube growth and guidance, double fertilization Seed development, fruit growth and dormancy: endosperm development, embryogenesis-landmarks of embryo pattern formation, polyembryony and apomixes, dynamics of fruit growth, importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy.

UNIT: III

Root development: organization of root apical meristem (RAM); vascular tissue differentiation; lateral roots, root hairs. Leaf growth and differentiation: determination; phyllotaxy; control of leaf form; differentiation of epidermis with special reference to stomata, trichomes, and mesophyll Senescence and programmed cell death (PCD): concept, types of cell death, mechanism of PCD. PCD in the life cycle of plants, metabolic changes associated with senescence significance of Pteridospermales, Cycadeoidales, Cordiales

UNIT: IV

Patterns in plant development: growth, differentiation and development, genetic control and hormonal regulation of development, physiology of hormones in plant development.

Shoot development: organization of the shoot apical meristem (SAM); cytological and molecular analysis of SAM; mechanisms of cell division and cell to cell communication; tissue differentiation with reference to xylem and phloem; secretory structures and laticifers Wood development in relation to environmental factors.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	The Embryology of Angiosperms.	Bhojwani, S.S. and Bhatnagar, S.P. 1975.	Vikas Publishing House, Delhi.
2	Seeds: Physiology of Development and Germination,	Bewley, J.D. and Black, M. 1994.	Plenum Press, New York.
4	Morphology of the Angiosperms.	Eames, A.J. 1961.	Tata McGraw Hill Publishing Co., Bombay.
5	An Introduction to the Embryology of Angiosperms.	Maheshwari, P. 1950.	Tata McGraw Hill Publishing Co. Bombay – New Delhi.

METABOLIC INTEGRATION

Course Code	BOT 508-18
Course Title	METABOLIC INTEGRATION
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of metabolism of biomolecules, signal transduction and Senescence in plants

UNIT: I

Long distance transport: Introduction, Overview of diffusive and active transport in plants, Importance of channel dimensions in defining the transport properties of the apoplast and symplast. Comparison of xylem and phloem transport. Transpirational water movement in the xylem, Symplasmic transport via plasmodesmata, Phloem transport, Intercellular transport of endogenous macromolecules.

UNIT: II

Nitrogen and sulphur : 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 uptake and reduction, Nitrate reduction, Nitrate reduction, Interaction between nitrate assimilation and carbon 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.

UNIT: III

Signal perception and transduction: Introduction, Overview of signal transduction, receptors, specific examples of plant receptors, G-proteins and phospholipid signaling, Cyclic nucleotides, Calcium, Protein kinases : primary elements in signal transduction, Particular pathways of signal transduction associated with plant growth regulators, The future of plant cell signal transduction research.

UNIT: IV

Senescence and Programmed Cell Death: Types of cell deaths observed in animals and plants, PCD in the life cycle of plants, Overview of senescence, Pigment metabolism during senescence, Protein metabolism in senescence, Impact of senescence of photosynthesis, Impact of senescence on oxidative metabolism, Degradation of nucleic acids during senescence, Regulation of metabolic activity in senescing cells, Endogenous plant growth regulators and senescence, Environmental influences on senescence, Examples of developmental PCD in plants, Examples of PCD as a plant response to stress, Further questions and future directions for PCD research.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of Plants.	Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000).	American Society of Plant Physiologists, Maryland.
2	Lehninger Principles of Biochemistry: 6th Edition	Nelson, D. L., Cox, M.M	Macmillan Learning, 2012
3	Galston, A.W. (1989).	Life Processes in Plants.	Scientific American Library, Springer-Verlag, New York.
5	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.
	Salisbury, F.B., and Ross, C.W. (1992).	Plant Physiology,	Wadsworth Publishing Co., California.

GENETICS, PLANT BREEDING AND EVOLUTION

Course Code	BOT510-18
Course Title	GENETICS, PLANT BREEDING AND EVOLUTION
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of Genetics, Plant Breeding and Evolutionary biology in plants

UNIT 1:

A brief history, scope and significance of genetics

Mendel's law of inheritance

Lethality and interaction of genes

Quantitative inheritance: polygenic inheritance

Nature and concept of chemical basis of heredity

UNIT: II

Multiple alleles, Self-sterility, Linkage and its measurement

Crossing over: theories of crossing over, Mapping of genes on chromosomes

Generic recombination in bacteria: conjugation, transformation and transduction

Cytoplasmic inheritance

Biochemical genetics of Neurospora

UNIT III

Origin of life, Mutation and evolution

Genetics and evolution

Mutation: types, methods of artificial induction, method of detection of mutants

Genetic drift, Speciation

UNIT: IV

Methods of plant breeding, plant introduction, mass line and clonal selection

Aims and objectives of hybridization types: inter specific and intergeneric; back crossing

