Minor Courses offered by the Department of Botany

"Student can choose any one course from each stream"

Year	Type of Course	Course Code	Title of the Course	Credits	Teaching Hours
1st Year (Semester-I & II)	MID -1(A)		**Introduction to Botany-I**	4	5
	MID -1(B)		**Plants in Traditional Systems of medicine**		
	MID -2(A)		**Introduction to Botany-II**	4	5
	MID -2(B)		**Herbal Technology**		
2nd Year (Semester-III & IV)	MID -3(A)		**Allied Chemistry-I**	4	5
	MID -3(B)		**Phytochemistry**		
	MID -4(A)		**Allied Chemistry-II**	4	5
	MID -4(B)		**Bioanalytical Techniques**		
3rd Year (Semester-V & VI)	MID -5(A)		**Economic Botany**	4	5
	MID -5(B)		**Medical Botany**		
	MID -6(A)		**Ecology and Biodiversity**	4	5
	MID -6(B)		**Research Methodology**		
4th Year (Semester-VII)	MID -7(A)		**Industrial Microbiology**	4	5
	MID -7(B)		**Marine Biotechnology**		
	MID -8(A)		**Forensic Botany**	4	5
	MID -8(B)		**Biostatistics and Computer Applications in Biology**		

SEMESTER I

INTRODUCTION TO BOTANY- I

(Bacteria, Algae, Fungi, Archegoniatae, Angiosperms and Economic Botany)

Course code	Credits	Teaching hours per week	Maximum Marks
MID-1A	4	5	ESE 75 (Theory) + ICA 25 (Practical) = 100

Course outcomes:

- Students able to understand the primitive group of plants such as Bacteria, Algae and Fungi
- To understand the characteristic features of Bryophytes, Pteridophytes and Gymnosperms
- To conceptualise the knowledge about different types of Inflorescence, Fruits and seeds in Angiosperms
- To recognise and identify different families of Angiosperms
- To understand the economic importance of some Angiosperms

Key words:
Cyanobacterium, *E. coli*, Fungi, Mycelium, Archegoniatate, Inflorecscence, Cereals, Spices, Beverages, Medicinal plants

THEORY

Unit 1: Monerans (9 lectures)
Salient features of bacterium and cyanobacterium. Ultrastructure and reproduction of *Escherichia coli* and *Nostoc*.

Unit 2: Algae and Fungi (9 lectures)
General characters of Algae and Fungi. Study of structure and reproduction of *Volvox* and *Oedogonium*; *Aspergillus* and *Puccinia*.

Unit 3: Archegoniatae (9 lectures)
Salient features of Bryophytes, Pteridophytes and Gymnosperms. Structure, reproduction and life cycle of the following genera: *Marchantia, Selaginella* and *Pinus*.

Unit 4: Angiosperms (9 lectures)
Introduction to flower, fruit and seeds. Study of Angiospermic families: Annonaceae, Apocyanaceae, Euphorbiaceae and Poaceae.

Unit 5: Economic Botany (9 lectures)
Binomial, family and morphology of the useful parts of the following categories: Cereals (rice, wheat, barley), Millets (finger millet, pearl millet, broom-corn), Pulses (green gram, ground nut, soya bean), Oils (sunflower, coconut, gingelly), Spices (clove, pepper, cardamom), Beverages (cocoa, tea, coffee) and Medicines (*Adhatoda*, ginger, *Aloe*).

PRACTICAL (30 lectures)

1. Study of the monerans: *Escherichia coli* and *Nostoc*
2. Study of the algae: *Volvox* and *Oedogonium*; *Aspergillus* and *Puccinia*
3. Study of the bryophytes: *Marchantia*
4. Study of the pteridophytes: *Selaginella*
5. Study of the gymnosperms: *Pinus*
2. Study of the angiosperm families: Annonaceae, Apocyanaceae, Euphorbiaceae and Poaceae.
3. Study of products of economic importance:
   Cereals (rice, wheat, barley),
   Millets (finger millet, pearl millet, broom-corn),
   Pulses (green gram, ground nut, soya bean),
   Oils (sunflower, coconut, gingelly),
   Spices (clove, pepper, cardamom),
   Beverages (cocoa, tea, coffee) and Medicines (*Adhatoda*, ginger, *Aloe*).

Suggested Readings

1.Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
2. Pandey B.P. College Botany (Vol. I). 2010. S.Chand and Company Ltd. New Delhi.
3. Rashid A. 1998. An introduction to Bryophyta. Vikas Publishing House (P) Ltd. New Delhi.
4. Singh G. 2010. Plant Systematics: An Integrated Approach. Science Publishers. USA.
5. Srivastava H.N. 1998. Gymnosperms. Pradeep Publications. Jalandhar.
6.Vasishta B.R., Sinha A.K. and Kumar A. 2010.Botany for degree students- Pteridophyta. S. Chand and Company Ltd. New Delhi.
7.Vasishta B.R., Sinha A.K. and Kumar A. 2011.Botany for degree students- Bryophyta. S.Chand and Company Ltd. New Delhi.

PLANTS IN TRADITIONAL SYSTEMS OF MEDICINE

Course code	Credits	Teaching hours per week	Maximum Marks
MID-1B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:

- Conceptualize ethnobotany as an interdisciplinary science
- Restate the established methodology of ethnobotany studies
- Categories various indigenous ethnic groups and their environmental practices.
- Understand the legalities associated with ethnobotany.
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Keywords:
Ethnobotany, Ethnic groups, Ethnobotanical sources, Biopiracy, Endangered taxa

THEORY

Unit 1: Ethnobotany (9 lectures)
Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit 2: Methodology of Ethnobotanical Studies (9 lectures)

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3: Role of Ethnobotany in Modern Medicine-I (9 lectures)
Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*.

