MANONMANIAM SUNDARANAR UNIVERISTY,
TIRUNELVELI-12

SYLLABUS

UG - COURSES – AFFILIATED COLLEGES

Course Structure for M. Sc. Botany
(Choice Based Credit System)
(with effect from the academic year 2024-2025 onwards)

Semester-III				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
III	CORE X	CELL AND MOLECULAR BIOLOGY		4
III	CORE XI	GENETICS, PLANT BREEDING & BIOSTATISTICS		4
III	CORE XII	RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL APPLICATIONS		4
III	CORE XIII	LABORATORY COURSE – 5 COVERING CORE PAPERS X AND XII		2
III	CORE XIV	LABORATORY COURSE – 6 COVERING CORE PAPER XI		2
III	CORE XV	INDUSTRIAL BOTANY		4
III	ELECTIVE V	ENTREPRENEURIAL OPPORTUNITIES IN BOTANY		2
III	SEC - II	PROFESSIONAL COMMUNICATION SKILL		2
III		INTERNSHIP / FIELD VISIT / INDUSTRIAL VISIT/ RESEARCH KNOWLEDGE UPDATING ACTIVITY		2

Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks

A. **Scheme for internal Assessment**:
Maximum marks for written test: **20 marks**
3 internal tests, each of **I hour** duration shall be conducted every semester.
To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks.

The break up for internal assessment shall be:
Written test- 20 marks; Assignment -5 marks Total - 25 marks

B. Scheme of External Examination
3 hrs. examination at the end of the semester
A – Part : 1 mark question two - from each unit
B – Part : 5 marks question one - from each unit
C – Part : 8 marks question one - from each unit

- **Conversion of Marks into Grade Points and Letter Grades**

S.No	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	AA	-	Absent

- **Cumulative Grade Point Average (CGPA)**

$$\mathbf{CGPA} = \frac{\mathbf{\Sigma\,(GP \times C)}}{\mathbf{\Sigma C}}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

- **Classification**
  a) First Class with Distinction : CGPA $\geq$ 7.5*****
  b) First Class : CGPA $\geq$ 6.0
  c) Second Class : CGPA $\geq$ 5.0 and $<$ 6.0
  d) Third Class : CGPA$<$ 5.0

CELL AND MOLECULAR BIOLOGY

Learning Objectives

- Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
- To understand the cell division and it molecular mechanism so as to appreciate and manipulate normal and abnormal cell and tissue growth.
- To enlighten people of past molecular biology developments.
- To comprehend the molecular processes.
- A thorough examination of DNA structure, replication process, transcription process and translation processes.

UNIT I

Concept of prokaryote and eukaryote cell. Cell Theory, Structural organization of plant cell, specialized plant cell types. Cell wall- Structure and functions, Plasma membrane; structure, models and functions, site for ATPase, ion carriers channels and pumps, receptors. Plasmodesmata and its role in movement of molecule.

UNIT II

Chloroplast-structure and function, genome organization, gene expression, RNA editing, Mitochondria; structure, genome organization, biogenesis. Plant Vacuole - tonoplast membrane, ATPases transporters as a storage organelle. Structure and function of other cell organelles- Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies.

UNIT III

Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. Ribosome- Structure and functional significance. RNA and DNA structure. A, B and Z forms. Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases. Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.

UNIT IV

DNA replication (prokaryotes and eukaryotes), enzymes involved in replication, DNA damage and repair (Thymine dimer, photoreactivation, excision repair), DNA sequencing: definition, Sanger sequencing - Transcription, enzymes involved in transcription, post transcription changes, reverse transcription, Translation, overlapping genes.

UNIT V

Genetic code and its characteristics, Wobble hypothesis; Central dogma – Mutation types- frame shift mutation, addition, deletion, substitution, transition and transversion, germinal verses somatic mutants. Molecular basis of mutations; Chromosomal aberrations: aneuploidy - autopolyploidy and allopolyploidy; with example. Structural aberrations of chromosomes. Giant chromosomes – Polytene and Lampbrush chromosomes. Differential staining of the chromosomes- Qbanding, G banding, C banding, R banding: In situ hybridization-FISH and GISH:

Recommended Text:

