

DEPARTMENT OF BOTANY
[DST-FIST & UGC-SAP SPONSORED DEPARTMENT]

M.Sc. Botany (CBCS)
Syllabus with effect from 2014 – 2015



ANNAMALAI UNIVERSITY
ANNAMALAI NAGAR – 608 002

ANNAMALAI UNIVERSITY
DEPARTMENT OF BOTANY

M.Sc. BOTANY
Choice Based Credit System (CBCS)
(2014-2015)

REGULATIONS

MASTER'S PROGRAMME

A Master's programme consists of a set of Core courses and Optional courses.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the respective faculties.

Optional courses will be suggested by the respective departments, and they may be distributed in all the four semesters.

A course is divided into five units to enable the students to achieve modular and progressive learning.

SEMESTERS

An academic year is divided into two semesters, Odd semester and Even semester. The normal semester periods are:

Odd semester: July to November (90 working days)

Even semester: December to April (90 working days)

CREDIT

The term credit is used to describe the quantum of syllabus for various programmes in terms of hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design. The minimum credit requirement for a two year Master's Programme shall be 90.

COURSES

Each course may consists of lectures / tutorials / laboratory work / seminar / project work / practical training / report / viva voce etc.,

COURSE WEIGHT

Core and Optional courses may carry different weightage. For example, a course carrying one credit for lectures, will have instruction of one period per week during the semester, if three hours of lecture is necessary in each week for that course then 3 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lecture tutorials/laboratory work and other forms of learning in a 15 week schedule:

- i) One credit for each lecture period per week.
- ii) One credit for each tutorial per week.
- iii) One credit for every three periods of laboratory or practical work per week
- iv) One credit for 3 contact hours of project work in a week.
- v) One credit for every two periods of seminar.

GRADING SYSTEM

The term Grading System indicates a 10 point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

DURATION

The duration for completion of a two year Master's Programme in any subject is four semesters.

STRUCTURE OF THE PROGRAMME

The Master's Programme will consist of:

- i) Core courses which are compulsory for all students.
- ii) Optional courses which students can choose from amongst the courses offered by the other Department of a faculty as well as by the Departments of other faculties. (Arts, Science, Education and Indian Language)
- iii) The Optional subjects will be allotted by counseling by a committee of the respective Heads of the Department under the Chairmanship of the Dean of the Faculty.
- iv) Dissertation/Project work/Practical training/field work, which can be done in an organization (Government, Industry, Firm, Public Enterprise etc.) approved by the concerned department.

ATTENDANCE

Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least Seven Calendar days before the last instruction day in the semester about the attendance particulars of all students.

Each student should earn 80% attendance in the courses of the particular semester failing which he or she will not be permitted to sit for the end-semester examination.

However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of a Condonation fee and such exemptions should not under any circumstance be granted for attendance below 70%.

EXAMINATIONS

The internal assessment for each course carries 25% marks for theory and 40% marks for Practicals and is based on two sessional tests and a variety of assessment tools such as seminar and assignment. The pattern of question paper will be decided by the respective faculty. **The tests are compulsory.**

There will be one End Semester Examination (75% marks) of 3 hours duration for each course. The pattern of question paper will be decided by the respective faculty.

The internal assessment for Practicals carries 40% marks and is based on test, record, herbarium, field note and slide submission.

EVALUATION

The performance of a student in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The sum of the total performance in each semester will be rated by GPA while the continuous performance from the 2nd Semester onwards will be marked by OGPA.

MARKS AND GRADING

A student cannot repeat the assessment of Sessional test I and Sessional test II. However, if for any compulsive reason, the student could not attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department. A student has to secure 50% minimum in the End Semester Examination. The student who has not secured a minimum of 50% of marks (sessional plus end semester examination) in a paper shall be deemed to have failed in that paper.

A candidate who has secured a minimum of 50% marks in all the papers prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's Programme.

GRADING

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme.

Marks	Grade Point	Letter Grade	Class
90	10	S	Exemplary
85-89	9.0	D++	Distinction
80-84	8.5	D+	„
75-79	8.0	D	„
70-74	7.5	A++	First Class
65-69	7.0	A+	„
60-64	6.5	A	„
55-59	6.0	B	Second Class
50-54	5.5	C	„
49 or Less		F	Fail

The successful candidates are classified as follows: I Class-60% marks and above in Overall Percentage of Marks (OPM). II Class-50-59% marks in overall percentage of marks.

Candidates who obtain 75% and above but below 90% of Marks (OPM) shall be deemed to have passed the examination in FIRST CLASS (Distinction) provided he/she passes all the papers prescribed for the programme at the **First appearance**.

For the Internal Assessment Evaluation, the break up marks shall be as follows for **theory**:

Test (Two)	---	15 Marks
Assignment	---	5 Marks
Seminar	---	5 Marks
Total		25 Marks

For the Internal Assessment Evaluation, the break up marks shall be as follows for **practical**:

Test (Two)- 10+10	---	20 marks
Record	---	10 marks
Herbarium/ Slide	---	10 marks
Total		40 Marks

The M.Sc., students of Botany shall undertake a Botanical Tour during third semester under the guidance of the staff members for field training and plant collection.

COURSE-WISE LETTER GRADES

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than F. A letter grade F in any course implies a failure in that course. A course successfully completed cannot be repeated for the purpose of improving the Grade point. The F grade once awarded stays in the grade card of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the odd/even semester in which the candidate has appeared for clearance of the arrears. A student who secures F grade

in any course which is listed as a core course has to repeat it compulsorily when the examination is held next. If it is an optional course, the student has the option to repeat it when it is offered next or to choose a new optional if he/she so desires in order to get a successful grade. When new optional is chosen in the place of failed optional, the failed optional will be indicated as dropped in the subsequent grade card. If a student secures F grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit it, if it involves only rewriting incorporating the clarifications of the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

M.Sc. BOTANY

CHOICE BASED CREDIT SYSTEM (CBCS) SCHEME OF EXAMINATION AND SYLLABUS

Total Credits: 90

FIRST SEMESTER

CODE	COURSE	L	P	C	Int. Asse. Marks	End Sem. Exam Marks	Total Marks
		Hrs					
BOTC 101	Plant Diversity - I	5	0	5	25	75	100
BOTC 102	Mycology, Microbiology and Plant Pathology	5	0	5	25	75	100
BOTC 103	Biological Techniques and Instrumentation	4	0	4	25	75	100
BOTP 104	Practical covering BOTC101,102 & 103	0	9	3	40	60	100
	Total	14	9	17			

SECOND SEMESTER

CODE	COURSE	L	P	C	Int. Asse. Marks	End Sem. Exam Marks	Total Marks
		Hrs					
BOTC 201	Plant Diversity - II	5	0	5	25	75	100
BOTC 202	Plant Anatomy, Embryology and Morphogenesis	5	0	5	25	75	100
BOTC 203	Genetics and Plant Breeding	5	0	5	25	75	100
BOTP 204	Practical covering BOTC201,202 & 203	0	9	3	40	60	100
	Soft Skill Development	4	0	4	25	75	100
	Optional I	4	0	4	25	75	100
	Total	23	9	26			

THIRD SEMESTER

CODE	COURSE	L	P	C	Int. Asse. Marks	End Sem. Exam Marks	Total Marks
		Hrs					
BOTC 301	Taxonomy of Angiosperms and Economic Botany	5	0	5	25	75	100
BOTC 302	Cell Biology and Molecular Biology	5	0	5	25	75	100
BOTC 303	Bio-technology , Genetic Engineering and Tissue Culture	5	0	5	25	75	100
BOTC 304	Research Methodology, Bio - informatics and Nanotechnology	4	0	4	25	75	100
BOT P 305	Practical covering BOTC301,302, 303 & 304	0	9	3	40	60	100
	Optional II	4	0	4	25	75	100
	Total	23	9	26			

FOURTH SEMESTER

CODE	COURSE	L	P	C	Int. Asse Marks	End Sem. Exam Marks	Total Marks
		Hrs					
BOT C 401	Plant Physiology	5	0	5	25	75	100
BOT C 402	Environmental Biology	5	0	5	25	75	100
BOT P 403	Practical covering BOTC 401 &402	0	9	3	40	60	100
BOT 404 A (or) 404 B	Optional III Applied Botany (or) Enzyme Technology	4	0	4	25	75	100
BOT 405 A (or) 405 B	Optional IV Horticulture and Landscaping (or) Bio prospecting of Medicinal and Aromatic plants	4	0	4	25	75	100
	Total	18	9	21			

I – SEMESTER
BOTC – 101 - PLANT DIVERSITY - I

Objectives:

1. To acquire knowledge of the algal flora in land, fresh water and marine environment.
2. To understand the structure, reproduction and life cycle of algae.
3. To appreciate the uses of algae as food, fodder and pharmaceuticals.
4. To study the character of thalloid and leafy liverworts and mosses.
5. To acquire knowledge about structure and reproduction of Lichens.

PHYCOLOGY

Unit – I

Classification, range of structure, reproduction; evolutionary trends; fossil history, economic importance, ecology and phylogeny in Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae,

Unit – II

Origin and evolution of sex in algae - Distribution of algae in soil, fresh water and marine environment- Role of Algae in soil fertility - fossil algae. Culture and cultivation of algae - Algal pigments and their uses –Ecological and Economic importance of algae.

BRYOLOGY

Unit- III

Introduction and Classification of Bryophytes, Life cycle and Alternation of Generation-two theories, Origin and Evolution of Bryophytes, Fossil Bryophytes and Interrelationship of Bryophytes.

Unit- IV

Gametophyte and sporophyte of thalloid liverworts, Gametophyte and sporophyte of leafy liverworts, Asexual and sexual reproduction in Bryophytes, Gametophyte and sporophyte of Mosses

LICHENOLOGY

Unit – V

General account of structure and life cycle of Lichens-broad outline classification. Structure, reproduction and lifecycle of the following types: a) *Parmelia*; b) *Usnea*. Ecological role and economic importance of lichens.

Practicals:

Phycology

Chlamydomonas, Volvox, Chlorella, Hydrodictyon, Ulothrix, Ulva, Draparnaldia, Oedogonium, Caulerpa, Acetabularia, Halimeda, Codium, Valonia, Chara, Nitella. Desmids, Ectocarpus, Colpomenia, Padina, Stoechospermum, Sargassum, Turbinaria.,

Batrochospermum, Polysiphonia, Gracilaria, Microcystis, Nostoc, Stigonema, Anabaena, Lyngbya, Scytonema and Spirulina.

Bryology

Riccia, Targionia, Reboulia. Dumortiera, Pallavicinia, Riccardia, Porella, Sphagnum and Bryum.

Lichenology

Collection and identification of lichen specimens and make labelled sketches of specimens. Study the external and internal structures of the types mentioned.