Unit 4: Role of Ethnobotany in Modern Medicine-II (9 lectures)
Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia, Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit 5: Ethnobotany and Legal Aspects (9 lectures)
Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

PRACTICAL (30 lectures)
1. Visit to the field and botanical garden in the nearby area and attempt to identify the plants.
2. Attempt be made to grow the ethnobotanical plants.
3. Visit the villages and rural areas to consult some senior people to discuss the

traditional medicines being used since ages.
4. Prepare a list of plants that provide parts for traditional uses and construct a chart or check-list in terms of botanical significance, chemical constituent, medicinal use, and major industries available in India and the world; Economical-value strength.

Suggested Readings

1. Jain, S.K. (1995). Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. Jain, S.K. (1981). Glimpses of Indian. Ethnobotany, Oxford and IBH, New Delhi.
3. Jain, S.K. (1989). Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. Jain, S.K. (1990). Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Colton, C.M. (1997). Ethnobotany – Principles and applications. John Wiley and sons.
6. Rama, R, N and Henry, A.N. (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
7. Sinha, R. K. (1996). Ethnobotany; The Renaissance of Traditional Herbal Medicine –INA –SHREE Publishers, Jaipur.
8. Faulks, P.J. (1958). An introduction to Ethnobotany, Moredale pub. Ltd.

SEMESTER II

INTRODUCTION TO BOTANY II
(Cytology, Anatomy, Physiology, Microbiology and Plant Ecology)

Course code	Credits	Teaching hours per week	Maximum Marks
MID-2A	4	5	ESE 75 (Theory) + ICA 25 (Practical) = 100

Course outcomes:
Students able understand the concept of ultrastructure of cell and cell organelles
To conceptualize the different types of cells and its architecture with the plant tissues.
Understand the basic concept of plant physiology.
Also, able to study the importance microorganism present in the soil especially for its application in agriculture.
Students also study the ecosystem and its component.

Keywords:
Chloroplast, Mitochondria, Photosynthesis, Nitrogen fixation, Auxin, Cytokinin, Symbiosis, Biofertilizers, Food spoilage, Food chain, Ecological pyramid.

Unit 1: Cytology (9 lectures)
Study of plant cell organelles with emphasis on cell wall, Chloroplast, Mitochondria and Nucleus.

Unit 2: Plant Anatomy (9 lectures)
Anatomy of primary and secondary structure of dicot- stem and root; primary structure of stem and root in monocot, anatomy of dicot and monocot leaf.

Unit 3: Plant Physiology (9 lectures)
Brief study of mechanism of ion uptake and transport, photosynthesis (photochemical reactions, carbon assimilation reactions-C3 and C4 cycles), nitrogen fixation by symbiotic bacteria and phytohormones (auxins and cytokinins).

Unit 4: Microbiology (9 lectures)
Survey of useful microbes: Agricultural uses of microbes: biodegradation and biodeterioration. Soil microflora- biofertilizers. Industrial uses of microbes (fermentation, alcoholic beverages); Food microbiology (microbial spoilage of food, microbial contamination of milk and water).

Unit 5: Plant Ecology (9 lectures)
Plant Ecology: Brief study of ecosystems, plants as primary producers, food chain and food web, ecological pyramids. Forests their importance and conservation, urban and rural forestry. Plants as pollution indicators.

PRACTICAL (30 lectures)
1. Study of Cell Organelles include in Unit 1 from electron micrographs.
2. Anatomical studies of plant parts included in Unit 2.
3. To perform simple experiments as included in Unit 3.
4. Study of microbes as included in Unit 4.

5. Study of ecological processes included in Unit 5.

Suggested Readings

1.De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology. 8th ed.). Lippincott Williams and Wilkins. Philadelphia.
2.Dickison W.C. 2000. Integrative Plant Anatomy. Academic Press. San Diego.
3. John Jothi Prakash E. 1987. A Text Book of Plant Anatomy. Emkay Publications. Delhi.
4. Kormondy E.J. 1996. Concepts of Ecology (4^{th} ed.). Prentice Hall, U.S.A.
5. Regland A. and Arumugan N. 2016. Fundamentals of Plant Anatomy and Microtechniques. Saras Publication. Nagercoil, Tamil Nadu.

HERBAL TECHNOLOGY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-2B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:
On completion of this course the students will be able to;

- Develop their understanding on Herbal Technology
- Define and describe the principle of cultivation of herbal products.
- List the major herbs, their botanical name and chemical constituents.
- Evaluate the drug adulteration through the biological testing
- Formulate the value added processing / storage / quality control for the better use of herbal medicine
- Develop the skills for cultivation of plants and their value added processing / storage /quality control

Keywords:
Herbal medicines, Plant products, Biopesticides, Pharmacognosy, Adulteration, Secondary Metabolites, Germplasm storage

THEORY

Unit 1: An Overview (9 lectures)
Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine). Cultivation - harvesting - processing - storage of herbs and herbal products.

Unit 2: Herbal Products (9 lectures)
Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmetics and biopesticides, their Botanical names, plant parts used, major chemical constituents.