1. Roy, S.C and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta.
2. Karp, G. 2010.Cell and Molecular Biology: Concepts and Experiments.6th edition. John Wiley& Sons.
3. Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India.
4. Geoffrey M. Cooper. 2019. The Cell: A Molecular Approach, Oxford University Press.
5. Turner, P.C., Mclenann, A.G., Bates, A.D. and White, M.R.H. 2001. Instant notes on molecular biology.
6. Watson, J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. 2014. Molecular Biology of the Gene (7th edition), Pearson Press.
7. Snustad Peter, D. Michael J. Simmons. 2015. Principles of Genetics, John Wiley Sons.
8. Clark, D. 2010. Molecular Biology. Academic Press Publication.
9. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
10. Geoffrey M. Cooper and Robert E. Hausman. 2015. The Cell: A Molecular Approach. 7th edn. Sinauer Associates is an imprint of Oxford University Press.

Reference Books:

1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
3. Lodish S, Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific American Books, N.Y
4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.
5. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA 7.

Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4th Edn, Sinauer Associates, USA.

6. Genes X– Benjamin Lewin, Jones and Bartlett, 2011 4. Molecular Biology of the Cell –Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999
7. Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 2002

Web Resources

1. https://www.pdfdrive.com/cell-biology-books.html
2. http://www.bio-nica.info/Biblioteca/Bolsover2004CellBiology.pdf
3. https://www.e-booksdirectory.com/listing.php?category=549
4. https://www.elsevier.com/books/molecular-biology/clark/978-0-12-813288-3
5. https://www.kobo.com/in/en/ebooks/molecular-biology

GENETICS, PLANT BREEDING & BIOSTATISTICS

Learning Objectives

- The students will be able to have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
- Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
- Familiarize with genetic basis of heterosis.
- Reflect upon the role of various non-conventional methods used in crop improvement.
- Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods

UNIT I

Mendal's Law of inheritance. Gene interactions and modified dihybrid ratios (Epistasis, duplicate genes, complementary genes, supplementary genes. Lethal genes, incomplete dominance). Polygenic Inheritance. Sex determination in plants and theories of sex determination. Sex linked characters. Structure and function of Gene, Operon, inducible operon, Operator site, Promoter, Polycistronic mRNA, Regulator, repressor, inducer. Regulation in prokaryotes with reference to Lac operon and trp operon. Producer gene, structural gene and integrator gene. Gene Regulation eukaryotes – Britten and Davidson model, Arabidopsis - gene regulation in flowering.

UNIT II

Recombination: Homologous and non-homologous recombination, site-specific recombination. Holiday model of recombination. Transposable genetic elements: Ac element, transposase, transposon, Is element. Transposons in Zea mays. Transposable

elements in prokaryotes. UV induced mutation and its repair mechanism. Mutagenesis - site directed mutagenesis, transposon mutagenesis, insertional mutagenesis. Mismatch DNA repair mechanism.

UNIT III

ABO blood group in humans. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers. Extra-chromosomal inheritance - Chloroplast Inheritance. Organelle genomes: Organization and functions of chloroplast and mitochondrial DNA.

UNIT IV

PLANT BREEDING:

Objectives of plant breeding, characteristics improved by plant breeding, Plant introduction, Genetic basis of breeding self and cross – pollinated crops. Pure line theory, pure line, mass and clonal selection methods. Hybridization – steps and types, Genetics and physiological basis of heterosis. Mutation breeding - important varieties produced.

UNIT V

BIOSTATISTICS:

Measures of central tendency (Mean, Median, Mode) and dispersal (Mean deviation, standard deviation), standard errors ANOVA (One way). Probability distributions (Binomial, Poisson and normal); difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis of variance; Chi-square test.

Recommended Text:

1. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
2. Stansfield, W.D. 1969. Theory and problems of Genetics. McGraw-Hill
3. Sinnott, E.W.Dunn, L.E and Dobzhansky, T. 1973. Principles of Genetics. McGraw- Hill.New York.
4. Chaudhari, H.K.1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company.
5. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall.
6. Chahal, G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
7. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers,

New Delhi
8. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
9. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.
10. Gupta, P.K. 2009. Genetics. Rastogi publications, Meerut, New Delhi.
11. Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.
12. Kothari, C.R and Garg, G. 2014. Research methodology –Method and techniques. New Age International (P) Ltd. New Delhi.
13. Gurumani, N. 2005. Biostatistics, 2nd edn. MJP publications, India.