Grafts hybrids, chimeras and bud spot

Heterosis: theories and applications with reference to maize

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Genomes	Brown, T.A. (1999).	BIOS Scientific Publishers limited, UK.
2	Principles of Genetics.	Gardener, E.J., Simsons, M.J., and Sinustad, D.P. (1991).	John Wiley Sons Inc., New York.
3	Gene VII.	Lewin, B. (2000).	Oxford University Press, New York.
4	Genetics.	Strickberger, M.W. (2001).	Prentice-Hall, Inc., Englewood Cliffs, N. Jersey.
5	Evolutionary Biology (Third Edition)	Douglas J. Futuyma.	Sinauer Publications.
	Cytogenetics of Aneuploids.	Khush G.S. (1973).	Academic Press, New York
	Genetics	Veer BalaRastogi	KedarNath Ram Nath

CSE554-18	BASIC CONCEPTS OF COMPUTER TECHNOLOGY
Course Title	COMPUTER APPLICATIONS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts and handling the use of computers in biological sciences.

UNIT:I

Evolution of computers.

Basics of computer and its operation: Functional Components and their inter-connections, concept of Booting, Use of Operating System for directory listing, hierarchical directory structure, renaming, deleting files/folders, formatting floppy, copying files, concepts of path and pathname, switching between tasks, installation/removal of applications

UNIT: II

Computers and their applications in biology

Operating systems:

- Need for operating system
- Functions of operating system (Processor Management, Memory Management, File Management and Device Management)
- Types of operating system - Interactive (GUI based), Time Sharing, Real Time and Distributed

Types of Software: System Software, Utility Software and Application Software

UNIT:III

Computer fundamentals, Introduction to digital computers, Organization,

Number system, I/O devices, Storage devices,

Introduction to internet and its applications – www, email

UNIT: IV

MS-Windows basics

MS-Word – Meaning of Word-Processing, Creating, Saving, Printing documents, Formatting, Spell-Check, Adding page numbers, Header and Footer, Macros, Creating tables, Converting table to text and vice-versa, Mail Merge.

MS-Excel – Spreadsheets, Using different types of formulae, Creating graphs and charts, Exporting charts to MS-Word,

MS-PowerPoint – Creating presentations, Formatting, Adding effects and timings..

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Computer Fundamentals	Sinha, P.K. (1992).	
2	Windows Based Computer Courses,	Sumit Kumar,	JBD Publishers
3	Fundamentals of Statistics.	Gupta, S.C. (2004).	Himalaya Publishing House.
4	Introduction to Computers, 6th Ed	Peter Norton's Introduction to Computers, 6th Ed	

PRACTICAL COURSE ON PTERIDOPHYTES, GYMNOSPERMS AND REPRODUCTIVE BIOLOGY

Course Code	BOT514-18
Course Title	PRACTICAL COURSE ON PTERIDOPHYTES, GYMNOSPERMS AND REPRODUCTIVE BIOLOGY
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	Study of comparative morphology and anatomy of vegetative and reproductive study of different genera of pteridophytes and gymnosperms. To understand different developmental stages of plant embryology.

LIST OF EXPERIMENTS

1. Study of morphology and anatomy of vegetative and reproductive tissues and organs using cleared whole mounts, dissections, sections, macerations and permanent preparation of living and fossil forms covered under theory
2. Study of Pteridophytes in their natural habitat.
3. Experiments on spore germination of prothallus, induction of sporophytes
4. Comparative study of the anatomy of vegetative and reproductive parts of *Gingko*, *Cedrus*, *Abies*, *Taxodium*, *Podocarpus*, *Taxus*, *Ephedra* and *Gentum*
5. Study of the important reproductive stages through specimens and permanent slides
6. Study of living shoot apex of Hydrilla
7. Study of cytological zonation in the shoot apical meristem in double stained permanent slides of any suitable plant.
8. Study of different leaf arrangements
9. Study of epidermal peels of leaves of appropriate to study various stomatal types
10. Study of anatomy of dicot and monocot roots and stems using appropriate materials
11. Study of microsporogenesis and gametogenesis in appropriate materials
12. Study of different types of ovules, embryo sacs through examination of permanent slides

13. Text and Reference books:

S. No.	Name/Title	Author	Publisher
1	Practical Manual for Bryophytes and Pteridophytes	Mohammed Gufran Khan	Lambert Academic Publishing
2	Practical Botany (Cryptogams & Gymnosperms)	PrabhaChoudhary, Tarkeshwar Prasad S SChoudhary	CBS Publishers & Distributors
3	An Introduction to the Embryology of Angiosperms.	Maheshwari, P. 1950.	Tata McGraw Hill Publishing Co. Bombay – New Delhi.