Unit 3: Pharmacognosy I (9 lectures)
Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, *Catharanthus roseus*, *Withania somnifera*, *Centella asiatica*, *Achyranthes aspera*, Kalmegh, Giloe (*Tinospora cordifolia*), Sathavar. Herbal foods, future of pharmacognosy.

Unit 4: Pharmacognosy II (9 lectures)
Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

Unit 5: Germplasm Storage (9 lectures)
Plant gene banks, Cultivation of Plants and their value-added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (*Withania somnifera*, neem and tulsi).

PRACTICAL (30 lectures)

1. Morphological and anatomical studies of crude drugs of plants included in the syllabus.
2. Identification of crude drugs by histochemical and phytochemical methods.
3. Identification of drug adulterants.

Suggested Readings

1. Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. (2013). Current scenario of Herbal Technology worldwide: An overview. *Int J Pharm Sci Res*; 4(11): 4105-17.
2. Arber, Agnes. (1999). Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. (2016). Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5: 88.
4. Aburjai, T. and Natsheh, F.M. (2003). Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.
5. Patri, F. and Silano, V. (2002). Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1.
ISBN 978-92-871-8474-0, pp 218.
6. AYUSH (www.indianmedicine.nic.in). *About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy.* New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
7. Evans, W.C. (2009): Trease and Evans PHARMACOGNOSY. 16th Edition, Saunders / Elsevier.
8. Sivarajan, V.V. and India, B. (1994). Ayurvedic Drugs and Their Plant Sources. *Oxford &IBH Publishing Company*, 1994 - Herbs - 570 pages.
9. Miller, L. and Miller, B. (2017). Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass*; *Fourth edition.*
10. Kokate, C.K. (2003). Practical Pharmacognosy. Vallabh Prakashan, Pune.

PHYTOCHEMISTRY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-3B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:

- Understand the fundamental concepts of phytochemistry
- Develop the skills of cold and hot solvent extraction.
- Examine the solvent fractionation.
- Evaluate the process of screening each fraction for plant pathogens or human pathogens

Keywords:
Sample collection, sample identification, Solvent extraction, Solvent fractionation, Secondary metabolites

THEORY

Unit 1: Extraction methods (9 lectures)
Collection of samples, identification and drying**,** Cold and hot solvent extraction (Soxhlet and otherwise) for analysis purpose

Unit 2: Post extraction methods (9 lectures)
Concentration of extract (Rotary evaporation/ air drying) and retrieving of solvent

Unit 3: Separation of the molecules (9 lectures)
Solvent fractionation (using separating funnel and solvent from polar to non-polar like methanol/ Chloroform/ isopropanol/butanol/hexane/water).

Unit 4: Screening for Secondary metabolites (9 lectures)
Determination of each fraction for secondary metabolites.
1. Phenolic compounds Flavonoids/anthocyanin
2. Terpenes essential oils (Limonene/composite- TLC)

Unit 5: Alkaloids and Screening for pathogens (9 lectures)
1. Alkaloids, Amino acids- proteins (potato) or non-protein seed of Cucurbitaceae -2D paper chromatography)
2. Screening each fraction for plant pathogens or human pathogens
3. Further analysis for active ingredient

PRACTICAL (30 Lectures)

1. Techniques of extraction and isolation of phytochemicals (solvent extraction, distillation methods, pressing and sublimation methods).
2. Extraction procedure using Soxhlet extractor.
3. Methods used in solvent fractionation.
4. Preparation for solutions and buffers.
5. Qualitative test for proteins and Carbohydrates.

6. Methods of separation of compounds from different system (solid in liquid mixture, liquid in liquid mixture)
7. Separation of phytochemicals by using TLC.
8. Phytochemical tests for Tannins and Alkaloids.
9. Qualitative analysis of secondary metabolites of the plant extracts.

Suggested Reading

1. Harborne. J.B. (1998). Phytochemical methods. A guide to modern techniques of Plant Analysis. Chapman and Hall publication, London
2. Plumber, D. T. (2006). An introduction to practical biochemistry TATA-McGraw-Hill Publication, New Delhi
3. Shah, B.N. (2005). Text book of Pharmacognosy and phytochemistry. CBS Publishers & Distributors, New Delhi.
4. Egbuna, C., Chinenye, J. Stanley I. and Udedi, C. (2018). Phytochemistry: Fundamental, modern techniques and applications. Apple Academic Press. CRC press.

BIOANALYTICAL TECHNIQUES

Course code	Credits	Teaching hours per week	Maximum Marks
MID-4B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:

At the end of the study of this course the students would be able to:

- Develop conceptual understanding of cell wall degradation enzymes and cell
- fractionation.
- Classify different types of chromatography techniques.
- Explain the principles of Light microscopy, compound microscopy, Fluorescence
- microscopy and confocal microscopy
- Apply suitable strategies in data collections and disseminating research findings.

Keywords:
Centrifugation, Chromatography, HPLC, Fluorochrome, Spectrophotometry, AGE, PAGE, FACS, FISH, SEM, TEM, Microscopy, Data analysis.

THEORY

Unit 1: Cellular Fractionation and Separation Techniques (9 lectures)
Good laboratory practices, Cell fractionation, Cell wall degradation enzymes, Sedimentation of cellular particles, Mobility of particles under external centrifugal forces, type of centrifugation: Differential and density gradient centrifugation, type of rotors, analytical centrifugation for estimation of mass of biological molecules, Svedberg equation, ultracentrifugation and applications.

