

M.Sc BOTANY

SYLLABUS
(with effect from June 2015)



DEPARTMENT OF BIOLOGY
The Gandhigram Rural Institute – Deemed University
Gandhigram – 624 302 Tamil Nadu

**MSc. BOTANY PROGRAMME
SCHEME OF EXAMINATION**

FIRST SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	15BOTP0101	Plant Diversity	4	4	-	3	40	60	100
	15BOTP0102	Taxonomy of Angiosperms	4	4	-	3	40	60	100
	15BOTP0103	Environmental Biology	4	4	-	3	40	60	100
	15BOTP0104	Developmental Botany, Horticulture & Plant Breeding	4	4	-	3	40	60	100
	15BOTP0105	Plant Diversity and Plant Taxonomy- Practicals	2	-	4	3	60	40	100
	15BOTP0106	Environmental Biology– Practicals	2	-	4	3	60	40	100
CNCC	15GTPP0101	Gandhi in Everyday Life	-	2	-	-	50	--	50
	15BOTP01F1	Field Visit	-	-	2		50	-	50
		Total credits	20						

SECOND SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	15BOTP0207	Plant Physiology & Biochemistry	4	4	-	3	40	60	100
	15BOTP0208	Medical Botany	4	4	-	3	40	60	100
	15BOTP0209	Biostatistics	4	4	-	3	40	60	100
	15BOTP0210	Plant Physiology & Biochemistry – Practicals	2	-	4	3	60	40	100
	15BOTP0211	Seminar	2	2	-	-	50	-	50
NME	-	Non Major Elective	4	4	-	3	40	60	100
CNCC	15BOTP02F2	Extension/Field visit/Internship	-	-	2	-	50	--	50
	15ENGP00C1	Communication and Soft Skills	-	-	2	-	50	-	50
		Total credits	20						

THIRD SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	15BOTP0312	Instrumentation Techniques and Research Methods	4	4	-	3	40	60	100
	15BOTP0313	Molecular Biology	4	4	-	3	40	60	100
	15BOTP0314	Fundamentals of Microbiology	4	4	-	3	40	60	100
	15BOTP0315	Instrumentation Techniques - Practicals	2	-	4	3	60	40	100
	15BOTP0316	Fundamentals of Microbiology-Practicals	2	-	4	3	60	40	100
ME	15BOTP03EX	Major Elective	4	4	-	3	40	60	100
MC	15BOTP03MX	Modular course	2	2	-	-	50	-	50
VPP	15EXNP03V1	Village Placement Programme	2	-	-	-	50	-	50
		Total credits	24						

FOURTH SEMESTER									
	Course code	Course Title	C	L	P	E	CFA	ESE	Total
CORE COURSES	15BOTP0417	Cell Biology and Genetics	4	4	-	3	40	60	100
	15BOTP0418	Plant Resource Utilization and Biodiversity Conservation	4	4	-	3	40	60	100
	15BOTP0419	Biotechnology & Genetic engineering	4	4	-	3	40	60	100
	15BOTP0420	Dissertation	6	12	-	-	75	75*+ 50**	200
MC	15BOTP04MY	Modular course	2	2	-	-	50	-	50
		Total Credit	20						
		Overall Credits	84						

*Evaluation by External Examiner	**Evaluation by External and Internal Examiners
L-Lecture Hours	C-Credits
P-Practical Hours	CNCC-Compulsory Non Credit Course
E-Exam Hours	MC- Modular course
CFA-In-semester continuous assessment	ME – Major Elective
ESE-End Semester Assessment	VPP – Village Placement Programme

*Major Elective Courses (4 credits)	Modular Courses (2 Credits) 15BOTP 03MX/ 04MY
15BOTP03E1 Mushroom Biotechnology	Advanced Molecular Techniques
15BOTP03E2 Plant Ecology	Rural Biotechnology
15BOTP03E3 Forest Botany	Bioinformatics
	Plant Tissue culture Technology

Objectives:

To enable the students:

- To have comprehensive knowledge on lower plants
- To understand the diversity, reproduction and economic importance of lower plants
- To understand the evolutionary significance of lower plants and Gymnosperms.

Learning Outcomes:

The course will provide a comprehensive knowledge on diversity of plant kingdom with focus on Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Paleontology.

On satisfying the requirements of this course, students will have the knowledge and skills on:

- Diversified forms of plants
- Salient features of every classification and can describe the functions of classification
- Review critically the biology and ecology of fossil groups of plants
- Economic importance and special characteristics of the specified examples under each category
- Phylogenetic relationship among lower plants
- Identification of fossil forms of Pteridophytes and Gymnosperms

Unit I**Phycology**

Classification of Algae by Fristch; General characteristics of all classes of Algae; Distribution, habitat, thallus organization, reproduction (vegetative, asexual, sexual) and life cycle of *Chlorella* and *Polysiphonia*; Phylogeny and Economic importance of Algae.

Unit II**Mycology and Plant Pathology**

Classification of Fungi by Aleoxopolous; General characteristics; Distribution, habitat, reproduction (vegetative, asexual, sexual) and lifecycle of *Rhizopus* and *Agaricus*; Economic importance of Fungi. General account on structure and reproduction of Lichens. Outline on plant diseases - causative agents, symptoms and control measures of Tikka disease of groundnut and Blast disease of rice.

Unit III**Bryophytes**

Classification of Bryophytes by Rothmaler; General characteristics of all classes of Bryophytes; Distribution, habitat, vegetative and anatomic structures, reproduction (vegetative, asexual, sexual) and lifecycle of *Marchantia* and *Funaria*; Phylogeny and Economic importance of Bryophytes.

Unit IV

Pteridophytes

Classification of Pteridophytes by Smith; General characteristics of all classes of Pteridophytes; Distribution, Morphology, anatomy, reproduction and lifecycle of *Selaginella* and *Adiantum*; Phylogeny and Economic importance of Pteridophytes.

Unit V

Gymnosperms & Paleobotany

Classification of Gymnosperms by Sporne; General characteristics of all classes of Gymnosperms; Distribution, vegetative, anatomy, reproduction and lifecycle of *Gnetum*; Phylogeny and Economic importance of Gymnosperms. Brief account of process of fossilization, type studies on *Rhynia* and *Leginopttris*.

Text Books

1. Vashista, P.C., Sinha, A.K. and Kumar, A. 2006. Gymnosperms. Revised Edition. S. Chand & Company Ltd, New Delhi.
2. Johri, R.M., Latha, S. and Sharma, S. 2004. Textbook of Algae. Dominant Publishers and distributors, New Delhi.
3. Johri, R.M., Latha, S. and Sharma, S. 2004. Textbook of Broyophytes. Dominant Publishers and distributors, New Delhi.
4. Vashista, P.C., Sinha, A.K. and Kumar, A. 2005. Pteridophyta. Revised Edition. S. Chand & Company Ltd, New Delhi.
5. Pandey, B. P. 2004. College Botany Volume I & II. S. Chand & company Ltd, New Delhi.
6. Kumar, H.D. and H.N. Singh. 1996. A Textbook of Algae. Affiliated East West Pvt. Ltd Madras.
7. Vashista, B.R. 1992. Algae. S. Chand & company Ltd. New Delhi.

Reference Books

1. Gilbert. M. Smith 1998. Cryptogamic Botany. Volume 1 & 2. Tata McGraw hill Publishing Company Ltd, New Delhi.
2. Aleoxopolous, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. IV edition, John Wiley & Sons, New York.
3. Sporne. K.R. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication.
4. Parihar. N.S. 1967. An introduction of Embryophyta, vol. III – Pteridophyta, Central book depot, Allahabad.
5. Chapman , V.J. 1962. The Algae. Macmillan & Co. Ltd. New York.
6. Smith, G.M. 1955. Cryptogamic Botany. II. McGraw-Hill Book Co., New York, U.S.A.
7. Fritsch F.E. 1935 & 1945. The structure and reproduction of Algae, Vol. 1&2, Cambridge University press, London.
8. Pathak, C. 2003. Latest Portfolio of Theory and Practice of Pteridophyta. Dominant Publication, New Delhi.

Objectives:

To enable the students:

- To understand the various aspects of plant nomenclature and classification
- To understand the classical and modern trends of Angiosperm taxonomy
- To understand the salient features of angiosperm families with special reference to sexual characters

Learning Outcomes:

Students are expected to gain theoretical knowledge and acquire basic skills on the plant taxonomy with special reference to Angiosperms. Upon completion of the course, the students will be able to:

- Illustrate the types; merits & demerits of various system of classification
- Relate taxonomy and other fields of botany
- Combine classical plant taxonomy with modern molecular phylogeny
- Integrate concepts of plant evolution and speciation into and understanding of how organisms are classified in a molecular phylogenetic framework
- Learn the norms of ICBN and Construction of keys.
- Identify the angiosperms families with specific key characters
- Learn various advanced tools to study plant taxonomy

Unit I**Introduction to plant taxonomy**

History of plant classification; History of botanical explorations and botanical researchers in India; Detailed study on sexual system: Carolus Linnaeus; Natural system: Bentham & Hooker; Phylogenetic system: Bessey and Hutchinson; Angiosperm Phylogenic Group: Brief outline of APG - I (1998), APG - II (2003), APG - III - (2009).

Unit II**Botanical nomenclature**

International code of Botanical Nomenclature; History of Botanical Nomenclature; principles of ICBN; Types method; Author citation; Retention and rejection of names; Publication of names; Effective and valid publication; Construction of taxonomic keys: Indented and bracketed keys.

Unit III**Phylogeny and modern aspects**

Phylogeny of Angiosperms: Origin and evolution of angiosperms; Important phylogenetic concepts; Taxonomic evidences obtained from Anatomy, Embryology and Palynology, Chemotaxonomy and Molecular taxonomy; Brief account on computer aided plant identification systems; e-floras; Virtual herbaria; Interactive keys.

Unit IV

Important families

Salient features; Vegetative and sexual characters of Magnoliaceae, Capparidaceae, Menispermaceae, Rhamnaceae, Meliaceae, Lythraceae, Fabaceae, Sapindaceae, Combretaceae, Vitaceae, Myrtaceae, Aizoaceae, Passifloraceae and Polygalaceae.

Unit V

Important families

Salient features; Vegetative and sexual characters of Rutaceae, Acanthaceae, Bignoniaceae, Lamiaceae, Verbenaceae, Loranthaceae, Rubiaceae, Commelinaceae, Orchidaceae, Cyperaceae and Poaceae.

Text Books

1. Sharma, O.P. 2013. Plant Taxonomy. McGraw Hill Education Pvt. Ltd. New Delhi.
2. Mondal, A.K. 2005. Advanced Plant Taxonomy. New Central Book Agency (P) Ltd., New Delhi.
3. Johri, R.M. 2005. Taxonomy. Vols. I-IV, Sonali Publication, New Delhi.
4. Bhattacharyya, B. 2005. Systematic Botany. Narosa Publishing House, New Delhi.
5. Subramanyam, N.S. 1999. Modern Plant Taxonomy. Vikas Publishing House, New Delhi.
6. Singh, V., Pandey, P.C. and Jain, D.K. 1997. A text book of Botany: Angiosperms. Rastogi Publications, Meerat.
7. Singh, V. and Jain, D. K. 1997. Taxonomy of Angiosperms. Rastogi publications. Shivaji Road, Meerat.