Books

1. Andrew J.wood. 2010. New Frontiers in Bryology: Physiology, Molecular Biology and Functional Genomics. Springer Netherland.
2. Fritsch, F.E. 1972. Structure and Reproduction of Algae I & II, Cambridge University Press.
3. Gilbert Smith. 1976. Cryptogamic Botany. Tata McGraw Hill Book company Ltd, New Delhi.
4. Pandey, S.N., S.P. Misra and P.S. Trivedi. 2002. A Text book of Botany Volume II. Vikas Publishing House Pvt Ltd, New Delhi.
5. Parihar, N.S. 1991. An Introduction to Embryophyta – Bryophytes, Central Book Depot. Allahabad.
6. Rashid, A. 2007. An Introduction to Bryophyta – Vikas Publications, New Delhi.
7. Sambamurthy A.V. S.S. 2005. A Text book of Algae. I.K. International Pvt. Ltd, New Delhi.
8. Sharma O.P, 2007 ; Text book of Algae; Tata Mcgraw – Hill Publications Pvt – New Delhi
9. Sundara Rajan, S. 2005, Practical Manual of Algae ; Anmol Publications Pvt New Delhi
10. Trivedi, P.C. 2013. Algal Biotechnology. Pointer Publishers, Jaipur.
11. Vashishta. B.R., A.K. Sinha and Adarsh Kumar. 2005. Botany for Degree students- Bryophyta. S. Chand and Company Ltd., New Delhi.
12. Vashishta. B.R., A.K. Sinha and Adarsh Kumar. 2008. Botany for Degree students - Algae. S. Chand and Company Ltd., New Delhi.

BOTC – 102 - MYCOLOGY, MICROBIOLOGY AND PLANT PATHOLOGY

Objectives:

1. To study the classification, structure and reproductive features of fungi, bacteria and viruses.
2. To develop skill in isolation and purification of microbes.
3. To understand the morphology and genetics of microbes and their uses.
4. To have knowledge of the causative organism, etiology, symptoms and control of various plant diseases.
5. To understand the host-parasite interactions and the role of enzymes and toxins in pathogenesis.

MYCOLOGY

Unit – I

Introduction to Fungi, Position of Fungi among living organisms – criteria and evidences - Recent trends in the classification of Fungi with special reference to Alexopoulos and Mims. Structure, Nutrition of fungi

Myxomycotina : *Fuligo, Physarum.*

Eumycotina : *Olpidium.*

Mastigomycotina : *Phytophthora, Perenospora*

Plasmodiophoromycetes : *Plasmodiophora.*

Zygomycotina : *Pilobolus.*

Unit – II

Classification and diversity of Fungi Ascomycotina : *Aspergillus, Xylaria, Claviceps, Peziza, Morchella*.

Basidiomycotina : *Lycoperdon, Ustilago, Polyporus*.

Deuteromycotina : *Alternaria, Fusarium*

Spore dispersal and factors affecting spore germination, reproduction, life history, phylogeny and affinities of the major groups of Fungi.

Heterothallism, Parasexual cycle, Degeneration of sexuality.

Economic importance, Fungi as bio-control agents.

Ecology of Fungi - Soil Fungi – Sugar Fungi – Cellulose and lignin degrading Fungi. Role of fungi in Industry, Medicine and as food.

MICROBIOLOGY

Unit – III

Ultra structure of Bacteria, Nutrition and growth curve of Bacteria- measurements of growth, Methods of culturing bacteria – sterilization – kinds of media and preparation techniques – Isolation: serial dilution technique - pure culture – maintenance and preservation- inoculation of bacteria- Bacterial staining methods – Stains and dyes –Gram's, flagellar and other types of staining. Morphology of viruses – classification of viruses – Virus-Vector relationships –replication of virus. Satellite virus. Bacteriophages - Viroids and Prions – isolation and purification of viruses. Uses of virus in Biotechnology.

Unit – IV

Role of microbes in cycling of nitrogen, carbon and phosphorus. Microbial control- methods of physical control (heat, cold, desiccation, radiation and sound waves). Microbial leaching of minerals. Sterilization by filtration, chemical agents – disinfectants, antiseptics and antibiotics. Role of Microbes in waste water treatment, General design and application of biofermentor. Microbes in food spoilage and food poisoning. Food preservation - Micro organisms as food – Probiotics. Microbes used as Bio fertilizers – *Rhizobium, Azospirillum, Acetobacter, Azolla* and blue-green algae.

PLANT PATHOLOGY

Unit – V

History of Plant Pathology – causes of Plant diseases –Diagnosis of Plant diseases - Koch's Postulates – Symptoms and signs. Classification of Plant Diseases – Host parasite interaction –Disease resistance defence - Histological and biochemical aspects - Metabolic changes during disease development – Role of enzymes and toxins during pathogenesis.

Etiology, Symptoms, Causative agents and Control of the following diseases: Tobacco Mosaic , Bunchy top of Banana, Leaf spot in Cotton, Blight of Paddy, Citrus canker, Soft rot in vegetables, Little leaf of Brinjal; Blast of Paddy, Red rot of Sugar cane, Tikka disease of ground nut and Damping off of seedlings. Plant disease management - Principles and methods of disease control – Chemical, Biological and Agronomical Practices – Modeling and disease forecasting- Legislation and quarantine practices in India.

Practicals :

Mycology

Structure, reproduction and diagnostic features of *Phytophthora, Peronospora, Pilobolus, Saccharomyces, Aspergillus, Xylaria, Claviceps, Peziza, Morchella, Lycoperdon, Ustilago, Polyporus, Alternaria, Fusarium*

Microbiology

Staining of microorganisms: Simple staining. Gram staining – spore and acid fast staining, preparation of culture media – Synthetic and Non-synthetic. Isolation of microorganisms. Aerobic and anaerobic forms and soil microbes, purification technique of microorganisms. Serial dilution technique. Hanging Drop method.

Plant Pathology

Verification of Koch's postulates. Identification of plant diseases included in theory syllabus.

Books:

1. Abigall A. Salyers, Dixie D. Whitt. 2013. Microbiology- Diversity, Disease and the Environment. Panima Distributors, Meerut.
2. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 2007. Introductory Mycology. IV Edition. Wiley India (P) Ltd., Daryaganj, New Delhi.
3. Brain D. Robertson and Brendan W. Wren. 2012. Systems Microbiology: Current topic and Applications. ISBN. 978-1-908230.
4. Charles lane, Paul Beales, Kevin Hughes. 2012. Fungal Plant Pathogens. CABI publishing.
5. Dasgupta, M.K. 2004. Principles of Plant Pathology. Allied publishers Ltd. New Delhi.
6. Dubey, R.C. and D.K. Maheswari, 2010. A Textbook of Microbiology, S. Chand & Company, New Delhi.
7. Gupta, G.P. 2004. Plant Pathology. Discovery Publishing House. New Delhi.
8. Raina M. Maier ; Lan L. Pepper ; Charles .P. Gerba 2009; Environmental Microbiology; Elsevier Ap Academic press
9. Rangaswami, G, A. Mahadeven. 2006. Diseases of crop plants in India. Prentice Hall Pvt. Ltd. New Delhi.
10. Robert Burns; 2010; Plant Pathology - Techniques and Protocols; Springer – Humana press
11. Sambamurthy A.V. S.S. 2006. A Textbook of Plant Pathology. I.K. International Pvt. Ltd., New Delhi.
12. Sharma, O.P. 2005. The Text book of Fungi. Tata McGraw Hill publishing company ltd, New Delhi.
13. Sharma, P.D. 2009. The Fungi. Rastogi publications, Meerut.
14. Singh. R.S. 2009. Plant Diseases. Oxford & IBH publishing Co. Pvt Ltd. New Delhi
15. Talaro K.P and Talaro, A. 2006. Foundation in Microbiology (6th Ed)- McGraw-Hill College, Dimensi.
16. Vashista, B.R and A.K. Sinha. 2008. Botany for Degree Students – Fungi. S.Chand & Company, New Delhi.

BOTC – 103 - BIOLOGICAL TECHNIQUES AND INSTRUMENTATION

Objectives:

1. To know the principles of various biological techniques and their applications
2. To understand the basic application and working principles of various equipments in Biological Sciences.

Unit – I

Principles, image formation and applications of Light, Confocal, Polarizing, Transmission and Scanning electron microscopes - Material preparation for Electron microscopy. Microscopic measurements: Micrometers – Ocular, Stage, Haemocytometer and Camera Lucida - Fixatives, dehydrating agents, stains and their uses.

Unit- II

Microtomes: Rocking, Rotary, Sledge and Ultra microtomes and their uses - Material preparation techniques for microtome sectioning. Killing, fixing and staining of plant tissues: Histochemical techniques – staining of Proteins, Carbohydrates, Lipids and Enzymes.

Unit III

Principles and applications of pH meter and Conductivity meter. Centrifugation – Density gradient and ultra centrifugation.

Unit-IV

Calorimeter-Principles and Applications – Spectrophotometry –UV-visible –Infrared- Atomic absorption Spectrophotometer – Chromatography – Paper, TLC, Column and Affinity. Radio Isotopes-Types of Radio activity- Gieger-Muller counter- Scintillation counters – Autoradiography.

Unit – V

Electrophoresis – General principles –SDS- PAGE– Agarose gel.
Blotting techniques- Southern, Northern and Western.
ELISA, RIA, Polymerase Chain Reaction, RAPD, RFLP, SSR, DNA finger printing and FISH techniques

Practicals :

Biological techniques

1. Principles, identification and components of Light , Polarizing , TEM , SEM, ELISA and PCR
2. Fixing , Embedding and Sectioning with microtome
3. Single and Double stained slide preparation with hand and microtome sections
4. Measurement of soil pH
5. Measurement of electrical conductivity
6. Electrophoretic separation of proteins by SDS-PAGE
7. Separation of DNA with Agarose gel
8. RAPD

Books:

1. Albert Schneider.2012. Microscopy and Microtechnique. Rare book club.com, United States, New York.
2. Albrecht Zimmermann. 2013. Botanical Microtechnique. Nabu press, New York
3. Baker and John Randal.1958. Principles of biological Micro technique: A study of Fixation and dyeing. London Methuen & Co. ltd, New York.
4. Berlyn, P.G, 1986. Botanical Microtechnique and Cytochemistry, Springer-Verlag, Belin, Germany.
5. Jayaraman, J. 1992. Techniques in Biology. Higgin Bothams Pvt Ltd, Chennai.
6. Jeremy K.M.Sanderson and Jeremy B.Sanderson.1994. Biological Microtechnique. Garland Science, London, UK.
7. John E.Sass. 2007. Elements of Botanical Microtechnique. Bente press, London, UK.
8. Krishnamurthy, K.V, 1988. Methods in Plant Histochemistry. Viswanathan printers and publishers, Chennai.
9. Marimuthu,R. 2010. Microscopy and Microtechnique, MJP publishers, Chennai
10. Michael J.Bykstra.1992. Biological Electron Microscopy. Springer-Verlag, New York.
11. Robinson, P.C, 1992. Qualitative Polarized light microscopy. Oxford University Press, U.K.
12. Srivastava, M.S. 2008. Bio- analytical Techniques, Narosa Publishing House, New Delhi.
13. Steven E.Ruzin. 1999. Plant Microtechnique and Microscopy. Oxford University Press, London, UK.
14. Surzycki.2013. Basic techniques in Molecular Biology. Panima Book Distributors, Bangalore.