Reference Books:

1. Watson, J.D. et al. 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
4. Sobtir. C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing house.
5. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd.London.
6. Acquaah, G.2007. Principles of Plant Genetics and Breeding. Blackwell Publishing.
7. William. S., Klug and Michael, R. Cummings, 2003. Concepts of Genetics. Seventh edition. Pearson Education (Singapore) Pvt. Ltd.
8. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London.
9. Lewin, B. 2000. Genes VII, Oxford University Press, USA.
10. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
11. Allard, R.W. 2010. Principles of Plant Breeding. 2 nd ed. John Wiley and Sons, Inc. New Jersey, US.
12. Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S. Chand & Co. (Pvt.) Ltd., New York.
13. Sobl. R.R and Rohif, F.J. 1969. Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freman and Co., San Francisco.
14. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.

Web Resources

1. https://www.cdc.gov/genomics/about/basics.htm
2. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
3. http://galaxy.ustc.edu.cn:30803/zhangwen/Biostatistics/Fundamentals+of+Biostatistics+8th+edition.pdf
4. https://www.britannica.com/science/evolution-scientific-theory
5. https://www.britannica.com/science/cell-biology

6. https://medlineplus.gov/genetocs/understanding/basics/cell/

RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL APPLICATIONS

Learning Objectives

- To understand the basis of genes and their interactions at population and evolutionary levels.
- Students should be familiar with the basics of genetics and molecular biology.
- To develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
- To learn the applied aspects of molecular biology and recombination technology, gene insertion and production of recombined new plants.
- To impart knowledge that leads to comprehensive understanding of the principles, tools and practices of rDNA technology.

UNIT I

Recombinant DNA technology – Enzymes, vectors – properties and types, direct and indirect gene transfer. Detection of recombinants - Production of cloned gene products from GMO. Bioassay for target gene effect. Transfection.

UNIT II

Genome sequencing, Genome editing and CRISPR-Cas9, RNA interference, Genome library, cDNA library. Isolation of genomic and plasmid DNA - Transformation and recovery of plasmid clones - Preparation of competent E. coli cells. Agarose gel electrophoresis. Nucleic acid hybridization - Blotting techniques types.

UNIT III

Vitamin-C is produced on a large scale from Saccharomyces cerevisiae and Zygosaccharomyces bailii yeast and Gluconobacter oxydans bacteria. Production of antibiotic medicines: Human Deoxyribonuclease I, β- Glucocerebrosidase, L-Asparaginase, Deoxycytidine kinase Anti-bacterial molecules produced by microbes - Penicillins, tetracyclines produced from fungi and bacteria.

UNIT IV

Production of recombinant hormones: insulin (somatotrophin), erythropoietin - uses. Production of Hepatitis B vaccine, Interferons, anticancer drugs - uses; Interferon-alfa - hairy cell leukemia. Interferon-Beta-1b - role in treating relapsing multiple sclerosis and melanoma.

UNIT V

rDNA technology uses in animal husbandry and sericulture: milk production in cattle, cheese ripening, and reduction of lactose levels. Fungal α-amylase, silk production in sericulture. Production of Vitamin B12 produced by recombinant bacteria like Paracoccus denitrificans, Propionibacterium shermanii, E. coli bacteria on a large scale by fermentation.

Recommended Text:

1. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. John Wiley & sons Inc.
2. Smith. J.K. 1996. Biotechnology – 3 rd Ed. Cambridge Univ. Press, Cambridge.
3. Khan. I.A. and A. Khanum .2004. Fundamentals of Biotechnology – Forensic Science Genetic Engineering. Ukaaz publication, Hyderabad.
4. Mba, C., Afza, R., Bado, S., and Jain, S.M. 2010. Plant Cell Culture: Essential Methods, John Wiley & Sons, UK.
5. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). 2017. Plant Biotechnology: Principles and Applications, Springer publishers.