Unit 2: Separation of Biomolecules (6 lectures)
Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 3: Characterization of Molecules I (12 lectures)
Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE.
Principles of microscopy; Light microscopy; compound microscopy, Fluorescence microscopy; Confocal microscopy.

Unit 4: Characterization of Molecules II (9 lectures)
Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching. Use in biological research, auto-radiography, pulse chase experiment.

Unit 5: Data Analysis (9 lectures)
Data collection methods, population, samples, parameters; Representation of Data: Tabula, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of

dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

PRACTICAL (30 lectures)

1. To separate nitrogenous bases by paper chromatography.
2. To separate sugars by thin layer chromatography.
3. Isolation of chloroplasts by differential centrifugation.
4. To separate chloroplast pigments by column chromatography.
5. To estimate protein concentration through Lowry's methods.
6. To separate proteins using PAGE.
7. To separate the DNA (marker) using AGE.
8. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
9. Demonstration of ELISA.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of 5 permanent slides (double staining).

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. 3rd edition. Tata McGraw-Hill Publishing Co. Ltd. New Delhi.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. 3rd edition. John Wiley & Sons.
4. Zar, J.H. (2012). Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.

SEMESTER V

ECONOMIC BOTANY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-5A	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:
The students after studying this course would be able to:

- Understand the plants and economic values
- Categorize the plants according to their uses
- Acquaint the knowledge on the origin, distribution and cultivation of various- Crop plants, Fible yielding plants, Timber yielding plants, Oil plants, Spices and Condiments.

Key words:
Vavilov's centres of origin, Crop plants, Timber plants, Oil plants, Spices, Condiments.

THEORY

Unit 1: Origin of Crop Plants (9 lectures)
Introduction to Economic Botany. Vavilov's centres of origin of crop plants. Origin, distribution, brief idea of cultivation and economic uses of the following Food plants:
i. **Cereals** (rice, wheat and maize)
ii. **Pulses** (gram, arhar and pea)
iii. **Vegetables** (potato, tomato and onion)

Unit 2: Fibre Plants (9 lectures)
Origin, distribution, brief idea of cultivation and economic uses of the following Fibre plants:
i. Cotton
ii. Jute
iii. Flax

Unit 3: Timber Plants (9 lectures)
Origin, distribution, brief idea of cultivation and economic uses of the following Timber plants:
(i) Neem
(ii) Teak
(iii) Cedar

Unit 4: Oil Plants (9 lectures)
Origin, distribution, brief idea of cultivation and economic uses of the following Oil plants:
i. Groundnut
ii. Sunflower
iii. Coconut

Unit 5: Spices and Condiments (9 lectures)
Origin, distribution, brief idea of cultivation and economic uses of the following Spices:
i. Coriander

ii. Clove
iii. Ginger

PRACTICAL **(30 lectures)**

1. Study of morphological features of Food plants:
i. Cereals (rice, wheat and maize)
ii. Pulses (gram, arhar and pea)
iii. Vegetables (potato, tomato and onion)

2. Study of morphological features of Fibre yielding plants:
i. Cotton
ii. Jute
iii. Flax

3. Study of morphological features of Oil yielding plants:
i. Groundnut
ii. Sunflower
iii. Coconut

4. Study of morphological features of Spices and Condiments:
i. Coriander
ii. Clove
iii. Ginger

5. Study of anatomical features of the following plants:
i. *Coriander*
ii. Clove
iii. Ginger
iv. *Azadirachta*
v. *Withania*.

6. Histochemical localization of starch in rice and potato.

7. Economic significance of tea, coffee, rubber, sugarcane

Suggested Readings:

1.Gonsalves J. 2010. Economic Botany and Ethnobotany. International Scientific Publishing Academy. New Delhi.
2. Kumaresan V. and Annie R. 2013. Taxonomy-Systematic Botany, Economic Botany, Ethnobotany. Saras Publication. Nagercoil.
3. Kocchar S.L. 2009. Economic Botany in The Tropics (3rded.), MacMillan Publishers India Ltd. New Delhi.
4. Pooja. 2005. Economic Botany. Discovery Publishing House. New Delhi.
5. Sambamurthy A.V.S.S. and Subramanyam N.S. 1989. A Textbook of Economic Botany. Wiley Eastern Ltd. New Delhi.
6. Sharma O.P. 1996. Hills Economic Botany. Tata McGraw Hill Co. Ltd. New Delhi.
7. Simpson B.B. and Conner-Ogorzaly M. 1986. Economic Botany- Plants in Our World. McGraw Hill. New York.
8. Verma V. 2009. Text Book of Economic Botany. Ane Books Pvt. Ltd. New Delhi.

MEDICAL BOTANY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-5B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:

- The students would learn the outlines of the Indian Traditional System of Medicine.
- Understanding on the crude drugs from the plants would be imparted to the students.
- Plant toxins and their uses will be taught to the students
- The stakeholders will learn how to isolate and identify the antibiotics from the lower plants
- Students will have an understanding on neutraceuticals and cosmeceuticals.

Key words:
Traditional systems of medicine, raw materials, active principles, carbohydrates, glycosides, tannins, fixed oils, volatile oils, resins, alkaloids, steroids, Allergens, Teratogens, Hallucinogens, Antibiotics.