PRACTICAL COURSE ON PLANT METABOLISM AND GENETICS

Course Code	BOT516-18
Course Title	PRACTICAL COURSE ON PLANT METABOLISM AND GENETICS
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	To learn the basic principles of metabolism and determination of probability of genetics.

LIST OF EXPERIMENTS

1. Determination of probability of tossing for one coin
2. Determination of probability for the throw of dice
3. Determination of probability for tossing of two coins
4. X^2 test as applied to the result of above three experiments
5. Permutation and combination
6. Correlation analysis
7. Determination of genotype from the data provided
8. Determination of linkage values from the data provided and preparation of chromosome map.
9. Determination of various Mendelian ratio by checker board as well as by binomial equation

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Practical and Numerical problems in Plant Breeding	<u>Phundan Singh</u>	Kalyani Publishers (2013)
2	Practical Handbook of Genetics	<u>VikasPali</u>	Kalyani Publishers

SEMESTER III

ANGIOSPERM MORPHOLOGY AND TAXONOMY

Course Code	BOT601-18
Course Title	ANGIOSPERM MORPHOLOGY AND TAXONOMY
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of angiosperm morphology and taxonomy

UNIT: I

Flower development: floral evocation, floral organ formation, flowering in perennials, seasonal flowering, polycarpy and biennial bearing. Co-evolution of flower *vis a vis* Pollinators

UNIT: II

Shoot development: Organisation of shoot apical meristem (SAM), Cytological and molecular analysis of SAM; control of cell division and cell to cell communication; control of tissue differentiation, especially xylem and phloem; Genetics of Flower Development in *Antirrhinum* and *Arabidopsis*.

Leaf growth and differentiation: Determination; Phyllotaxy; control of leaf from; differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

Root development: Organization of root apical meristem (RAM), Cell fates and lineage, differentiation of vascular tissue regulation of root growth, lateral roots; root hairs; root microbe interactions.

UNIT III

Botanical exploration-historical perspective, Botanical survey of India, its organization and role

Plant identification: methods of identification; dichotomous keys (kinds and construction); polyclaves (a brief account); cybertaxonomy (concept and scope), e-floras and e-herbaria

Practice of nomenclature: type method (concept and kinds); author citation; effective and valid publication; basionyms and synonyms; homonyms; autonyms and tautonyms.

UNIT: IV

Botanical nomenclature, ICBN, Principles, recommendation and amendments of code

Familiarity with botanical literature, monographs, icons and floras, important periodicals with emphasis on Indian floristics, methods of literature consultation, Threat assessment, different categories of threat, IUCN, Red Data Book, Important threatened plants of India

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century.	Beck, C.B. 2005.	Cambridge University Press.
2	Morphology of the Angiosperms.	Eames, A.J. 1961.	Tata McGraw Hill Publishing Co., Bombay.
3	Developmental Biology of Flowering Plants,	Raghavan, V. 1999.	SpringerVerlag, New York.
4	Plant Anatomy.	Mauseth, J.D., 1998,	The Benjamin Cumming Publishing Company Inc. Menlo Park, California, USA.
5	Anatomy of Seed Plants, 6rd Edition.	Esdu, K., 1977,	John Wiley and Sons, New York
6	Plant anatomy: Experiment and Interpretation, Part II,	Cutter, E.G., 1971,	Organs Edward Arnold, London.

ECOLOGY

Course Code	BOT603-18
Course Title	ECOLOGY
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of ecological modeling and principles

UNIT 1:

Population ecology: population characteristics; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. Habitat and niche: concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Species interactions: types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

UNIT: II

Community ecology: nature of communities; community structure and attributes; species diversity and its measurement, richness and evenness; edges and ecotones; guilds Community development: temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models, resource ratio hypothesis); changes in ecosystem properties, concept of climax and its characterization. Community stability: diversity- disturbance, and diversity stability relationships; ecology of plant invasion- process of invasion.