II – SEMESTER BOTC 201- PLANT DIVERSITY - II

Objectives

1. To acquire knowledge on living and Fossils forms of Pteridophytes and Gymnosperms.
2. To understand the reproductive feature of Pteridophytes and Gymnosperms.
3. To apply the knowledge on fossil and fossilization.

PTERIDOLOGY

Unit – I

Classification of Pteridophytes (Reimer's) - Origin of Vascular plants - Different theories –Telome concept - Life cycle of Pteridophytes. Range of structure, reproduction and evolution of Sporophytes in Pteridophytes of Fossil forms: *Rhynia*, *Horneophyton*, *Asteroxylon*, *Lepidodendron*, *Sphenophyllum* and *Calamites*. Living forms: *Ophioglossum*, *Angiopteris*, *Osmunda*, *Dicranopteris*, *Alsophila*, *Adiantum*, *Pteris*, *Salvinia* and *Azolla*. Types of Sporangium development – Eusporangiate type Leptosporangiate type- polarity Type - Embryo development and Spore germination.

Gametophytes in Pteridophytes,– sex organs. Apogamy and Apospory

Unit – II

Stelar evolution and soral evolution in Pteridophytes and Phylogeny. Heterospory and seed habit, ecology and ecological indicators and economic importance of Pteridophytes.

GYMNOSPERMS

Unit – III

Classification of Gymnosperms (Sporne,1965). A general account of distribution, morphology, anatomy, reproduction, phylogeny and relationship of the following orders with special reference to the genera mentioned against each order.

Cycadopsida

1. Pteridospermales

Lyginopteridaceae : *Lyginopteris*, *Heterangium*, *Lagenostoma*, *Physostoma*.

Medullosaceae : *Medullosa*, *Trignocarpus*

Glossopteridaceae : *Glossopteris*

Caytoniaceae : *Caytonia*.

2. Bennettitales

Cycadeoidaceae : *Cycadeoidea*.

3. Pentoxylales

Pentoxylaceae : *Pentoxylon*

4. Cycadales

Cycadaceae : *Zamia*

UNIT – IV

Coniferopsida

1. Cordaitales.

Cordaitaceae : *Cordaites*.

2. Coniferales.

Cupressaceae : *Cupressus*

Podocarpaceae : *Podocarpus*.

Araucariaceae : *Araucaria*

3. Taxales

Taxaceae : *Taxus*.

4. Ginkgoales
Ginkgoaceae : *Ginkgo*

Gnetopsida

Ephedraceae : *Ephedra*

Evolution of Gymnosperms. General account of Cycadofilicales. Economic importance of Gymnosperms.

PALAEOBOTANY

UNIT – V

Contributions of Birbal Sahani to Palaeobotany – Study of fossils in understanding evolution – Fossilization and fossil types. Economic importance of fossils – fossil fuels and Industrial raw materials.

Geological Time scale- Radio Carbon dating, Fossils and fossilization. Kinds of fossils: Impressions, Compressions, casts, molds, petrifications and coal balls. Importance of the study of Palaeobotany

Practicals :

Pteridology

Fossil forms: *Rhynia*, *Horneophyton*, *Asteroxylon*, *Lepidodendron*, *Lepidocarpon*, *Sphenophyllum* and *Calamites*.

Living forms: *Ophioglossum*, *Angiopteris*, *Osmunda*, *Dicranopteris*, *Alsophila*, *Adiantum*, *Pteris*, *Marsilea*, *Salvinia* and *Azolla*.

Gymnosperms

Identification and characteristic features of *Lyginopteris*, *Heterangium*, *Lagenostoma*, *Physostoma*, *Trignocarpus*, *Zamia*, *Cupressus*, *Podocarpus*, *Araucaria*, *Ginkgo*, and *Ephedra*.

Paleobotany

Compression, Impression and Petrified Fossils

Books

1. Arnold C.R.1974. Introduction to Palaeobotany. TMH publishing Co.Ltd., Bombay.
2. Bhatnagar, S.P. and Alok Moitra, 2003. Gymnosperms, New age International Pub., New Delhi.
3. Biswas,C., B.M.Johri, 1999. The Gymnosperms, Narosa Publishing House, Chennai.
4. Johri,R.M. 2012. A Textbook of Gymnosperms. Dominant publishers and Distributors pvt., ltd, New Delhi.
5. Johri, Lata and Tyagi.2012. A Textbook of Gymnosperms. Dominant publishers and Distributors pvt.,ltd, New Delhi.
6. Kumar,A. 2012. Textbook of Gymnosperms. Random experts publishers and distributors, New Delhi.
7. Parihar,N.S. 2005.An Introduction to Embryophyta – Pteridophytes – Central Book Depot, Allahabad.
8. Pandey, B.P. 2006. College Botany-Volume –II. S.Chand & Company ltd, New Delhi.
9. Rashid.A. 2007. An Introduction to Pteridophyta – Vikas Publications, New Delhi.
10. Mukta Bhargava. 2003. The latest portfolio of theory and practice in Gymnosperms, Dominant Publishers and Distributers, New Delhi.
11. Sambamurthy A.V. S.S. 2005. A Textbook of Pteridophytes, Bryophytes, Gymnosperms and Paleobotany ; I.K. International Pvt.Ltd., New Delhi.
12. Singh S. K.; 2008 Gymnosperms and Palaeobotany; Campus books Publications – New Delhi
13. Shukla.A and Mishra S.P. 1975. Essentials of Palaeobotany. Vikas Publishing House, Pvt. Ltd. New Delhi.
14. Shirpad N.Agashe. 1995. Palaeobotany. Oxford & IBH Publishing Co.Pvt.Ltd, New Delhi.
15. Vashishta. P.C., A.K. Sinha and Anil Kumar. 2008. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.

BOTC 202- PLANT ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Objectives:

1. To acquire the knowledge on internal structure of plants.
2. To understand the fertilization and development of Embryo.
3. To apply knowledge on cell enlargement and differentiation.

PLANT ANATOMY

Unit – I

Simple and Complex permanent Tissues – Cell wall: Ultra structure and Chemical nature –Plasmodesmata - Meristems: Apical, Lateral and Intercalary meristem –Theories of Apical organization: Apical theory, Histogen theory and Tunica carpus theory – Shoot apex and Root apex - Xylem and Phloem:– Primary and Secondary structures– Phylogenetic trends and specialization of xylem and phloem – Vascular cambium: Origin, Structure and Seasonal activity - Transfer cells – Lenticels

Unit – II

Leaf Anatomy – Types of stomata and Stomatal index. Anatomy of floral parts, Anatomy of Fruit wall and Seed Coat.

Nodal anatomy – Types and phylogenetic trends in nodes – Periderm formation: rays and Fibers - Lignin, Cellulose, Pectin, Waxes - wound healing and grafting – Secondary growth in thickness – Anomalous secondary thickening in dicots and monocots.

Wood anatomy: Physical, chemical and mechanical properties of wood – Defects in wood – compression and Tension wood.

EMBRYOLOGY

Unit - III

Pollen – pistil interactions and fertilization : barriers of fertilization, control of fertilization and current concept of fertilization – self incompatibility – methods to over come self incompatibility - Experimental Embryology including pollen storage and test tube fertilization. Endosperm : classification and types, haustoria - functioning of storage metabolites
Embryo – development of dicot and monocot embryo –nutrition of embryo

Unit - IV

Polyembryony : classification and types

Apomixis : diplospory , apospory, parthenogenesis and parthenocarpy : practical applications of apomixis and polyembryony.

Embryology and Taxonomy – embryological features of taxonomical importance.

Shoot, root and leaf development and phyllotaxy; Transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

MORPHOGENESIS

Unit - V

Morphogenesis : Basic concepts and its importance. Morphogenetic factors –extra cellular matrix and cell membrane- their role in morphogenesis.

Cell differentiation and its mechanism – nucleo-cytoplasmic interactions .

Internal morphology: Classical concept of flower, conduplicate carpel theory, floral vascularization – inferior ovary and carpel polymorphism

Practicals:**Plant Anatomy:**

Examination of Root and Shoot apices ; Maceration , clearing and peeling techniques; cambial variant in *Bougainvillea*, *Boerhaavia*, *Nyctanthes*, *Bignonia*, *Aristolochia*, *Strychnos* and *Dracaena*. Nodal Anatomy – Different types of nodes. Different types of stomata - Calculation of stomatal index and frequency.

Fruit wall and Floral vascular Distribution.

Embryology

Different stages of anther, embryo sac, endosperm and embryo development

Pollen germination and viability test

Dissection of embryo – *Tridax*, *Crotalaria* and *Cleome*

Endosperm and endosperm haustoria – Cucurbitaceae members

Morphogenesis

Wounding of young stem and study of the wound healing response

Effect of removal of leaf primordial and axillary buds

Study of T.S. of Receptacle, Sepal, Petal, Stamen of Carpel traces and Inferior ovary.

Books:

1. Cutler, D.F., Botha, T and Stevenson, D.W. 2013. Plant Anatomy – an applied approach. Panima Educational Book Agency, New Delhi.
2. Edmond W. Sinnott.1960. Plant Morphogenesis. McGraw Hill Book Company, Inc- USA
3. Fahn, 1989. Plant Anatomy. Pergaman Press. London.
4. Katherine Esau. 2006. Anatomy of seed plants. John Willey & sons publications, New Jersey.
5. Maheshwari, P. 1963. An Introduction to Embryology of Angiosperms. Tata Mc Grow Hill. New York.
6. Pandey B.P., 1995. Embryology of Angiosperms. S.Chand & Company Ltd., Ram nagar, New Delhi
7. Pandey, S.N and A.Chadha.2005. Plant Anatomy and Embryology. Vikas Publishing House Pvt Ltd., New Delhi.
8. Sharma H.P; 2009; Plant Embryology; Narosha Publishers, New Delhi
9. Shivanna.K.R. 2003. Pollen Biology and Biotechnology. Oxford IBH, New Delhi
10. Singh.V., P.C. Pandey and D.K.Jain. 2003. Embryology of Angiosperms. Rastogi Publications. Meerut.
11. Singh.V, Pande.P.C and S.D.K.Jain. 1998. Anatomy of Seed Plants. Rastogi Publications, Meerut.
12. Steward, F.C. 1971. Plant growth and development, Academic Press, New York.
13. Tayl, M.S. 2008. Plant Anatomy. Rastogi publications, Meerut.

BOTC 203 - GENETICS AND PLANT BREEDING**Objectives:**

1. To acquire the knowledge in Heredity and variation.
2. To understand the fundamental and molecular basis of gene action.
3. To develop skill on different methods and techniques in plant breeding.

GENETICS**Unit – I**

Mendelian Inheritance – Introduction, basic concepts and outputs. Non-Mendelian Inheritance- Types of Interaction of Genes.

Sex determination in plants and sex linked inheritance, Chromosome mapping –Reverse genetics and epigenetics and their biological importance.

Unit – II

Extra-nuclear inheritance: cytoplasmic inheritance – chloroplast and Mitochondrial genome in higher plants.

Microbial Genetics: Methods of Gene transfers – Transformation, Conjugation, Transduction - Mapping genes by interrupted mating – Transposable elements, Jumping genes- Population genetics.