THEORY

Unit 1: **Introduction** **(9 lectures)**
Introduction- Health through herbs. Historical back ground, present status, scope of medicinal botany, Indian contribution to medicinal botany, Ethnobotany, a brief outline on traditional systems of medicine – Ayurvedha, Siddha, Unani, Naturopathy and Homeopathy.

Unit 2: **Raw materials for Drugs from Plants I** **(9 lectures)**
Plant secondary metabolites of medical importance: source, description of the products, chemical constituents, active principles and therapeutic uses of the following:
i. **Carbohydrates -** Ispaghula (*Plantago ovata*), Agar (*Gracilaria*).
ii. **Glycosides** - Senna (*Cassia* sp), *Digitalis*, *Glycorrhiza* and *Aloe.*

Unit 3: **Raw materials for Drugs from Plants II** **(9 lectures)**
Plant secondary metabolites of medical importance: source, description of the products, chemical constituents, active principles and therapeutic uses of the following:
i. **Tannins** - *Acacia* and Myrobalan (*Terminlia chebula).*
ii. **Fixed oils** - Groundnut oil (*Arachis hypogea*) and Castor oil (*Ricinus communis*).
iii. **Volatile oils** - *Eucalyptus*, Clove, lemon and *Ocimum*.
iv. **Resins** - Asafoetida and *Pinus*.
v. **Alkaloids** - Cinchona, *Rauwolfia, Atropa, Opium,* Vasaka (*Adhatoda zeylanica)* and *Ephedra*.
vi. **Steroids** – *Solanum* and *Dioscorea.*

Unit-4: Plant Toxins **(9 lectures)**
Toxins of plant origin: Allergens, Teratogens and hallucinogens from hemp and mycotoxins and aflatoxins from fungi.

Unit-5: Antibiotics (9 lectures)

Introduction to Antibiotics: Properties and Functions of antibiotics. Extraction, chemistry and therapeutic uses of the antibiotics obtained from *Penicillium, Aspergillus,* and *Streptomyces.* General account on neutraceuticals and cosmoceuticals.

PRACTICAL (30 lectures)

1. Morphological and anatomical studies of crude drugs of plants included in the syllabus.
2. Identification of crude drugs by histochemical and phytochemical methods.
3. Identification of drug adulterants.

Suggested Readings

1. Evans W.C. 1989. Trease and Evans Pharmacognosy (13th ed.). BaillièreTindall. London.
2. Kadavul K. 2016. Hand Book on Utilization of Medicinal Plants. Published by author.No.9, 4th Cross Street, Vengateswara Nagar-East, Puducherry-605013.
3. Kokate C.K., Purohit A.P. and Gokhale, S.B. 2003. Pharmacognosy (23rd ed.). Nirali Prakashan. Pune.
4. Purohit and Vyas. 2008. Medicinal Plant Cultivation: A Scientific Approach (2nd ed.). Agrobios. India.
5. Trivedi P.C. 2006. Medicinal Plants: Ethnobotanical Approach. Agrobios. India.

SEMESTERS VI

ECOLOGY AND BIODIVERSITY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-6A	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:
After the completion of this course, the learner will be able to:

- Develop understanding of the concept and scope of plant biodiversity
- Identify the causes and implications of loss of biodiversity
- Apply skills to manage plant biodiversity
- Utilize various strategies for the conservation of biodiversity
- Conceptualize the role of plants in human welfare with special reference to India

Key words:
Biodiversity, Biodiversity loss, Hot spots, Biodiversity management, Conservation strategies, Biodiversity awareness programmes.

THEORY

Unit 1: Introduction, soil and water (9 lectures)
Basic concepts; Levels of organization. Abiotic and biotic Components and their interrelationships and dynamism, homeostasis. **Soil:** Origin; Types and Formation; Composition; Physical, Chemical and Biological components; Soil profile. Types of soils in India. **Water:** States of water in the environment; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Atmospheric moisture; Water in soil; Ground water table. Water resources of India

Unit 2: Ecological adaptations, Population ecology (9 lectures)
Variations in adaptation of plants in relation to light, temperature, water, wind and fire. **Biotic interactions:** Competition: Inter- and intraspecific competition; Ammensalism, heterotrophy; mutualism, commensalism, parasitism; herbivory, carnivory, protocooperation, **Population ecology:** Characteristics and population growth, population regulation, life history strategies; *r* and *k* selection. Ecological Speciation.

Unit 3: Plant Communities and Ecosystem (9 lectures)
Community characteristics: analytical and synthetic; Concept of ecological amplitude; Habitat and niche; Ecotone and edge effect; Succession: processes, types; climax concept. Primary vs Secondary succession. **Ecosystem:** Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India. Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus.

Unit 4: Plant Diversity and its Scope (9 lectures)
Levels of biodiversity: Genetic, Species and Ecosystem; Agrobiodiversity and cultivated plant taxa and related wild taxa. Values and uses of Biodiversity, Methodologies for

valuation, Ethical and aesthetic values, Uses of plants; Ecosystem services. Loss of biodiversity- causes and implications, Hot spots of biodiversity, extinction of species, projected scenario for biodiversity loss.

Unit 5: Conservation and Management of Plant Biodiversity (9 lectures)
Organizations associated with biodiversity management, IUCN, UNEP, WWF, UNESCO, NBPGR; Methodology for execution; Biodiversity legislation; Information management and communication. Conservation of genetic, species and ecosystem diversity, *In situ* and *ex situ* conservation strategies, India's biodiversity and its conservation Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

PRACTICAL (30 lectures)

ECOLOGY

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (with pH meter, universal indicator/Lovibond comparator and/or pH paper strip)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. Study of morphological adaptations of hydrophytes and xerophytes (four each).
8. Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).
9. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
10. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
11. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
12. Field visit to familiarise students with ecology of different sites.

