Placed at the meeting of
Academic Council
held on 26.03.2018

APPENDIX - S

MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)

M.Sc. Botany (Semester)
REVISED SYLLABUS
Course Structure under CBCS
(From the academic year 2018-19 onwards)

1. **Introduction to the Programme:** Life science deals with the dynamics of living organisms. Plants are the autotrophs and responsible for the animal diversity on the earth. In the current scenario, bioactive natural products, medicinal plant are given greater importance and value in our day-to-day life. Comprehensive knowledge of modern and fundamental aspects of non-flowering and flowering plants is essential for understanding the plant kingdom. Sustainability and conservation of biodiversity is critically important for protecting our mother land and endangered bioresources.

2. **Eligibility for Admission:** A candidate who has passed the B.Sc., degree examination in Botany/ Plant Science/ and Plant Biology & Plant Biotechnology of the University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible to appear and qualify for the M.Sc. Degree in Botany of this University after a course of study of two academic years.

   Duration of the Course

   The course for the degree of Master of Science in Botany shall consist of two academic years divided in to four semesters. Each semester consist of 90 working days.

3. **Objectives of the programme:**

   - To provide comprehensive knowledge on fundamental aspects of plant kingdom.
   - To trace the relationship and interconnectedness between the lower and higher forms of life in the plant kingdom.
   - To apply the various concepts and values of plants in day to day life.
   - To motivate students to pursue research in national and international level research institutions.

4. Expected outcomes

On successful completion of the M.Sc. Botany programme, the students will be:

- Competent enough in the fundamental aspects of Botany.
- Able to apply the knowledge of modern techniques while pursuing research.
- Competent enough to create entrepreneurship skill and opportunities in Botany and be self-employed.

Course Structure:

The course is organized on semester basis with a total of four semesters. A student must secure 90 credits to get the degree.

Semester	Course	Course Title	Ins. Hrs./ week	Credits	Exam Hrs.	Marks		Total
						Internal	**External**	
I	Core Paper I	Plant Diversity I (Algae, Fungi & Lichens)	6	4	3	25	75	100
	Core Paper II	Plant Diversity II (Bryophytes, Pteridophytes& Gymnosperms)	6	5	3	25	75	100
	Core Paper III	Bioinstrumentation and Biotechniques	6	4	3	25	75	100
	Practical I	Practical related to theory paper I, II & III	6	4	4	40	60	100
	Major Elective I	Ecology and Biodiversity	6	5	3	25	75	100
II	Core Paper IV	Cell and Molecular Biology	6	5	3	25	75	100
	Core Paper V	Genetics and Evolution	6	5	3	25	75	100
	Core Paper VI	Plant Anatomy and Embryology of Angiosperms	6	4	3	25	75	100
	Practical II	Practical related to theory paper IV, V & IV	6	4	4	40	60	100
	Major Elective II	Fermentation Biotechnology/Biofertilizer	6	5	3	25	75	100
III	Core Paper VII	Taxonomy of Angiosperms	6	4	3	25	75	100
	Core Paper VIII	Microbiology and Plant Pathology	6	4	3	25	75	100
	Core Paper IX	Biochemistry	6	5	3	25	75	100

	Practical III	Practical related to theory paper 7, 8 & 9	6	4	4	40	60	100
	Non-major Elective	Mushroom Cultivation	6	5	3	25	75	100
IV	Core Paper X	Plant Physiology	6	5	3	25	75	100
	Core Paper XI	Research Methodology & Bioinformatics	6	4	3	25	75	100
	Core Paper XII	Plant Biotechnology	6	5	3	25	75	100
	Practical IV	Practical related to theory paper X,XI,XII	6	4	4	40	60	100
	Major Elective III/ Project	Project work	6	5	3	25	75	100

7. Non-subject Elective

Herbal Botany

8. Unitization

Semester-wise List of Papers, Hours & Credits

	Papers	**Hours**	**Credit**
Semester I	5	30	22
Semester II	5	30	23
Semester III	5	30	22
Semester IV	5	30	23
Total	**20**	**120**	**90**

9. **Semester Examination**

The examinations shall be conducted separately for theory and practical to assess the knowledge acquired during the study. There shall be two systems of examinations *viz*., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests, Peer Team teaching, assignments and seminar. The internal assessment shall comprise of maximum 25 marks for each subject.

The external examination shall be three hours duration to each paper at the end of each semester. The external examinations shall comprise of maximum of 75 marks for each subject. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination. Practical examinations for M.Sc. Course in Botany should be conducted at first, second and third semester. At the end of fourth semester viva-voce will be conducted on the basis of the Dissertation report submitted by the student.

Distribution of marks

Theoretical Examinations

S.No	Component	Marks
1	Internal examination*	25
2	External examination	75
3	Total	100

10. Internal examination*: The following procedure shall be followed for awarding internal marks.

S.No	Component	Marks
1	Internal Test	10
2	Seminar	5
3	Assignment	5
4	Peer Team Teaching	5

Practical examinations

S.No	Component	Marks
1	Internal examination*	40
2	External examination	60
3	Total	100

Internal examination*: The following procedure shall be followed for awarding internal marks.

S.No	Component	Marks
1	Continuous assessment	25
2	Recor d	10
3	Viva	5
4	**Total**	40

11 and 12. External Examination Question Paper Pattern

Time: 3 Hours Max. Marks: 75

Part A- 10 x 1 Marks = 10 Marks (Answer all questions; 2 questions fromeach unit)

Part B -5 x 7 Marks = 35 Marks (Answer all questions; either/or pattern; equal weightage for all units)

Part C- 3 x 10 Marks = 30 Marks (answer any three from five questions;equal weightage for all units)

13. Scheme for Evaluation

The Internal and External marks will be in 25:75

External exam

The pattern of Question Paper (External) will be

Time : 3 Hours and Max.Marks : 60

Section A: (10 x 1 = 10 marks)
Question No. 1 to 10 (Multiple choice or Objective type)
Section B: (5 x 7 = 35 marks)
Answer all questions choosing either (a) or (b)
Section C: (3 x 10 = 30 marks)
Answer any three out of five (one question from each unit)

14. Passing Minimum

Passing minimum – 50% (aggregate)
No pass minimum for internal
27/60 (45%) is the minimum in External

15. Teaching Methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power Point presentations. The lecture would be such that the student should participate actively in the discussion. Periodic field visit enable the student for gathering the practical experience and up to date industrial scenario. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

16. Retotalling and revaluation provision

Revaluation means to re evaluate the paper of a particular subject completely. Under this, Student has to surrender his/her original marks of particular paper and accept the final marks when declared by the University as a result of Revaluation. Application form available at Examination Section and University Website. Fee Structure Rs. 500/ per subject for Revaluation Rs. 250/ per subject for Retotalling.

Condition- Application for Revaluation is to be made within 15 days from the date of publication of result on University website. Application form is to be completely filled and signed by the student (concerned) only. Select the paper carefully in which you wish to seek revaluation. No second application for additional papers shall be accepted. The fees once paid shall not be refunded.The application is to be made by the student in his/her own handwriting and under his/her own signature and not by anyone else on his/her behalf.

Rules for Revaluation - Revaluation shall be available only for the paper of end term examination. Revaluation for the paper of end term examination shall be sent to two external evaluators for evaluation. The average of the marks awarded by two external evaluators shall be taken as final marks and the original marks obtained by the student shall have no value.

17. Transitory provision

PG syllabus revision once in 2 years and afterwards 2 years under transitory provision.

Paper I

Plant Diversity I (Algae, Fungi and Lichens)

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Identify Algae, Fungi and Lichens
- Understand the structural organization of Algae, Fungi and Lichens
- Relate the structure and lifecycle patterns of Algae, Fungi and Lichens
- Appreciate the economic importance of Algae, Fungi and Lichens

Unit I: Classification of Algae (F.E. Fritsch, 1945). Criteria used for algal classification. Range of thallus structure, Life cycle patterns of algae, Phylogeny and Evolutionary trends in algae. General account on the structure and reproduction of algae belonging to Cyanophyceae, Chlorophyceae, Bracillariophyceae, Phaeophyceae and Rhodophyceae.