UNIT III

Euploidy: origin, meiosis and breeding behaviour of haploidy, autopolyploids and allopolyploids. Chromosome and chromatid segregation in autopolyploids Role of polyploidy in crop improvement and evolution of crop plants. Aneuploidy: types of aneuploids, origin, meiosis and breeding behaviour of aneuploids, aneuploid aberrations in humans. Ecosystem organization: biotic component-food chains, food web, trophic cascades; abiotic component-soil formation, soil profile development, soil horizons and soil classification. Ecosystem function: primary production (gross and net primary production, controlling factors and methods of measurement), energy flow pathways, ecological efficiencies; litter accumulation and decomposition (mechanisms, substrate quality and climatic factors).

UNIT: IV

Diversity Patterns: species abundance distribution, diversity patterns (latitudinal gradient-contributory factors and explanatory theories) Biogeography: MacArthur and Wilson's island biogeography equilibrium theorylimitations and modifications; colonization vs. extinction; species area relationship Biomes: types (terrestrial and aquatic), distribution and unique features

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Ecology and Environment	P.D. Sharma	Rastogi Publications, 'Gangotri' Shivaji Road, Meerut
2	Ecology: Principles and Applications.	Chapman, J.L. and Reiss, M.J. (1988).	Cambridge University Press, Cambridge.
3	Fundamentals of Ecology.	Odum, E.P. (1971).	Saunders, Philadelphia..
4	Basic Ecology.	Odum, E.P. (1983)	Saunders, Philadelphia
5	Methods in Plant Ecology.	Moore, P .W and Chapman, S.B. (1986).	Blackwell Scientific Publications, Cambridge.

CYTOLOGY AND MOLECULAR BIOLOGY OF PLANTS

Course Code	BOT605-18
Course Title	CYTOLOGY AND MOLECULAR BIOLOGY OF PLANTS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of cell and its organelles and molecular mechanism of DNA replication, transcription and translation.

UNIT 1:

The Plant cell: Structure, Organization, Cell cycle mechanism and its molecular basis, cytokinesis, Nucleus: Structure, nucleolus organization, Generalized structure of plant cell organelles

UNIT: II

Chromosome: Structure, molecular basis of chromosome structure. DNA: packaging of DNA, Nucleosome, nuclear membranes, C-value paradox, Cot curves, Chemical structure, genetic code ,Prokaryotic genome organization, Variation in chromosome and its significance

UNIT III

DNA replication in prokaryotes and eukaryotes. Transcription, RNA splicing. Translation, Prokaryotic and eukaryotic gene regulation

Meiosis: Origin and molecular events during meiosis

Mitosis: Origin and molecular events during mitosis

Chromosomal aberrations: Heteroploidy, structural changes in chromosomes

UNIT: IV

Transposable elements and its molecular basis

Membrane structure and function, ATPase sites

Membrane transport with reference to transport protein

Signal Transduction: An Overview

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Plant Molecular Biology – A Practical Approach.	Shaw C.H. (1988).	IRL Press Oxford.
2	Plant Molecular Biology,	Grierson, D., and Covey, S.N. (1984).	Black Publishers, New York
3	“Cell Biology, Genetics and Molecular Biology”,	Verma P.S. & V.K. Agarwal, (2000)	S. Chand. Pvt. Ltd
4	Cell and Molecular biology	De Robertis, E.D.P. and Robertis, E.M.F (1991)	Lea and Febiger, Washington
5	Molecular Cell biology	Darnell, J., Lodish, KL and Baltimore, D., (2008)	W. H. Freeman Publishers.

PLANT TISSUE CULTURE AND GENETIC ENGINEERING

Course Code	BOT607-18
Course Title	PLANT TISSUE CULTURE AND GENETIC ENGINEERING
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of Plant Tissue Culture and Genetic Engineering. To understand the different principles and methods of genetic engineering.

Unit 1:

Introduction: historical perspective and scope Cellular totipotency: concept, cytodifferentiation and its mechanism Cell culture and cell cloning: isolation of single cells from plant organs and cultured tissues; cell suspension culture, culture of single cells; organogenesis-processes and controlling factors, shoot- bud differentiation and somatic embryogenesis

Unit: II

Haploids: androgenic and gynogenic; ontogeny of androgenic haploids, applications of haploids in plant breeding. Somatic hybridization: isolation, culture and fusion of protoplasts; selection, regeneration and utility of hybrids and cybrids. Industrial applications: production of secondary metabolites and their applications, hairy root cultures and bioreactors Germplasm conservation: cryopreservation of plant cells and organs, short term and long term storage.