BIODIVERSITY
1. Visit any unattended area with natural vegetation
2. Use Quadrat method to evaluate the minimum size of the quadrat required for vegetation study
3. Find out the minimum number of quadrats need for analyzing the vegetation structure in the study area
4. Find out the alpha-diversity of plants in the area

Suggested Readings
1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.

3. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. 1996. Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. (4^{th} ed).
5. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
6. Singh, J.S., Singh, S.P. and Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
7. Reddy, K.V. and Veeraiah, S. 2010. Biodiversity and Plant Resources. Aavishkar publication, New Delhi.
8. Heywood, V. H. and Watson, R. T. 1995. Global biodiversity and Assessment. Cambridge University Press.

RESEARCH METHODOLOGY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-6B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:
At the end of the course the students will be able to:

- Understand the concept of research and different types of research in the context of
- biology
- Develop laboratory experiment related skills.
- Develop competence on data collection and process of scientific documentation
- Analyze the ethical aspects of research
- Evaluate the different methods of scientific writing and reporting

Key words:
Qualitative, Quantitative, Reproducibility, Scientific methodology, Plagiarism, Scientific misconduct, Ethics in Science

THEORY

Unit 1: Basic Concepts of Research (9 lectures)
Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: Data Collection and Documentation of Observations (9 lectures)
Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography.

Unit 3: Overview of Biological Problems (9 lectures)
History; Key biology research areas, Model organisms in biology (A brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network.

Unit 4: Ethics and Good Practical's and Art of Scientific Writing I (9 lectures)
Authors, acknowledgements, reproducibility, plagiarism, Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references.

Unit 5: Ethics and Good Practical's and Art of Scientific Writing II (9 lectures)
Power-point presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

PRACTICAL (30 lectures)
1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.

5. Technical writing on topics assigned.
6. Identification of different type of research in day-by-day life
7. Testing of a formulated hypothesis with type I and type II errors
8. Curation of relevant scientific literature from Google Scholar
9. Poster presentation on defined topics
10. Demonstration for checking of plagiarism using recommended software
11. Technical writing on topics assigned.
12. More Practical may be added depending on the local habitats and available facilities.

Suggested Readings

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 Development Association, Hong Kong.
3. Ruzin, S. E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

SEMESTER VII

INDUSTRIAL MICROBIOLOGY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-7A	4	5	ESE 75 (Theory) + ICA 25 (Practical) = 100

Course outcomes:
After completion of the course, the students will be able to:

- Understand concepts of industrial microbiology
- Apply the usage of microorganisms in industry
- Measure the growth of microorganisms
- Analyze the use of microbes in industries such as dairy and medicines
- Explain the concept of fermentation
- Understand the use of patent with respect to industrial microbiology

Keywords:
Industrial microorganisms, Culture collection, Strain maintenance, Growth curves, Fermentation, Sterilization

Unit 1: Fundamentals of Industrial Microbiology (9 lectures)
Fundamentals of Industrial microbiology: Definition, history and scope, Desirable characteristics and selection of industrial microorganisms, Isolation of suitable industrial microorganism form natural habitat. Culture collection Centres, Strain improvement and maintenance.

Unit 2: Measurement of Microbial Growth (9 lectures)
Media for fermentation, sterilization, development of inoculums, aeration. Definition of growth, mathematical nature and expression of growth, Generation time, growth curves in bacteria.
Measurement of growth (cell number, cell mass and cell constituent. Effect of environment on the microbial growth (temperature, pH and other parameters).

Unit 3: Fermentation Process (9 lectures)
Fermentation and fermenter, Concept of fermentation and discovery of fermentation. Fermentation system, Fermentor design, Scale up study, metabolic control of product formation. Batch, Fed-batch and Continuous fermentation, solid and liquid state fermentation, Down-stream processes, fermentation economics: market potential, fermentation and product recovery cost.

Unit 4: Fermentation Products (9 lectures)
Fermented dairy products (yoghurt, butter milk and cheese fermentation, baking product (bread), fermented beverages (beer, wine and ethanol), Single cell protein, probiotics and prebiotics; Recombinant protein, Enzymes (amylase), organic acid (citric acid), antibiotic (penicillin).

Unit 5: Product Patenting (9 lectures)

Patent and secret processes: concept of patent, composition and characteristics of patent; protection of right.

PRACTICAL (30 lectures)

1. Practice of cleaning and disinfecting of the glassware/plasticware
2. Use of laminar flow
3. Measurement of Microbial growth
4. Preparation of wine from grapes
5. Preparation of different culture media
6. Measurement of growth - cell number, cell mass and cell constituent
7. Study impact of environmental conditions on microbial growth.

Suggested Readings

1. Casida, L. E. J. R. 2016. Industrial Microbiology. New Age International Publisher.
2. Sivakumaar, P.K. 2010. An Introduction to Industrial Microbiology. S Chand publishing.
3. Waites, M.J., Morgan, N.L., Rockey, Higton G. 2001. Industrial Microbiology: An Introduction. Blackwell Science.
4. Okafor, N., Benedict, C. and Okeke. 2017. Modern Industrial Microbiology and Biotechnology. Taylor & Francis.