Unit II: Ecology of Algae: freshwater algae, marine algae, soil algae, symbiotic algae and parasitic algae. Algae as pollution indicators, algal blooms, algicides. Culture and cultivation of fresh water and marine algae. Economic importance of algae: Food and Feed, Agar-agar, Carrageenan, Diatomaceous earth, Iodine, Vitamin, Medicine, Single cell protein and Industrial products.

Unit III: Fungi: General features, occurrence and distribution, mode of nutrition in fungi, culture of fungi, classification of fungi (Alexopoulous and Mims, 1979), recent trends in the classification of fungi. General characters of major classes: Myxomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidomycetes and Deuteromycetes (Thallus organization, cell structure and fruiting bodies)

Unit IV: Homothallism and heterothallism in fungi. Homokaryon and heterokaryon. Sex hormones in fungi. Reproduction – Life cycle types, parasexual cycle, reduction in sexuality in fungi. Spore dispersal mechanism. Ecological and Economic importance of fungi.

Unit V: Lichens: A general account of lichens with special reference to their mode of life. Gross and fine structure, nutrition, reproduction, classification; micro-chemical tests for their classification; their economic importance and ecological significance; role of lichens in biological estimation of pollution. Lichens -*in vitro* culture– a detailed study of one or two available species of lichens belonging to *Ascolichen* and *Basidiolichen*.

Practical

1. Critical examination of algal and fungal samples of different classes
2. Micro preparation of lichens

3. Field visit for 2 days for collection of specimen
4. Preparation of herbarium sheets (minimum 20)
5. Spotters related to theory

References

1. Barsanti, L. & Gualtieri, P. 2014. **Algae- Antotomy, Biochemistry and Biotechnology,** 2nd edition, CRC Press, New York
2. Bhatia, A. 1994. **Treatise on Algae.** S. Chand & Company. New Delhi.
3. Bold. H.C. & Wynne, M.J.1985. **Introduction to the Algae.** Prentice Hallof India. New Delhi.
4. Chapman. V.J. Chapman, D.J. 1975. **The Algae.** Macmillan India Ltd.. Delhi.
5. Fritsch, F.E.1945. **Structure and reproduction of Algae.** Cambridge University Press
6. Hale, M.E.(Jr) 1983. **The Biology of lichens.** Edward Arnold. Mayland.
7. Lee, R.E. 2008. **Phycology**. Cambridge University Press, New York.
8. Lewin, R.A. (Ed.).1962. **Physiology and Biochemistry of Algae.** AcademicPress.
9. Nash, T.H. 2008. **Lichen Biology**.Cambridge University Press, Cambridge.
10. Orlando Necchi Jr (Ed.). 2014. **River Algae,** Springer, Switzerland.
11. Pandey. B.P.1994. **Algae.** S.Chand& Company Ltd. New Delhi.
12. Roberts, P. Evans, S. 2014. The Book of Fungi: A Life-Size Guide to Six Hundred Species from around the World. University of Chicago Press,
13. Round. F.E.1984. **The Ecology of Algae.** Cambridge University Press.
14. Sharma, O.P.1998 **Text book of Algae.** Tata McGraw Hill. New Delhi.
15. Vashishta, B.R.1999. **Algae.** S.Chand & Company, New Delhi.
16. Webster, J. and Weber, R.W.S. 2007.**Introduction to Fungi**. Cambridge University Press, New York.
17. Watkinson, S.C., Boddy,L.& Money, N. 2016. **The Fungi.** Elsevier, London

SEMESTER – I

PAPER II

PLANTDIVERSITY II (BRYOPHYTES, PTERIDOPHYTES & GYMNOSPERMS)

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Understand and differentiate the structural organization and diversity of Bryophytes, Pteridophytes and Gymnosperms
- Appreciate the evolutionary trend in Bryophytes, Pteridophytes and Gymnosperms

- Trace the connecting links of fossil forms in Bryophytes, Pteridophytes and Gymnosperms
- Appreciate the economic importance of Bryophytes, Pteridophytes and Gymnosperms

Unit I: Bryophytes: General features, distribution and classification of Bryophytes (Rothmaler, 1955). Structure, reproduction and life cycle of major groups –Marchantiales, Jungermanniales, Anthocerotales and Polytrichales. Range of vegetative structure, Evolution of gametophytes and sporophytes. Spore dispersal mechanisms in Bryophytes – spore germination patterns in Bryophytes. Ecological and economical mportance of Bryophytes.

Unit II: General characters, origin and classification of Pteridophytes (K. R. Sporne). Morphology, reproduction and evolution of gametophytes and Sporophytes of the following groups: Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

Unit III: Phylogenetic trends – Stelar evolution, Sporangial organization – Heterospory and Seed habit – Apospory, Apogamy and Parthenogenesis. Fossil forms – Calamitales and Sphenophyllales.

Unit IV: General characteristics and classification of Gymnopserms (Coulter and Chamberlin). Morphology and reproduction in orders Pteridospermales, Pentoxylales, Cordaitales, Cycadales, Coniferales and Gnetales.

Unit V: Economic importance of Gymnosperms. Living fossil – Affinities with Angiosperms and Pteridophytes. Fossil Gymnosperms – Lyginopteris and Lagenostoma.

Practical

1. Critical examination of Bryophytes and Pteridophytes, Gymnosperms of different classes.
2. Study of fossils forms in Pteridophytes and Gymnosperms
3. Permanent slide preparation of Pteridophytes
4. Spotters related to theory

References

Bhatnagar, S. P. and Moitra, A.1996. Gymnosperms. New Age Int. Pvt. Ltd., New Delhi.

Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi.

Chamberlain, C. J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.

Chopra, R.N. and Kumra, P.K. 2005. Biology of Bryophytes. New Age Int. Pvt. Ltd., New Delhi.

Parihar. N.S.1980. An Introduction to Embryophyta Vol. I. Bryophyta. Central Book Depot.

PremPuri, 1981. Bryophytes: Morphology, Growth and differentiation. Atma Ram and Sons. New Delhi.

Rashicl, A. 1999. Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.

Sharma. O.P. 1990. **Textbook of Pteridophyta.** Macmillan India Ltd. Delhi.

Sporne, K. R.1986. **Morphology of Gymnosperms**. Hutchinson University Press.

Sporne, K.R.1986. **The morphology of Pteridophytes.** Hutchinson University Press.

SundaraRajan, S.1999. **Introduction to Pteridophyta.** New Age International Publishers, New Delhi.

Vashishta, P.C. 1999. **Bryophyta.** S. Chand & Co. New Delhi.

Vashista, B. R., Sinha, A.K. & Kumar, A. 2011. **Bryophyta** (Revised Edition), S. Chand & Co. New Delhi.

SEMESTER – I
PAPER III
BIOINSTRUMENTATION AND BIOTECHNIQUES

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Understand the basic principles and working mechanisms of various scientific instruments
- Acquire hands-on training on different scientific instruments
- Relate the importance and applications of various scientific instruments

Unit I: Principle and uses of various microscopes: Simple, Compound, Phase Contrast, TEM, SEM, Atomic Force Microscope. Principles and applications of Micrometer, Haemocytometer and Microtome. Biological sample preparation techniques for microscopy.

Unit II: pH meter – basic principles, Types of electrodes, Preparation of buffers. Centrifugation: Principle, Types of Rotors. Types of Centrifuges – Clinical, Refrigerated and Analytical centrifuges and their applications.

Unit III: Chromatography – Principles (Absorption, Partition, Ion exchange and Affinity), components, methodology and applications of Column chromatography, GC – MS, HPLC. Electroporation – Principle, Procedure and application of AGE, SDS – PAGE separation of proteins. Blotting techniques – Principles and types (Northern, Western and Southern).

Unit IV: Radiometry – Isotopes – Measurement of Radioactivity. Radioactive detectors: Scintillation and Geiger Mueller Counter. Autoradiography and its application.

Unit V: Spectroscopy – Principles, Components and Working mechanism of spectrophotometer, Flame photometer, Bomb calorimeter and Atomic absorption spectrophotometer.

Practical

1. Calibration of stage and ocular micrometer
2. Measurement of plant cells using micrometer
3. Counting of yeast cells using Haemocytometer
4. Measurement of PH of different solution
5. Preparation of buffer
6. Demonstration of the working mechanism of various instruments mentioned in the syllabus
7. Spotters related to theory

References

Burdan R.H. Knippenbergh RH. (editors). 1989, Techniques in Biochemistry and Molecular Biology, 2" ed, Elsevier.