Reference Books:

1. Watson, J.D. et al. 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
4. Sobtir. C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing house.
5. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London

Web Resources

1. https://www.nature.com/scitable/topic/cell-biology
2. https://plato.stanford.edu/entries/molecular-biology/
3. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

LABORATORY COURSE- 5
COVERING CORE PAPERS X AND XII

Learning Objectives

- Observe the different stages of mitosis and chromosome behaviour and organization during various stages and to learn staining techniques of various plant tissues.
- Understand the electron microscopic structure of cell organelles
- Expose the students to gain recent advances in molecular biology.
- Students able to differentiate the cell structure
- Understand the principles of rDNA techniques.

EXPERIMENTS

UNIT I

CELL AND MOLECULAR BIOLOGY

1. Identification of different stages of mitosis from suitable plant material. (Onion root tips).
2. Identification of meiosis from suitable plant material (floral buds).
3. Acetocarmine staining (Nucleus) and light microscopic observation (Chloroplast)

UNIT II

4. Study of mitotic index from suitable plant material.
5. Study of cyclosis in cells of suitable plant material.
6. Measure the length and breadth of the stomata/trichome by using micrometer.

UNIT III

7. Study on Electron microscopic structure of cell organelles given in the syllabus
8. Comparative study of cell structure in onion cells, Hydrilla and Spirogyra.
9. Study of models on DNA and RNA, DNA replication structures,

UNIT IV

rDNA TECHNOLOGY

1. Isolation of genomic DNA
2. Isolation of plasmid DNA
3. Agarose Electrophoresis
4. Transformation and recovery of plasmid clones

UNIT V

rDNA TECHNOLOGY (spotters)

1. pBR 322, Ti Plasmid, cosmid
2. Microinjection, Electroporation, Liposome mediated gene transfer, gene gun
3. Blotting technique (Southern blot, Northern blot and Western blot)

Recommended Text:

1. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th

ed.). Jones & Bartlett.
2. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
3. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut.
4. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi.
5. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
6. Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.
7. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
8. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India.

Reference Books:

1. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
4. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
5. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
6. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. Hackett, P.B. and J.A. Fuchs, J.W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California. 8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
8. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
9. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual.
10. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.
11. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.

Web Resources

1. https://www.madrasshoppe.com/cell-biology-practical-manual-dr-renu-gupta9788193651223-200674.html
2. https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_M anual.pdf
3. https://www.kopykitab.com/Genetics-With-Practicals-by-Prof-S-S-Patole-Dr-

V-R-Borane-Dr-R-K-Petare
4. https://www.kopykitab.com/Practical-Plant-Breeding-by-Gupta-S-k
5. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya
6. https://www.amazon.in/Plant-Tissue-Culture-Theory-Practicals/dp/9386347350

LABORATORY COURSE- 6
COVERING CORE PAPER XI

Learning Objectives

- Observe the problem-solving skills in Genetics and Biostatistics.
- Explain the principles of linkage, crossing over and the hereditary mechanisms.
- Expose the students to Chromosome mapping.
- Understand the principles of plant breeding to apply crop improvement programmes
- Understand the biostatistics problems.

EXPERIMENTS

UNIT I

1. Problem solving on dihybrid phenotypic, genotypic and test cross ratios.
2. Problem solving on incomplete dominance.
3. Modified dihybrid ratio problems based on the theory syllabus.

UNIT II

4. Problems on Multiple alleles in plants, blood group inheritance in human.
5. Problems on Sex linked inheritance in Drosophila and plants.

UNIT III

6. Chromosome mapping from three-point test cross data. Calculation of chiasmatic interference.

UNIT IV

PLANT BREEDING

Plant Breeder's kit, Emasculation, Bagging

Study of Floral Structure, Emasculation and Hybridization technique in cross pollinated and self-pollinated crops (availability of the specimens).

UNIT V

BIOSTATISTICS

Measures of central tendency (Mean, Median, Mode)

Measures of dispersal - standard deviation & standard errors

t-test and Chi-square test

Recommended Text:

1. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones & Bartlett.

2. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
3. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut.
4. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi.
5. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
6. Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.
7. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
7. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India.

Reference Books:

1. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323- 333). Springer, New York, NY.
4. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
5. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
6. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. Hackett, P.B. and J.A. Fuchs, J.W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California. 8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
8. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
9. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual.
10. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.
11. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.