Unit – III

Classification of Mutation - Gene, Genomatic and Chromosomal mutation: spontaneous and induced mutation – physical and chemical mutagens. Molecular basis of gene mutation, point and frame shift and suppressor mutation. Gene regulatory mechanisms. Genetic disorders in Human being, Gene therapy.

PLANT BREEDING

Unit - IV

Introduction- Floral biology: significance – floral biology of crop plants in relation to their breeding systems.

Importance of male sterility and haploid plants in Plant breeding- Heterosis.

Breeding methods: Methods of Plant breeding in self and cross pollinated crops.

Centre of origin of cultivated plants – Role of plant domestication, Introduction and acclimatization in plant breeding.

National and International organizations for crop improvement.

Unit – V

Selection techniques: Types of selection – pure line selection – mass selection – recurrent selection and clonal selection.

Selection in segregating populations – Pedigree method, bulk method and back cross method

Plant Hybridization – Types and process of Hybridization

Modern methods of Plant breeding- Mutation breeding, Polyploidy breeding and Distant hybridization.

Role of Biotechnology in Plant breeding .

Practicals:

Genetics

1. Genetics problems in Mendelian inheritance, gene interaction, quantitative inheritance , multiple alleles, sex linkage and genetic maps
2. Survey of genetic inheritance in a population.

Plant Breeding

1. Methods of vegetative propagation – Layering, Budding and Grafting
2. Techniques in selfing and hybridization

Books:

1. Basu.S.B. and M.Hossain.2004. Principles of Genetics. Books and Allied (P). Ltd, Kolkatta.
2. Chaudhari, H.K. 1984. Elementary Principles of Plant Breeding Oxford IBH..New Delhi
3. Gardner, Simmons, Snustad; 2006; Principles of Genetics; Wiley student edition.
4. Gurbachan and S. Miglani, 2000. Basic Genetics, Narosa Publishing House, New Delhi.

5. Hartle, D.L. and E.W. Jones, 2005. Genetics - Analysis of Genes and Genomes. 6th Ed., Jones and Bartlett publishers, London.
6. Hays, K.K. Immer, F.R. and Smith, D.C. 1985. Methods in Plant Breeding. Tata Mc Graw Hill. New York.
7. Inbasekar.2013. Cell Biology and Genetics. Panima Book Distributors, Bangalore.
8. Jack Brown & Peter callgarl.2013. An Introduction to Plant Breeding. Panima Book Distributors, Meerut.
9. John Ringo, 2004. Fundamental Genetics. Cambridge University press, UK
10. Lynch, M. 2013.Genetics and Analysis of Quantitative Traits. Panima Book Distributors, Bangalore.
11. Maloy.2013. Microbial Genetics-2nd Edition, Panima Book Distributors, Bangalore
12. Mohan, K.V.2010. Essentials of Plant Breeding. PHI Learning Private Limited, New Delhi.
13. Neal.C. Stopskopf. 1999. Plant Breeding Theory & Practices. Scientific Publishers, Jodhpur.
14. Sanjay Kumar Singh.2005. Plant Breeding. Campus book international, New Delhi.
15. Sarin.C.2002. Genetics. Tata McGraw-Hill Publishing Co.Ltd, New Delhi.
16. Sharma. A.K. and Sharma, A. 1980. Chromosome Techniques Theory and Practice. Oliver and Boyd, London.
17. Singh,B.D. 2001. Plant Breeding, Principles and Methods. Kalyani Publications, New Delhi.
18. Singh.B.D.2005.Genetics.Kalyani Publishers. New Delhi.

III - SEMESTER

BOTC - 301 - TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Objectives

1. To acquire knowledge in naming of plants.
2. To understand the method of plant classification
3. To apply the knowledge in biosystematics
4. To develop skill to enumerate the family characters.
5. To appreciate the economic potential of plants.

TAXONOMY OF ANGIOSPERMS

Unit – I

Essentials of Taxonomy, Historical account on classification of angiosperms- A detailed account of the systems of classification of Linnaeus, Bentham and Hooker, Engler and Prantl and a general account on the system of classification of Takhtajan . Chemotaxonomy and Numerical taxonomy.

Nomenclature and taxonomical techniques. Plant Nomenclature – Brief History on the origin and development of nomenclature; Detailed study of the major provisions of the International Code of Botanical Nomenclature (ICBN) – Effective and valid publications , Role of priority and its limitation, typification, Different kinds of types, Author citation and rejection and retention of names, conserved names.

Unit- II:

APG System and its significant-Different kinds of identification keys, Construction of dichotomous keys- Indented and bracketed keys. Various kinds of Taxonomic literature: Floras, Revisions, Manuals – Monographs, Periodicals. Computational Taxonomy, Information systems- data banking and use of computers in Taxonomy, computer constructed keys. Uses of molecular tools in Taxonomy, RFLP, RAPD and AFLP. Methods of Plant exploration ; Management of Herbaria; Major Herbaria in India and the World; Role of Herbaria in

Taxonomy. Botanical Survey of India. Conservation of Biological Diversity (*In situ* and *Ex situ*)

Unit – III

A detailed study of the following families with their interrelationship and phylogeny

Annonaceae	Combretaceae
Portulacaceae	Myrtaceae
Sterculiaceae	Lythraceae
Zygophyllaceae	Passifloraceae
Rhamnaceae	Cucurbitaceae
Sapindaceae	Apiaceae
Fabaceae	

Unit – IV

A detailed study of the following families with their interrelationship and phylogeny

Rubiaceae	Nyctaginaceae
Apocyanaceae	Verbenaceae
Gentianaceae	Euphorbiaceae
Boraginaceae	Casuarinaceae
Scrophulariaceae	Liliaceae
Acanthaceae	Poaceae
Lamiaceae	

ECONOMIC BOTANY

Unit – V

A brief account of Botany, cultivation and utilization of Cereals, pulses, nuts, vegetables and fruits

Spices and condiments

Fats and oils-essential oils

Commercial crops- Wheat, Cotton and Sugarcane, fibres, timbers

Tannins, resins, alkaloids

Drug yielding plants

Plants as a source of renewable energy – Ethnobotany and its importance.

Practicals:

Taxonomy of Angiosperm

Detailed study of the families mentioned in the theory with two representative species from the local area.

Familiarity of the binomial nomenclature of the available species from the local flora using Gamble's flora.

Solving the taxonomical problems

Economic Botany

Identification of family, genus, species and morphology of the useful parts of plants mentioned in the theory.

Books

1. Dutta, S.C. 2003 Systematic Botany, New age International (P) Ltd, Publication, New Delhi.
2. Gamble, J.S. 1956. Flora of the Presidency of Madras . Vol. I,II & III. Bishen Singh Mahendra Pal Singh, Dehradur, India.
3. Greuter, W., 1988. International Code of Botanical nomenclature. Today and Tomorrow's Printers and Publishers, New Delhi.
4. Gurucharan Singh, 2004. Plant Systematics, Oxford & IBH Publishing company (P) Ltd, New Delhi

5. Jain, S.K. and R.R. Rao, 1977. A Handbook of field and herbarium methods. Today and Tomorrow's Printers and Publishers, New Delhi.
6. Jones, S.D and A.E. Luchsinger, 1987. Plant Systematics. Tata McGraw-Hill, New York
7. Lawrence, G.H.M. 1964, Taxonomy of Vascular Plants, Oxford & IBH Publishing company (P) Ltd, New Delhi.
8. Naik, V.N. 2002. Taxonomy of Angiosperms, Tata McGraw-Hill, New York
9. Pandey, B.P. 2009. Taxonomy of Angiosperms. S.Chand & Co. Ltd. New Delhi.
10. Quicke, D.L.J, 1993. Principles and techniques of contemporary Taxonomy, Chapman and Hall, London.
11. Sambamurty, A.V.S.S, 2005. Taxonomy of Angiosperms, I.K. International Pvt. Ltd.,
12. Simpson, 2010. Plant Systematics, Academic Press.
13. Singh S.K, Seema Srivastava; 2009; Taxonomy of Angiosperms; Campus book International, New Delhi
14. Singh V. Jain D.K. 2001. Taxonomy of Angiosperms; Rastogi Publications, Meerut
15. Singh, S.K and Seema Srivastava. 2009. Economic Botany. Campus Book International, New Delhi.
16. Singh, V, P.C. Pande and D.K. Jain. 2013. Economic Botany. Rastogi Publications, Meerut.
17. Sivarajan, V.V., 1999. Principles of Plant Taxonomy, Oxford and IBH, New Delhi.
18. Stace, C.A, 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
19. Subramaniam, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House, New Delhi.
20. Wickens. 2013. Economic Botany: Principles and Practices. Panima Book Distributors, Bangalore.

BOTC - 302 - CELL BIOLOGY AND MOLECULAR BIOLOGY

Objectives:

1. To acquire the knowledge of fundamental unit of living being.
2. To understand the different types of cells and cell organelles.
3. To apply the knowledge in structure and function of gene at molecular level.
4. To develop skill on different methods of Molecular Biology.

CELL BIOLOGY

Unit – I

Structural organization and functions of intracellular organelles: Cell Wall, Nucleus, Mitochondria, Golgi body, Lysosome, Endoplasmic reticulum, Ribosome, Peroxisome, Plasmid, Vacuole, Chloroplast, structure & function of Cytoskeleton and its role in motility. Cell Membrane, Structure and Membrane Transport.

Cell signaling: Signaling through G-Protein coupled receptors - signal transduction pathways - Second messengers - regulation of signaling pathways. Hormone receptors - signal transduction and gene expression.

Unit – II

Cell division: Types of cell divisions, Events of cell division, Differences between Mitosis and Meiosis - Molecular basis of cell cycle.

Synapsis, Synaptonemal complex, Mechanism of crossing over and formation of Chiasma.

Chromosomes: Types, Fine structure of eukaryotic chromosome – Kinetochore, chromomeres, satellite, Euchromatin and Heterochromatin- special types of chromosomes - Chromosome banding and chromosome painting.

Chromosomal variation and aberration, Karyotype analysis

MOLECULAR BIOLOGY

Unit – III

Chemical nature of DNA– A,B and Z forms of DNA – Superhelical structure of DNA – Structure of Prokaryotic gene-Structure of simple, compound and complex genes – Regulatory structures – Promoter, Enhancer, Attenuator and Terminator - Structure of Eukaryotic gene - Introns and Exons- Satellite DNA

DNA Replication – Methods of DNA Replication- Enzymology of DNA replication- Mechanism of DNA replication- RNA primers- - origin of replication - Replication fork - Okazaki fragments- Continuous and Discontinuous synthesis of DNA - DNA repair mechanism: Excision repair -Mismatch repair.

Unit - IV

Transcription – Definition– Initiation, elongation and termination in prokaryotes and eukaryotes –Promoters – Pribnow box-- TATA binding proteins – Complimentary palindroms - Prokaryotic and Eukaryotic- RNA polymerases- Regulatory proteins – Zinc fingers - Post transcription modifications in prokaryotes and eukaryotes—Capping- Polyadenylation – RNA splicing – Types of RNA - Amino acyl t-RNA synthetase- Peptidyl transferase.