Daphne. J. O and Micheal. B. J. 1989. Cell separation in plants physiology,Biochemistry and Molecular Biology. Springer-Verlag, Berlin.

Gahan, P.B. 1984. Plant Histochemistry and Cytochemistry. Academic Press, London.

Gary, P. 1964. Hand Book of Basic Microtechnique. John Wiley & Sons, New York.

Holcapek, M., Byrdwell, Wm. C. 2017. Handbook of Advanced Chromatography /Mass Spectrometry Techniques, Elsevier.

Jefrey. M., Backer el al., 1996. Biotechnology- A Laboratory Course. Academic Press, New York.

Johanson, DA. 1940. Plant microtechniques. Mc Graw Hill.

Johanson, W. A. 1982. Botanical Histochemistry - Principles and Practice.Freeman & Co.

Johanson, W. A. 1984. Plant Microtechnique. Mc Graw Hill, New Delhi

Kierman, J. A. 1909. Histological and Histochemical Methods. ButterworthPublications, London.

Mahiga, P. Klessing, D.F. Cashmore, A.R. Grinssen, W. and Varner, J.E. 1995.Methods in Plant Molecular Biology - A Laboratory Course - Manual. CSHL Press. New York.

Plummer, D.T. 1996. An introduction to practical biochemistry. Tata Mc GrawHill.

Robards, K., Jackson, P. E. & Haddad, P.R. 2012. Principles and Practice of Modern Chromatographic Methods, Elsevier.

Ruzin, Z. E. 1999. Plant Microtechnique and Microscopy. Oxford University Press, New York.

Stock, R and Rice, C.B.F. 1980. Chromatographic methods. Chapman and Hall.

Yeung, E. C. T., Stasolla, C., Sumner, M.J., Huang, B.Q. 2015. **Plant Microtechniques and Protocols**, Springer.

Wilson, K. & Walker, J. 2010. **Principles and Techniques of Biochemistry and Molecular Biology** (Seventh Edition). Cambridge University Press, Yow York.

SEMESTER – I
MAJOR ELECTIVE I
BIODIVERSITY

Contact hours: 5 hrs. /week

Learning Outcomes:

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

- Appreciate the values and the need for conservation and management of biodiversity

Unit I: Biodiversity definition, concept, scope, Levels of biodiversity Genetic, species and ecosystem diversity, Magnitude of biodiversity; Concept of Hot Spots; distribution of hotspots in India and the world; values of biodiversity; Island biogeography theory; Endemic diversity, Measures of biodiversity – alpha, beta and gamma diversity – Diversity indices – dominance and Evenness – methods of studying diversity.

Unit II: Marine biodiversity – plankton – nekton – benthos – classification – classification of marine environments benthic and pelagic – neritic and oceanic system – littoral and deep – sea system – features, primary, secondary and territory production – methods for measuring the productivity – factors affecting primary production – general account of productivity in different oceans – red tide – harmful algal blooms – causes and effects.

Unit III: Causes and consequences of loss of biodiversity; Impact of exotic species on local biodiversity; extinction of species; Key stone species and their significance. Climate Change mediated Impacts on Biodiversity – El-Nino Southern Oscillation phenomenon (ENSO) and its impacts-sea surface water temperature (SST) elevation and coral reef bleaching, impacts of coral bleaching on coral biodiversity; Red Data Book and its importance.

Unit IV: Wildlife Conservation and management - need for conservation – *insitu* conservation; Sanctuaries, National parks, biosphere reserves – *exsitu* conservation, Zoological parks, gene banks and cryopreservation –Role of indigenous people in conservation – sacred species, sacred groves; role of remote sensing in biodiversity conservation; Biodiversity conservation – human animal conflicts.

Unit V: Indigenous knowledge, Bioprospecting, Biopiracy, Intellectual property rights and its impact on biodiversity;Impact of new technologies biotechnology and genetic engineering.

References

1. Gadgil, M., Ghate, U, and Pramod, P.1996 Biodiversity resource materials, center for ecological sciences.Indian Institute of Sciences, Bangalore and Biodiversity Unit, Jawaharlal Nehru, Centre for AdvancedScientific Research, Bangalore.
2. Gillson, L. 2015. **Biodiversity Conservation and Environmental Change**, Oxfrd University Press, Oxford,.
3. Krishnamoorthy, K.V. 2009. **An advanced Text book on Biodiversity –Principles and practice,** Oxford & IBH Publishing co, PVT. Ltd., New Delhi.
4. Kumar, H.D. 1999. **Biodiversity and sustainable conservation**. Oxford and IBM publishing Company, NewDelhi.
5. Melchias, G.2001, **Biodiversity and Conservation**, Oxford and IBM publishing company Pvt., Ltd. New Delhi.

6. Ronald H. Karlson. **Dynamics of Coral Communities**. 1999. Kluwer Academic Publishers, Boston.
7. Rosenberg. E and Loya. Y. (eds.) 2004 **Coral health and Diseases**, Springer, Berlin, Heidelberg, New York.
8. Schulze,E., Beck,E., & Muller-Hohenstein, 2005. **Plant Ecology,** Springer, Berlin-Heidelberg.

SEMESTER II
PAPER IV
CELL AND MOLECULAR BIOLOGY

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Understand the structure and function of various cell organelles
- Recognize the structure and the functional significance of DNA and RNA
- Compare the mechanism of gene regulation in prokaryotes and eukaryotes

Unit I: Prokaryotic and Eukaryotic Cell – Ultra structure and functions of cell wall. Plasma membrane fluid mosaic model and functions. Ultrastructure and functions of cell organelles – Chloroplast, Mitochondria, Ribosomes, ER, Golgi bodies, Peroxisomes and tonoplast

Unit II: Ultrastructure of Nucleus and Chromosomes, Special types of chromosomes – Giant, Lampbrush and Polytene chromosomes. Molecular basis of mutation – Physical and Chemical mutagens – DNA damage and repair mechanism, cell cycle and its regulation.

Unit III: Structure of DNA and RNA. Topology of nucleic acids – levels of DNA packaging, repeat sequences in DNA. C-Value paradox, DNA denaturation kinetics, DNA replication types and mechanism. Difference betweenreplication in prokaryotes and eukaryotes.

Unit IV: Central Dogma of protein synthesis. Transcription in prokaryotes and eukaryotes. Post-transcriptional and Post-translational changes.

Unit V: Regulation of gene expression in Prokaryotes (Operon concepts – Lac and Trp). Lambda phage. Prokaryotic and Eukaryotic gene expression.

Practical

1. Onion root tip preparation for microscopic observation Mitosis
2. *Tradescantia* flower bud preparation for Meiosis
3. Colorimetric estimation of DNA, RNA
4. Isolation of autotrophic UV mutants by replacement planting technique
5. Spotters related to Theory.

References

1. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Keith Roberts, 2014. **Essential Cell Biology**, Garland Science Publishers.
2. David Freifelder, 1985. **Essentials of Molecular Biology**. Narosa PublishingHouse. New Delhi.

3. David. E. Sadava. 1993. **Cell Biology**. Jones and Bartlett Publishers, Boston.
4. De Robertis and De Robertis 1998. **Cell and Molecular Biology**. B.1. Waverly Pvt. Ltd. New Delhi.
5. Geoffrey M. Cooper, Robert E. Hausman, 2009. **The Cell - A Moleeular approach**. ASM Press, Washington.
6. Gerald Karp. 1984. Cell Biology. McGraw Hill. New Delhi.
7. Gupta, P.K. 1999. **Elements of Biotechnology**. Rastogi Publications, Meerut.
8. Krebs, J.E., Goldstein, E.S., and Kilpatrick, S.T. 2014 **Lewin's Genes XI**. Jones & Bartlett Learning, Burlington. .
9. Kumar, H.D. 1999. **Molecular Biology**. Vikas Publishing House Pvt. Ltd. New Delhi.
10. Lodish, et al. 2000. **Molecular and Cell Biology**. W. H. Freeman & Co. NewYork
11. Satyesh Chandra Roy and Kalyan Kumar De. 1999. **Cell Biology**. New CentralBook Agency (P) Ltd. Calcutta.
12. Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz, Graham
13. Johnson, 2016. **Cell Biology** (3rd Edition), Elsevier Health Sciences publication.
14. William D. Stansfield et al., 1996. **Schaun'sout line of theory and problems of Molecular and Cell biology**. McGraw Hill, New York.