MARINE BIOTECHNOLOGY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-7B	**3 + 1**	**5**	**ESE 50 (Theory) + ICA (Theory) 25 + ESE (Practical) 25 = 100**

Course outcomes:

- Students will understand the overview structure and function of life in the marine environment.
- Students will also understand the diversity of organisms in the ocean and their importance.
- They will also appreciate marine resources and how oceans influence the climate.

Key words:

Seawater, Barophiles, Thermophiles; Seaweeds, Plankton, GFP

THEORY

Unit 1: Marine Ecosystem (9 lectures)
Sea as a biological environment; Classification of the marine zones; Estuarine ecosystems; Coral reefs - occurrence, distribution and economic importance; Mangroves - distribution, adaptation (morphological, anatomical) and their importance; Critical habitats and biological hotspots.

Unit 2: Ocean Climatic Change (9 lectures)
Seawater composition and its properties; differences between fresh and seawater; Ocean acidification and its significance; El Niño-Southern Oscillation: El Niño & La Niña and its effect on global climate; Marine pollution.

Unit 3: Marine Diversity (9 lectures)
Diversity of marine microorganisms: viruses, bacteria, archaea, protists, fungi Specialized microorganisms: Extremophiles: barophiles, thermophiles, psychrophiles, halophiles, actinomycetes, polyextremophiles, anaerobes.

Unit 4: Marine Plants (9 lectures)
Marine algae and plants (seaweeds, sea grasses, mangrove plants); Plankton (phytoplankton and zooplankton); Marine biomass and productivity - primary production, photosynthetic efficiency; secondary production; Geographical Information System (GIS) for chlorophyll distribution.

Unit 5: Applications of Marine Organisms (9 lectures)
Application of Marine organisms: Barophilic organisms & their applications; Seaweeds for removal of metal pollutants; GFP, RFP characteristics and their applications; Green mussel adhesive protein; Chitosan : products and applications; Marine Biomimetics

PRACTICALS (30 lectures)

1. Estimation of Dissolved oxygen
2. Estimation of Salinity
3. Estimation of pH
4. Identification of locally available Sea Grasses.
5. Identification of locally available Seaweeds.
6. Identification of locally available Mangroves.
7. Sampling (Field trips) and identification: Phytoplankton & Zooplankton
8. Estimation of Chlorophyll
9. Study of morphology and cultural characteristics of microbes
10. Preparation of solid & liquid media for bacterial and fungal study
11. Isolation of bacteria from seawater /sediments samples
12. Cultivation of marine fungi
13. Gram staining of marine bacteria

Suggested Readings:

1. Sumich, J.L., 1999. Introduction to the Biology of Marine life. Seventh Edition. The Mc Graw Hill Companies Inc.
2. Hogarth P. 2007. The Biology of Mangroves and Seagrasses First Edition. Oxford Press.
3. Munn, C.B. 2004. Marine Microbiology: Ecology and Applications, BIOS Scientific Publisher.
4. Krichman, D.L., 2000, Microbial Ecology of the Oceans. Wiley-Liss, New York.
5. Naskar K. and Mandal R., 1999. Ecology and Biodiversity of Indian Mangroves. Daya.
6. Le Gal, Y., Ulber, R., & Antranikian, G. 2005. Marine Biotechnology
7. Nabti, E. 2017. Biotechnological Applications of Seaweeds.
8. Day, R., Davidson, M. 2014. The Fluorescent Protein Revolution.
9. Hicks, B. 2002. Green Fluorescent Protein.
10. Ahmed, S., Ikram, S. (2017). Chitosan.
11. Bar-Cohen, Y. (2006). Biomemetics.
12. Beer, T. (2017). Environmental oceanography. CRC Press.
13. Robert Blasiak et al. (2022). A forgotten element of the blue economy: marine biomimetics and inspiration from the deep sea. PNAS Nexus, 2022, 1,1–17 (Assess :https://doi.org/10.1093/pnasnexus/pgac196)
14. Grasshoff, K., 1999. Methods of Sea water Analysis. Wiley VCH, New York.

FORENSIC BOTANY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-8A	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:
After completing this course, the learner will be able to:

- Conceptualize classification of plants from forensic point of view.
- Understand forensic importance of different parts of plants.
- Collect and preserve botanical evidences of crime and analyze classic and DNA based forensic botany cases**.**

Key words:
Plant classification, Forensic importance, Poisonous plants, Drugs, Botanical evidences, Sample analysis

THEORY

Unit 1: Organization and Classification of Plants (9 lectures)

Introduction to Forensic Science- Locard's exchange principle. General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: - vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.

Unit 2: Importance of Plant Parts (9 lectures)

Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibres – forensic aspects of fibre examinations, Identification and comparison of man–made and natural fibres.

Unit 3: Identification of Microbes and Plant Products (9 Lectures)

Various types of Planktons and diatoms and their forensic importance,
Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.
Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, dhatura, *Psilocybin* mushrooms.

Unit 4: Poisonous Plants (9 lectures)

Various types of poisonous plants-*Abrus precatorius*, *Aconitum*, *Anacardium occidentale, Argemone mexicana, Calotropis, Cannabis sativa, Claviceps purpurea, Cinchona, Croton tiglium, Atropa belladonna, Erythroxylum cocoa, Gloriosa superba, Jatropha curcas, Lathyrus sativus, Manihot utilissima, Nerium oleander, Nicotiana tabacum, Plumbago zeylanica, Ricinus communis, Semicarpus anacardium, Strychnos nux vomica, Thevetia peruviana,*

Unit 5: Application of various Techniques in Forensic Botany (9 lectures)
Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration, Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.