Web Resources

1. https://www.madrasshoppe.com/cell-biology-practical-manual-dr-renu-gupta-9788193651223-200674.html
2. https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf
3. https://www.kopykitab.com/Genetics-With-Practicals-by-Prof-S-S-Patole-Dr-

V-R-Borane-Dr-R-K-Petare
4. https://www.kopykitab.com/Practical-Plant-Breeding-by-Gupta-S-k
5. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya
6. https://www.amazon.in/Plant-Tissue-Culture-Theory-Practicals/dp/9386347350

INDUSTRIAL BOTANY

Learning Objectives

- To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.
- The student would be competent to work in industries.
- To educate people about the widespread commercial uses of fungi.
- To know about the economic importance of plants.
- To acquire knowledge on in vitro cultivation techniques to develop protocols targeted towards commercialization.

UNIT I

ALGAE IN INDUSTRIES:

Fertilizer industry-Seaweeds, pharmaceutical industry – antibiotics, agar, carageenin, alginin, diatomate earth, mineral industry, cosmetics, fodder industry

UNIT II

FUNGI IN INDUSTRIES:

Beneficial use of yeast, Fermentation of alcohol, preparations of enzyme (amylase, protease, cellulase), organic acid preparation (oxalic and citric acid), cheese production, protein manufacture, vitamins, fats.

UNIT III

PLANT PRODUCTS:

Fibres and Fibre-Yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils and Vegetable fats, sugars and starches, pulp and paper, gums, resins, beverages and spices.

UNIT IV

BACTERIA IN INDUSTRY:

Food industry, dairy products, bioleaching, biogas production, bioremediation, production of alcoholic beverages, enzymes, antibiotics, Interferons, vaccines.

UNIT V

RECOMBINANT PLANTS:

Tissue culture: Micropropagation, somatic seeds, cell culture. Hairy root cultures - methods, applications; Biotransformation; Role of tissue culture in production of

pathogen - free plants and "synthetic seeds"; Transgenic plants for crop improvement- Herbicide tolerant - Basta, Dhara Mustard Hybrid, glyphosate. Insect resistant crops - Bt-cotton, BT-brinjal, Biofortification - golden rice. Flaour save tomato etc. barnase and barstar. Transgenic plants for molecular farming

Recommended Text:

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
2. Dinabandhu, S and Kaushik. B.D. 2012. Algal Biotechnology and Environment. I.K. International, New Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
4. Dilip K. Arora. 2003. Handbook of Fungal Biotechnology. CRC Press book.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt. Ltd. New Delhi.
6. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication.
7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology, Tata McGraw Hill Publishing House, New Delhi.
8. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delh.

Reference Books:

1. Becker. E.W. 1994. Micro algae Biotechnology and Microbiology. Cambridge University press.
2. Borowitzka, M.A. and Borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press, Cambridge,
3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New Delhi.
4. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
5. Street, H.E. 1978. Essay in Plant Taxonomy, Academic Press, London, UK.
6. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
7. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.
8. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons
9. William Charles Evans.1989. Pharmacognosy, 14th ed. Harcourt Brace & Company.
10. Kumar,H.D. 1999. Introductory Phycology. Affiliated East-WestPress, Delhi.
11. Das, Sand Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
12. Willie, J and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
13. Reinert, J. Bajaj. T.P.S. 1977. Applied and Fundamental Aspects of Plant cell, tissue and organ Culture. Springer – Verlaug.

Web Resources

1. https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6
2. https://www.amazon.in/Fungi-Biotechnology-Prakash-ebook/dp/B07PBF2R3D
3. https://www.amazon.in/Plant-Based-Natural-Products-Derivatives-Applicationsebook/dp/B07438N1CJ
4. https://link.springer.com/book/10.1007/978-981-16-5214-1
5. https://link.springer.com/book/10.1385/0896031616

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Learning Objectives

- Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture.
- Develop their competency on pre and post-harvest technology in horticultural crops.
- Analyze the different methods of weed control and harvest treatments of horticultural crops.
- Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops.
- Evaluate the importance of floriculture and contribution spices and condiments on economy.

UNIT I

Organic manures and fertilizers. Composition of fertilizer, NPK content of various fertilizers. Common organic manures bone meal, cowdung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost, aerobic and anaerobic – advantages. Vermicompost preparation, vermiwash. Panchakaviyam.

UNIT II

Common garden tools. Methods of plant propagation by seeds. Vegetative propagation, cutting, grafting, budding and layering. Use of growth regulators for rooting.