EMESTER II
Paper V
GENETICS & EVOLUTION

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Recall the Mendelian principles
- Interpret the concepts of linkage, crossing over and polyploidy
- Appreciate the evolutionary theories and variations in gene frequencies in a population

Unit I: Introduction – Mendelism - Monohybrid cross- Dihybrid Cross, Interaction of genes – incomplete , co dominance lethal genes. Complementary genes, supplementary genes, epitasis, duplicate genes, Multiple alleles with reference to Blood groups , Polygenic inheritance with reference to wheat linkage – Types, Theories related to linkage.

Unit II: Recombination Genetics in Prokaryotes - Transduction, Transformation, Conjugation Eukaryotes – Reciprocal – crossing over – Types , Mechanism various theories , significance – Cytological basis for crossing over in corn. Non Reciprocal recombination – gene conversion, Transposans position effect.

Unit III: Sex Determination in plants – different types – sex determination in melandinum – sex linked inheritance colorblindness- sex limited; Sex influenced traits Cytoplasmic inheritance – antibiotic resistance in chlamydomones and male sterlityy in Maize,

Unit IV: Chromosomal abberations- - Population Genetics – frequency of genes in population – Handy Weinberg's law

Unit V: Evolution: Various theories of Evolution – Lamarckism, Darwinism – Modern synthetic theories of Evolution – Natural selection and speciation Role of RNA in organic Evolution.

Practical

1. Solving problems related to monohybrid, dib rid crosses, Test cross, Multiple alleles.
2. Solving problems related to gene interaction mentioned in the syllabus
3. Calculating gene frequency using Hardy-Weinberg Law
4. Chromosomal mapping

References

1. Blackie, 1983. **Evolutionary Principles**. Oxford & 1BH, New Delhi.
2. Brooker, R.J. 2017. **Genetics: Analysis and Principles.** McGraw-Hill Education**.**
3. Briggs. D. and Walters. S.M. 1984.**Plant variation and Evolution**. Cambridge University Press. London.
4. Dyansager. V.R. 1986. **Cytology and Genetics**. Tam Mc Graw-Hill. New Delhi.
5. Echrlich& Holm. 1974. **Process of Evolution**. Oxford & IBH. New Delhi.
6. Futuyma,D. & Kirkpatrick, M., 2017. **Evolution**, Sinauer
7. Goodenough, U. **Genetics**. III edn. Holt. Saunders. New York.
8. Gupta, P.K. **Genetics**. Rastogi Publications. Meerut.
9. Hall, B.K. & Hallgrimsso, B., 2014. **Strickberger's Evolution**. Jones and Bartlett Publishers, New York.
10. Jha, A.P. 1997. **Genes and Evolution**. Macmillan India ltd. Delhi.
11. Jurgen Schulz Scalier. 1985. **Cytogcnertics-Plants, Animals and Humans**. Springer-veriag. Berlin.
12. Kiichi Fukui and Shigeki Nakayam (Eds.) **Plant Chromosomes – Laboratory Methods**. CRC Press. New York.
13. Mitra. S. 1994. **Genetics - A blue print of life**. Tata McGraw Hill. NewDelhi.
14. Savage J.M. 1969. **Evolution**. Oxford & IBH, New Delhi.
15. Singh. B. D. 2000. **Fundamentals of Genetics**. Kalyani Publishers. New Delhi.
16. Snustad,D.P., Simmons, M.J. 2015. **Principles of Genetics**, John Wiley & Sons
17. Strick berger . M. W. 1985. **Genetics**. Macmillan India. New Delhi.
18. Strickberger. M. W. 1999. **Genetics**. Prentice Hall of India Pvt. Ltd. New Delhi.
19. Swanson. C.P. (Ed.) 1980. **Cytogenetics**. Prentice Hall.
20. Theodosius Dobozhansky et al., 1986. **Evolution**. Surjeet Publications. Delhi.
21. Wooley. P. 1983. **Molecular theory of Evolution**. Springer - Verlag, Berlin.

SEMESTER II

Paper VI

PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Acquire knowledge about the structure and functional development of cells and tissues
- Interpret the normal and anomalous secondary growth in Dicots and Monocots
- Trace the developmental process of tissue form Spermatogenesis, Oogenesis to Embryo formation

Unit I: Meristems – characters, classification and theories – Apical cell theory, Tunica – Corpus theory and Korper - Kappe concept. Vascular Cambium – Types, divisions, arrangement and seasonal activity, Factors affecting cambial activity. Origin, Structure, development and ontogeny of xylem and phloem. Reaction wood – structure and properties. Identification of common timbers in Tamilnadu. Heart wood and sap wood-strength, ability, grains, texture and defects. Anomalous secondary growth in Dicots and Monocots.

Unit II: Leaf ontogeny – initiation, apical, intercalary, marginal and adaxial growth, plate meristem and development of vascular tissues plastochronic index. Transfer cells –Structure, development and functions. Classical concept of flower; Floral anatomy and its role in classification. Plant galls; Types, structure and development. Role of polarity in cell differentiation and symmetry. Role of sucrose in Vascular tissue differentiation.

Unit III: Development of microspores and megaspores – types and factors involved. Development of micro gametophyte – pollen wall development - vegetative and generative cell; pollen viability test. Development of megagametophyte – structure and types of ovule. Development of monosporic, biosporic and tetrasporic types of embryosac and their cellular organization.Endosperm – Origin , types, structure, development : Haustorial endospen.

Unit IV: Pollen-Pistil interaction and fertilization, types of stigma and style events on stigmatic surface, pollen tube growth, guidance and entry into ovule and embryo sac. Double fertilization – significance. Incompatibility – interspecific – homomorphic and heteromorphic, Causes and methods to overcome incompatibility. Classification of embroyo development in Dicots and Monocots. Development of fruit wall and differentiation.

Unit V: Polyembryony – causes – Apomixis, Apospory.Their role in plant improvement programmes and seed development. Biochemical and physical factors in fruit development. Parthenocarpy. Prospects and significance of embryo and endosperm culture.

Practical

1. Anomalous secondary thickening in stems in Antigonon, Achyranthes, Nyclanthes, Aristolochia and Bougainville
2. Preparation of 5 permanent slides using double staining technique
3. Observation of pollen types and pollen germination
4. Section of anther (observation of different stages)
5. Endosperm and embryo mounting

References

1. Bhojwani S. S. and Bhatnagar, S.P.2000. **The Embryology of Angiosperms**, Vikas Publishing House Pvt. Ltd., New Delhi
2. Cutler, D.F. 1978, **Applied plant Anatomy**, Orient Longman Publishers, New Delhi
3. Easu, 1987 . **The Anatomy of seed plants**. Wiley Eastern Ltd., New Delhi
4. Fahn, A. 1989 **Plant Anatomy**,Pergamon press, Oxford, New York.
5. Fosket, D.E. 1994**. Plant Growth and Development – a molecular approach**. Academic Press.
6. Jphri, B.M. 1984 **Embryology and Angiosperms**. Springer Verlag. Berlin
7. Maheshwari, P. 2015. An Introduction to the Embryology of Angiosperms, Scholar Select Publishers.
8. Pandey , A.K., 1997. **Introduction to Embryology**. CBS Publishers and Distributors , New Delhi
9. Pandey, S.N. and Chadha , A. 2000. **Embryology**. Vikas Publishing House Pvt. Ltd., , New Delhi
10. Paula J. Rudall, 2007. **Anatomy of Flowering Plants: An Introduction to Structure and Development (3rd Edition),** Cambridge University Press.
11. Ray F. Evert, 2006**. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development**. John Wiley **& Sons.**
12. Shivanna, K. R. 2003 . **Pollen Biology and Biotechnology**. Oxford and IBH publishing house, New Delhi.
13. Vargjese T.M. 1984. **An introduction to Experimental and Applied Embryology of Angiosperms**. Oxford.