Unit III

Recombinant DNA technology: gene cloning principles, restriction enzymes characteristics and utility, cloning vehicles and their properties (plasmids, phages, phagemids and cosmids), artificial chromosomes (YAC), construction of recombinant DNA. Isolation of gene of interest - gel electrophoresis, southern blotting, genomic and cDNA libraries, bacterial transformation and selection of recombinants, polymerase chain reaction (PCR) – principle, technique and applications.

Unit: IV

DNA sequencing: Maxam-Gilbert's chemical degradation and Sanger's chain termination method, molecular markers (RAPD, AFLP, SSR & SNP) – concept and utility. Genetic engineering of plants: Agrobacterium the natural genetic engineer, Ti plasmids, mechanism of gene transfer, applications of transgenic plants. Direct methods of gene transfer (electroporation and biolistics), biosafety - possible ecological risks and ethical concerns of GM crops. Genomics and proteomics: concept and applications, microarray technology and its applications. Brief account of gene silencing; antisense RNA technology and RNA interference (RNAi).

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	An Introduction to Biotechnology	Gupta P.K., (1990),	Rastogi Publications, Meerut.
2	Plant Tissue Culture. Theory Practice	Bhojwani, S.S. and M.K. Razdan (1983),	Elsevier science publications Amsterdam
3	Hand Book of Plant Cell Culture, Vols. 1 – 5.	Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990).	McGraw Hill Publishing Company, New York.
4	Principles of Gene Manipulation: An Introduction to Genetic Engineering,	Old, R.W. and Primrose S.B. (1991).	Blackwell Scientific Publications, Oxford.
5	Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture,	Reinert, J. and Bajaj, Y.P.S. (1977).	Springer Verlag, Berlin.
	Plant Molecular Biology	Grierson, D., and Covey, S.N. (1984).	Black Publishers, New York

PROJECT WORK

COURSE CODE	BOT609-18
COURSE TITLE	PROJECT WORK
Type of course	Practical Work
L T P	0 0 10
Credits	5
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	The main objective of project work is to introduce the candidate to the practical aspects of research work

Each student will submit project work report on any one topic related to Botany. Project work will be guided by supervisor of the university and will be examined by external.

PRACTICAL COURSE ON ANGIOSPERM MORPHOLOGY, TAXONOMY AND ECOLOGY

Course Code	BOT611-18
Course Title	PRACTICAL COURSE ON ANGIOSPERM MORPHOLOGY, TAXONOMY AND ECOLOGY
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	To learn the preparation of permanent slides and herbarium and different methods of ecological studies of plants

LIST OF EXPERIMENTS

1. Preparation of cleared whole mounts of floral parts of polypetalae, Sympetalae and monocots for vasculature
2. Description of specimen
3. Preparation of models (plasticine/thermocoll) of vascular skeleton of flower and placentation
4. Location of key characters, use of keys at generic levels, after description a collective exercise
5. Location of key characters, use of keys at family levels
6. Identification of diagnostic characters and use of key (Provided) at level of various families after description has been made
7. Determination of minimum size of quadrat by species area curve method
8. Determination of minimum number of quadrat by species area curve method
9. Determination of frequency of various species by quadrat method and preparation of frequency diagram.
10. Determination of density of quadrat method
11. Determination of abundance of species by quadrat method
12. Determination of relative density by quadrat method
13. Preparation of biological spectrum of a locality

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Practical Manual of Plant Morphology	Rajan S. Sundara	Anmol Publications, Publishers & Distributors
2	Practical Manual of Plant Ecology and Plant Physiology	Sundara S. Rajan	Anmol Publisher

PRACTICAL COURSE ONCYTOLOGY, TISSUE CULTURE AND GENETIC ENGINEERING

Course Code	BOT613-18
Course Title	PRACTICAL COURSE ONCYTOLOGY, TISSUE CULTURE AND GENETIC ENGINEERING
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	To learn the basic principles of staining and methods of tissue culture and DNA extraction and PCR .