Unit – V

Genetic code –Types of codons – codons usage – universal codon – Wobble hypothesis Polycistronic m-RNA – overlapping genes – Components of protein synthesis – sigma factor – *Rho* factor – structure of ribosome – polysomes – ribosome entry sites – selenocysteine insertion sequence - Protein synthesis in Prokaryotes – Initiation, Elongation - Termination.

Alternative Splicing: RNA Splicing – Spliceosome machinery – Splicing pathways – Alternative Splicing regulated by activators and Repressors – Sn RNPs- Exon Shuffling – RNA Editing – mRNA Transport.

Coupled transcription - Translation - Translation and post-translational modifications in Eukaryotes-Protein folding.

Practicals:

Cell Biology

1. Squash and smear techniques
2. Study of cell division – Mitosis (*Allium cepa*, *Rhoeo*, *Urgenia*, *Scilla*)
3. Study of Meiosis - (*Allium cepa*, *Helianthus*, *Tredescantia* flower buds)
4. Study of chromosomal aberrations and polyploidy
5. Karyotype analysis – Idiogram preparation
6. Study of special types of chromosomes

Molecular Biology

1. Isolation of high molecular weight genomic DNA from rice
2. Isolation of DNA from tender coconut
3. Separation of plant genomic DNA by electrophoresis
4. Qualification of Plant Genomic DNA by Spectrophotometric method
5. Quality checking of DNA by Electrophoresis
6. RAPD Techniques
7. Isolation of plasmid DNA
8. Southern blotting (Demonstration)
9. Western blot - detection of proteins (Demonstration)

Books:

1. Allison.A. 2007. Fundamental Molecular Biology. Blackwell Publishing, UK.
2. Benjamin, Levin. 2004. Genes VIII. Pearson Education International, USA.
3. De Robertis and De Robertis, 2004. Cell and Molecular Biology. Lippincott. Williams and Wilkins. USA.
4. Freifelder, 1990. Molecular Biology, Narosa Publishing House, New Delhi.
5. Geoferey M. Cooper . 2013. The Cell : A Molecular Approach. Panima Book Distributors, Bangalore.
6. George,M. Malacinsji, 2007.Essentials of Molecular Biology, IV Edition, Joures and Bartlett Publishers, Massachusetts.
7. Gerald Karp. 2010. Cell biology. John wiley & Sons. Inc
8. Harvey Lodish, Arnold Berk, Chris A.Kaiser. 2013. Molecular Cell Biology-7th Edition, Panima Distributors, Meerut.
9. Mary A. Schuler Raymond and E.Zrelinski, 2005. Methods in Plant Molecular Biology, Academic Press. An imprint of Elsevier
10. Peter Porella, 1998. Introduction to Molecular Biology, Mc Graw – Hill, New York.
11. Pragya Khanna; 2008; Cell and Molecular Biology ; I.K. International Publications- New Delhi.
12. Ramawat,K.G. and Shaily Goyal, 2010. Moleuclar Biology and Biotechnology, S.Chand Company Ltd Publication, New Delhi.
13. Rastogi, S.C. 2004. Cell Biology. New age International Publications, New Delhi.
14. Sambamurty A.V.S.S.; 2008; Molecular Biology; Narosa Publishers- New Delhi
15. Singh and Tomar.2004. Cell Biology. Rastogi Publishers, Meerut.
16. Swanson, C.P. 1972. Cytology and Cyto genetics. Mac Millan. New York.
17. Twyman.R.M. 2003. Advanced Molecular Biology. Viva Books Pvt. Ltd, New Delhi
18. Walker, J.M and R. Rapley, 2003. Molecular Biology and Biotechnology, IV Edition. Panima Publishing Corporation, Bangalore.
19. Watson Baker Bell, Gana Levine Losick, 2004. Molecular Biology of the gene. V Edition, Pearson Education.
20. William D. Stansfield. Jaine S. Colone Raul J. Chand, 2004. Molecular and Cell Biology, Tata Mc Graw-Hill Publishing Company, New Delhi.

BOTC - 303 - BIOTECHNOLOGY , GENETIC ENGINEERING AND TISSUE CULTURE**Objectives**

1. To understand and acquire the knowledge of Bio-technological innovative methods and products
2. To acquire basic knowledge on Plant Genomics
3. To understand the basic knowledge on Patent rights
4. To acquire knowledge about the various aspects of tissue culture and their importance.

BIOTECHNOLOGY**Unit – I**

Introduction - Scope and importance of Biotechnology. Microbial fermentation- Types and design of fermentors - Production of biogas, alcohol, hydrogen. Algal biotechnology: Single cell protein - Production of food and flavour. Fungal biotechnology: Production of food and flavours – Mushroom cultivation. Enzyme Biotechnology – Methods of Enzyme production – Application of enzymes. Plants as bioreactors: Edible vaccines - Production of antibiotics. Plant neutraceuticals: Introduction, scope and applications. Molecular farming.

Unit – II

Industrial applications of enzymes and secondary metabolites: *In vitro* techniques of synthesis – various enzymes and secondary metabolites. Production of amylase, pectinase, cellulase, proteinase and their uses. Immobilized enzymes - Methods of immobilization and applications. Biotechnology and novel production in crops- transgenic traits: Delayed ripening - Modification of starch, oil, vitamins, minerals and seed storage proteins.

GENETIC ENGINEERING

Unit – III

Basic principles: Restriction endonucleases– Methods of gene transfer - Particle Gun Method – Electroporation- Microinjection – Liposome - Calcium Phosphate Co-precipitator - Cloning vectors – plasmids - phages - cosmids -viral vectors.
DNA Sequencing Methods: Maxam and Gilbert – Sanger method and Pyrosequencing method – Short gun sequencing – High throughput sequencing by sequencers.
c-DNA libraries - Genomics for evolutionary studies, Choice of host organisms for cloning- bacteria, yeast plants- Preparation of molecular genetic maps in cereals, legumes, cotton and forest trees.

Unit – IV

Genetic engineering of *nif* genes in non leguminous plants – marker gene enzymes, vector, organization, transformation and integration. Transgenic plants – methods, selective marker genes and detection of gene transformation. Fungicide and herbicide resistance markers – Biocontrol methods of pest and diseases. Control of transgene expression in plants: Selectable markers for plants. Role of Biotechnology in agriculture

TISSUE CULTURE

Unit – V

Principles of tissue Culture- Callus, organ-shoot culture - Synthetic seeds, production of synthetic seeds, artificial seeds - Protoplast isolation fusion and somatic hybridization technique, Haploids and their significance, Anther and Pollen culture.
Somatic embryogenesis and hybridization - Somaclonal variation: mechanism, causes and Applications of somaclonal variations – Cryopreservation - production of secondary metabolites through cell culture. Micropropagation of banana and eucalyptus - Hairy root culture for secondary metabolites - Tissue culture as a tool for Biotechnology.

Practicals:

1. Isolation of single cell protein
2. Immobilization of yeast cells
3. Analysis of digest from cellulose
4. PCR – Technique with known primers
5. Bio control of plant insects using *Bacillus thuringiensis*
6. Bio control of plant insects using PHV.
7. Preparation of explants
8. Establishment and maintenance of Carrot callus
9. Initiation and establishment of cell suspension culture of carrot
10. Embryogenesis in cultured cells of carrot
11. Microspore culture- preparation of artificial seeds

Books:

1. Bernard R. Glick and Jack J. Pasternak, 2001. Molecular Biotechnology – 2nd edition, ASM press, Washington DC.
2. Brown.2013. An Introduction to Biotechnology. Panima Book Distributors, New Delhi.
3. Chawla, H.S, 2000. Introduction to Biotechnology. Oxford & IBH Publishing Co Pvt. Ltd, New Delhi
4. Dubey R.C.; 2009 A Textbook of Biotechnology; Chand & Company LTD. New Delhi.
5. Gupta, P.K. 2011. Elements of Biotechnology-2nd Edition. Rastogi Publisher, Meerut.
6. Ignachimuthu, S.1997. Biotechnology: An Introduction-2nd Edition, Narosa Publishing House, New Delhi.
7. Renneberg,R.2013. Biotechnology for Beginners. Panima Book Distributors.
8. Kumar, H.D. 2004. A Textbook on Biotechnology – 2nd edition, Affiliated East West press Pvt., Ltd., London.
9. Gupta, P.K. 2003. Biotechnology and Genomics, Rastogi Publisher, Meerut.
10. Ralph Rapley and Stuart Harbon. 2004. Molecular Analysis and Genome Discovery. John Wiley & Sons Ltd., England.
11. Ramawat,K.G. 2003. Plant Biotechnology. S.Chand & Co., New Delhi
12. Ramawat, K.G and JM. Merillon. 2003. Biotechnology: Secondary Metabolites. Oxford & IBH Publishing Co.Pvt.Ltd, New Delhi.
13. Rastogi, S.C. 2007. Biotechnology- Principles and Applications. Narosa Publishing House, New Delhi.
14. Smith Rastogi and Neelam Pathak.2009. Genetic Engineering. Oxford Univ.press.
15. Walker J.M and R. Repley. 2006. Molecular Biology and Biotechnology. IV Edition. Panima Publishing Company, New York.
16. William. J.Thieman, Michael A.Palladino. 2012. Introduction to Biotechnology. Benjamin Cummings publishers.

BOTC - 304 - RESEARCH METHODOLOGY, BIO-INFORMATICS AND NANOTECHNOLOGY**Objectives:**

1. To acquire basic knowledge on Research methodology and computer application
2. To acquire basic knowledge on Bio-informatics and Nanotechnology
3. To understand the basic applications of hardware and softwares of computer
4. To develop skill in Internet usage.

RESEARCH METHODOLOGY**Unit – I**

Scientific writing – Characteristics, Logical format for writing thesis and papers

Essential features of abstracts - components of thesis writing-

Introduction –Review of literature – Primary, secondary references

Materials and methods- Effective illustration- Tables and figures- Discussions, Reference styles – Harvard and Van couver system

Unit – II

Computer in Biological science, scope and prospects.

Operation system – Definition- Classification-Input and output devices.

Introduction to windows operating system- MS windows – MS-Word-folders, files, MS Excel – MS Power point - creating slides – templates – animation and transitions - Data storage – Data analysis - On line publications: Electronic journals - Internet-World Wide Web-Search engines – their functions- Email-e-access data base concepts and implication.

Biostatistics packages- Data base preparation- Graphic applications in Biology.

BIOINFORMATICS

Unit – III

Introduction and scope of bioinformatics- Boolean searching – file formats- Biological Databases – Nucleic acid , protein sequence and structure data bases- data retrieval - web based tools for sequence searches – sequence similarity searches – FASTA and BLAST, Clustral and Phylip –Motif analysis and presentation.

NANOTECHNOLOGY

Unit – IV

Introduction, Basic principles, tools and techniques, nanobioelectronic devices and Polymer nano containers, Microbial production of inorganic nano particles, Role of Computers in Nanotechnology. DNA based nanostructures- Topographic and electrostatic properties of DNA and proteins – Hybrid conjugates of gold nano particles – DNA Oligomers metal nano particles and nucleic acid and protein based recognition groups- nano particles as carrier for genetic materials – Applications of nanotechnology in medicine and agriculture.