SEMESTER – II
MAJOR ELECTIVE II
FERMENTATION BIOTECHNOLOGY

Contact hours: 5 hrs. /week

Learning Outcomes:

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

- Come to know about the various industrially important microorganisms
- Understand the principles and process of fermentation

- Illustrate the design of various fermenters and bioreactors
- Explain the process of production of various fermented products

Unit I: Industrially important microorganisms – Screening industrially important microorganisms, thermophilic microorganisms- strain improvement by classical and recombinant methods. Principles fermentation – liquid and solid state fermentations, medium development and industrial scale fermentation.

Unit II: Design of fermenters and bioreactors – Basic fermenter and control of basic fermenter, various designs of fermenters – lift – fixed – bed reactor, fluidized bed reactor, batch, fed batch and fermentation cell and enzyme immobilization.

Unit III: Large scale fermentation and downstream processing – scale up of microbial fermentation. Growth kinetics, effect of pH, temperature, nutrient concentrations. Downstream processing, precipitation, centrifugation, filtration, solvent extraction, chromatographic purification, affinity purification, fermentation economics – cost analysis.

Unit IV: Major products of industrial microbiology – single cell protein and industrial enzymes – analyses & proteases, alcoholic fermentation – beer and wine , antibiotics – penicillin – organic acid – citric acid , amino acid – glutamate, vitamins B12 , biogas production

Unit V: Fermentation of foods, Fermented milk and milk products – food spoilage and methods of preservation.

References

1. Demain, A.L. (et.al) 1999. **Manual of Industrial Microbiology and Biotechnology**. 2nd Edition ASM press.
2. Gerald Reed E/e. 1981. **Prescott and Dunn's Industrial Microbiology**. Chapman & Hall.
3. Michael , J. Waites, 2001. **Industrial Microbiology: An introduction (Illustration)**. Blackwell Science Inc.
4. Stanbury, P.F., Whitaker, A. & Hall, S.J. 2016. **Principles of Fermentation Technology**, Butterworth-Heinemann publications.

SEMESTER – II
MAJOR ELECTIVE II
BIOFERTILIZERS

Contact hours: 5 hrs. /week

Learning Outcomes:

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

- Familiarize with the basic principle and techniques of Biofarming
- Appreciate the agronomic importance of beneficial micro-organisms
- Formulate, produce and apply Biofertilizers in a pilot scale

Unit I: Biofertilizers - Introduction, scope. A general account of plant growth promoters and regulators – Cyanobacterial Biofertilizer: Algalization – mass cultivation of cyanobacterial biofertilizers.

Unit II: Nitrogen fixing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Rhizobium and Azospirillum. Mechanism of nitrogen fixation (free-living and symbiotic) - Biochemistry and molecular basis of nitrogen fixation.

Unit III: Azolla – Structure and Morphology – Mass cultivation method and Application. Economic and Ecological importance of Azolla.

Unit IV: Phosphate solubilizing Bacteria: Isolation, characterization, identification, mass cultivation and inoculation method of Phosphobacteria. Biochemistry of Phosphate solubilization and mobilization.

Unit V: Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Isolation and method of inoculation of Arbuscular mycorrhizae (AM), Legume - AM interactions .

Carrier based inoculum production methods and Field application

References

1. **A text book of microbiology**, second reprint. S. Chand and Company• Ltd., New Delhi. Refernce Books Ann Larkin Hansen , 2010,
2. Dubey, R. C. 2008. **A Textbook of Biotechnology**. S. Chand & Co., New Delhi.
3. Kannaiyan, S. 2002 **Biotechnology of Biofertilizers**. Narosa publishing house, New• Delhi. Dubey, R.C. 2001.
4. Subba Rao, N. S. 2002. **Soil Microbiology**. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. **The Organic Farming Manual:** A Comprehensive Guide to• Starting and Running a Certified Organic Farm. Storey Publishing LLC.
6. Niir Board, 2004. **The Complete Technology Book On Bio-Fertilizer And Organic Farming,** National Institute Of Industrial Research, Delhi.

SEMESTER III
Paper VII
TAXONOMY OF ANGIOSPERMS

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Acquire knowledge on principles of Botanical nomenclature
- Comparative study about different systems of classification
- Describe the salient features of various families belonging to Dicotyledons and Monocotyledons
- Appreciate the modern trends in Taxonomy

UnitI: History of Plant Taxonomy, Definition, Aims, importance and scope of Taxonomy Development and phases of classification, systems of classification. Artificial- Linnaean system. Natural – Bentham and Hooker system. Phylogenetic – Engler, Pratil and Hutchinson, Tautajhan and Cronquist system (Comparative study).

Unit II: ICN – Norms, New Regulations, Morphology of Angiosperms, Herbarium techniques, Digital Herbarium, Botanical museums, Botanical libraries, Botanical Garden, Effective and valid publication, Type concept and Author citation retention of names, publication of names: rules of priority.

Unit III: Modern concepts and trends in plant taxonomy: Elementary treatment of Cytotaxonomy, Chemotaxonomy, Numerical Taxonomy, Molecular Taxonomy, Cladistics

Unit IV: Study of important taxonomic character and popular examples of the following natural order of Benthem and Hooker classification – Ranumulaceae - Magnolianceae, Nymphaeceae, Caoarudaceae, Caryophyllaceae, Rutaceae, Rhamnaceae, Sapindaceae, Rosaceae, Lythraceae, Aizoaceae, Apiaceae, Rubiaceae, Asteraeeae, Sapotaceae, Gentianaceae, Asclepiadaceae, Convolvulaeeae, Scorphulariaceae, Bignoninaceae, LamiaceaeVerbenaeeae, Nyctaginaieae, Piperaceae, Loranthaceae, Duphorbiaceae, Amaryllidaceae, Lilliaceae, Arecaceae, Araceae, Orchidaceae, Cyperaceae.

Unit IV: Polypelateae: Study of important taxonomic characters and popular examples of the following natural order of Bentham and Hooker classification – Ranucelaceae, Magnolaceae, Nymphaeacea, Capperdaceae, Caryofleullaceae, Strerculaceae, Rutaceae, Rhamanceae, Sapendaceae, Rosaceae, Lythraceae, Passifloraceae, Ficaceae, Apraceae, Ganuplatae, Rubeaceae, Aeteraeeae, Sapotaceae, Genetranaceae, Convolunlaceae, Scrophularakale, Bignenaceae, Verbeaceae, Lamaceae

Unit V: Manochelamydeae and Monocotepedece, Nyctaginaceae, Arutolocheace, Piperaceae, horanthaceae, Euphortriaceae, Hlydrchautaceaee, Orchidaceae, Amaryclideceae, comoneluaceae, Palmaceae, Cypereceae.

Practical

1. Identification of families mentioned in the syllabus with the help of salient features
2. Preparation of dichotomous key
3. ICN problems
4. Name of the plant using Gamble
5. Submission of 30 herbarium sheets
6. Field trip for minimum of 3 days for collection of plants and preparation of herbarium
7. Study of local flora
8. Spotters related to Theory

References

1. Bhattacharya, B and Johri, B.M. 1996. **Flowering plant- Taxonomy and Phylogeny**. Narosa Publishing House, New Delhi. 1996
2. Cole, A.J. 1969. **Numerical Taxonomy**. Academic Press, London.

3. Gurcharan Singh, 2016. **Plant Systematics:** An Intergrated Approach, Third Edition, CRC Press, Taylor & Francis group.
4. Heywood, V.H. and Moore, DN 1994. **Current concepts in plant taxonomy**. Academic Press London.
5. Lawrence, GHM 1959. **Taxonomy of vascular plants**. Mac Millan, New York.
6. Nalki, V.N.1993. **Taxonomy of Angiosperms**. Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi.1993
7. Pascale Besse, 2014. **Molecular Plant Taxonomy: Methods and Protocols**, Humana Press, New York.
8. Sharma, O.P., 2011. **Plant Taxonomy** (2nd Edition), Tata McGraw-Hill Education, Delhi.
9. Sivarajan V. V. 1991. **Principle of Plant Taxonomy**. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
10. Sokal R.R. and Sneath P.H.A 1963. **Principles of numerical taxonomy**. Fremen& Co. San Francisco. USA.
11. Stace, C. 1985. **Plant taxonomy and biosystematics**, Edward Arnold, London.
12. Subrahmanyam, N.S. 2009. **Modern Plant Taxonomy**. Vikas Publishing House Pvt. Ltd. New Delhi
13. Takhtajan, A.L. 1997. **Diversity and classification of flowering plants**. Columbia Univ. Press, New York.
14. Woodland, D.W. 2009. **Contemporary Plant Systematics**. Prentice Hall, New Jersey.
15. Walter S. Judd, Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens, Michael J. Donoghue, 2015. **Plant Systematics: A Phylogenetic Approach,** Sinauer, USA.