LIST OF EXPERIMENTS

1. Staining
2. Study of microscope
3. Study of the size and shape of the cell
4. Vital staining
5. Staining of mitochondria
6. Study of chloroplast
7. Cytoplasmic streaming
8. Study of meiosis by squash and smear method
9. Study of meiosis
10. Study of salivary and meiotic chromosome
11. Camera-Lucida diagrams of chromosome
12. Study of ultra structure of various cell organelles from electrom micrographs
13. Washing and sterilization of glassware.
14. Techniques for establishment of callus cultures and study of different types of calli viz. Compact, friable and nodular types.
15. In vitro differentiation of roots and shoots in suitable explants.
16. Demonstration of rhizogenesis in *Glycine max*.
17. DNA extraction protocol and its quantification by UV- spectrophotometric method
18. Demonstration of DNA sequencing by Sanger's dideoxy method.
19. Demonstration of RAPD, SSR and AFLP analysis.
20. Demonstration of PCR, centrifuge, deep freezer, and gel electrophoresis apparatus
21. Gel electrophoresis techniques and analysis

S.No.	Name/Title	Author	Publisher
1	Practical Book of Biotechnology & Plant Tissue Culture	Nagar Santosh,AdhavMadhavi	S Chand & Company
2	Principles of Gene Manipulation: An Introduction to Genetic Engineering,	Old, R.W. and Primrose S.B. (1991).	Blackwell Scientific Publications, Oxford.

SEMESTER-IV

ADVANCED CELL BIOLOGY

Course Code	BOT602-18
Course Title	ADVANCED CELL BIOLOGY
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of advanced cell biology To understand the molecular mechanisms of development of multicellular organisms, transport across membranes, phototrophic energy metabolism and cell cycle regulation.

UNIT 1:

Origin and Evolution of Cells: First cell, evolution of metabolism, Present day Prokaryotes, Eukaryotic Cells, Development of multicellular organisms.

Cells as experimental models: *Escherichia coli*, *Yeasts*, *Dictyosteliundiscoideum*, *Caenorhabditis elegans*, *Drosophila melanogaster*, *Arabidopsis thaliana*

Techniques in Molecular cell biology: Microscopy-light, phase-contrast, fluorescence, confocal, scanning electron microscopy. Use of radioisotopes, cell culture, fractionation of cells contents.

UNIT: II

Transport across membranes: Simple Diffusion, Facilitated diffusion, Active transport, Energetics of transport.

Oxidative metabolism in Mitochondria: Electron transport chain, Chemiosmotic coupling, role of mitochondria in the formation of ATP.

UNIT III

Phototrophic Energy Metabolism: Light Harvesting, NADPH Synthesis, ATP Synthesis.

Cell signalling: Modes of cell-cell signaling, hormones and their receptors, functions of cell surface receptors, pathways of intracellular signal transduction.

UNIT: IV

Regulators of cell cycle progression: MPF, families of cyclins and cyclin dependent kinases, Growth factors, cell cycle inhibitors.

Cancer: Properties of cancer cells, types of cancer, virus-induced cancer, oncogenes tumorsuppressor genes, Apoptosis.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	The World of the Cell.	Becker, W.M., Kleinsmith, L.J. and Hardin, J. (2000).	The Benjamin/Cummings Publishing Company.
2	The Cell – A Molecular Approach.	Cooper, G.M. (2000).	ASM Press, Washington, D.C.
3	Cell and Molecular Biology: Concepts and Experiments.	Karp, G. (1999).	John Wiley & Sons Inc., New York.
4	Cell Biology: Molecular and Cell Biochemistry.	Smith, C.A. and Wood, E.J. (1993).	Chapman & Hall, London
5	Cell Biology: Organelle Structure and Function.	Sadava, D.E. (1993).	Jones and Barlett Publishers, Boston, London.

MOLECULAR GENETICS

Course Code	BOT604-18
Course Title	MOLECULAR GENETICS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of molecular genetic transformations. To understand molecular genetic mechanism of DNA recombination.