Unit – V

IPR Patents - Patent procedures - Infringement problems – Patenting information systems and services in India - Trade secrets - Copy rights and Trade marks - Patenting biological materials - Higher plants, transgenic organisms, isolated genes and DNA sequences- biotechnological innovations.

IPR for Plant breeding: Plant variety protection - Plant breeder's rights - Farmer's rights - WTO – GATT, conventions and treaty on patent and trade, TRIPS.

Bioethics – Biosafety regulations, IBSC, Good Laboratory practices.

Practicals:

1. Acquiring of basic skills in Internet browsing
2. Familiarization of web browsers and search engines
3. Familiarisation of important biological and bioinformatics web sites
4. Write an algorithm to find sequence similarity search using BLAST
5. Write an algorithm to determine protein structure using protein databases.

Books:

1. Andreas D. Baxevanis and B.F. Francis overlette, 2002. Bio-informatics, John Wiley & Sons.
2. Challa, S.S.R. Kumar, Josef Hormes, Carola Leuschaer. 2005. Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. Willey – VCH.
3. Connor and Peter Woodford, 1979. Writing scientific paper in English. Pitman Publ. Co, U.K.
4. Deenadayalu, R. 1987. Computer Science Vol I. Tata MacGraw Hill. Pub, Co, U.K.
5. Des Higgins, Willie Taylor, 2004. Bio-informatics, Oxford University Press.
6. Ignacimuthu, S.J. 2005. Basic Bio-informatics, V.K. Mehra, Narosa Publishing House, New Delhi.
7. Irfan Alikhan, Atiya Khanum, 2003. Essentials of Bio informatics, Ukaaz publications.
8. Kothari, C.R, 1991. Research Methodology—Methods and Techniques. Wiley Eastern Ltd, New Delhi.
9. Niemeyer, C.M and C.A. Mirkin. Wiley, 2004. Nanobiotechnology – Concepts, Applications and Perspectives. VCH.
10. Pradeep, T.2007. Nano: The essentials. McGraw- Hill education.
11. Singh, R. 2006. Research Methodology in Plant Science. M.J.P. Publications, New Delhi.
12. Sree Ramalu, V.S, 1988. Thesis writing. Oxford & IBH publications, New Delhi.

IV- SEMESTER BOTC – 401 - PLANT PHYSIOLOGY

Objectives:

1. To acquire the knowledge about the metabolism in plants
2. To understand the biophysical and biochemical processes
3. To understand the role of growth regulators on growth and development of plants
4. To understand the plant adaptation to various environmental conditions

Unit – I

Physical and chemical properties of water – water in soil – water absorption by roots – Apoplast and Symplast - water transport through the xylem – SPAC concept – Transpiration and evapotranspiration- stomatal structure and function – mechanism of stomatal opening and closing – mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders – absorption of solutes – translocation of solutes – pathways and mechanisms.

Unit – II

Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra- photoreceptors- Ultra structure and biochemical compartmentation of Chloroplast; Photosynthetic Electron Transport and Photophosphorylation (cyclic and non-cyclic); Photosystems and reaction centres - Light Harvesting complexes - Photo System II and Oxidation of Water; Carbon metabolism: C₃, C₄ and CAM pathways and their distinguishing features - photorespiration and its significance – phloem loading and unloading - translocation of photosynthates – source- sink relationship – partitioning of assimilates and harvest index.

Unit – III

An overview of plant respiration – Glycolysis – TCA cycle– Electron Transport and ATP synthesis – chemiosmotic Theory - Pentose Phosphate Pathway– Respiration and its significance in crop improvement. Cyanide resistant respiration; Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation: Nitrate and Ammonium assimilation, Secondary metabolites in plants: Nature, distribution and function of alkaloids, flavonoids, and nitrogenous compounds.

Unit – IV

Definition of growth – growth factors – growth correlation – growth dynamics and growth analysis; Growth substances (Auxin, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, polyamines, jasmonic acid, salicylic acid): Chemical nature, biosynthesis, physiological effect and mechanism of action in agricultural and horticultural crops; Photoperiodism – classification of plants and mechanism of flowering in photoperiodic sensitive plants – theories related to flowering – phytochrome and their action on flowering – vernalization: mechanism and its practical application; Plant senescence and their biochemical mechanism; fruit ripening and its molecular basis and manipulation.

Unit – V

Responses of Plants to Biotic (Pathogen and insects) and Abiotic stress (Water deficit and flooding, Temperature - high and low, chilling and freezing, salinity and alkalinity): Mechanism of tolerance to various stresses – significance of water use efficiency, importance of osmoregulation, stress responsive proteins - Role of antioxidative mechanism in stress tolerance.

Practicals:

1. Determination of osmotic potential by plasmolytic method.
2. Determination of water potential using gravimetric method.
3. Determination of water potential using dye method (Chardakov's method).
4. Effect of Monochromatic light on apparent photosynthesis.
5. Effect of CO₂ concentration on apparent photosynthesis.
6. Effect of temperature on protoplasmic membrane.
7. Separation of chloroplast pigments using paper chromatographic technique.
8. Estimation of chlorophyll content using Arnon's method.
9. Determination of rate of photosynthesis using O₂ electrode.
10. Experiment to study the rate of Hill activity of isolated chloroplast by dye-reduction.
11. Rice coleoptile straight growth test for Indole Acetic Acid.
12. Effect of Auxin on root initiation
13. Experiments to show the herbicidal action of Auxin (2-4D).
14. Effect of synthetic Cytokinin on the destruction of chlorophyll.
15. Estimation of Proline content
16. Estimation of Glycinebetaine content
17. Determination of Relative Water Content

Books

1. Bidwell, R.G.S. 1974. Plant Physiology, Macmillan Publisher, Boston.
2. Devlin, R.M. 1996. Plant Physiology, PWS publisher, Boston.
3. Heldt, H.W. 2005. Plant Biochemistry. Academic press, London.
4. Jain, V.K. 2008. Fundamentals of Plant Physiology, S.Chand & Company Ltd., New Delhi
5. Leopold, A.C, 1994. Plant growth and Development, McGraw Hill, New York.
6. Lincoln Taiz and Eduardo Zeiger, 2005. Plant Physiology. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd Edition). Springer-verlag, New York, USA.
8. Noggle, R.G and Fritz, G.J. 2010. Introductory Plant Physiology, PHI Learning Pvt Ltd, New Delhi.
9. Park, S. Nobel. 2005. Physicochemical and Environmental Plant Physiology. Elsevier Academic press, New York.
10. Panda, S.K, 2005. Advances in Stress Physiology of Plants. Scientific Publishers India, Jodhpur.
11. Robert L. Benech and Arnold Rodolfo A. Sanchez. 2013. Handbook of Seed Physiology. Panima Book Distributors.
12. Salisbury, F.B and Cleon Ross, 2007. Plant Physiology, Wadsworth Publishing Company, Belimont.
13. Shinha, R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.
14. William G. Hopkins, 1999. Introduction to Plant Physiology, John Wiley and sons, INC, New York.

BOTC – 402 - ENVIRONMENTAL BIOLOGY

Objectives :

1. To acquire knowledge on the components of environment.
2. To understand the different type of ecosystem.
3. To apply the knowledge in control of pollution.
4. To understand Biodiversity and its conservation
5. To study about the various aspects of Conservation Biology.

Unit – I

Autecology and Synecology. Ecological life cycle – species interaction – types – Population Ecology – Density, Mortality, Natality. Survival and r and k selection- Density, Abundance, Frequency and IVI, Polygraph charting – Raunkiaer's Life forms. Population Dynamics. Remote sensing - study of vegetation with remote sensing.

Unit - II

Environmental Pollution: causes, effects and control of air, water, soil, noise, marine, thermal and radioactive pollution. Biomagnification: Eutrophication, Solid Waste management. Urban Waste Management. Bioremediation - saline land reclamation Causes, effects and control of Green house effect, Ozone layer depletion and Acid rain - Energy crisis- its dimensions and management. Disaster Management: Earthquake, Volcanoes, Landslides and Tsunami. Environment and human health.

Unit - III

Biodiversity: Concepts, types measures and distribution of diversity, Major Biomes of the World – Biogeographical zones of India- Vegetational types. Economic values of Biodiversity, Loss of biodiversity. Endemism, Hotspots, Red Data Book, Threatened plants and animals of India,–

Unit - IV

Conservation of Biodiversity and Wild Life (*Ex situ* and *In situ* methods) – Forests: Afforestation –Social Forestry, Agro forestry, Extension forestry and Urban forestry. Sustainable development: Public Awareness - Environmental Protection Act. (Air, Water, Wildlife and Forest) Rio-summit Agenda: Chipko movement, Carbon credit. Importance of Environmental Impact Assessment (EIA) studies.

Unit - V

Principles of Conservation: Conservation of Natural Resources. National and International conservation agencies (UNEP, MAB, WWF, CITES, RAMSAR and Biodiversity convention), Conservation strategy in India (Project Tiger; Biodiversity Heritage sites, Biosphere Reserves) Biodiversity act - 2002.

Practicals:-

Methods of studying vegetation

1. Quadrat method : List quadrat, count-quadrat, minimum size of the quadrat for a given vegetation.
2. Transect method : Line transect, belt transect and bisect method. Relative frequency, relative density and relative dominance. Important value index and polygraph charting.

Pollution studies

Effect of industrial effluents on seed germination, - Estimation of dust pollution on plants. - Ecological Instruments- Ecological adaptation of plants.

Water analysis

Estimation of EC,pH, turbidity and TDS.

Estimation of Sulphate and Nitrate

Analysis of Na, K, Ca and Cl in pond water

Soil analysis

Estimation of EC,pH

Soil moisture content

Soil N,P,K, turbidity and TDS

Books

1. Agarwal, K.C, 2001. Fundamentals of Environmental Biology, S.Chand, New Delhi.
2. Chapman,J.L.2009. Ecology principles and applications. Cambridge University press.
3. Daniel B.Botkin and Edward A.Keller.2014. Environmental Science: Earth as a living planet, 9th edition, Wiley.
4. Dash, M.C, 2004. Fundamentals of Ecology, Tata McGraw, Hill, New Delhi.
5. Dubey,A.K.2012. A Text book of Ecology. Dominant publishers pvt ltd.,
6. Duffous, J.H, 1980. Environmental Toxicology. Edward Arnold Publication, London.
7. Edward J. Kormondy, 2003. Concepts of Ecology – 4th edition, Prentice Hall of India Pvt.,
8. Eugene Odum and Murray Bavvick. 2005. Fundamentals of Ecology, Cengage Learning.
9. Gabriel Melchais. 2004; Biodiversity and conservation ; Oxford & IBH Publishing company Pvt. Ltd.
10. Hamlyn G. Jones and Robin A.Vaughan, 2010. Remote sensing of vegetation Principles, Techniques and Applications. First Ed., <http://www.oup.com>
11. Iqbal Hussain, P.K.Goel, Rubkumar.2010. Textbook of Plant Ecology.ABD publishers.
12. Joshi, P.C. Namita Joshi, 2004. Biodiversity and Conservation, APH publishing company, New Delhi
13. Krishnamurthy, K.V. 2004. An advanced text book of Biodiversity. Oxford & IBH, New Delhi.
14. Michael Begon, Colin R. Tounsend and John L.Harper. 2013.Ecology, 4th edition.Panima Distributors.
15. Odum, E.P.1978. Basic Principles of Ecology. Thomson, Brooks/cole, Australia.
16. Odum, E.P. Gary W. Barrelet.2004. Fundamentals of Ecology- 15th edition. Thomson Asia pvt., Ltd.
17. Prithipalsingh, 2007; An Introduction to Biodiversity; Anes book India – Chennai
18. Sharma , P.D, 1993. Environmental Biology and Toxicology. Rastogi Publications, Meerut.
19. Sharma.P.D. 2011. Ecology and Environment. 11th edition, Rastogi Publishers, Meerut.
20. Subramaniyam N.S, A.V.S.Sambamurthy; 2008. Ecology. Narosha Publications, New Delhi.