SEMESTER III
Paper VIII
MICROBIOLOGY AND PLANTPATHOLOGY

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Trace the history of Microbiology
- Understand the structure, lifecycle and function of microorganisms
- Identify the causative agents, symptoms, mode of transmission and control of various diseases

Unit I: History of Microbiology, Bergey's classification of Bacteria, General Characteristics of bacteria; Morphological, Cultural and Biochemical characteristics, ultra-structure of bacterial cell. Bacterial cell wall: Nature - Chemistry and Biosynthesis, Isolation and

purification of plant viruses,overview of structure of virus and life cycle (Lytic and Lysogenic), Virions, Prions.

Unit II: Sterilization – Incubation – pure culture, spread plate, pour plate & streak plate techniques. Media preparation, Growth and multiplication, Growth curve, measurement of Growth. Staining technique: simple & differential.

Unit III: Role of microbes in industry – Vinegar, Ethanol, Penicillin. Antibiotics – source and mode of action of penicillin and streptomycin. Food Microbiology - Microflora of milk, role of microbes in the dairy industry. Food spoilage and preservation methods. Single cell protein. Environmental Microbiology – Bioleaching – Sewage treatment.

Unit IV: Plant Pathology – General Principles – Classification of plant diseases – Symptoms – Defense mechanisms – Chemical and biological control - Integrated pest management.

Unit V: Study the following organisms with special reference to causative organisms, symptoms, host-pathogen interaction and control measures: Red rot of Sugarcane, Tikka disease of ground nut, Blast of Paddy, Rust disease of Wheat, Cotton Wilt, Late blight of Potato, Citrus canker. Viral diease - Bunchy top of Banana, Mosaic disease, Leaf roll of Potato. Mycoplasma – Little leaf disease of Brinjal.

Practical

1. Sterilization methods
2. Preparation of media
3. Isolation of microbes using serial dilution technique
4. Staining of bacteria – simple and differential
5. Standard analysis of water for the presence of coli forms
6. Isolation of plant pathogen from infected tissues
7. Observation of infected plant specimens mentioned in the syllabus/
8. Spotters related to theory

References

1. Alexopoulos, C.J., Mims. C.W. Blackwell, M. 1996. **Introductory mycology**. John Wiley & Sons., New York.
2. Atlas. M. and Bartha, R. 2000. **Microbial Ecology**. Addison Wesley Longman,Inc. New York.
3. Black, J.G. & Black, L. J. 2014. **Microbiology: Principles and Explorations,** John Wiley.
4. Brock, T.D. 1996. **Biology of Micro-organisms**. Prentice Hall.
5. Casida, 1997. **Industrial Microbiology**. New Age International Publishers. New Delhi.
6. Dubey, R.C. and Maheswari, D.K. 2000. **A Text Book of Microbiology**. S Chand& Co. Ltd. New Delhi.

7. Kumar, H.D. and Swati Kumar, 2001. **Modern Concepts of Microbiology**. Vikas Publishing House Pvt. Ltd. New Delhi.
8. Marshall, H. 1999. **Diseases of Plants**. Anmol Publications Pvt. Ltd. New Delhi.
9. Mathew. R.E F. 1981. **Plant Virology**. Academic Press, London
10. Mehrotra, R.S.2000. **Plant Pathology**. Tata McGraw Hill Publishing Co. New Delhi.
11. Nicklin. J el 4, 1999. **Instant notes in Microbiology**. Viva Books Pvt. Ltd.New Delhi.
12. Pelezar, M.J. Chan. E.C.S and Kreig, N.R. 1993. **Microbiology-Concepts and Applications**. McGraw Hill, Inc. New York.
13. Pommerville, J. & Pommerville, 2017**. Fundamentals of Microbiology,** Jones & Bartlett Learning, Burlington.
14. Rangaswamy, G. 1992. **Diseases of Crop Plants in India**. Prentice Hall of India. New Delhi. Singh, R.S. 1991. **Plant Diseases**. Oxford IBEL New Delhi.
15. Singh. R.S. 1994. **Introduction to the Principles of Plant Pathology**. Oxford IBH. New Delhi.
16. Stainer, R. Y. et al.; 1990. **The Microbial World**. Prentice Hall.
17. Swarup et al., 1999. **Plant Diseases**. Anmol Publications Pvt. Ltd., New Delhi.
18. Tortora,G,J., Funke, B.R. & Case, C.L. 2015. **Microbiology: An Introduction,** Pearson publications.
19. Vashishta, P.C. and Gill, P.C. 1998. **Plant Pathology**. Pradeep Publications, Jalandhar. Wheeler. B.E. 1972. **An Introduction to Plant Diseases**. John Wiley.

SEMESTER III
Paper IX
BIOCHEMISTRY

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Acquire knowledge about various biomolecules
- Define the structure, properties and significance of biomolecules
- Understand the metabolic pathways of biomolecules
- Discriminate the biomolecules from hormones and vitamins
- Describe the classification, mechanism of enzyme action and enzyme kinetics

Unit I: Chemistry of Enzymes: Classification and nomenclature of enzymes: IUB, Isolation and purification of enzymes: Concept of active site, mechanism of enzyme action: Michaelis Menton equation and Km value. Enzyme modifiers – activators, inhibitors, allosteric enzymes : Regulation of enzyme action: Isozymes – diagnostic applications.

Unit II: Amino acids and Proteins: biosynthesis of amino acids: properties and chemical reaction concerned with amino acids: Proteins: primary, secondary, territory structure of protein, 3 D structure and protein folding, physiochemical properties of proteins.

Unit III: Metabolism of Carbohydrates: chemical reactions & derivatives of monosaccharide: Glycol sis – T.C.A. Cycle. E.T Chain- ATP synthesis: Glycogenolysis – H.M.P. Pathway: Glyconeogenesis.

Unit IV: Metabolism of Lipids: Oxidation of any one fatty acids and its bioenergetics: Biosynthesis of any one fatty acid: palmitic acid unsaturation: biosynthesis of cholesterol: Importance of cholesterol and plant lipids

Unit V: Chemistry of vitamins, hormones and alkaloids : Vitamins as Co-enzymes : Chemistry and biosynthesis of hormones- thyroxin. Catecholamine's. steroidal hormones. Biologically important alkaloids: intermediary metabolism : integration of metabolic pathways.

Practical

1.Qualitative tests for carbohydrates, lipids, proteins and amino acids

2. Estimation of glucose, starch, protein and amino acids

3. Determination of enzymes activity – effect of enzyme concentration, pH temperature, substrate, concentration of analyze

4. TLC separation of dyes/ pigments

Reference

1. Campbell, M.K.& Farrell, S.O. 2011. **Biochemistry**, 7th Reprint, Cengage Learning Publishers.
2. Conn. E.E. and stumpf P.K. 2009. **Outlines of Biochemistry**. John Wiley and Sons, New Delhi
3. David T. Dennis and David H. Turupin (Eds.) 1993**. Plant Physiology, Biochemistry and Molecular Biology**. Longmann Scientific and Teachnical Singapore.
4. Fisher J. & Arnold,2003. **BIOS Instant notes in chemistry for Biologists**. Garland Science publications.
5. Goodwin and Mercer 1996. **Introduction to plant Biochemistry**. CBS Publishers and Distributors, New Delhi.
6. Hames, B.D. et. Al. 1999**. Instant notes in Biochemistry**. Viva books Pvt. Ltd., New Delhi
7. Dey, P. M. Harborne, J. B. 1997**. Plant Biochemistry**, Elsevier publications.
8. Jain J.L. 2000. **Fundamentals of Biochemistry**. S. Chand & co. New Delhi.
9. Plummer, D.T. 1996. **An introduction to practical Biochemistry**. McGraw Hill
10. Satyanarayana, U, 1999. **Biochemistry. Books and Allied** (P) Ltd. Calcutta.