UNIT III

Gardening – types of garden, ornamental, indoor garden, kitchen garden, terrace garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing, garden components flower beds, borders, hedges, edges, drives, paths, garden adornments.

UNIT IV

Packaging of fruits, vegetables. Preservation techniques drying, heat treatment, low temperature storage and by chemicals. Preparation of wine, vinegar and dairy products.

UNIT V

Significance of mushrooms. Types of mushrooms. Spawn isolation and preparation. Cultivation (button mushroom, oyster mushroom). Value added products from mushroom – pickles, candies and dried mushrooms.

Recommended Text:

1. Chmielewski, J. G and Krayesky, D. 2013.General Botany laboratory Manual. Author House, Bloomington, USA.
2. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Webster J and Weber, R. 2007. Introduction to Fungi, 3rdEd.Cambridge University Press, Cambridge.
5. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 10thed). Rastogi Publications, Meerut.
6. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3rd Edition Agrobios (India), Jodhpur.

Reference Books:

1. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.
2. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
3. Peter, K.V. 2017. Basic Horticulture.
4. Hartman, H.T. and D.F. Kestler. 1976. Plant propagation principles and practice. Prentice Hall of India, New Delhi.
5. Jules Janick, 1982. Horticulture Science. Surjeet publications, New Delhi.
6. Ignacimuthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.
7. Gupta. P.K., 1998. Elements of Biotechnology. Rastogi publications, Meerut.
8. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
9. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA

Web Resources

1. https://www.kobo.com/in/en/ebook/composting-process-organic-manures-through-ecofriendly-waste-management-practices
2. https://books.google.co.in/books/about/Plant_Propagation.html?id=KgQh6OI7GcC&redir_esc=y
3. https://www.ebooks.com/en-us/subjects/gardening/
4. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutritionebook/dp/B00RXCXB3Q
5. https://www.elsevier.com/books/food-preservation-techniques/zeuthen/978-1-85573-530-9

PROFESSIONAL COMMUNICATION SKILL

Learning Objectives

- To teach the four language skills - Listening, Speaking, Reading and Writing; critical thinking skills to students.
- To enable students, comprehend the concept of communication.
- To help students cultivate the habit of Reading and develop their critical reading skills
- Develop vocabulary and language skills.
- Analyze, interpret and effectively summarize a variety of textual content.

UNIT I

Communication: An Introduction - Definition, Scope of Communication, importance of Communication, Process and types of Communication. Barriers to communication - overcome barriers of communication, Perspectives in communication, communication styles, effective communication

UNIT II

Elements of Communication: Introduction, Face to Face Communication – Tone of voice, Body Language (Non-Verbal Communication), Verbal Communication, Visual Communication.

UNIT III

Listening Skills The process, importance and types of listening. Enhancing Listening Skills - Paraphrasing, Summarizing, Guidelines to increase listening, Activities to enhance listening

UNIT IV

Telephone Skills: Telephonic Communication: Do's and Don'ts. Speaking Skills: Introducing yourself, describing a person, place, situation and event, giving instruction, making inquiries – at a bank, post-office, air-port, hospital, reservation counter and role play, Asking Questions

UNIT V

Letter Writing: Informal Letter, (Formal) Business Letters: Essential and Occasional Parts of a letter, layout and Letter of Inquiry, Complaint and Adjustments, orders and replies of it. Report Writing: Format, Structure and Types, Technical Reports and Project Reports.

Recommended Text:

1. Meenakshi Raman & Sangeetha Sharma. 2012. Technical Communication. New Delhi: OUP
2. Rizvi, M. A. 2005. Effective Technical Communication. New Delhi: Tata McGraw Hill

3. Sanjay Kumar & Pushphatha. 2012. Communication Skills. New Delhi: OUP
4. Er. A. K. Jain, Dr. Pravin S. R. Bhatia & Dr. A. M. Sheikh. 2013. Professional Communication Skills. S. Chand Publishers. New Delhi.
5. Farhathullah, T.M. 2009. English for Business Communication. Bangalore: Prism Publishers
6. Bikram K Das. 2011. Functional Grammar and Spoken and Written Communication in English. Kolkata: Orient Blackswan
7. Kiranmai Dutt, P et al. 2011. A Course in Communication Skills. New Delhi: CUP India
8. Krishnaswamy, N. 2000. Modern English – A Book of Grammar, Vocabulary and Usage. Macmillan India Pvt. Ltd
9. Ramachandran, K K. et al. 2007. Business Communication. New Delhi: Macmillan
10. Taylor, Ken. 2011. 50 ways to improve your Business English. Hyderabad: Orient Blackswan