Reference Books

8. Simpson, M.G. 2006. Plant Systematics. Academic Press, London
9. Ramasubbu, R. and Kumuthakalavalli, R. 2014. Trends in Angiosperm taxonomy. The Gandhigram Rural Institute - Deemed University, Dindigul.
10. Pandurangan, A.G. Vrinda, K.B. and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.
11. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition, Regency Publication, New Delhi.
12. Sivarajan, V. V. 1996. Principles of plant taxonomy. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

Objectives:

- To provide fundamental
- environmental principles that provides an in-depth understanding of our environment.
- The scientific basis for understanding how environmental systems work, population and wealth of our natural resources, environmental education, pollution effects and control, monitoring and assessment of environment.

Learning Outcomes:

The Course will provide an overview on the scope of environmental biology, fundamental principles, natural, wildlife resources & their conservation, resources, conservation strategies, remote applications, monitoring and assessment of environment.

- Understand the scope of environmental biology & Appreciate how ecosystem works
- Appreciate how elements are cycling in the environment
- Identify the natural resources and importance of national parks, sanctuaries and biosphere reserves
- Understand remote sensing and applications
- Appreciate the importance of environmental education
- Describe the types, effects and control of pollutions and importance of green house effect, acid rain and ozone depletion
- Recognise the need of environmental protection acts and laws on air and water pollution
- Realise the organizations involved in environmental protection
- Study the importance of monitoring and assessment of environment

Unit I**Ecosystem, Productivity and Biogeochemical cycles**

Scope of Environmental Biology- Ecosystem-Structure and functions-Types- Terrestrial- Forest and Grassland –Aquatic- Freshwater and Marine- Food chain and food web, ecological pyramids-Productivity- Primary and secondary- Biogeochemical cycles- Oxygen, carbon, nitrogen, sulphur and phosphorus.

Unit II**Population and Natural Resources**

Population ecology-Natural Resources-Renewable- Food, water and forest and Non-Renewable-Land, energy and mineral-Conservation of natural resources-wildlife conservation and management- National parks, sanctuaries and biosphere reserves.

Unit III

Remote Sensing and Environmental Education

Remote sensing-Components, types and applications-GIS and its application-Environmental Education-Objectives, goals, scope, guiding principles and Centre for Environmental Education.

Unit IV

Pollution

Environmental Pollution-Types;Air, water, soil and radio-active-sources, biological effects and control measures-Environmental protections acts - Air and water-Environmental Laws- Organizations involved in environmental protection.

Unit V

Monitoring and Assessment

Environmental Impact Assessment-Definition, steps, methods and problems- Public participation – Impact Analysis and Environmental Audit- Environmental Standards-Air and water- Physical, chemical and biological treatment of liquid effluents- Bio indicators and Environmental Monitoring-Bioassay –Application in Environment.

Text Books

1. H.D. Kumar 1995 General Ecology. Vikas publication House, New Delhi. pp. 258 –302; 556-598
2. B.K. Sharma and H. Kaur 1994 Environmental Chemistry. Goel pub. House, Meerut. pp. 47-515
3. Pushpa Dahiya and Manisha Ahlawat 2013 Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.
4. Purohit, Shammi & Agrawal 2012 Environmental Sciences – A New Approach Agrobios (India), Jodhpur
5. Sharma, P.D. 2002 Environmental biology Rastogi and company, New Delhi : pp – 315 – 373; 517-530

Reference Books

6. Agarwal, S.K. 2002 Eco – informatics. Vol I, III, IV APH pub. Company, New Delhi. Vol. I: 135 – 165 : 265 – 311; Vol. III : 221 – 259; Vol. IV : 1-140.
7. Metcalf and Eddy 2011 Waste water Engineering- Treatment and Reuse. Tata Mc Graw Hill Education Pvt. Ltd, New Delhi. pp.311-1026.
8. V.S. Kulkariani, S.N. Kaw and R.K. Trivedy 2002. Environmental Impact Assessment for wetland protection. Scientific publishers (India). Jodhpur pp: 4 – 24; 49 - 62
9. Kaiser Jamil 2001. Bio indicators and biomarkers of Environmental pollution and Risk assessment. Oxford and IBH Pub. Co. Pvt. Ltd, New Delhi. pp.1 – 168.
10. R.K. Trivedy 2000. Pollution and bio-monitoring of Indian rivers. ABD publishers, Jaipur, India. pp.1-332.
11. Ramesh Ghanta and Digumarti Bhaskara Rao 1998. Environmental education – problems and prospects – Discovery pub. House, New Delhi pp1-14.
12. Kailash Thakur 1997. Environmental protection law and policy in India. Deep and Deep pub. New Delhi. pp. 184-197; 210 – 248.
13. Trivedi, P.R. 1996. Encyclopedia of environment pollution, planning and conservation APH Pub. New Delhi. Vol. 2; 45 – 144

**15BOTP0104 DEVELOPMENTAL BOTANY, HORTICULTURE Credits -4
AND PLANT BREEDING**

Objectives:

To enable the students:

- To understand the various aspects of plant development and sexual reproduction
- To learn different techniques on horticulture
- To understand the various aspects of plant breeding and its methodologies

Learning Outcomes:

This course outline is designed to develop awareness and interest among students in plants and plant development; plant propagation and plant breeding to develop commercial crops. By the end of the course, students may be able to:

- Discuss the structural elements of plants meristems, organogenesis and embryology
- Understand the micro and mega spirogenesis; sexual incompatibility, types of endosperm
- Describe the techniques involved in plant propagation and plant breeding knowledge on plant biotechnology and conventional horticulture techniques.
- Acquire combined knowledge with special emphasis over pure line and clonal selections
- Acquire knowledge on various aspects of Indoor and Outdoor gardening

Unit I

Plant Anatomy

Plant morphogenesis: Meristems – types; Organization of shoot apical meristem ; Theories of organization of meristems ; Root - stem transition; Cambium: Origin, Structure and function, Factors affecting cambial activity; Wood: Structure, physical and mechanical properties, reaction wood, compression and tension wood, preservation of wood.

Unit II

Embryology I

Microsporogenesis: Anther and Pollen development; Physiological relationship of tapetum and sporogenous tissues, pollen fertility, sterility, pollen storage and pollen germination ; Megasporogenesis ; Female gametophyte development, structure of pistil.

Unit III

Embryology II

Pollination, Pollen - Pistil interaction; Double fertilization; Endosperm types: Nuclear, cellular, helobial and ruminant endosperms; Incompatibility: Methods to overcome

incompatibility; Development of monocot and dicot embryos; Apomixis and polyembryony.

Unit IV

Horticulture

Cultivation of commercial flower crops and vegetables; Propagation methods: cutting, layering, grafting and budding; Micropropagation of horticulture crops: Callus culture, somatic embryogenesis and synthetic seeds; Outdoor gardening: Hedges, fences, trees, rockeries and terrace garden; Indoor gardening: Bonsai and hanging basket.

Unit V

Plant Breeding

History of plant breeding, methods of plant breeding; Selection: Mass, pureline and clonal selection, merits and demerits; Heterosis and inbreeding depression; Improvement of crops through mutation, polyploidy and distant hybridization.

Text Books

1. Kumar, N. 2010. Introduction to Horticulture. VII Edition, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
2. Bhojwani, S.S. and Bhatnagar, S.P. 2008. The Embryology of Angiosperms. V Edition, Vikas publishing house Pvt Ltd., Noida, India.
3. Gupta, P.K. 2002. Cytology, Genetics, Evolution and Plant breeding. Deep and Deep publications, New Delhi.
4. Pandey, S.N. and Chadha, A. 2000. Embryology. Vikas Publishing House, New Delhi.
5. Pandey, B.P. 1995. Embryology of Angiosperms. S. Chand & Company Ltd., New Delhi.
6. Pandey, B.P. Plant Anatomy, 2004. S. Chand & Company Ltd., New Delhi.
7. Kumar, N. 1994. Introduction to Horticulture. Rajalakshmi Publications, India.

Reference Books

8. Kierman, J.A. 1999. Histological and Histochemical methods. Butterworth Publications, London.
9. Fahn, A. 1989. Plant anatomy. Peragamon Press, Oxford, New York.
10. Esau, K. 1987. The Anatomy of seed plants. Wiley Eastern Ltd, New Delhi.
11. Ervin, L.D. 1979. Principles of horticulture. MacMillen Publishing Co. Inc. New York.
12. Maheswari, P. 1950. An introduction to embryology of Angiosperms. McGraw hill, New York.

**15BOTP0105 PLANT DIVERSITY, TAXONOMY AND
DEVELOPMENTAL BOTANY – PRACTICALS**

Credits - 2

Objectives:

To enable the students:

- To develop the skill on the identification of lower and higher plants with their salient features
- To develop the skill on preparation of herbarium and microslides for identification
- To create an overall knowledge on identification of all group of plants including fossil

Learning Outcomes:

The students will be able to:

- Evaluate and discuss groups of plants in terms of their diversity and describe their evolution, phylogeny.
- Apply the taxonomic principles in preparing keys and herbaria
- Analyse the anatomical and embryological stages of plants and their development
- Provides skill in structural and functional characteristics of various plant parts
- Acquire practical knowledge on identification of various groups of plants

EXPERIMENTS:

1. Morphology of vegetative and reproductive characteristics of the following:

Algae: *Hydrodictyon, Bulbochaete, Pithophora, Stigeoclonium, Fritschiella, Codium, Halimeda, Dictyota, Padina, Fucus* and *Batrochospermum*

Fungi: *Rhizopus, Peziza, Aspergillus, Agaricus, Polyporus* and *Lycoperdon*

Bryophytes: *Riccia, Marchantia, Plagiochasma, Dumortiera* and *Polytrichum*

Pteridophytes: *Psilotum, Lycopodium, Selaginella, Adiantum, Pteridium, Polypodium* and *Azolla*

Gymnosperms: *Cycas, Pinus* and *Gnetum*

Fossil forms: *Rhynia, Calamites, Bothrodendron, Calamostachys*

Lyginopteris, Heterangium, Cordaites, and Cardiocarpus

2. Salient features, vegetative and sexual characters of Magnoliaceae, Capparidaceae, Menispermaceae, Rhamnaceae, Meliaceae, Lythraceae, Fabaceae (Faboideae, Caesalpinoideae and Mimosoideae), Sapindaceae, Combretaceae, Vitaceae, Myrtaceae, Aizoaceae, Passifloraceae, Polygalaceae, Rutaceae,

Acanthaceae, Bignoniaceae, Lamiaceae, Verbenaceae, Loranthaceae, Rubiaceae, Commelinaceae, Orchidaceae, Cyperaceae, Poaceae

- 3. Preparation of dichotomous key for angiosperm families**
- 4. Collection, identification and preparation of 15 herbarium specimens and maintenance of a field note book**
- 5. Study tour or field trip to analyze the local flora**
- 6. Analysis and identification of fresh and herbarium specimens**
- 7. Observation of permanent slides of related topic covered in Anatomy (meristem, cambium and wood) and Embryology (anther, pollen, ovules, embryo and endosperms)**

Reference Books

1. Vashishta, K.M. 2008. Singa, A.K. and Singh, V.P. Algae. 9th Edition. S. Chand & Company Ltd, New Delhi. .
2. Vashista, P.C., Sinha, A.K. and Kumar, A. 2006. Gymnosperms. Revised Edition. S. Chand & Company Ltd, New Delhi.
3. Vashista, P.C., Sinha, A.K. and Kumar, A. 2005. Pteridophyta. Revised Edition. S. Chand & Company Ltd, New Delhi.
4. Sharma, P.D. 2005. Fungi and Allied Organisms. Narosa Publishing House, New Delhi.
5. Johri, R.M. 2005. Taxonomy. Vols. I-IV, Sonali Publication, New Delhi.
6. Pathak, C. 2003. Latest Portfolio of Theory and Practice in Bryophyta. Dominant Publishers and Distributors, New Delhi.
7. Sporne. K.R., 1976. Morphology of Pteridophytes. 4th edition, B.I. Publication.
8. Gupta. M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra.
9. Parihar. N.S. 1967. An introduction of Embryophyta. vol. III Pteridophyta. Central book depot, Allahabad.
10. Sporne. K. R. 1950. Morphology of Gymnosperms. Hutchinson University Library, USA.
11. Gamble, J.S. 1919-1925. The Flora of Presidency of Madras. Vol. I, II and III. Bishen Singh and Mahendra Pal Singh, Dehra Dun.