SEMESTER III
NON-MAJOR ELECTIVE
MUSHROOM CULTIVATION

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Understand the cultivation process and nutritive value of mushrooms
- Discriminate edible mushrooms from poisonous mushrooms
- Develop entrepreneurial skills with experience in mushroom cultivation

Unit I: General characters of mushroom – present status of the mushroom industry in India common edible and non-edible mushrooms. Vegetative characters – Formation and development of basidiocarp, structure of Basidiocarp - *Agaricus*.

Unit II: Nutritional value of edible mushrooms: proteins, vitamins, minerals, carbohydrates and fats. Nutritive and Energy value of mushrooms.

Unit III: Methods of spawn production – factors determining the spawn production. Storage of spawn.

Unit IV: Methods of cultivation and harvesting – paddy straw mushroom. Oyster mushroom, white button mushroom and milky mushroom.

Unit V: Bacterial, Fungal & viral diseases and their control. Diseases and pests of mushrooms: preservation of mushrooms: Recipes: Marketing of mushroom products – Role of Mushrooms in compost preparation.

References

1. Muthusamy A.D. and Yesuraja I., 1999. **Mushroom Culture**. TNAU publication, Madurai.
2. Nita Bahl, 1988. **Hand book on mushrooms**. Oxford & IBH publisher. New Delhi.
3. Suman, B.C. & Sharma, V.P.2007. **Mushroom cultivation in India.** Daya Publishing House, Delhi.
4. Petre, M. 2015. **Mushroom Biotechnology: Developments and Applications,** Academic Press Publications.
5. Diego Cunha Zied, Arturo Pardo-GimAcnez 2017. **Edible and Medicinal Mushrooms: Technology and Applications**. John Wiley & Sons.

SEMESTER IV
Paper X
PLANT PHYSIOLOGY

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Understand the physiological pathways of plant systems
- Familiarize the factors influencing plant growth
- Understand the activity of hormones on plant growth and development

Unit I: Water relations of plants: Physicochemical properties of water, chemical potential and water potential in the plant, bulk movement of water, soil – plant atmosphere continuum. Transpiration: Types, cuticular, lenticular and stomatal. Factors affecting transpiration. Stomatal physiology and regulation.

Unit II: Mineral nutrition: Macronutrients and Micronutrients. Modern concepts of mineral salt absoption and translocation. Active and passive absorption of minerals. Mechanism of Nitrogen fixation, physiological role, Nitrogen uptake and assimilation.

Unit III: Photoshnthesis: Photophysical and photochemical phase: light reactions, sequence of photosynthetic pathway – Electron Transport Chain, Photophosphorylation. Pathways of CO_2 fixation in C3, C4 plants and CAM pathway. Glycolate pathway. Factors affecting photosynthesis

Unit IV: Respiration: Aerobic and Anaerobic, fermentation, respiratory quotient, Glycolysis, Kreb's cycle.Oxidative phosphorylation. Factors affecting respiration. Photorespiration.

Unit V: Plant growth regulators: Auxin, Gibberellin, cytokinin, Ethylene and Abscisic acid their physiological role and mode of action. Flowering : Photoperiodism – short day plants, Long day plants and Day neutral plants. Role of phytochrome in flowering. Seed dormancy, cause and methods of breaking dormancy. Progammed cell death – Physiological and biochemical change. Water and salt stress.

Practical

1. Determination of water potential – plasmolytic,Chardkov's and Gravimetric method
2. Quantifications of non photosynthetic figments (chla, chlb, chla+b)
3. Quantifications of photosynthetic fragments (Anthocyanin and flavones)
4. Absorption and Action spectra of Chlorophyll pigment
5. Effect of pH, temperature and detergents on membrane permeability
6. Effect of hormones on seed germination
7. Seed viability test (Tetrazoline blue dye reduction)
8. Smith's fermentation (Kuhn's fermentation tube)

References

1. Brett. C.T. and Waldron. K.W. 2012. **Physiology and Biochemistry of Plant Cell Walls.** Springer Science & Business Media.
2. Osborne, D.J. Micheal. B.J. 2013. **Cell separation in Plant Physiology, Biochemistry and Molecular Biology.** Springer Science & Business Media.
3. David T. D. and David H. T. (Eds.) 1993. **Plant Physiology, Biochemistry and Molecular Biology.** Longmann Scientific and Technical, Singapore.
4. Devlin and Witham. 1997. **Plant Physiology.** CBS Publishers and Distributors. New Delhi.
5. Fitter. A.H. and Hay R.K.M. 2012. **Environmental physiology** of **plants.** Academic Press.
6. Hall, D.O. and Rao. K.K. 1999. **Photosynthesis.** Cambridge UniversityPress.
7. Hess. D. 1975. **Plant physiology.** Narosa Publishing House. New Delhi
8. Lincoln Taiz and Eduardo Zeiger. 1991. **Plant Physiology.** The Benjamin/Cummings publishing Company. Inc.
9. Noggle and Fritz. 1999. **Introductory Plant physiology.** Prentice hall,London.
10. Salisbury. E.B. and Ross. C. 2000. **Plant physiology.** John Wiley & Sons.New Delhi.
11. Stratford, G.A. 1979. **Essentials of Plant Physiology.** Heinemann PublishingCo. New York.
12. Verma, V. (2016) **Plant Physiology.** 2nd ed. Ane Book Publishers, New Delhi
13. Wilkins, M.B. (Ed) 1984. **Advanced Plant Physiology.** Pitman PublishingCo. New York.
14. Willey, N. 2016. **Environmental Plant Physiology**, Garland Science, Taylor and Francis, London
15. William G. Hopkins. 1999. **Introduction to Plant Physiology.** John Wiley &Sons. Inc. New York.

SEMESTER IV
Paper XI
RESEARCH METHODOLOGY AND BIOINFORMATICS

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Formulate and design research experiments
- Understand the basic principles and applications of research instruments
- Apply statistical methods to analyse data and prepare written material for research publication
- Apply computing techniques to annotate, process and analyse data in and from databases

Unit I: Population and Sample – Methods of Sampling. Collection of data: primary and secondary data – methods of collecting data. Presentation of data: tabulation – types of table. Diagrams and graphs: simple – multiple and subdivided diagrams – pie diagram – histogram and frequency polygon.

Unit II: Data analysis and data interpretation – measures of central tendency – Mean, Median, and Mode. Measures of deviation – Range, Quartile deviations, Correlation, Regression, Probability, T-test, Standard deviation, ANOVA.

Unit III: Thesis writing: General format of thesis, certificates, introduction, review of literature, materials and methods, results, discussion, summary and bibliography. Sources of literature – primary and secondary. Literature citation in text and bibliography. Standard proof correction marks. Preparation for oral and poster presentation. Preparation of research article and publication in peer-reviewed journals. Research ethics and Plagiarism.

Unit IV: Bioinformatics – Definition, objectives, basic components of computers – Internet, Website. Application of Bioinformatics – Transcriptomics, Metabolomics and Pharmacogenomics.

Unit V: Types of data and data sets: Genomic DNA – cDNA – rDNA – Expressed sequence tags (ESTs) – Genomics survey sequences. Primary nucleotide databases: NCBI – EMBL – DDBJ. Primary protein databases: SWISS PROT – PDB. Swquence submission – Storage – Sequence annotation databases.

Practical

1. Frequency distribution
2. Histogram, frequency polygon, frequency curves and cumulative frequency curves.
3.Graphic location of median and mode
4. Bar and pie diagrams
5. Computation of mean, median, mode, quartile deviation, , standard deviation and coefficient and correlation co-efficient
6. Regressive equation of X on Y on and Y on X
7. Problems connected with probability rules
8. Chi square test problems. Test of goodness of fit
9. Calculation of probability using bi normal and normal distribution
10. Test for significance of means of random sample
11. Calculation of standard deviation / standard error
12. Demonstration of Bioinformatics tools
13. Visit to Bioinformatics centers

References

Arthur M. Lesk, 2014. **Introduction to Bioinformatics,** 4th Edition, Oxford University Press, Oxford.