UNIT I:

Recombination in bacteria, genetic transformation, conjugation and transduction and their role in mapping of bacterial genes Plasmids – general properties and regulation of replication (control of copy number)

UNIT: II

Genetics of phages – molecular basis of lytic and lysogenic life cycle; genetic recombination in phage; deletion mapping Concept of gene and allele, Cis-Trans/complementation test, genetic fine structure (r-II locus)

UNIT III

Mutations: types of mutations; molecular basis of gene mutation; site directed mutagenesis Transposable elements in prokaryotes and eukaryotes, transposon induced mutations. Concept of proto-oncogenes and oncogenes

UNIT: IV

DNA recombination mechanisms, molecular mechanism of recombination; Multigene families and their evolution Chromosome mapping in eukaryotes: genetic and physical mapping of genes/chromosomes, restriction mapping- concept and applicability.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Genomes.	Brown, T.A. (1999).	BIOS Scientific Publishers limited, UK.
2	Principles of Genetics.	Gardener, E.J., Simons, M.J., and Sinustad, D.P. (1991).	John Wiley Sons Inc., New York
3	Gene VII	Lewin, B. (2000).	Oxford University Press, New York.
4	Genetics.	Strickberger, M.W. (2001).	Prentice-Hall, Inc., Englewood Cliffs, N. Jersey.
5	Evolutionary Genetics.	Smith, J. M. (1998).	Oxford University Press, New York.
6	Principles of Genetics,	Snustab, D. P., Simmons, M. J. and Jenkins, J. B. (1997).	John Wiley and Sons, Inc., New York.

STRESS PHYSIOLOGY

Course Code	BOT606-18
Course Title	STRESS PHYSIOLOGY
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical with Botany as one main subject
Course Objective	To learn the concepts of stress physiology in plants To understand the mechanisms of plants for alleviating the stress.

UNIT : I

Stress: abiotic and biotic stress – overview Osmotic adjustments: role of Glycine betaine, mannitol, proline, polyamines Changes in carbohydrate metabolism, Reactive Oxygen Species (ROS)

UNIT: II

Role of transcription factors; DREB, dehydration-responsive element (DRE) binding protein; COR/CBF regulon; Role Late Embryogenesis proteins (LEA), heat shock proteins, Dehydrins, antifreeze proteins, etc.

UNIT III

Signal transduction in response to stress: role of calcium and G-proteins; Role of phytohormones in plant stress; ethylene response pathway; the abscisic and regulatory network; Biotic stress signalling (calcium mediated pathogen defence programme)

UNIT: IV

Bioengineering plants for stress tolerance: genetic engineering approaches for insect resistance (Bt approach); gene silencing; RNAi – role in biotic stress management; concerns about GM crops; regulation of GM crops.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Molecular Stress Physiology of Plants	AnathBandhu Das, GyanaRanjan Rout	Springer India
2	Plant Physiology	Mukherjee, S., Ghosh, A.K.	New Central Book Agency; 3rd Revised edition edition
3	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.

Course Code	BOT608-18		
Course Title	ADVANCED PLANT BIOCHEMISTRY		
Type of course	Theory		
L T P	4	0	0
Credits	4		
Course prerequisite	B.Sc. Medical with Botany as one main subject		
Course Objective	To learn the concepts of principles of bioenergetics and the metabolism of biomolecules. To understand the mechanism of respiration and photochemistry and photosynthesis.		
4	Plant Physiology,	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.

ADVANCED PLANT BIOCHEMISTRY

UNIT 1:

Principles of bioenergetics: bioenergetics and thermodynamics; concept of free energy; biological oxidation-reduction reactions- redox potential and free energy; phosphoryl group transfer and ATP. Enzymes: kinetics of single-substrate enzyme catalyzed reactions- Michaelis-Menton equation and its significance; enzyme inhibition and mechanism of enzyme catalysis; extraction and purification of enzymes (brief account).

UNIT: II

Nitrogen and sulphur metabolism: nitrogen in environment; mechanism of nitrate uptake and assimilation; ammonium assimilation; biological nitrogen fixation; nodule formation and nod factors; photorespiratory nitrogen cycle; sulphur uptake, transport and assimilation.

UNIT: III

Respiration and lipid metabolism: glycolysis and citric acid cycle (overview and unique features in plants); pentose phosphate pathway; electron transport system; synthesis and release of ATP; alternative oxidase system; cyanide resistant respiration; classification of lipids; fatty acid biosynthesis; oxidation of saturated and unsaturated fatty acids; glyoxylate cycle.