Reference Books:

1. Andreja. J. Ruther Ford, Basic communication skills for Technology, 2nd Edition, Pearson Education, 2011
2. Aubrey Daniels, Bringing out the best in people, 2nd Edition, Mc Graw Hill, 1999
3. Stephen.P. Robbins Organizational Behaviour, 1st Edition, Pearson, 2013
4. Gill Hasson, Brilliant- Communication skills, 1st Edition, Pearson Life, 2011
5. Gopala Swamy Ramesh, The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5th Edition, Pearson, 2013
6. Deborah Dalley, Lois Burton, Margaret Developing your influencing skills, , Greenhall, 1st Edition Universe of Learning LTD, 2010
7. Konar nira, Communication skills for professionals, 2nd Edition, New arrivals –PHI, 2011
8. Barun K Mitra, Personality development and soft skills, 1st Edition, Oxford Press, 2011
9. Butter Field, Soft skill for everyone, 1st Edition, Cengage Learning India pvt. ltd, 2011
10. Francis Peters SJ, Soft skills and professional communication, 1st Edition, McGraw Hill Education, 2011
11. John Adair, Effective communication, 4th Edition, Pan Mac Millan, 2009

Web Resources

1. https://library.ku.ac.ke/wpcontent/downloads/2011/08/Bookboon/Career%20and%20Personal%20Development/effective-communication-skills.pdf
2. https://agrimoon.com/communication-skills-pdf-book-free-download/
3. https://ncert.nic.in/vocational/pdf/kees101.pdf

4. https://ncert.nic.in/vocational/pdf/kees101.pdf
5. https://baou.edu.in/assets/pdf/BCADES_201_slm.pdf
6. https://mrcet.com/downloads/MBA/Professional%20Communication%20Skills.pdf

INTERNSHIP / FIELD VISIT / INDUSTRIAL VISIT / RESEARCH KNOWLEDGE UPDATING ACTIVITY

Learning Objectives

- C1 The main goal of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme is to give students exposure to industry and help them comprehend current management techniques by having them work for at least fifteen days in an industry/institution over the summer.
- C2 To comprehend how theoretical ideas are applied in many sectors and industries.
- C3 To create a foundation for industry-integrated education, as well as to give students better practical knowledge and hands-on experience, improve their leadership qualities, and sharpen their problem-solving and management skills.
- C4 The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity must focus on practice. The college will require the students to visit the offices of the research lab/industry/institution it has a memorandum of understanding (MOU) with in order to receive on-the-job training in the many different areas of those businesses' operations.
- C5 Internship / Field Visit / Industrial Visit / Research Knowledge Updating activities provide students with practical experience in a variety of fields, including manufacturing, productivity, development, and quality analysis. These experiences prepare students for competitive hiring processes in reputable MNC industries.

UNIT I

Guidelines for Internship/ Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme:

1. To give students the opportunity to spend few days on their own during the II Semester vocation / in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures.
2. Individual instruction is provided for the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme must be completed in order to receive a credential.
3. Students are required to identify a research labs /industry/ recognized institution for their Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator in consultation with and approval of their faculty guide. The choice of the research labs/industry/recognized institution should be intimated to the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity coordinator before commencement of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity. Simultaneously, students should also have identified a guide within the research labs/industry/recognized institution (industry guide) under whose supervision and guidance they would carry out their Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Program.
4. Students are expected to learn about the history of the research labs, industry, and recognized institution during their time. They must also learn about its founders or

shareholders, the nature of business, organizational structure, reporting relationships, and how the various management functions (such as finance, HR, marketing, sales, and operations) operate. This list is merely illustrative and not comprehensive. Students should collect and gather as much as possible of written materials, published data, and related matter.