BOT 404 A- APPLIED BOTANY**Objectives:**

1. To understand the Post harvest technology of fruits
2. To study about the principles of seed storage
3. To acquire knowledge on seed certification.

Unit – I:

Classification of fruits – Temperate and subtropical production – varieties, climate and soil requirements – propagation, planting density and cropping system- training and pruning – uses of growth regulators and nutrients to improve production. Weed management – pests, disease and their control – harvesting, post harvesting handling and storage – Marketing and export of the following.

Citrus, Banana, Guava, Mango, Grapes, Papaya, pineapple and Tamarind.

Unit – II:

Rose, Jasmine, Crossandra, Marigold, Dahlia and Anthurium, Micropropagation of orchids- Shadenet and green house cultivation.

Unit – III:

Principles and methods of seed storage. Effect of storage environment on seed longevity. Growth of seeds – seed maturation, Germination – Factors affecting germination – metabolism during germination – seed dormancy – types of dormancy.

Unit – IV:

Seed production in self and cross pollinated crops. Classes of seed: Nucleus, breeder, foundation and certified seeds - Seed harvesting, seed processing, seed treatments, seed testing and seed sampling. Viability and vigour - Seed borne pathogens - Seed certification, standard inspection, legislation and seed law-enforcement.

Unit – V:

Introduction: production of fruits- quality losses of fruits, Determination of harvest maturity and handling methods - Factors affecting fruits during storage, package design, packaging types.

Practicals:

1. Analysis of seed purity
2. Determination of seed moisture
3. Germination Test
4. Tetrazolium test for seed viability
5. Determination of seed vigour
6. Study of starch degradation during ripening of fruits
7. Effect of storage moisture on seed viability
8. Effect of storage temperature on seed viability

References:

1. Hartme,H.T. and Kester,D.E.1986. Plant propagation principles and practices. Prentice Hall of India Ltd., New Delhi
2. Janick,J.W.H.1988. Horticultural Science. Freeman and Co., San Francisco.
3. Kumar, N.1993. Introduction to Horticulture. Rajalakshmi publication, Nagercoil.
4. Agarwal,R.L. 2008. Seed Technology. Oxford and IBH publishing. New Delhi.
5. Agarwal, P.K and M.Dadlani. 1992. Techniques in seed science and technology.
6. Khan.A.A.Ed.1977. Physiology and Biochemistry of seed dormancy and germination.

BOT 404 B- ENZYME TECHNOLOGY**Objectives:**

1. To acquire the knowledge of nomenclature, classification, properties of enzymes and mechanism of action.
2. To understand the methods of isolation and purification of enzymes
3. To understand the various methods of immobilization and its application
4. To know about the enzymes of industrial and clinical significance.
5. To study about the enzymes in salinity tolerance and in Food Industry

Unit – I

Enzymes: Biological catalysts – Nomenclature and classification; properties of enzymes – Isoenzymes, enzyme co-factors and activators, factors affecting enzyme activity; Mechanism of enzyme action (Kinetics of enzymatic catalysis); enzyme inhibition; Co-enzymes; Regulation of enzyme activity; Non-protein enzymes- Ribozymes and DNA enzymes.

Unit – II

Isolation and Purification of enzymes: Biological sources for enzymes production; Location of enzymes; Extraction of enzymes; Purification by differential solubility, Chromatographic methods, Electrophoresis and Ultracentrifugation; Bio safety in Industrial isolation and purification of enzymes.

Unit – III

Immobilised Enzymes: Advantages of using immobilised enzymes; Methods of Immobilization: Adsorption, Entrapping, ionic bonding, cross linking and encapsulation. Effect of enzyme immobilization on enzyme stability, Applications of immobilized Enzymes.

Unit – IV

Industrial Enzymology: Enzymes of Industrial and clinical significance, sources of Industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, peptic enzymes, lipases.

Unit – V

Enzymes biotechnology: Enzymes in salinity tolerance, New strategies for target identification, validation and use of enzymes in high-throughput screening; use of genomics for enzyme-based drug discovery; assigning precise function to genes; redesigning binding and catalytic specificities of enzymes;

Practicals

1. Estimation of protein by Lowry *et al.*
2. SDS – PAGE of Proteins
3. Estimation of α - amylase and β amylase
4. Determination of optimum pH and temperature for any two enzymes
5. Isolation and purification of any two enzymes
6. Estimation of proline oxidase
7. Estimation of Super Oxide Dismutase

References and Text books

1. J.L.Jain, Sunjay Jain and Nitin Jain, 2008. Fundamentals of Biochemistry. Published by S.Chand and Company Ltd. New Delhi
2. Mathews, Van Holde and Ahern, 2005. Bio chemistry. Published by Pearson Education (Singapore) Pvt. Ltd.
3. William H. Elliott and Daphne C. Elliot, 2005. Biochemistry and Molecular biology. Oxford University Press Inc., New York.
4. Prakash S.Lohar, 2005. Biotechnology. MJP publishers, Chennai.
5. Sriram Sridhar, 2005. Enzyme Biotechnology. A.S. Saini for Dominant publishers and Distributors, Delhi.
6. R.C.Dubey, 2008. A Textbook of Biotechnology. S. Chand and company Ltd. New Delhi.
7. Uhlig, H. 1998. Industrial Enzymes and their applications. John Wiley.

BOT 405 A- HORTICULTURE AND LANDSCAPING

Objectives

1. To acquire knowledge on structure and construction of garden
2. To understand the diseases and control measures in Horticultural crops
3. To acquire knowledge on cultivation of fruit and flowering crops

Unit – I

Importance of Horticulture, divisions of Horticulture - classification of Horticultural plants.

Garden and Garden design. Knowledge of plants – Soil Types – Transplanting- Potting- Soil less culture.

Lawn – Rock garden – Rosary – water garden – terrace garden – Kitchen garden – Landscaping-Fences for utility and beauty – Archers and pergolas – Green house and glasshouse – summer house.

Unit- II

Seed – Seed dormancy – Seed germination – Seed Production in Vegetables - Propagation techniques – Sexual propagation –Vegetative cuttings – Layering – Grafting – Budding – Stock – Scion relationships – Micro Propagation- Marketing.

Unit – III

Use of plant growth regulators in horticulture
Manures and Manuring – Training and Pruning – Irrigation techniques
Fungal and bacterial disease management in tropical and subtropical fruit crops
Some important diseases of Horticultural Plants and plant protection.

Unit – IV

Fruit culture : Mango – Guava – Banana – Papaya, Jack fruit, Limes and Lemons.
Culture of Economically important flowers: Jasmine – Chrysanthemum - Rose – Cut flowers.

Unit – V

Flower arrangements and decorations- Harvesting – Marketing – Scientific Post harvest
Storage of fruits and vegetables – Preservation and transport of fruits and vegetables – their economic impacts.

Books:-

1. Adams C.R and Early M.P. 2005. Principles of Horticulture. Elsevier India Pvt Ltd, New Delhi.
2. Bhattacharjee,S.K. 2010. Advanced commercial Floriculture. Aavishkar publishers, Jaipur.
3. Bose .T.K. Som. M.G. and Katrir. J. 1993. Vegetable Crops, Naya Prakash, Calcutta.
4. Bose T.K. 1990. Fruits of India. Tropical and subtropical, Naya Prakash, Calcutta.
5. Chadha,K.L.2003. Handbook of Horticulture. Indian Council of Agricultural Research, New Delhi.
6. Hartman. H.T. and Kester D.E . 1986. Plant propagation principles and practices Prentices Hall of India Ltd., New Delhi.
7. Janick. J.W.H. 1988. Horticulture Science. Freeman and Co., Sanfrancisco.
8. Nambisan .K.M.P. 1992. Design Elements of Landscape Gardening- Oxford and IBH Publications, New Delhi
9. Shanmugavelu K.G. 1989. Production Technology of vegetable Crops. Oxford India. Publication, New Delhi.

BOT 405 B- BIO PROSPECTING OF MEDICINAL AND AROMATIC PLANTS

Objectives:

1. To acquire knowledge on medicinal and aromatic plants
2. To understand antioxidant metabolism
3. To study about post harvest technology in medicinal plants

Unit – I:

Medicinal and Aromatic Plants – Importance and Scope – Classification of medicinal plants – based on morphology of useful parts, habit, taxonomical , pharmacological , chemical and Ayurvedic formulations – Cultivation of medicinal and aromatic plants – History of herbal medicine- Contribution of the Egyptians, Chinese, Greeks, Arabs and Indians -Different systems of herbal medicine: Ayurveda, Siddha and Unani.

Unit – II:

Quality control for medicinal and aromatic plant materials: Microscopic and Macroscopic examination – Visual examination and odour – Histochemical detection of cell walls and contents. Drug Evaluation: Methods of drug evaluation: Organoleptic, Microscopic, Physical, Chemical and Biological evaluation. Chemical nature of drugs: Crude drugs – Preparation and preservation - Chemical nature and Methods of tests for Carbohydrates, Glycosides, Tannins, Volatile oils, Lipids, Resinous substances and Proteins.

Unit – III:

General properties of Alcohols, Aldehyde, Glutaraldehyde, Halogens, Phenols, Gases, Surface active agents and Metallic salts ; Secondary Metabolites - Classification , General characters, Chemical nature, Extraction and Estimation methods for Alkaloids, Flavanoids,

Terpenoids and Phenolic compounds -Separation, Identification and Characterization of the potential bioactive compounds using UV, FTIR, ¹H NMR, ¹³C NMR, 2D NMR,GC-MS and XRD. Bioactive molecules – Antibacterial, Antifungal, Antiplasmodial, Larvicidal and Antiviral drugs – mode of its action.

Unit – IV:

Antioxidant metabolism: Plant defense mechanism – Antioxidants – Reactive oxygen species – Enzymatic and non enzymatic antioxidants –Role of antioxidants –Estimation of antioxidants – Ascorbic acid and alpha Tocopherol. Antioxidant enzymes – Peroxidase, SOD and Catalase. Free radicals, types of free radicals, Production of free radicals and Lipid peroxidation.