UNIT: IV

Photochemistry and photosynthesis: photosynthesis from historical and evolutionary perspective; photosynthetic pigments; components of light reaction; light harvesting complexes; photo-oxidation of water; mechanisms of electron and proton transport; carbon assimilation, Calvin cycle (C3 cycle), C4 Cycle, CAM pathway; characteristics of C3, C4 and CAM plants; photorespiration and its energetics

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of Plants.	Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000).	American Society of Plant Physiologists, Maryland.
2	Lehninger Principles of Biochemistry: 6th Edition	<u>Nelson</u> , D. L., <u>Cox</u> , M.M	Macmillan Learning, 2012
3	Plant Physiology,	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.
4	Plant Physiology	Mukherji, S & Ghosh, A.K.	New Central Book Agency (P) Limited, 2009-
5	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.
6	Biochemistry and Molecular Biology of Plants.	Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000).	American Society of Plant Physiologists, Maryland.

PROJECT WORK

COURSE CODE	BOT610-18
COURSE TITLE	PROJECT WORK
Type of course	Practical Work
L T P	0 0 10
Credits	5
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	The main objective of project work is to introduce the candidate to the practical aspects of research work

Each student will submit project work report on any one topic related to Botany. Project work will be guided by supervisor of the university and will be examined by external.

PRACTICAL COURSE ON CELL BIOLOGY AND MOLECULAR GENETICS

Course Code	BOT612-18
Course Title	PRACTICAL COURSE ON CELL BIOLOGY AND MOLECULAR GENETICS
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	To learn the basic methods of cell and molecular biology.

LIST OF EXPERIMENTS

1. Study of DNA replication mechanism
2. Demonstration of cell cycle, mitosis and meiosis.
3. Identification of different stages of mitosis and meiosis from temporary and permanent slides.
4. Study of morphology of metaphase chromosomes from onion root meristems.
5. Study of various cell organelles using prepared slides and models
6. Demonstration of microscopes (Simple compound microscope, phase contrast, fluorescence, SEM)
7. Isolation of plant DNA and its quantification by spectrophotometric method.
8. Plant DNA extraction using standard protocols.
9. Aseptic culture techniques for establishment and maintenance of cultures
10. Isolation of plant DNA and its quantification by spectrophotometric method
11. DNA check run by Agarose Electrophoresis
12. Preparation of different growth media for bacteria
13. Estimation of growth rate in different bacteria and preparation of growth curve.
14. Isolation of different bacterial colonies by streaking method.
15. Preparation of bacterial colonies by plating method.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Practical Applications of Plant Molecular Biology	<u>Robert J. Henry</u>	Nelson Thornes
2	Plant Molecular Biology — A Laboratory Manual	Melody S. Clark	Springer-Verlag Berlin Heidelberg

PRACTICAL COURSE ON STRESS PHYSIOLOGY AND BIOCHEMISTRY

Course Code	BOT614-18
Course Title	PRACTICAL COURSE ON STRESS PHYSIOLOGY AND BIOCHEMISTRY
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical with Botany as main subject.
Course Objective	To understand the enzyme activity changes in stress conditions and qualitative quantitative methods for estimation of biomolecules

LIST OF EXPERIMENTS

1. Changes in biochemical parameters in response to biotic/abiotic stress
2. Estimation of changes in amino acids response to stress
3. Changes in superoxide dismutase in response to stress
4. Changes in catalase in response to biotic/abiotic stress
5. Changes in ascorbate peroxidase in response to stress
6. Changes in glutathione reductase in response to stress
7. Changes in protein in response to biotic stress by SDS- PAGE
8. Changes in protein levels in response to cold stress by SDS-PAGE
9. Estimation of reducing sugars in a sample by titrimetric method.
10. Determination of saponification value of a given fat or oil.
11. To study the effect of time and enzyme concentration on the rate of reaction (e.g. action of diastase on starch) by spot plate method.
12. To study the effect of substrate concentration on the activity of enzyme and determination of its K_m value.
13. Extraction and separation of chloroplast pigments in the plant material by partitioning into different solvent systems.
14. Separation of chloroplast pigments by thin layer chromatography.
15. Determination of succinate dehydrogenase activity.
16. To study principles of colorimetry and spectrophotometry.
17. Extraction of chloroplast pigments from leaves and preparation of absorption spectrum of photosynthetic pigments and anthocyanins.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Practical Text Book of Plant Physiology	Daniel Trembly Macdougall	Logmans, Green and Co.
2	Practical Manual of Plant Ecology and Plant Physiology	Sundara S. Rajan	Anmol Publisher
3	Practical Physiology of Plants: With Illustrations	Francis Darwin	Forgotten Books
4	Practical Plant Biochemistry	Muriel Wheldale Onslow (Hon)	Nabu Press
5	Practical Plant Biochemistry	Muriel Onslow	Read Books