15BOTP0106 ENVIRONMENTAL BIOLOGY PRACTICALS Credits – 2

Objectives:

- To estimate electrical conductivity, dissolved solids, dissolved oxygen, carbon dioxide, chloride, hardness, BOD and BOD in different water samples
- To understand how to study the population of plants.
- To understand how to design bioassay studies on industrial effluents/ pesticides using fish, aquatic insects and larvae.

Learning outcomes:

By the end of this course students will be able to:

- Understand how to estimate Electrical conductivity, Dissolved solids. Dissolved oxygen, Carbon dioxide, Chloride, hardness, BOD and BOD in different water samples
- Understand how to study on population of plants.
- Understand the Bioassay studies on industrial effluents/ pesticides using fish, aquatic insects and larvae.

EXPERIMENTS:

1. Estimation of Electrical conductivity
2. Estimation of Dissolved solids
3. Estimation of Dissolved oxygen
4. Estimation of Carbon dioxide
5. Estimation of BOD in different water samples
6. Estimation of COD in different water samples
7. Estimation of Chloride
8. Estimation of Total hardness
9. Quadrant study on population
10. Bioassay studies on industrial effluents/ pesticides using fish, aquatic insects and larvae

Reference Books

1. P.K.Gupta 2012 Methods in Environmental Analysis Water, Soil and Air. Agrobios (India), Jodhpur.
2. APHA 2012 Standard Methods for the examination of water and waste water (20th Edition). American Public Health Association, Washington. D.C.

CNCC - COMPULSORY NON CREDIT COURSE

15GTPP0001

GANDHI IN EVERYDAY LIFE (2 Hours per week)

Objectives:

1. To understand and appreciate the principles and practices of Gandhi and their relevance in the contemporary times.
2. To develop noble character and attitude to enable the students to cope up with the challenges of daily life.

Learning Outcomes:

To enable students to:

- To study in-depth the life and message of Gandhi.
- To understand the Gandhian way of Management.
- To practice the Gandhian model of conflict reduction.
- To lead a humane life on Gandhian lines.
- To become a Gandhian constructive worker.

- Unit.I. **Understanding Gandhi:** Child hood days, Student days, influence of Books and Individuals, Religion, Family, and Social factors. Gandhi as rebel, acquaintance with vegetarianism, as lawyer, encountering and transforming humiliation: in India, in south Africa- train incident, Coach incident, on path way, at court, attack by protesters. Gandhi as political leader and reformer.
- Unit.II. **Management:** Gandhi’s experiments in managing family- Eleven vows, non-possession and sacrifice begin at home – Managing Ashram - community living, service and financial ethics – Managing Social movements- Transvaal March and Salt Satyagraha and nonattachment to position (Nishkama Seva).
- Unit.III. **Conflict Reduction:** Pursuance of truth and nonviolence ends and means, openness, transparency, love and kindness in handling relationship, nonviolent communication, practicing nonviolence in social and political issues (Satyagraha), conflict resolution practices, art of forgiveness and reconciliation and shanti sena.
- Unit.IV. **Humanism:** Trust in goodness of human nature, respect for individual and pluralistic nature of society, dignity of differences, equal regard for all religions (Sarvadharmā Samabhava), castes, races, colours, languages etc., simple and ethical life, swadeshi and unity of humankind.
- Unit.V. **Constructive programmes** and contemporary issues: Concept of Sarvodaya, poverty, terrorism, environmental degradation, problems in sharing common resources, health systems and education, science and technology and centralization of power and governance.

References:

- M.K. Gandhi, (2012) *An Autobiography or The Story of My Experiments with Truth*, Navajivan Publishing House, Ahmedabad.
- . (2003) *Satyagraha in South Africa*, Navajivan Publishing House, Ahmedabad.
- . (1945) *Constructive Programme: Its Meaning and Place*, Navajivan Publishing House, Ahmedabad.
- . (2003) *Key to Health*, Navajivan Publishing House, Ahmedabad
- . (1949) *Diet and Diet Reform*, Navajivan Publishing House, Ahmedabad.
- . *Basic Education*, Navajivan Publishing House, Ahmedabad.
- . (2004) *Village Industries*, Navajivan Publishing House, Ahmedabad.
- . (1997) *Hind Swaraj*, Navajivan Publishing House, Ahmedabad.
- . (2004) *Trusteeship*, Navajivan Publishing House, Ahmedabad.
- . (2001) *India of my Dreams*, Navajivan Publishing House, Ahmedabad.
- K.S.Bharathi (1995) *Thought of Gandhi and Vinoba*, *Shanti Sena*, Sarva Seva Sangh Prakashan, Varanasi.
- V.P.Varma, (1999) *Political Philosophy of Mahatma Gandhi and Sarvodaya*, Lakshmi Narain Agarwal, Agra.
- Louis Fisher (2010) *Gandhi: His Life and Message*.
- B.R. Nanda. (2011) *Mahatma Gandhi: A Biography*, Allied Publishers Private Ltd., New Delhi.
- N.K. Bose. (2008) *Studies in Gandhism*, Navajivan Publishing House, Ahmedabad.
- Gopinath Dhawan, (2006) *The Political Philosophy of Mahatma Gandhi*, Navajivan Publishing House, Ahmedabad.
- N. Radhakrishnan, (2006) *Gandhi's Constructive Programmes: An Antidote to Globalized Economic Planning?*, Gandhigram Rural Institute, 2006.

Films.

- Richard Attenborough, **Gandhi**.
- Syam Benegal, **The Making of Mahatma**.
- Anupam P. Kher, **Mine Gandhi Ko Nahin Mara**.
- Peter Ackerman and Jack Duvall, **A Force More Powerful**.

Objectives:

To enable the students :

- To understand the physiological mechanism of plants
- To understand the various biochemical pathways of plants
- To create a knowledge on different biochemical pathways, physiology and developmental aspects of plants

Learning outcomes:

This course will provide theoretical knowledge in plant structure and their functions.

After completion of this course this students are expected to be able to:

- Describe the physiological phenomena of plants in terms of mechanisms
- Will know the overview of biorhythms; stress physiology of plants
- Discuss different metabolic pathways
- Relate the characteristics and role of enzymes
- Comprehend nitrogen and lipid metabolism
- Understand photoperiodism & physiology of flowering

Unit I

Plant - water relations

Different Bio-physico-chemical phenomena; Diffusion; Imbibitions; Osmosis; Cell as an osmotic system; Absorbtion of water and minerals - Definition, pathway, mechanism, factor, significance; Translocation of water - Definition, theories related factor, significance; Mineral nutrition – Absorption theories, Macro and Micronutrients - Source, function, deficiency symptoms; Solution and sand culture; Transpiration – Definition, types, mechanism, factor, significance.

Unit II

Carbohydrate metabolism

Photosynthesis: Pigments and absorption spectra, Light reactions: Cyclic, non-cyclic and pseudocyclic photophosphorylation; Mechanism of photosynthesis, C4 cycle, CAM pathway and photorespiration;` Metabolic pathways - Carbohydrate metabolism - Glycolysis or EMP pathway, Pentose - Phosphate pathway, Krebs cycle (TCA cycle) Electron transport chain and oxidative phosphorylation - Biochemical importance and regulation.

Unit III

Nitrogen and fat metabolism

Classification of protein based on source, shape, composition and solubility, essential and non-essential amino acids; Nitrogen metabolism: NO_3 , NO_2 and NH_3 assimilation,

biosynthesis of amino acids, nitrogen fixation; Lipids: Classification, and importance, lipid metabolism - β Oxidation and Glyoxalate cycle.

Unit IV

Enzymes

Major classes of enzymes - oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases and Ligases - Characteristics of enzymatic reaction (enzyme concentration, substrate concentration and Michaelis - Menten equation); Enzyme specificity and enzyme inhibitors.

Unit V

Growth and development & Stress physiology

Growth and development: mode of action and physiological role of growth hormones; Physiology of flowering, phytochrome as photoreceptor - mode of action, photoperiodism; Vernalisation; Fruit set and ripening; Seed germination and dormancy; Biorhythms-basic concepts, characteristics & significance of biological clocks and circadian rhythm; General account on biotic and abiotic stress on plants.

Text Books

1. Pandey, S.N. and Sinha, B.K. 2009. Plant Physiology. IV Edition, Vikas Publishing company, Noida, UP.
2. Sinha, S. K. 2004. Modern Plant Physiology. Narosa publishing House, New Delhi, Chennai, Mubai.
3. Verma, S. K. 1995. A text book of Plant Physiology and Biochemistry. S. Chand & Company Ltd. Ram Nagar, New Delhi.

Reference Books

4. Taiz, L. and Zeiger, E. 2002. Plant Physiology, III Edition Sinauer Associates.
5. Noggle, G.R. and Fritz, G.J. 2001, Introductory Plant Physiology, Prentice - Hall, India.
6. Devlin, R.M., 2000, Plant Physiology, Affiliated East West Press Pvt. Ltd.
7. Epstein, E. 2000, Mineral Nutrition in Plants-Principles and Perspectives. Wiley.
8. John Charles Walker, 1997. Plant Physiology. McGraw Hill book Company, New York.
9. Devlin and Witham, 1996. Plant Physiology. CBS Publishers and Distributors, Delhi.
10. Mukhevji, S. and Ghosh, A. K. 1996. Plant Physiology. Tata McGraw- Hill publishing Company Ltd. New Delhi.
11. Salisbury, F.B. and Ross, C.W. 1993. Plant Physiology, IV Edition Wadsworth publishing company, California.
12. Goodwin, T.W. and Mercer, E.I. 1983. Introduction to Plant Biochemistry. Pergaman Press, U.S.A

Objectives:

To enable the students:

- To understand the various systems of treatment and herbal products
- To understand the effect of various phyto-constituents to cure various ailments
- To learn the preparative methodologies of various drug formulations to control diseases and symptoms

Learning outcomes:

The course will provide an overview of medicinal plants and special knowledge on the Indian medicine and role of herbals in treating various diseases; their pharmacognosy and phytochemical; herbal gardening and formularies & ethnobotany. On completion of this course students are expected to understand

- Different systems of Indian medicine, drugs from plant parts and their remedial properties
- Pharmacognosy, drug preparation, adulteration, drug evaluation
- Prospective medicinal plant cultivation methods and formularies
- Traditional health care systems & tribal medicines

Unit I**History and Classification of medicinal plants**

History, systems and developments of Indian Medicine: AYUSH: Ayurveda, Unani Siddah, Homeopathy; Classification of medicinal plants based upon the plant parts and phytoconstituents; Root drugs - *Aconitum napellus*, Bark drugs- *Cinchona officinalis*, Stem drugs- *Aristolochia indica*, Leaf drugs-*Digitalis purpurea*, Flower drugs-*Syzygium aromaticum*, Fruit drugs- *Papaver somniferum*, Seed drugs- *Strynox nux-vomica*, Whole plant - *Cannabis sativa*, Unorganized drugs - *Aloe vera*.