5. Before leaving the research labs/industry/recognized institution, obtain the Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme completion certificate on the letterhead of a research lab/industry/, or an accredited institution.
6. Maintain Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme record with details on activities and personal learning during their project period.
7. The department head and the coordinator of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme form a committee to ensure that the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity is followed.
8. At least two copies of the report must be prepared by the intern at the conclusion of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programone for submission to the college and one copy for the student. If the organization, the guide, or both request additional copies, more copies may be made. The sources from which the information was gathered should be made crystal apparent in the report. Every page needs to have a number, which should be centred at the bottom of the page. All tables, figures, and appendices must be appropriately labelled and consecutively numbered or lettered. The report must be printed, bound (ideally with soft binding), and contain at least 25 pages.
9. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity training report should be submitted to the department within a month from the date of commencement of third semester. However, such submission shall not be accepted after the end of third semester Examinations.

2 Guidelines to field visits (during Third semester)

1. Students are required to complete at least three field visits from the following options
   i. One - Central Research Institute/ State Agriculture Research Institute
   ii.One – Nationally recognized Herbarium/Botanical Garden/ Museum relevant to Botany
   iii. One – Sanctuary/ Biosphere reserve/National Park

The field visit completion certificate should be signed by the Principal, HOD and Programme Coordinator.

3 Guidelines to industrial visits (during Third semester)

- Students are required to complete at least three industrial visits
- The visiting companies shall be relevant and suitable ones according to the specialization and academic requirements.
- Industrial visit shall fall within the stipulated period set by the Department.
- Students should apply to HoD well in advance to enable to go through a diligent process including communicating to the potential companies and obtaining permission to visit.
- Participating students must be given an undertaking that they will abide by the rules and guidelines throughout the industrial visit.
- Students undergoing Industrial visit should compulsorily carry college ID card.
- The heads of department should also ensure prior permission for the industrial

visit and gain written permission from one of the parents or the local guardian for each student.

- It is compulsory that all students must submit a detailed report to the department.

After the completion of the visit, the signed Letter of Intent and the report of the visit with a GIS photograph needs to be submitted to the Industrial Visit Coordinator.

4 Guidelines for Research Knowledge Updating Activity Programme

- Students should undergo training in any research topic for a specific field of interest relevant to Botany. Student does some research work on the topic.
- Based on his/her training/knowledge obtained, the student should publish a paper in a reputed journal and present one paper at the national/international seminar.
- Students should participate at least two national/international level seminars/conferences/workshops.

The Research knowledge updating activity programme completion certificate should be signed by the Principal, HOD and faculty in-charge.

UNIT II

Evaluation of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity:

i. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity program will be assessed by the assigned Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator from the host institute.
ii. Evaluation will be done by the Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator of the host institute and through seminar presentation/viva-voce.
iii. The presentation should be specific, clear and well analyzed, and indicate the specific sources of information.

According to the statement of the draft the evaluation of the interns will be done as per the sincerity and research output of the students. In addition, the evaluation will also be assessed according to the activity of the log book, format of presentation, quality of the report made by the interns, uniqueness, skill sets and evaluation report of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity coordinator.

UNIT III

College Guide Manual – Summer Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Program

1. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator should give proper procedures to the intern before and after the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity.
2. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the

Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity.

The weekly report submitted by the student should be reviewed and reported to the Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme coordinator.

UNIT IV

Internal:50 marks

Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity Programme Completion certificate -10 marks

Attendance/ documentation in field/observation note book –10 marks

Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity report - 10 marks

Basic knowledge and Presentation Skills - assessed by group discussion with their classmates - 10 marks

Topic of Interest/ lab involvement and record/ Experimentation/data collection- 10 marks

External: 50 Marks

Powerpoint presentation – 20 marks

Knowledge, Attitude - 10 marks

Completion certificate and report with GIS photographs – 10 marks

Discussion/Viva-voce - 10 marks

UNIT V

CONTENTS OF THE REPORT

Title page

Page for Supervisory Committee

Declaration by student

Acknowledgement

Internship / Field Visit / Industrial Visit / Research Knowledge Updating

Activity Certificate

Executive Summary

Introduction of the Report

Overview of the Organization

What I have Learned

Analyses

(GPS Photographs showing date and time should attached)

Summary

Recommendations and Conclusion

References

Appendices

Recommended Text:

1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice DevelopmentAssociation, Hong Kong.