Attwood T.K and Parry - Smith.1999. **Introduction to bio-informatics.** A.W.Longman Ltd.UK.

Baxevanis AD and Francis B.J 1998 Bioinformatics. A practicalGuide to the analysis of genes and proteins. John Wiley & sons. Inc.

Bliss CI. 1970. Statistics in Biology. Vol. Iand II. McGraw-Hill Inc. USA.

Chap T.Le., Eberly, L.E., 2016. Introductory Biostatistics, 2nd Edition, Wiley and Sons, Hoboken.

Daniel WW, 1995. Biostatistics. 7th edition. John Wiley and Sons. NewYork. USA.

Hodgmen, T.C., French, A., 2010. Bioinformatics, 2nd Edition, Taylor and Francis, New York.

K. Shanmughavel. P. 2006. Trends in Bioinformatics, Pointer Publishers. Jaipur, India.

Khan and Khan. 1904. Biostatistics. VikasPublising House Pvt. Ltd. New Delhi

Shanmughavel. P. 2005. Principles of Bioinformatics. Pointer Publishers. Jaipur, India.

Stryer L. Biochemistry. 4th Ed. W H Freeman and company. New York.

SEMESTER IV
Paper XII
PLANT BIOTECHNOLOGY

Contact hours: 6 hrs. /week

Learning Outcomes:

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

- Appreciate the role of biological organisms for Human welfare
- Formulate biological compounds through biological techniques in industrial scale
- Familiarize with the genetic basis of metabolite control in plant system

Unit I: Scope – definition multidisciplinary approach of biotechnology, Recombinant DNA technology - molecular tools – nomenclature and characteristics of Restriction enzymes, ligases and DNA modifying enzymes. Plasmids vectors – properties and classification – PBR

322, pUC 18. lambda (gt 10) and M13 phage vector. Cosmids (pJB 8), Yeast vectors – cloning genes using above vectors. Genomic library and cDNA library – construction, screening libraries by colony. Plaque hybridization.

Unit II: Methods of gene delivery – Agrobacterium and CaMV mediated gene transfer; direct gene transfer using PEG, electroporation, biolistics, microinjection and liposome mediated. Transposons as vectors; use of mixed vectors. Agro bacterium and genetic engineering in plants – Ti plasmid (Octopine and Nopaline) – Disarmed Ti plasmid vectors- Ri plasmid. Gene maps and expression of T-DNA. Incorpporation of T-DNA into the nuclear DNA of plant cells – role of virulent genes.

Unit III: Plant genome – Nuclear, Chloroplast and Mitochondrial: Structure, organization and expression. Analysis and expression of cloned genes – DNA sequencing, DNA markers Southern, Northern and Western Blotting: PCR – types and applications.

Unit IV: Micro propagation – Somatic hybridization, Cybrids, Artificial seeds and Somaclonal variation. Transgenic plants – Herbicide resistant plants. Virus resistant plants. Development of Bt cotton. Golden rice and FlavrSavrTamato, Agricultural Biotechnology – Biofertilizers – BGA, Mycorrhiza, bacterial Rhizobium, Azospirillum, Azotobacter, Biopesticides, BC NPV. IPR, patent right Social and ethical considerations – India scenario – a brief account. Case studies on Neem, Turmeric, Basmati.

Unit V: Applications of rDNA technology – DNA finger printing – DNA vaccines – plants as edible vaccines – Hybridoma. Production of secondary metabiolites, Cell immobilization, bio-reactor technology; conservation of germplasm in vitro strategies.

Practical:

1**.** Isolation of Bacterial chromosomal DNA

2. Isolation of plant chromosomal DNA

3. Isolation of bacterial plasmid – Demonstration

4. Agarose gel Electrophoresis and visualization of DNA

5. Plant tissue culture, suspension culture induction – Demonstration

6. Demonstration of regeneration from callus cultures

7. Demonstration of isolation of plant protoplasts.

8.Photographs of DNA on Agarose gel, Blue/white clones, plant tissue cultures, protoplasts, Transgenic plants.

9. Diagram of vectors. Southern blot, Western blot setups.

10. Amplification of DNA using PCR procedure – demonstration**.**

References

Brown, C.M. Campbell. I. and Priest, F.G. 1990. **Introduction to Biotechnology.**Blackwell Scientific Publications, Oxford, London.

Brown. T.A. 2007. **Genomes 3**. Garland Science Publications.

Chawla, H.S. 2009. **Introduction to Plant Biotechnology.** Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Gamborg, O.L and Phillips, G.C. 2013. **Plant Cell, Tissue Organ Culture.** Springer Science & Business Media.

Govil, C.M., Aggarwal, A. & Sharma, J. 2017. **Plant Biotechnology and Genetic Engineering.** PHI Learning, PVT Ltd**.,** New Delhi.

Griffiths et al., 1999. **Modern Genetic Analysis.** W.H. Freeman & Co. NewYork.

Hopkins, W.G. 2007. **Plant Biotechnology**, Chelsea house publishers, New York.

1. Jefrey. M. Backer el al., 1996. **Biotechnology- A Laboratory Course**. Academic Press, New York.
2. Keshav Trehan, 2002. **Biotechnology** (reprint). New Age International Ltd., Publishers, New Delhi.
3. Kumar, H.D. 2000. **Modern concepts of Biotechnology.** Vikas Publishing House Pvt. Ltd. New Delhi.
4. Pamela Peters. 1993. **Biotechnology- a guide to Genetic Engineering.** Wim.C. Brown Publishers, USA.
5. Primrose, S.B. 1989. **Modern Biotechnology**. Blackwell Scientific Publications.
6. Thorpe, T.A. 1981. **Plant Tissue Culture.** Academic Press, London.
7. Trivedi. P.C. (Ed.) 2000. **Plant Biotechnology - Recent Advances**. PanimaPublishing Co. NewYork.

SEMESTER – I
Non-MAJOR ELECTIVE I
HERBAL BOTANY

Contact hours: 5 hrs. /week

Learning Outcomes:

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

- Acquire traditional knowledge on herbal medicine
- Understand the pharmacological action of plant drugs
- Classify and characterize various bioactive components of plant origin

Unit I: Brief history and scope of raw drugs of plant origin. Definition, herbals, classification and description. Classification of vegetable drugs. Biological sources of drugs.

Unit II: Factors involved in the production of drugs – climate; cultivated and wild plants – collection, drying and storage. Deterioration of drugs – primary factors, mould and bacterial attack, control of insect pests. Methods of preparation of drugs from various plantmaterials – extraction of plant material (including the traditional method of preparation) – separation and isolation of constituents – distillation, chromatography – TLC.

Unit III: Pharmacological action of plant drugs – action on the autonomic nervous system, heart muscle, blood vessel, respiratory system, gastrointestinal tract and uterus**.**

Unit IV: Basic study of the source and medicinal value of the phytochemicals, glycosides, alkaloids, phenols, saponins and steroidal saponins. Natural steroids production for pharmaceuticals – Dioscoria, Sarsaparilla root.

Unit V: Drugs from roots: *Rauwolfia, Aconitum and Smilax*. Drugs from underground stem: *Curcuma, Zingiber* and *Acorus*. Drugs from leaves: *Eucalyptus*, *Adhatoda, Digitalis* and *Andrographis*. Drugs from fruits: *Emblica*, *Cuminum*, *Capsicum* and *Piper*. Drugs from whole plant: *Phyllanthus amarus, Catharanthus roseus* and *Withania somnifera*.

References

1. Chopra, R.N. Nager, S.L. and Chopra, I.C. 1956. **Glossary of Indian Medicinal Plants**. CSIR, New Delhi.
2. Nadkarni, K.M. 1982. **Indian Materia Medica**. Popular Prakasham Pvt. Ltd.
3. Trease, G.E. and Evans, W.C. 1980. **Text Book of Pharmacognosy**. ELBS, Bailliere, Tindall.
4. Sambamurthy, A.V.S.S. and Subramanian, M.S. 1989. **A text book of Economic Botany**. Wiley Eastern Co., New Delhi.
5. Wallis, T.E. 1985. **Text Book of Pharmacognosy.** CBS Publishers and Distributors, New Delhi.