Unit II**Medicinal plants and Health care**

Poisonous plants; classification. description, mode of action, symptoms and treatments, some poisonous plants of Algae, Fungi, Pteridophytes, Gymnosperms and Angiosperms; Remedial plants for Cancer, Common diseases of nervous system, circulatory system, respiratory system, urinary system and reproductive system; Psycho active plants; Allergens: types - aero-allergens, pollen, spore allergens, ingessant allergens, skin allergens, drug allergy, phytotherapy for allergic symptoms.

Unit III

Pharmacognosy and Drug evaluation

Pharmacognosy - Collection and Processing of medicinal plants; Guidelines for harvesting, processing and marketing of medicinal plants; Preparation of crude drugs; Drug adulteration; Methods of drugs evaluation - Morphological characters and organoleptic methods; anatomical features.

Unit IV

Herbal garden and Cultivation

Herbal gardens - Introduction and scope, Principles and process involved; Plant growing methods, propagation techniques; Cultivation of medicinal plants: *Dioscorea floribunda* and *Papaver somniferum*.

Unit V

Traditional health care system and Ethnobotany

Local traditional health care system; Herbal home remedies of South India; Indigenous knowledge system on medicinal plants; Herbal formularies: Infusions and decoctions, oil extractions, ointments, lotions, washes, suppositories; Ethnobotany – Tribals of South India and tribal medicines.

Text Books

1. Jain, S.K. 1981. Glimpses of Ethnobotany. Oxford & IBH, New Delhi.
2. Kumar, N.C. 1993. An Introduction to Medical Botany, Emkay Publications, New Delhi.
3. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai.

Reference Books

4. Nadkarani, 1981. Materia medica, Popular Prakasam Publication, New Delhi.
5. Harborne, J.B. 1998. Phytochemical methods. Springer (India) Ltd., New Delhi.
6. Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent, Scientific publishers, India.

Objectives:

- Students will be able to make informed decisions based on data and apply statistical tools and techniques in their research works

Learning outcomes:

On the completion of the course students may able to:

- Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods
- Create and interpret visual representations of quantitative information, such as graphs or charts
- Understand and critically assess data collection and its representation
- Understand why biologists need a background in statistics

Unit I**Introduction to Statistics**

Introduction to Bio-Statistics - Development of Biostatistics and its applications - Sources of biological data - Secondary and Primary sources - Classification and tabulation of data - frequency distribution -Diagrammatic and Graphical representation of statistical data

Unit II**Descriptive Statistics**

Sampling and Theoretical Distributions - Sampling – meaning, advantages, concept of parameter and statistics, sample size, sampling error, sampling frame, Types of samples – Probability and non-Probability samples – purposive sampling, Reliability of samples. Introduction of probability and its applications – Theoretical Distributions – Binomial, Poisson and Normal distributions; Properties, uses and applications.

Unit III**Sampling and Theoretical Distributions**

Descriptive Statistics - Measures of central tendency - Measures of Dispersion: Measures – Mean, Median, Mode Range, and standard deviation, absolute and relative measures of dispersion.

Unit IV

Correlation and Regression Analysis

Correlation and Regression Analysis - Theory of correlation and regression. Definition, uses, types and correlation, Regression Lines – Properties of regression coefficients.

Unit V

Testing of hypothesis

Biological Measures and Hypothesis Testing: Rates, incidence, prevalence, mortality rate, case fatality; Measurement of risk, odds ratio and Bio-assay and dose responses
Test of attributes, small and large sample tests - Analysis of variance – one-way and two-way classification.

Reference Books

1. Arora P.N. Malhan P.K. 1996. Biostatistics, Delhi : Himalaya Publishing House.
2. Gupta, S.P.1992. Statistical Methods, New Delhi: Sultan Chand, 1992.
3. Gupta C.B.1992. An Introduction to statistical methods Vikas Publishers, New Delhi;
4. Daroga Singh, Chaundjari F.S.1986. Theory and Analysis of Sample survey, New Delhi; Wiley Eastern Ltd. New Delhi.
5. Palanichamy S. and Manoharan M. Statistical methods for biologists.

15BOTP0210 PLANT PHYSIOLOGY & BIOCHEMISTRY – PRACTICALS

Credits - 2

Objectives:

To enable the students:

- To develop the skills on quantitative and qualitative analysis of various biochemical components of plants
- To estimate the various biochemicals and their importance to the physiology of plants
- To understand the various physiological actions of plants

Learning outcomes:

This course will provide practical knowledge on Physiology and Biochemistry of plant structure and functions. After completion of this course, the students are expected to:

- Analyze the biochemical components of any plant samples
- Understand the photosynthetic mechanism and related events of plants
- Understand the role of various growth promoting substances and their action
- Acquire knowledge on physiological response of plants to various factors

EXPERIMENTS:

1. Determination of osmotic potential of cell sap by plasmolytic method
2. Estimation of moisture, dry matter and ash content in higher plants through pot culture studies
3. Quantification of photosynthetic pigments (Chlorophyll a, b, and carotenoids)
4. Quantification of non photosynthetic pigments (anthocyanin and flavonoids) in plants
5. Separation of anthocyanins by paper chromatography and thin layer chromatography
6. Absorption spectrum of chlorophyll
7. Measurement of Hill reaction in isolated mesophyll cells
8. Estimation of total carbohydrates in plant tissues (sugars / starch)
9. Estimation of protein in plant tissues
10. Estimation of lipids in plant tissues

11. Determination of seed viability by Triphenyl Tetrazolium Chloride (TTC) test
12. Bioassay of IAA and GA₃
13. Effect of phytochrome and kinetin on seed germination
14. Determination of mineral deficiency of plants through hydroponics
15. Effect of soil less growth on plants (hydroponics)

Reference Books

1. Palanivelu, P. 2009. Analytical biochemistry and separation techniques. IV Edition
Twentyfirst century publication, Madurai.
2. Sawhney, S.K. and Randhir Singh, R. 2000. Introductory Practical Biochemistry.
Narosa Publishers, New Delhi.
3. Harborne, J.B., 1998. Phytochemical Method. Springer (India) Pvt. Ltd., New
Delhi, 1998.
4. Bajracharya, D. 2003. Experiments in Plant Physiology, Narosa Publishing House,
New Delhi.
5. Sadasivam, S. and Manickam, A. 1992. Biochemical Methods for Agricultural
Science. Wiley Eastern Limited, New Delhi.
6. Mannar Mannan, R. 1989. A Short Term Course Manual in Plant Physiology for
College Teachers. Madurai Kamaraj University, Madurai.

CNCC - COMPULSORY NON CREDIT COURSE
15ENGP00C1 COMMUNICATION AND SOFT SKILLS
(2 Hours per week)

CONTENTS

1. Listening, Reading and Documentation

1.0 Objectives

1.1 Oral Communication Skills

1.1.1 Listening

1.1.2 Listening and Hearing

1.1.3 Barriers to Listening

1.1.4 What Do You Gain by Listening?

1.1.5 Everyday Listening

1.1.6 Workplace Listening

1.1.7 Documenting

1.1.8 Review questions

1.2 Written Communications Skills

1.2.1 Reading

1.2.2 What Do You Read?

1.2.3 What is Reading?

1.2.4 What are the Reading Skills?

1.2.5 Barriers to Reading

1.2.6 Reading Strategies

1.2.7 Review Questions

1.3 Summary

2. Instructions and Transcoding

2.0 Objectives

2.1 Ability to Read and Follow Instructions

2.1.1 Instructions

2.1.2 Giving and Following Instructions

2.1.3 Directions

2.1.4 Language of Instructions

2.1.5 Review Questions

2.2 Ability to Interpret and Transcode Information

2.2.1 Graphic Communication

2.2.2 Interpretation of Charts, Tables and Graphs

2.2.3 Transcoding

2.2.4 Review Questions

2.3 Summary

3. Interpersonal Communication

3.0 Objectives

3.1 Asking for and Responding to Information

3.1.1 Relationship in communication

3.1.2 Information Collection

3.1.3 Telephone Conversation

- 3.1.4 Informational Communication
- 3.1.5 Encoding and Decoding Strategies
- 3.1.6 Principles of Communication
- 3.1.7 Review Questions
- 3.2. Communication with Employees, Supervisors and Customers
 - 3.2.1 Appreciating Others
 - 3.2.2 Accepting Criticism from Others
 - 3.2.3 Relational Communication
 - 3.2.4 Perception
 - 3.2.5 Environment
 - 3.2.6 Emotional Intelligence
 - 3.2.7 Benefits of Emotional Intelligence
 - 3.2.8 Review Questions
- 3.3. Summary
- 4. Employment Communication**
 - 4.0 Objectives
 - 4.1 Purpose of Education
 - 4.1.1 Goal Setting Activity
 - 4.1.2 Written Communication
 - 4.1.3 Spelling
 - 4.1.4 Grammar
 - 4.1.5 Review Questions
 - 4.2 Job Application and Interview
 - 4.2.1 Communication for Employment
 - 4.2.2 Covering Letter
 - 4.2.3 Résumé Writing
 - 4.2.4 Interview
 - 4.2.5 Frequently Asked Questions
 - 4.2.6 Model Interview
 - 4.2.7 Review Questions
 - 4.3 Summary
- 5. Courtesy and Eye Communication**
 - 5.0 Objectives
 - 5.1 The Importance of Being Courteous
 - 5.1.1 Politeness Story
 - 5.1.2 Politeness expressions
 - 5.1.3 Five Magic Expressions in English
 - 5.1.4 Review Questions
 - 5.2 Non-verbal Communication
 - 5.2.1 Body Language
 - 5.2.2 Paralanguage
 - 5.2.3 Eye Contact
 - 5.2.4 Review Questions
 - 5.3 Summary

**15BOTP0312 INSTRUMENTATION TECHNIQUES AND
RESEARCH METHODS**

Credits – 4

Objectives:

To enable the students:

- To understand the working principles and applications of instruments used in the studies related to various disciplines of biological sciences.
- To appreciate the importance, concept of research and learn the art of thesis, paper writing and publication.