Unit – V:

Post-harvest technology in medicinal plants: scope and importance. Processing and utilization – Storage of crude drugs, Adulteration with reference to plant drugs, types of adulterants and methods of adulteration, Identification of adulterants. - Importance of herbal marketing -Future prospects and constraints of the herbal drug industry - Regulatory status of herbal medicine in India.

References:

1. Farooqi, A.A. and B.S.Sreeramu, 2004. Cultivation of medicinal and aromatic crops. Revised edition, Universities Press (India) Private Limited, Hyderabad.
2. WHO, 2002. Quality control methods for medicinal plant materials, World Health Organization, Geneva, A.I.T.B.S., Publishers and Distributors, New Delhi.
3. Harbone, J.B. 1998. Phytochemical Methods; A guide to modern techniques of plant analysis. 3rdEdn., Springer (India) Private Limited , New Delhi.
4. Mc.Kane, L. and J. Kandel. 1996. Microbiology: Essential and Applications. 2ndEdn., McGraw – Hill, Inc, New Delhi.
5. Ananthanarayan, R. and C.K.J. Paniker. 1996. Text book of Microbiology. 5thEdn., Orient Longman Ltd., Chennai.
6. Halliwall, B. and J.M.Gutteridge. 1985. Free radicals in Biology and medicine. Oxford university press.
7. Roxanne Rutledge, C. 2008. Mosquitoes (Diptera: Culicidae). Encyclopedia of Entomology, Springer Science+ Business Media B. V. Berlin.
8. Tyagi, B.K. 2003. Medical Entomology: A Hand book of Medicinally important Insects and other Arthropods. Scientific Publishers (India), Jodhpur.
9. Animal cell culture; A practical approach, 4th Edition by Wiley Publications.

**Optional papers for Inter Departmental Students
BOT O 215/315- PLANT TISSUE CULTURE**

Objectives:

- 1.To acquire knowledge in recent developments in Plant Tissue Culture
- 2.To understand the concepts in plant propagation.
- 3.To study about production of secondary metabolites

UNIT – I

Plant cell – Totipotency – Culture of plant cells, tissue and organs. Organization of Plant tissue culture laboratory – Aseptic techniques. Culture media – Nutritional components.

UNIT – II

Preparation of explants – Callus initiation types and maintenance –Hardening. Root culture – Cell suspension cultures- Meristem culture- Organogenesis .Maintance of culture vilification.

UNIT – III

Micro-propagation – Shoot apex culture – Somatic embryogenesis – Isolation, purification and culture of protoplasts. Protoplast fusion and somatic hybridization, Artificial seed.

UNIT – IV

Anther and pollen culture – Somaclonal variation – Screening and Production of tolerant plants for various stresses.

UNIT – V

Production of secondary metabolites and single cell proteins by cell culture – Artificial seed, Rapid propagation Case studies on Tissue Culture in conservation of endangered plants – Banana – Rose and orchids. Tissue culture as a tool for Bio- technology.

Books:

1. Baker. F.N.G.1992. Rapid propagation of fast growing woody species CAB International. London.
2. Bhojwani,S.S. and M.K.. Razdan.2013. Plant Tissue Culture , theory and Practices. Panima book Distributors.
3. Dodds. J.H and L.N. Roberrtis.1985. Experiments in Plant tissue culture, Cambridge University Press – New York.
4. Reinert.J and M.M .Yeoman.1983. Plant Cell and Tissue Culture – Laboratory manual. Narosa Publishing House. New Delhi
5. Narayanaswamy.S.2005. Plant Cell and Tissue Culture. Tata Mc.Graw Hill, New Delhi

BOT O 215/315- GARDENING AND HORTICULTURE

Objectives

1. To acquire knowledge on structure and construction of garden
2. To understand the diseases and control measures in Horticultural crops
3. To acquire knowledge on cultivation of fruit and flowering crops

Unit – I-

Garden and Garden design. Knowledge of plants – Soil Types – Transplanting- Potting- Soil less culture.

Lawn – Rock garden – Rosary – water garden – terrace garden – Kitchen garden – Landscaping-Fences for utility and beauty – Archers and pergolas – Green house and glasshouse – summer house.

Unit- II

Propagation techniques – Sexual propagation – Seed – Seed dormancy – Seed germination – Vegetative cuttings – Layering – Grafting – Budding – Stock – Scion relationships – Micro Propagation.

Unit – III

Manures and Manuring – Training and Pruning – Irrigation techniques.

Use of plant growth regulators in horticulture – Some important diseases of Horticultural Plants and plant protection.

Unit – IV – Pomology and Floriculture

Fruit culture : Mango – Guava – Banana - Papaya.

Culture of Economically important flowers : Jasmine – Rose – Cut flowers.

Unit – V - Post Harvest Technology – Storage and Transport

Flower arrangements and decorations- Harvesting – Marketing – Scientific Post harvest

Storage of fruits and vegetables – Preservation and transport of fruits and vegetables – their economic impacts.

Books:-

10. Bhattacharjee, S.K. 2010. Advanced commercial Floriculture. Aavishkar publishers, Jaipur.
11. Bose .T.K. Som. M.G. and Katrir. J. 1993. Vegetable Crops, Naya Prakash, Calcutta.
12. Bose T.K. 1990. Fruits of India. Tropical and subtropical, Naya Prakash, Calcutta.
13. Hartman. H.T. and Kester D.E . 1986. Plant propagation principles and practices Prentices Hall of India Ltd., New Delhi.
14. Janick. J.W.H. 1988. Horticulture Science. Freeman and Co., Sanfrancisco.
15. Nambisan .K.M.P. 1992. Design Elements of Landscape Gardening- Oxford and IBH Publications, New Delhi
16. Shanmugavelu K.G. 1989. Production Technology of vegetable Crops. Oxford India. Publication, New Delhi.

BOT O 215/315- PLANT SCIENCE – I**Objectives:**

1. To acquire basic knowledge in Plant Science
2. To impart knowledge in classical and modern concepts of Plant Science.
3. To understand the economic importance of plants.

SYSTEMATIC BOTANY**Unit – I**

Principles of Taxonomy – Taxonomic structure –Classifications of Plant Kingdom – Bio-systematics – Plant Geography – Biogeographical zones of India.

PLANT DIVERSITY**Unit – II**

Patterns of variation in morphology and Life History in plants. Broad outlines of classification and evolutionary trends among Algae, Fungi, Bryophytes and Pteridophytes – Principles of Palaeobotany – Economic importance of Algae, Fungi and Lichens.

ANATOMY**Unit – III**

Comparative Anatomy and Developmental Morphology of Gymnosperms and Angiosperms – Meristems and Tissue Differentiation and Morphogenesis.

EMBRYOLOGY**Unit – IV**

Structural and Functional aspects of pollen and pistil - Androgenesis and Gynogenesis - Pollination Biology – Fertilization – Embryo and Seed development Male sterility – Self and interspecific incompatibility.

PLANT BREEDING**Unit – V**

Principles of Plant breeding – Conventional methods of breeding, self, cross pollinated and vegetatively propagated crops - Non-conventional methods of breeding – Polyploidy – Genetic variability – Plant diseases and defensive mechanism.

Books

1. Chahal S.S. Gosal. 2003. Plant Breeding. Narosa Publishers, New Delhi.
2. David Allen Sleper and John Milton Poehlman.2006. Breeding Field Crops – 5th Edition. Blackwell publishing.

3. Jack Brown and Peter Callgarl.2013. An Introduction to Plant Breeding. Panima Book Distributors.
4. Malik,C.P.2009. Crop Breeding and Biotechnology. Aavishkar publishers and Distributors, Jaipur.
5. Sambamurthy, A.V.S.S., 2005. Taxonomy of Angiosperm, I.K. International Pvt.Ltd., New Delhi
6. Sarabhai,B.P. 2005. A Textbook of Algae. Anmol publications, New Delhi.
7. Sharma O.P. 2007. A Textbook of Algae. Tata Mc Graw Hill Publishing Co.Ltd. New Delhi.
8. Singh,V., Pande, P.C. and D.K. Jain. 2005. Embryology of Angiosperms. Rastogi Publications, Meerut.
9. Sivarajan,V.V.1999. Introduction to the principles of Plant Taxonomy. Oxford & IBH Publishers, New Delhi.
10. Sundararajan,S. 2005. Practical manual of Plant Anatomy and Embryology. Anmol publications, New Delhi.
11. Tayal,M.S. 2001. Plant Anatomy. Rastogi Publications, Meerut.

BOT O 215/315-PLANT SCIENCE – II

Objectives:

1. To acquire knowledge in recent developments in plant science
2. To impart the functional concepts of plant science.
3. To study about tissue culture techniques

PLANTS AND HUMAN WELFARE

Unit – I

Plants and civilization, center of origin and Gene diversity of crop plants – utilization, cultivation of plants for food, drug, fibre and industrial values, unexploited plants of potential economic value – plants as a source of renewable energy – Genetic resources and their conservation.

PLANT PHYSIOLOGY

Unit – II

Water relations – Photosynthesis – C₃, C₄ & CAM Cycles - Photorespiration – Stomatal Physiology – source and sink relationship - Mineral nutrition – Nitrogen, Phosphorus and Sulphur metabolism.

PLANT GROWTH AND DEVELOPMENT

Unit – III

Dormancy, Physiology and Biochemistry of seed dormancy and seed germination – Plant Hormones - Hormonal regulation of growth and development – photoregulation, growth responses, physiology of flowering – senescence.

PLANT TISSUE CULTURE

Unit – IV

Sterilisation techniques – media preparations – plant cell, Totipotency- Cell and tissue culture in plants –cell line – cell clones. Callus cultures – soma clonal variations – clonal propagation.

MICROPROPAGATION

Unit – V

Micropropagation – somatic embryogenesis – Haploidy. Protoplast isolation, fusion and somatic hybridization – Cybrids– Artificial seeds– Gene transfer methods in plants.

Books:

1. Bhojwani,S.S. and M.K.. Razdan.2013. Plant Tissue Culture, theory and Practices. Panima book Distributors, Meerut.

2. Deberg, P.C and R. Zimmerman. 2013. Micropropagation, Technology and Application. Panima Book distributor, Meerut.
3. Dodds J.H and L.W. Roberts. 1995. Experiments in Plant tissue culture. (2nd Ed) Cambridge Uni. Press. London.
4. Lincoln Taiz and Eduardo Zeiger 2002. Plant Physiology. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
5. Narayanaswamy. S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Reinert, J. and Bajaj, Y.P.S., 1989. Applied and fundamental aspects of Plant cell tissue and organ culture. Narosa Publishing House, New Delhi.
7. Wetter, L.R. and F. Constabel ed., 1982. Plant tissue culture methods. National research council of Canada. Ontario, CANADA.
8. Wickens. 2013. Economic Botany- principles and Practices. Panima book Distributors, Meerut.
9. William G. Hopkins, 1999. Introduction to Plant Physiology. John Wiley and Sons. INC, New York.
10. Yeoman, 1987. Plant cell culture technology. Narosa Publishing House, New Delhi.