PRACTICAL (30 lectures)
1. Study of phytoplanktons using morphological characters- Diatoms, Microalgae, etc.
2. Study of plant pollen grains types
3. Study of narcotic leaf, *Cannabis* / tobacco with the from other non-narcotic leaf using external morphological and anatomical features.
4. Study of plant stems- Rose wood/ Sandal wood and common plants wood.
5. Study of poisonous and non-poisonous plant flowers
6. Study on the differentiation of poisonous seeds of *Nerium* and *Ricinus communis* (Castor) from non-poisonous seeds.
7. Differentiation of cotton fibres with synthetic fibres using dyes.
8. Study of plant crystals.
9. Study of poisonous and non-poisonous mushrooms

Suggested Readings
1. Coyle H.M. 2004. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.
2. James S.H., Nordby J.J., Bell S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4th edition.
3. Hall D.W. and Byrd J. 2012 Forensic Botany: a practical guide. Wiley-Blackwell, 1st edition.
4. Bock J.H. and Norris D.O. 2016. Forensic Plant Science. Academic Press.

BIOSTATISTICS AND COMPUTER APPLICATIONS IN BIOLOGY

Course code	Credits	Teaching hours per week	Maximum Marks
MID-8B	**4**	**5**	**ESE 75 (Theory) + ICA 25 (Practical) = 100**

Course outcomes:
At the end of the course the students will be able to:

- Comprehend the fundamental concepts related to descriptive and inferential biostatistics.
- Develop skills in data tabulation, its treatment, analysis, interpretation and graphical representation of data.
- Analyze the implications of inferential statistics in biology.
- Develop their competence in hypothesis testing and interpretation.

Key words:
Probability, Frequency, ANOVA, t-test, P-value, Hypothesis testing, Correlation, regression

THEORY

Unit 1: Biostatistics-I (9 Lectures)
Introduction to Biostatistics, definition, characteristics, importance and usefulness, limitations. Collection, classification and presentation of data (tabulation, graphical representation-Histogram, simple bar, multiple bar and divided bar diagrams, pie diagram, frequency curve and frequency polygon). Frequency distribution: definition, types, class width, class mark, class frequency, relative frequency, percentage frequency and frequency density.

Unit 2: Biotstatistics-II (9 Lectures)
Measures of central tendency- Characteristics: definition and calculations of mean, median, and mode. Measures of variation- standard deviation and standard error.

Unit 3: Basics of Computer (9 Lectures)
Types of computers, accessories and its functions, input-output devices, concepts of different operation systems, details of Networks, Internet and email. Database types and its uses, fundamentals of digital imaging, uses of different programming languages.

Unit 4: Softwares used in Biology (9 Lectures)
Outline of MS-Office (MS-Word, MS-Excel and MS-Power point). Database softwares- MS access, Image editing softwares (Photoshop), Biological Sequence Searching and Comparison softwares (BLAST), Search engines (Google, Mozilla Firefox), GIS softwares (Google Earth).

Unit 5: Computer Applications in Biology (9 Lectures)
Introduction to Bioinformatics and its applications, EMBL and GenBank Data Libraries, PIR Database, Fundamentals of Geographic Information Systems (GIS) and Remote Sensing and its uses in biology. Information systems- BTIS, ENVIS.
Introduction to statistical softwares- SPSS and PSPP (open source), use for descriptive statistical analysis.

PRACTICAL (30 Lectures)

1. Tabulation of biological data.
2. Calculation of mean, median, mode, standard deviation and standard error using biological data.
3. To plot and import Graphs and Charts using biological and statistical data in MS-office.
4. Search biological information (texts and images) using Internet.
5. Biological sequence searching using BLAST software.

Suggested Readings

1. Banerjee P.K. 2009 Introduction to Biostatistics- A Text Book of Biometry. S.Chand & Co. New Delhi.
2. Bemis K. PSPP: Purdue STAT 582 User Manual.http://www.stat.purdue.edu/~jennings/stat582/software/pspp_manual.pdf
3. Chernick M.R. and Friis R.H. 2003. Introductory Biostatistics for the Health Sciences: Modern Applications including Bootstrap. John Wiley & Sons. New Jersey.
4. Cox J. Lambert J. and Frye C. 2011. Step by Step: Microsoft Office Professional 2010. Microsoft Press. Washington.https://capdtron.files.wordpress.com/2013/01/office-professional-2010-step-by-step.pdf
5. Daniel W.W. 2005.Biostatistics: A Foundation for Analysis in the Health Sciences (7thed.). John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
6. Lambert J. and Frye C. 2015. Microsoft Office 2016 Step by Step. Microsoft Press. USA. https://ptgmedia.pearsoncmg.com/images/9780735699236/samplepages/9780735699236.pdf
7. PSPP Users' Guide. GNU PSPP Statistical Analysis Software Release 0.10.2.http://www.gnu.org/software/pspp/manual/pspp.pdf
8. PSPP Tutorial. https://www.youtube.com/watch?v=GG-wbMS9i7g
9. Rutkosky 2007. MS Office.BPB Publication. New Delhi.
10. Genebank: https://www.ncbi.nlm.nih.gov/genbank/
11. EMBL Nucleotide Sequence Database http://www.ebi.ac.uk/