Learning Outcomes:

The Course will provide an overview to know the general laboratory procedures and maintenance of research equipments, concept of research and preparation of thesis:

- Understand general laboratory procedures and maintenance of research equipments, microscopy, pH meter and preparation of different buffers
- Describe the pH measurement in soil and water samples
- Understand how to isolate cellular constituents
- Realise the need of centrifuges and their uses in research
- Understand how to separate amino acids and sugars using paper & thin layer chromatography
- Realise the principle and applications of gas liquid chromatography, HPLC and
- Learn the principles and applications of electrophoresis
- Realise the importance of UV-Visible.
- Understand how to estimate sugars, amino acids and sugars using spectroscopic techniques
- Describe the principle of flame photometer and bomb calorimeter
- Understand the objectives, types and importance of research
- Understand how to present research papers in seminars and conferences
- Realise the need of publication and know the importance of impact factor & citation index
- Describe the methods of writing scientific paper and components of research paper
- Understand how to prepare manuscript & methods of correcting proof
- Able to know how to prepare research proposals, identification of funding agencies and availability of research fellowships

Unit I

Microscopy, pH and Buffer

General Laboratory procedures and maintenance of research equipments- Microscopy- General principles-Confocal Microscope,SEM and TEM; pH; basic principles and construction of pH meter- pH electrodes- Principles and application of buffers- Mechanism of buffer action and preparation of common buffers- Citrate, acetate, tris and phosphate- Application of buffers- pH measurements of soil and water.

Unit II: Isolation, Fractionation and Separation

Isolation, fractionation and separation of cellular constituents- Isolation of chloroplasts, mitochondria, nucleic acids and enzymes- Homogenization- Manual, mechanical and sonication- Centrifugation- Centrifuges and their uses- Micro centrifuge, high speed refrigerated centrifuges, ultra centrifuges, differential and density gradient centrifugation- Chromatography- Paper, thin layer, Ion-exchange, column, affinity - separation of amino acids and sugars- Gas liquid chromatography, HPLC.

Unit III: Electrophoresis, Colorimetry and Calorimeter

Electrophoresis- Principles, factors affecting electrophoretic mobility- Support medium- Agarose and polyacrylamide gels- Electrophoresis of proteins and nucleic acids- Spectroscopic techniques- UV-Visible and FT-IR - Flame photometer and Bomb calorimeter- Principle and applications.

Unit IV

Research and Project writing Methods

Research- Definition, objectives, types and importance- Research methods in Biological Sciences- Research process- Literature survey- sources- scientific databases- Research report writing- Parts of Thesis and Dissertation-Title, certificate, declaration, acknowledgements, contents- List of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods- Results- Presentation of data-Tables, figures, maps, graphs, photographs-Discussion-Summary, Bibliography/References and Appendix.

Unit V

Scientific paper writing

Presentation in seminars and conferences- Writing scientific paper- Organization of scientific paper- Importance of title- abstract- key words, Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References-Publication in research journals-Standards of Research journals- Peer- review- impact factor- citation index-Preparation of manuscript- Proof correction- proof correction marks symbols- Method of correcting proof- Writing chapters in books- Preparation of Research proposal and funding agencies – Research fellowships.

Text Books

1. N. Gurumani 2010. Research Methodology for Biological Sciences. MJP Publishers, Chennai.
2. Biju Dharmapalan, 2012. Scientific Research Methodology. Narosa Publishing House, New Delhi.
3. David T. Plummer 1988. An introduction to practical biochemistry, Tata Mc Graw Hill pub. Co. Ltd, New Delhi.
4. J. Jeyaraman 1981. Laboratory Manual in Biochemistry. New Age International publishers, New Delhi.

Reference Books

5. S. Palanichamy and M. Shunmugavelu 2009. Research methods in biological sciences. Palani paramount publications, Palani.
6. K. Kannan 2003. Hand book of Laboratory culture media, reagents, stains and buffers Panima publishing corporation, New Delhi.
7. Keith Wilson and John Walker 2002. practical biochemistry – Principles and techniques. Fifth edn. Cambridge Univ. Press.
8. P. Asokan 2002. Analytical biochemistry – Biochemical techniques. First edition – Chinnaa publications, Melvisharam, Vellore
9. Rodney Boyer, 2001. Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.

Objectives:

- To impart information on the historical developments of Molecular Biology
- An in-depth study on Structure and organization of Chromosome, Replication Process, Transcription process, Translation process and Mutagenesis.
- To expose the students on the understanding of various techniques used for molecular studies.

Learning outcomes:

The students are being able to:

- Understand in-depth knowledge on Molecular Biology
- Know various types of Mutagenesis
- Understand in detailed mechanisms of DNA Replication
- Understand the overall concepts of Transcription
- Understand in detailed mechanisms Translation

Unit I**Introduction to Molecular Biology**

Introduction and historical development - Central dogma of Molecular biology. The Logic of molecular biology – the efficient argument, examination of models and strong inference. Molecules of life – DNA world – RNA world and protein world. Prokaryotic and Eukaryotic Chromosome organization. Genes – definition, types and functional organization. Gene transfer mechanism- bacterial transformation, conjugation and transduction. Structure of DNA - primary, secondary and different forms (A, B, C Z).

Unit II**Mutagenesis**

Mutation – Types – Molecular and biochemical basis of mutation. Mutagenesis – Spontaneous and induced – Base – analog, physical agents, chemical mutagens, intercalating substances and mutator genes. Reversion – definition – Types – Mechanisms – application (Ames test). Mutants – Types and Uses.

Unit III

DNA Replication

Basic rule. The Geometry of DNA replication – Semiconservative replication of double – stranded DNA and Circular DNA molecules. Enzymology – DNA Polymerases I and III, DNA ligase and DNA gyrase. Events in the replication fork – Continuous and discontinuous. Plasmid and ϕ 174 DNA replication. DNA damage – repair mechanism – DSOS function.

Unit IV

Transcription

Basic factors of RNA Synthesis. RNA polymerases – I, II and III. Mechanisms – RNA Chain Initiation, elongation and termination. Classes of RNA Molecules – Messenger, ribosomal and transfer RNA. RNA splicing mechanisms – Spliceosomes, Group I and Group II introns. Self-splicing. Capping and tailing of 5' and 3' termini of Eukaryotic mRNA molecules.

Unit V

Translation

Genetic code – Definition, deciphering of codons – Universality of the code – Wobble hypothesis and codon dictionary. Mechanism of protein synthesis and post translational modifications. Regulation of gene expression in prokaryotes – the operon model. Lactose, galactose and tryptophan operon. Feed back inhibition and Allosteric enzymes.

Text Books

1. David Freifelder, 1996, Molecular Biology, 4th Reprint., Narosa Publishing House, New Delhi, India.

Reference

1. B. Lewin 2000, Genes VII Oxford University Press.
2. H.D. Kumar, 1993, Molecular Biology & Biotechnology, Vikas publishing house Pvt. Ltd., New Delhi.
3. R.F. Weaver and P.W. Hedrick 1992, Genetics Wh.C. Brown publishers, Dubuque.
4. E.J. Gardener *et al.*, 1991 Principles of Genetics (8th Ed.,) John Wiley & Sons, New York.
5. David Freifelder, 1986, Molecular Biology 2nd ed., Jones and Barflett publishers, Inc. Boston.
6. S.C. Rastogi, V.N. Sharma, Biology & Biotechnology, Vikas Publishing House Pvt. Ltd., New Delhi.

Objectives:

- To enhance the students knowledge on the historical aspects and development of microbiology
- To acquire an overall knowledge on the morphology and functions of prokaryotes and eukaryotes.
- To make the students knowledgeable on various microbiological techniques involved.
- To impart an overview on microbial ecology-microbial habitats, their interactions and plant-microbe relationship

Learning outcomes:

By the end of this course students will be able to:

- Insight on the milestones of Microbiology and present status
- Identify key components and their functions in both prokaryotes and eukaryotes.
- Understand in depth the techniques used in Microbiology
- Insight to the interactions and characteristics of microorganisms.

Unit I**History of Microbiology and Microscopy**

Historical and recent developments - Spontaneous generation, germ theory of disease and development of medical microbiology, microbial genetics, physiology, virology, plant pathology, soil microbiology, industrial microbiology and molecular biology. Microscopy: Simple, Compound, Dark field, Phase contrast, Fluorescence and Electron microscopy.

Unit II**Prokaryotic and Eukaryotic Cell**

Ultra structure of Prokaryotic and Eukaryotic cell- The Prokaryotic Cell: Size, shape and arrangement of bacterial cells; structure of cell wall, and structures external (glycocalyx, flagella, pili, etc.) and internal (plasma membrane, cytoplasm, inclusion bodies, etc.) to the cell wall. The Eukaryotic Cell: Cilia, flagella, cytoskeleton, cytomembrane systems, mitochondria and chloroplast. Comparison of Prokaryotic and Eukaryotic cell.

Unit III

Microbiological Techniques I

Sterilization: Dry Heat, Moist Heat, Filtration, Tyndallization, Pasteurization, Radiation, Antimicrobial Chemicals- classification - mode of action - antibiotic resistance - tests for antibiosis.

Unit IV

Microbiological Techniques II

Cultural techniques: pure culture techniques, types of media - media preparation - preservation of cultures - aerobic and anaerobic culture techniques - growth of bacteria: batch and synchronous culture - factors influencing growth - growth curve. Methods to study microbial morphology - wet mount and hanging drop method. Staining techniques - Gram's acid fast, spore and capsule staining.

Unit V

Microbial Ecology

Microbial habitat- An overview, the niche, aquatic habitats (marine and fresh water)-soil habitats-subsurface and atmospheric. Microbial Interactions- neutralism, mutualisms, commensalisms, competition, amensalisms, parasitism, predation, antagonism, syntrophism and symbiotic associations. Plant-microbes interactions – Ectomycorrhizae and Endomycorrhizae- Root and stem nodules, rhizosphere and phyllosphere.

Text Books

1. Madigan, M.T., Martinko, J.M., Stahl, D.A. and Clark, D.P. 2011. Brock Biology of Microorganisms 13th Ed. Benjamin Cummings, N.Y.
2. Tortora, G.J, Funke B.R. and Case, C.L.. 2010. Microbiology: An introduction 10th Ed, Benjamin Cummings, N.Y.
3. Dubey, R.C and Maheswari, D.K 2005. A text book of Microbiology, Revised Edt., S.Chand Publishers, New Delhi.
4. Pelczar, Jr., Michael, Chan E. C. S. and Kreig Noel. 2000. Microbiology. 5th Ed. Tata McGraw Hill Book Company.
5. Wiley, J.M., Sherwood, L.M. and Wodverton, C.J. 2009. Prescott's principle of Microbiology, Mc Graw Hill, New York.
6. Stanier, Y. Roger, John L. Ingrahm, Mark L. Wheelis and Page R. Painter. 2003. General Microbiology. V Ed. MacMillan Press Ltd. New Jersey. pp: 621-626; 655-670.

Reference Books

7. Sundararajan, S. 2003. Microorganisms. I Ed. Anmol Publications Pvt. Ltd. New Delhi..
8. Hans G. Schlegel. 2002. General Microbiology. VII Ed. Cambridge University Press. UK..
9. Salle, A. J. 2001. Fundamental and Principles of Bacteriology. 7th Ed. Tata McGraw Hill Publishing Co. Ltd.
10. John L. Ingrahm and Catherine Ingrahm.. 2000. Introduction to Microbiology. II Ed. Brooks/Cole, Thompson Learning division. USA. pp: 86 – 117.
11. Lansing M. Prescott, John P. Harley and Donald A. Klein. 1999. Microbiology. IV Ed. WCB/McGraw Hill Company. pp: 1- 95; 135- 147.
12. Brock, T. D., Smith, D. W and Madigene, M. T. 1997. Biology of Microorganisms: Milestones in Microbiology. Prentice-Hall International Inc. London.
13. Talaro, K and Talaro, A. 1996. Foundations in Microbiology, 2en Ed., Wm. C. Brown publishers, Toronto.

15BOTP0315 INSTRUMENTATION TECHNIQUES - PRACTICALS Credits – 2

Objectives:

- To know the preparation of buffers and determination of pH.
- To separate amino acids and sugars using chromatography and electrophoresis
- To estimate proteins, sugars, nucleic acids, chlorophyll, sodium, potassium, calcium and magnesium using different equipments.

Learning outcomes:

By the end of this course students will be able to:

- Know the preparation of buffers and determination of pH.
- Separate amino acids and sugars using chromatography and electrophoresis
- Estimate proteins, sugars, nucleic acids, chlorophyll, sodium, potassium, calcium and magnesium using different equipments.

EXPERIMENTS:

1. Preparation of buffers and determination of pH using pH meter
2. Differential and density gradient centrifugation.
3. Separation of amino acids and sugars using paper chromatography (2D)
4. Separation of amino acids and sugars using thin layer chromatography
5. Separation of pigments by column chromatography
6. Separation of proteins based on molecular weight using PAGE
7. Isolation and separation of plasmids and nucleic acids using agarose gel electrophoresis.
8. Verification of Beer- Lambert's law using spectrophotometer.
9. Estimation of sodium, potassium, calcium and magnesium using Flame photometer
10. Estimation of calorific value of feed/ fire wood samples.

Reference Books & Manuals

1. Rodney Boyer, 2001. Modern Experimental Biochemistry. III Ed. Addison Wesley Longman Pte. Ltd, Indian Branch, Delhi, India.
2. J. Jeyaraman 1981. Laboratory Manual in Biochemistry. New Age International publishers, New Delhi.

15BOTP0316 FUNDAMENTALS OF MICROBIOLOGY - PRACTICALS

Credits-2

Objectives:

- To enhance the student's knowledge and impress upon the important aspects of micro-organisms
- To provide practical knowledge and skill in the isolation and handling of microorganisms
- To understand the working procedure and principles of microscopes.
- To know pure culture techniques and methods of culturing, preservation and maintenance of microorganisms
- To gain skill in isolation of microorganisms from various samples.

Learning Outcomes:

By the end of this course students will be able to:

- Identify standard methods for the isolation, identification and culturing of microorganisms.
- Comprehend the ubiquitous nature of microorganisms and identify the different groups of microorganisms from different habitats and their applications
- Carry out experiments to evaluate microbial quality of food products and water

EXPERIMENTS:

- 1.a) Safety measures and rules of conduct to be followed in a microbiological laboratory.
 - b) Cleaning of Glasswares
 - c) Handling and Care of Microbiological Instruments.
2. a) Microscopic Examination of Living Organisms – Demonstration of motility.
 - b) Sample preparation and characterization of microorganisms using Scanning Electron Microscope (SEM).
 - c) Measurement of Microorganisms using Micrometry.
3. Staining Techniques – Gram's staining, Acid-fast staining, Endospore Staining, Capsule staining.

4. Basic Laboratory and Culture techniques
 - a) Preparation of Culture Media for Microorganisms. Preparation and sterilization.
 - b) Demonstration of Techniques for Pure Culture of Micro-organisms by Serial dilution techniques and determination of Bacterial numbers.
 - i) Streak Plate method.
 - ii) Pour Plate method
 - iii) Spread Plate method
 - iv) Isolation of Anaerobic Bacteria
 - v) Isolation and maintenance of pure cultures.
 - vi) Determination of bacterial numbers
5. Isolation of Bacteriophage from Sewage.
6. Milk Analysis – Total Aerobic count and Methylene Blue Reductase Test
7. a) Standard Qualitative Analysis of Water
 - i) Presumptive Test for Coliform Group of Bacteria.
 - ii) Confirmed Test of Coliform Bacteria.
 - iii) Completed Test for Coliform Bacteria.
 b) Water Analysis for Total Bacterial Population by Standard Plate Count Method.
8. Isolation and Enumeration of selected Microorganisms such as Bacteria, Actinomycetes, Yeast, Phycomycetes, Ascomycetes and Basidiomycetes.
9. Isolation of Protozoa from Soil.
10. Isolation of VAM spores from soil.
11. Isolation of yeast from grapes.
12. Demonstration of Spore Germination (Fungus)
13. Identification of unknown bacteria.

Reference Books

1. James. G. Cappucino. And Natabe Sherman, 2004. Microbiology – A Laboratory Manual, VI Ed., (I Indian Reprint). Pearson Education (Singapore) Pvt. Ltd., India.
2. Dubey, R.C and Maheswari, D.K. 2002. Practical Microbiology, I Ed., Chand and Company Ltd., India.

Objectives:

To enable the students:

- To understand the structure of cell and its various organelles
- To understand the various aspects of structure and functions of living cells
- To acquire broad knowledge on basic and recent trends of genetics

Learning Outcomes:

This course outline is designed to develop awareness and interest among students on basic structure and function of cell; genetics of various levels of organisms. By the end of the course, students may be able to:

- Understand the structure and function of cell and its organelles
- Acquire combined knowledge on Cell division and cell cycle
- Analyse the various factors determining the heredity from one generation to another
- Acquire combined knowledge with special emphasis on molecular mechanism of heredity.

Unit I**Structure of Cell and cell membranes**

Ultra structure of plant and animal cell - Cell membrane: Structure and function, Variation among membrane, molecular organization of plasma membrane, models (Unit membrane - Dawson Danielli model - Fluid mosaic model); Membrane functions - permeability of plasma membrane to water and solutes; Concentration gradients - movements of ions, Passive diffusion, Active Transport; Pinocytosis and phagocytosis; Modifications of plasma membrane – microvilli, tight junctions; Desmosomes; Cell surface adhesion, non - cellular surface adhesion, inter-cellular recognition.

Unit II**Cell organelles**

Endoplasmic reticulum: Morphology, chemical composition, distribution, ER membrane, role of ER in plant cell, special functions of ER; Mitochondria: Morphology, chemical composition, mitochondrial DNA and RNA, Enzyme distribution, functions; Golgi complex: Morphology, electron microscopic structure, functions, synthesis of glycoproteins, secretion - recycling of secretory granules, lipid packing and secretion, acrosome formation, regulation of fluid balance; Ribosomes: Structure, types, functions; Plastids: Structure and function.

Unit III

Nucleus

Nucleus: Ultra structure of nuclear membrane, chemical composition, function; Chromosomes: Structure, euchromatin, heterochromatin, centromeres, banding, polytene and lampbrush chromosomes; Nucleolus: Structure, composition, function; Cell growth: cell cycle, mitosis, cell plate formation; Meiosis - Genetic consequences of meiosis; Karyotype: Chromosome abnormalities; Biology of cancer cells - Oncogenes.

Unit IV

Mendelian genetics

Mendelian inheritance: Law of dominance, segregation, independent assortment; Expression and interaction of genes, Complementary genes, Supplementary genes, Epistasis. Multiple alleles: Blood group, Rh factor, multiple gene inheritance; Simple mendelian traits in man; Eugenics - human betterment; Sex determination and Sex linked inheritance.

Unit V

Linkage and Crossing over

Linkage and crossing over: Coupling and repulsion, arrangement of genes, expression of linkage, linkage groups, complete and incomplete linkage, Theories - factors affecting linkage; Crossing over: Theories, kinds, factors affecting crossing over, frequencies of crossing over, significance; Molecular mapping methods; RFLP, Chromosome walking and chromosome jumping; Cytoplasmic inheritance; Predetermination - Virus like inclusions and infective particles, milk factor, kappa particles, plastid inheritance, maternal inheritance.

Text Books

1. Sundara Rajan , S. 2003. Introduction to Cell Biology. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Nair, P.K.G. and Prabhakar Achari, K. 1999. A Text Book of Cell Biology.
3. Konark Publishers Pvt. Ltd., Delhi
4. Verma, P.S. and Agarwal, V.K. 2004. Cell biology, Genetics, Molecular Biology, Evolution and Ecology. S.Chand & Company Ltd. New Delhi.
5. Gupta and Jains, 1991. The Cell and Biotechnology, 1st Edition, Agro Botanical Publication, New Delhi.

Reference Books

6. Eldon J. Gardner. 2004. Principles of Genetics 8th edition, John Wiley and Sons, New York.
7. Giese, A.C. 1999. Cell Physiology. 5th Edition, W.B. Saunders Company.
8. Charlotte J. Averse. 1995. Molecular Cell Biology. Addison Wesley Publ. Co.
Gerald Karp, Cell Biology, II Edition – McGraw Hill International Book Co., New Delhi
9. Edmund, W. Sinnott, L.C. Dunn and Dobzhansky, T. 1990. Principles of Genetics, 5th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
10. Goodenough, U. 1984, Genetics 3rd edition CBS College Publishing, Halt, Rineshait and Winstion.

15BOTP0418

**PLANT RESOURCE UTILIZATION &
BIODIVERSITY CONSERVATION**

Credits – 4

Objectives:

To enable the students:

- To understand the economic importance of different plants
- To understand the origin and diversity of domesticated plants
- To understand the various threats of biodiversity and the strategies for conservation

Learning outcomes:

The course will provide the various uses of plants; biodiversity status, loss and management strategies. On completion of this course the students will be able to:

- Describe economically important plants with binomial names, family & uses and strategies for green revolution
- Analyse the biogeography, status and loss of biodiversity, initiatives for biodiversity conservation
- Have knowledge on biodiversity management, role of biotechnology, organization involved, ITR, IPR and biopiracy

Unit I

Economic Botany I

Botanical name, family, morphology of useful part and uses of Cereals - Paddy, wheat, maize; Millets - Sorghum, Ragi, rye; Legumes - Blackgram, pigeon pea, green gram; Nuts - Ground nut, cashew nut, almond; Vegetables - Tomato, carrot, cabbage; Fruits - Apple, mango, date palm; Fibers - Cotton, jute.

Unit II

Economic Botany II

Botanical name, family, morphology of useful part and uses of Wood - Teak, rose wood; Essential oil - Sunflower oil, groundnut oil, sesam oil; Spices and condiments - Cinnamon, pepper, cardamom, nut-meg, clove, turmeric, chillies; Beverages - Coffee, cocoa; Tannin - Myrobalan; Latex - Rubber; Dyes - Indigo, henna; Gum - Gum arabic; Sugars - Sugarcane; Fumigatory and mastigatory – Tobacco, Areca nut.

Unit III

Sustainable Development

Origin of agriculture - world Centres of Primary Diversity of Domesticated plants; Green revolution - Benefits and adverse consequences; Innovations for meeting world food demands.

Unit IV

Biodiversity Status and Loss

Biogeography of India; Biodiversity of India: Species diversity, Genetic diversity and Ecosystem diversity; Loss of biodiversity; IUCN red list categories; International and Indian initiatives on Biodiversity Conservation.

Unit V

Biodiversity Management

Conservation of Biodiversity: Current practices of biodiversity conservation - *In situ* conservation (Biosphere reserve, Wildlife sanctuaries, National parks); *Ex situ* conservation (Botanic garden, Gene banks, Agroforestry, Pollen bank, Seed bank, Cryopreservation); Role of biotechnology in the conservation of biodiversity; Biodiversity management - Organizations involved Biodiversity information and communication, Indigenous knowledge systems, Biopiracy, IPR.

Text Books

1. Kochhar, S.L. 2011. Economic Botany in the Tropics. IV edition. Macmillan Publishers India Pvt. Ltd. New Delhi.
2. Bawa K.S., Primack, R.V. and Oommen, M.A. 2011. Conservation biology: A Primer for South Asia, ATREE, Bangalore.
3. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity, Oxford and IBH Publishing Co. Pvt Ltd. New Delhi.
4. Swaminathan, M.S. and Cocchar S.L. (Eds) 1999. Plants and society. MacMillien Publications Ltd. London.
5. Sambamurthy, A.V.S.S. and Subramanian, N.S. 1999. A text Book of Economic Botany, Wiley Eastern Limited, New Delhi.
6. Pandey, B.P. 1998. Economic Botany, S. Chand & Co., New Delhi.

Reference Books

1. Frankel, O.H. Brown and Burdon, J.J. 1995. The conservation of plant diversity. Cambridge University Press, Cambridge.
2. Hill, F.A. 1952. Economic Botany: A text book of useful plants and plants products, Tata McGraw Hill Publishing Co., Ltd., New Delhi.

15BOTP0419 BIOTECHNOLOGY & GENETIC ENGINEERING Credits - 4

Objectives:

- To impart information on the history, development of Biotechnology and Genetic Engineering
- To provide knowledge and in-depth study on plant & animal tissue culture techniques, Fermentation techniques & Biosensors, Environment & Energy, Concepts & Scope in Genetic Engineering and Applications of Genetic engineering
- To expose the students on the basic understanding of various techniques used in Biotechnology and Genetic Engineering

Learning outcomes:

The students able to:

- Understand in-depth knowledge on Biotechnology and genetic engineering
- The various techniques used in Biotechnology and genetic engineering studies
- Know the alternate energy sources and biomass energy
- Gain knowledge on GMOs.
- Know the Rules and regulation in biotechnology –hazards of environmental engineering & biosafety, IIR & IPP and bioethics

Unit I

Concepts and Scope in bio-technology

Plant cell and tissue culture – Culture techniques – Protoplast technique – Anther and pollen culture. Animal tissue culture- culture techniques – Animal bio reactors. Gene banks and Germplasm storage. Immobilization of microbial cells / enzymes – Adsorption, entrapping, ionic bonding, cross linking, encapsulation and microencapsulation. Application of immobilized enzymes.

Unit II

Fermentation and Biosensors

Biotransformation and production of useful compounds – Glycerol, acetons, Alkene oxide, Poly hydroxy butyrate, Xanthangum and Microbial Leaching. Biosensors – definition, outline design and types – Biosensors nutrients – glucose and acetic acid sensors. Sensor for cell population – Fuel cell type electrode, potentiostatic, piezoelectric membrane – Dye-coupled electrode membrane filter – Oxygen electrode system and Lactate sensor. Biosensor for products - alcohol sensor, formic acid sensor and methane sensor. Biosensor for environmental control – BOD sensor, Ammonia sensor, Nitrite sensor and Sulfite Ion sensor.

Unit III

Environment and Energy

Energy sources – nuclear energy, fossil fuel energy and non-fossil and non-nuclear energy. Biomass energy – Composition of biomass-wastes as sources of renewable energy – Composition wastes – sources of wastes (Industrial, agricultural, forestry, municipal sources). Biomass conversion – non-biological process, direct combustion (Pyrolysis, Gasification, liquefaction); biological process (enzymatic digestion, anaerobic digestion, aerobic digestion). Bioenergy products – ethanol, biogas and Hydrogen. Bioremediation – microbial degradation of xenobiotics.

Unit IV

Genetic Engineering

Definition and outline strategy. Enzymology – Restrict enzymes, DNA ligases, reverse transcriptase, klenow fragment, Alkaline phosphatase, Polynucleotide kinase, terminal transferase, Dnase and Rnase. Cloning vehicles- Plasmids – pBR 322 & pUC; phage, cosmid, shuttle and YAC vectors. Gene cloning strategy – Isolation of foreign DNA and recombinant DNA construct – Transformation – Screening and Storage. Expression of cloned genes in prokaryotic and eukaryotic systems – minicell, maxicell, Fused and unfused gene expression.

Unit V

Applications of Genetic engineering

GMOS – Transgenic plants – Bt Cotton - Development of crops for disease resistance, Salt tolerances, drought tolerance, herbicide tolerance and nutritional quality. Transgenic animals and its applications. Genetically modified Microorganisms and its applications. Rules and regulation in biotechnology – biosafety, bioethics hazards of environmental engineering, and intellectual property rights (IPR) and protection (IIP).

Text Books

1. Dubey R.C., 2001. A text book of Biotechnology 1st Edition. S.Chand & Company Ltd., New Delhi. Pg. 43-80; 113-197; 331-391.
2. Chhatoval G.R., 1995. Text book of Biotechnology, 1st Edi, Anmol Publications Pvt. Ltd., New Delhi.
3. Kumar H.D. 1991. A text book on Biotechnology 2nd Ed, East-west Press Private Ltd., New Delhi. Pg.1-250; 411-472; 534-555.

Reference Books

4. Dubey, R.C. 2001. A Text Book of Biotechnology .S. Chand & Company Ltd., Ramnagar, New Delhi.
5. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
6. Kumar, H.D. 1993. Molecular Biology & Biotechnology, Vikas Publishing House Pvt., Ltd., New Delhi.
7. Kumar, H.D. 1991 Biotechnology, 2nd Ed., East – West Press Private Ltd., New Delhi.
8. Trevan, M.D, Boffey, S., Goulding, K.H. and Stanbury, P. 1990. Biotechnology- The basic Principles. Tata McGraw Hill, New Delhi.
9. Demain, A.L., Solomon, N.A. 1986. Manual of Industrial Microbiology and Biotechnology, ASM Press, Washington

Objective:

To enable the students:

- To understand the various aspects of mushroom technology
- To understand the effective methodology to cultivate Oyster, button and milky mushrooms
- To learn the importance and application of Mushrooms and its products

Learning outcomes:

On completion of this course, the students will be able to:

- Understand the mushroom characteristics and their importance
- Comprehend the lifecycles of various classes of fungi
- Discuss on the principles and methods involved in different stages of mushrooms
- Apply their knowledge in cultivating various tropical and subtropical mushrooms and their role in human welfare.

Unit I

Biology of Mushrooms

Introduction to mushroom biology: Mushroom past and present, characteristics, importance of mushrooms - as food, tonics and medicines. Basics of fungi as background for mushroom biology: Fungal characteristics, history of mycology, habitat, morphology, nutrition and reproduction of fungi.

Unit II

Mushroom technology

General principles of production of mushrooms and mushroom products: Contributing fields - microbiology, mycology and environmental engineering; phases of mushroom technology - pure culture, spawn, preparation of compost, mushroom development, management and marketing.

Unit III

Application of mushrooms

Mushroom biotechnology: Applications: Bioconversion of organic wastes into protein, fodder, soil conditioner and fertilizer, bioremediation, nutraceuticals, pharmaceuticals and medicinal properties

Unit IV

Mushroom cultivation technology

Prospects of tropical mushroom cultivation technology: Oyster mushroom technology, paddy mushroom technology, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects.

Unit V

Field visit/Survey

1. Field visit to mushroom farms
2. Demonstration on various stages of mushroom cultivation
3. Interaction with mushroom farmers
4. Mini project work & report submission

Reference Books

1. Philip G. Miles, Shu-Ting Chang, 1997. Mushroom biology, World Scientific, Singapore.
2. Kaul, T.N. 1999. Introduction to mushroom science, Oxford & IBH Co., Pvt. Ltd., New Delhi.
3. Bahl, N. 1988. Handbook on mushrooms. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.

15BOTP03E2

Elective-2 PLANT ECOLOGY

Credits - 3+1

Objectives:

To enable the students:

- To understand the ecological relationship of plants with environment
- To understand the nature of soil and biogeochemical cycles
- To understand the various components of biodiversity, threat and conservation

Learning Outcomes:

On completion of this course, the students will be able to:

- Understand vegetation and their relationship with the ecosystem
- Acquire knowledge on ecosystem organization, biogeochemical cycle and ecosystem stability
- Comprehend the information on biodiversity, threats and conservations

Unit I

Vegetation and ecosystem

Climate, soil, vegetative patterns of the world, vegetation organization, community concepts, interspecific associations, ordination concept of ecological niche, vegetation development, changes in ecosystem properties during succession.

Unit II

Organization of ecosystem

Ecosystem organization, structure and functions, primary production, energy dynamics, global biogeochemical cycles of C, N, P and S mineral cycles in terrestrial and aquatic ecosystems.

Unit III

Biodiversity

Biological diversity, concept and levels, role of biodiversity in ecosystem, functions and stability, speciation and extinction, IUCN, Categories of threat, terrestrial biodiversity hot spots.

Unit IV

Ecosystem and management

Ecosystem stability, concept, natural and anthropogenic perturbations, their impact on plants and ecosystem, ecology of plant invasion; Environmental impact assessment ecosystem, restoration, ecological management, sustainable development.

Unit V

Field visit/survey

1. Inventory and analysis of local vegetation
2. Field visit to learn plant ecological methods
3. Discussion on Environmental Impact Assessment (EIA)
4. Mini project & report submission

Reference Books

1. Odum, E.P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.
2. Muller Dombosis. Dand Ellenberg, H. 1974. Aims and methods of vegetation Ecology. Wiley, New York.
3. Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.
4. Ludwig, J. and Reynolds, J.F. 1988. Statistical Ecology, John Wiley & Sons.
5. Begon, M. Harper, J.L. and Townssend, C.R. 1996. Ecology, Backwell Science, Cambridge, USA.
6. Smith, R.L. 1996. Ecology and Field Ecology, Harper Collins, New York.

Objectives:

To enable the students:

- To understand the importance and value of forest and its products
- To accentuate the awareness on conservation and sustainable utilization of forest and its resources
- To understand the ecological relationship, hydrological cycle and vegetation dynamics of forest

Learning outcomes:

On completion of this course, the students will be able to:

- Understand the values and importance of various types of forest
- Comprehend the information on conservation and sustainable utilization of forests
- Acquire knowledge on hydrological cycle protected areas and forest research organizations

Unit I**Forest types and associations**

General introduction to forest; Classification of world forests and Indian forests: Tropical, temperate, evergreen, semi-evergreen, deciduous, monoculture, social, industrial; Forest and climate; Forest and biodiversity; Forest and gene conservation; Forest and ecosystem; Forest and civilization; Multipurpose forestry and preservation of natural forestry and pollution control.

Unit II**Forest ecosystem and NWFP**

Strong interrelationships: Forest genetics, forest physiology, forest ecology; Macro dynamic ecosystem reserves, hydrological cycles; Importance and value of wood and Non-wood forest products (NWFP); Major and minor forest products; Use and misuse of forests by man, direct and indirect forest wealth; Forest policies, forest protection through people committee.

Unit III**Silviculture and forest research**

Silviculture: concept and scope; Seed dynamics in forest: seed production, dissemination, germination, establishment and mortality, seedling dynamics; Forest research organizations, importance of forest research.

Unit IV

Conservation of wildlife

Forest and Wildlife: Floristic and faunastic wealth of India; Important Biosphere reserves; National parks and wildlife sanctuaries of India; National policies on Wildlife protection; Keystone species, Importance of wildlife, Forestry for social and national development.

Unit V

Field visit/survey

1. Field visit to study the types of forest
2. Analyse the value of NWFP/NTFP
3. Visit to forest/silviculture nursery
4. Scientific visit and documentation of wildlife

Text Books

1. Principles of Silviculture, Frederick S. Backer, Mc Graw Hill Book Co. NY, 1950.
2. Forest menturation, Donald Bruce and Grancis X. Schumacher, Mc Graw Hill Book Co. NY, 1950.
3. Multipurpose tree germplasm, Ed. Burley S. and Von Carlowitz P. international council for research in agroforestry, Nairobi, 1984.
4. Tropical forests, Ed. Holm – Neilsen L.B. Nielsen. DC and balslev II Academic press, London, 1989.

15BOTP 03MX / 04MY ADVANCED MOLECULAR TECHNIQUES Credits -2

Objectives:

- To impart knowledge on advanced biological and molecular techniques
- To provide hands on experience on various advanced Instruments used for biological and molecular studies

Learning outcomes:

The students are being able to:

- Understand in-depth knowledge on Electrophoretic techniques
- Realize Molecular Sequencing techniques
- Know the principle and applications of PCR techniques
- Familiar with Chromatographic and Spectrophometric techniques
- Distinguish Genome sequencing and Physical mapping of genome analysis

Unit I

Electrophoresis

Principle and application: paper electrophoresis, agarose gel electrophoresis, polyacrylamide gel electrophoresis (Native PAGE and SDS- PAGE) and Immunoelctrophoresis.

Unit II

Molecular Sequencing

Amino acid sequencing and analysis -MALDI-TOF, DNA sequencing –Enzymatic & chemical methods and new generation sequencing. Blotting techniques – Southern, northern, western and Dot blots. Microarray techniques – oligonucleotide array and cDNA array and its applications.

Unit III

PCR techniques

Principle and applications- types of PCR - enzymology- primer types-methods. PCR amplification for Detection of mutation, monitoring cancer therapy, detect bacterial & viral infections, sex determination of prenatal cells, linkage analysis in sperm cells and studies on molecular evolution.

Unit IV

Chromatographic and Spectrophometric techniques

Principle and applications of Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC). Principle and applications of Atomic Absorbance Spectra (AAS), Infra –red (IR) Spectra and LC-MS technique.

Unit V

Genome sequencing and Physical mapping of genome analysis

Restriction fragment Length Polymorphism (RFLP) technique, Random Amplified polymorphic DNA (RAPD) technique and 16 S rRNA sequencing. Methods and applications of Chromosome walking & Chromosome jumping.

Text Books:

1. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
2. James .D.Watson, Michael Gilman, Jan Wit Koeski and Mark Zuller, 2001. Recombinant DNA. IInd Ed. Scientific American Book, New York.
3. B. Lewin 2000. Genes VII Oxford University Press.
4. E.J. Gardener *et al.*,. 1991. Principles of Genetics (8th Ed.,) John Wiley & Sons, New York.

Objectives:

- To impart knowledge on various biotechnological commercial processes and its usefulness
- To provide hands on exposure to various biotechnological commercial processes such as biogas production, composting methods, mushroom production, *Spirulina* cultivation and ornamental fish cultures.

Learning outcomes:

The students are being able to:

- Understand in-depth understanding on biogas technology and its uses
- Understand composting technology and its applications
- Know the cultivation and uses of Mushrooms
- Know the cultivation and uses *Spirulina*
- Understand the value of Ornamental Fish culture

Unit I**Biogas technology**

Introduction and history – anaerobic digestion – microbes involved – factors influencing methane production – Stages of methane generation – Wastes used in methanogenesis – various bioreactors used for methane generation – Advantages and disadvantages. Visit to biogas production units with field demonstration.

Unit II**Composting technology**

Historical background – waste availability – factors influencing – methods- biomaturity-enrichment of Compost and crop productivity. Vermiculture Technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting. Utilization of vermicompost for crop production. Visit to vermicompost industries with field demonstration.

Unit III**Mushroom technology**

Bioconversion of organic wastes into protein - Oyster mushroom technology, paddy mushroom technology, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects. Visit to mushroom farms with field demonstration.

Unit IV

***Spirulina* cultivation technology**

Biology of *Spirulina* - cultivation methods, post harvest technology and single cell protein formulation. Visit to *Spirulina* industries with field demonstration.

Unit V

Ornamental Fish culture

Present status and importance – popular varieties – artificial and live feeds – breeding techniques of egg layers – gold fish, angel fish, fighter and barbs – live bearers – guppy, molly, platy and sword tail – economics. Visit to ornamental fish farms with field demonstration.

Text Books

1. Kaul, T.N. 1999. Introduction to mushroom science, Oxford & IBH Co., Pvt. Ltd., New Delhi.
2. Philip G. Miles, Shu-Ting Chang, 1997. Mushroom biology, World Scientific, Singapore.
3. Bahl, N. 1988. Handbook on mushrooms. Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.
4. Tripathi, G. 2003. Vermireources technology, 1st Ed., Discovery Publication House, New Delhi.
5. Gaur, A.C., 1999. Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.
6. Subba Rao, N.S., 1999. Soil Microbiology, 4th Ed., Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Chawla O.P. 1986. Advances in Biogas Technology, ICAR, New Delhi.
8. Martin Alexander 1976. Introduction to Soil Microbiology, Wiley eastern Ltd., New Delhi.
9. Anita Saxena, 2003. Aquarium management. Daya Pub. House, New Delhi.
10. Srivastava, C.B.L, 2002. Aquarium fish keeping. Kitab Mahal, Allhabad.

Reference Books

11. Kumar, H.D., 1991. A Textbook on Biotechnology, II Edition, East-west Press Pvt. Ltd., New Delhi.
12. Chatwal, G.R., 1995. Textbook of Biotechnology, Anmol Publications Pvt. Ltd., New Delhi.
13. Jasra, O.P., 2002. Environmental Biochemistry, I Ed., Sarup & Sons, New Delhi, India.

MODULAR COURSE

15BOTP 03MX / 04MY

BIOINFORMATICS

Credits - 2

Objectives:

- An- in depth study on Bioinformatics, microbial genomics and proteomics
- To make the students to understand genome analysis, sequence analysis and protein analysis
- To make the students to know the tools used in Bioinformatics

Learning outcomes:

Unit I : Students understand whole genome analysis methods

Unit II: Students know the computational tools used for sequence analysis tools

Unit III: Students know the use of internet in data analysis

Unit IV: Students acquire knowledge on DNA microarray techniques

Unit V: Students know the different methods of protein analysis

Unit –I : Whole genome analysis: Preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, shotgun libraries and sequencing.

Unit–II : Sequence analysis: Computational methods, homology algorithms (BLAST) for proteins and nucleic acids. PROSITE, PEAM, and Profile Scan.

Unit–III : Databases Analysis: Use of internet, public domain databases for nucleic acid and protein sequences (EMBL, GenBank); database for protein structures (PDB).

Unit-IV : DNA microarray and general Analysis: DNA microarray printing or oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expressions using fluorescent labeled DNA or end labeled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips.

Unit-V : Protein analysis and Proteomics :Sequence analysis of individual protein spots by mass spectroscopy. Protein microarray. Advantages and disadvantages of DNA and protein microarrays. Introduction to docking.

References

1. Read, TD., Nelson, KE., Fraser, CH. 2004. Microbial Genomics. Humana Press Inc., USA.
2. Rashidi, H.H. and Buchler, L.K. 2002 Bioinformatics Basics :Applications in Biological Science and Medicines, CRC Press, London
3. Stephen P. Hont and Rick Liveey (OUP) 2000. Functional Genomics, A practical Approach.
3. Perysju, Jr. abd Peruski 1997. The Internet and the New Biology: Tools for Genomic and molecular Research.
4. Mark Schena (OUP). DNA Microarrays, A practical approach.

15BOTP 03MX / 04MY PLANT TISSUE CULTURE TECHNOLOGY Credits -2

Objectives:

To enable the students:

- To understand the basic principles and methodologies of plant tissue culture
- To understand the different standard protocol for the production of viable clones
- To learn the knowledge on various methods of Tissue Culture and secondary metabolites production.

Learning Outcomes:

This course will impart a thorough knowledge on research oriented learning which will develop analytical problem solving approach. On completion of this course, the students will be able to:

- Understand various media, sterilization, totipotency, cell induction, organogenesis
- Able to apply the techniques to develop a standard protocol for Plant Tissue Culture
- Have comprehensive knowledge on GM technology, bio-safety relations and germplasm storage

Unit I

Basic concepts Plant tissue culture

Plant tissue culture; History, concept of totipotency, sterilization, media types, preparation; culture of plant materials.

Unit II

Plant tissue culture techniques

Basic techniques in plant tissue culture; Methods of plant cell, tissue and organ culture; Cell suspension culture, somatic embryogenesis, protoplast culture;

Unit III

Micropropagation and haploid production

Micropropagation: Methods and application, androgenesis and gynogenesis for haploid production, protoplast culture and somatic hybridization, somaclonal variation and conservation of germplasm.

Unit IV

Secondary metabolites production and GM technology

Production of secondary metabolites from the culture cells; Production of synthetic seeds; edible vaccines; GM technology and bio-safety regulations .

Unit V

Application of plant tissue culture

Application of plant tissue culture in agriculture: Production of Banana, Horticulture: Propagation of Orchids; Forestry: Propagation of a commercial and endangered tree species.

Reference Books

1. Kesavachandran, R. and Peter, K.V. 2008. Plant Biotechnology: Methods in Tissue culture and gene transfer. University Press Ltd. Hyderabad.
2. Bhojwani , S.S. and Razdan , M.K. 1996. Plant Tissue Culture : Theory and Practice (revised edition). Elsevier Science Publishers, New York, USA
3. Jain, S.M.Sopory, S.K. and Veilleux, R.E.1996. In Vitro Haploid Production in HigherPlants, Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers,Dordrecht, The Netherlands
4. Vasil, I.K. and Thorpe, T.A.1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.
5. Bhojwani, S.S. 1990 , Plant Tissue Culture: Applications and Limitations Elsevier Science Publishers , New York , USA
6. Kartha, K.K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.