DEPARTMENT OF PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

B.Sc. Plant Biology and Plant Biotechnology

U.G. PROGRAMME

SYLLABUS

Effective from the Academic Year 2016-2017

Loyola College (Autonomous)

Chennai- 600 034

LOYOLA COLLEGE (AUTONOMOUS)
CHENNAI - 600 034.

Department of Plant Biology & Plant Biotechnology

S.NO	SUBJECT CODE	SUBJECT TITLE
1	16UPB1MC01	ALGAE AND BRYOPHYTES
2	16UPB1MC02	FUNGI
3	16UPB1MC03	LABORATORY COURSE - I (ALGAE, BRYOPHYTES& FUNGI)
4	16UZO1AL01	ANIMAL DIVERSITY
5	16UZO1AL02	ANIMAL DIVERSITY LAB COURSE
6	16UPB2MC01	PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY
7	16UPB2MC02	PLANT ANATOMY AND EMBRYOLOGY
8	16UPB2MC03	LABORATORY COURSE - II (PTERIDO. GYMNO. AND PALEO BOT. & PLANT ANATOMY AND EMBRYOLOGY)
9	16UZO2AL01	AGRICULTURAL ENTOMOLOGY
10	16UZO2AL02	AGRICULTURAL ENTOMOLOGY LAB
11	16UPB3MC01	MICROBIOLOGY
12	16UPB3MC02	CELL BIOLOGY AND EVOLUTION
13	16UPB3MC03	LABORATORY COURSE - III (MICROBIOLOGY, CELL BIOLOGY AND EVOLUTION
14	16UCH3AL03	GENERAL CHEMISTRY FOR BIOLOGY-I
15	16UCH3AL04	CHEMISTRY PRACTICAL FOR BIOLOGY-I
16	16UPB4MC01	ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY
17	16UPB4MC02	LABORATORY COURSE - IV (ANG. TAXON AND ECO. BOT)
18	16UPB4ES01	BIOLOGICAL TECHNIQUES
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20	16UPB4ES03	HORTICULTURE AND LANDSCAPING
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22	16UCH4AL03	GENERAL CHEMISTRY FOR BIOLOGY-II
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24	16UPB5MC01	PLANT PHYSIOLOGY
25	16UPB5MC02	GENETICS AND PLANT BREEDING
26	16UPB5MC03	ECOLOGY, PHYTOGEOGRAPHY AND FORESTRY
27	16UPB5MC04	LABORATORY COURSE- V (PLANT PHYSIOLOGY)
28	16UPB5MC05	LABORATORY COURSE-VI (GENETICS AND PL. BREEDING & ECOLOGY, PHYTOGEOGRAPHY AND FORESTRY)
29	16UPB5ES01	PRINCIPLES OF AGRICULTURE
30	16UPB5ES02	PRINCIPLES OF AGRICULTURE LAB.
31	16UPB5ES03	BIOINFORMATICS AND BIOSTATISTICS
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33	16UPB5SK01	PRODUCTION OF MUSHROOM, BIOFERTILIZERS AND SINGLE CELL PROTEIN
34	16UPB6MC01	PLANT DISEASES AND MANAGEMENT
35	16UPB6MC02	HERBAL SCIENCES AND ETHNOBOTANY
36	16UPB6MC03	MICROBIAL TECHNOLOGY
37	16UPB6MC04	ENVIRONMENTAL BIOTECHNOLOGY
38	16UPB6MC05	LABORATORY COURSE- VII (PLT. DIS.AND MANG.,& HERBAL SCIENCES AND ETHNOBOTANY)
39	16UPB6MC06	LABORATORY COURSE-VIII (MICROBIALTECH. & ENV. BIOTECH)

40	16UPB6MS01	PLANT BIOTECHNOLOGY
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16UPB1MC01 – ALGAE AND BRYOPHYTES

SEMESTER: I CREDITS: 3
CATEGORY: MC HOURS / WEEK: 3

Objectives:

1. *To provide knowledge on the structure and reproduction of certain selected algal and bryophyte forms besides giving an overview.*
2. *To introduce students to basics of algal biotechnology and economic importance of both groups.*

Unit 1: Algae - Overview (1 + 7 + 1)

Phylogeny of Algae - A general account of Algae: distribution - range of thallus organization – pigmentation- flagellation- reserve food – Reproduction(vegetative-asexual-sexual); Lifecycle patterns – Classification of algae (F.E.Fritsch)- salient features of the various classes as per Fritsch's – Fossil algae.

Unit 2: Algae -Type Study (1 + 7 + 1)

Structure and reproduction with reference to the following algal forms: *Volvox, Chara, Diatoms, Ectocarpus, Sargassum andGracilaria* (excluding the developmental stages).

Unit 3: Algae – Applications(1 + 7 + 1)

Algal biotechnology: single cell proteins (SCP): *Spirulina* as single cell protein-production and harvesting of algal biomass – factors affecting biomass production.Cyanobacterial inoculants (BGA): Isolation, preparation of starter culture, mass cultivation, field applications and crop response. Economic importance of algae: Algae as food and fodder, use of algae in agriculture and space research, commercial products of algae: Agar Agar, Alginates, Carrageenin, diatomite, mucilage, minerals and elements - Algae in medicine and biofuels.

Unit 4: Bryophytes – Overview(1 + 7 + 1)

Phylogeny of Bryophytes- General account of habit, distribution – classification (Rothmaler,1951)- characteristics of *Hepaticopsida,Anthocerotopsida* and *Bryopsida* – methods of reproduction:vegetative, asexual and sexual- life cycle pattern - fossil bryophytes - economic importance.

Unit 5: Bryophytes - Type Study (1 + 7 + 1)

A detailed study of the range of vegetative and reproductive structure - Life cycle of liverworts (*Marchantia*); hornworts (*Anthoceros*) and mosses (*Funaria*) (excluding the developmental stages).

BOOKS FOR STUDY:

1.Srivastava, H.N. 1999.Algae.Pradeep publications, Meerut.

2. Sharma, O.P. 2004. A textbook ofAlgae.Tata McGraw- Hill publishing Company Limited, New Delhi.
3. Bilgrami, K.S. and Saha, L.C. 2012. A textbook of Algae. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
4. Pandey, S.N., Misra, S.P., and Trivedi, P.S. 1997. A text book of Botany, Vol. II, Vikas Publishing House Pvt. Ltd.
5.Dubey, R.C. 2009. A Textbook of Biotechnology. S. Chand & Company Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Bold, H. C. 1982. Morphology of Plants - Wiley Eastern Ltd. New Delhi.
2. Gangulee&Khar, 1980. College Botany, Vol. II Tata McGraw Hill, New Delhi.
3. Sporne, 1967. Bryophytes - Hutchinson & Co, London.
4. Rashid A, 2006. An introduction to Bryophyta, Vikas Publishing, Delhi
5. Raven JA, 1984. Biology of Non-Vascular plants, Wiley Publishing, London.

E- BOOKS:

1. Rogers K. 2011. " Fungi, Algae and Protists". First Edition.BritanicaEducational Publishing.
2. Encyclopaedia Britannica, 2011. Plants, Algae and Fungi".Encyclopaedia Britannica Inc.

16UPB1MC02– FUNGI

SEMESTER: I CREDITS: 3
CATEGORY: MC HOURS/ WEEK: 3

Objectives:

1. *To provide knowledge on the structure and reproduction of important fungal forms besides giving an overview.*
2. *To introduce students to basics of fungal biotechnology and clinical mycology.*

Unit 1: General characters of fungi(1 + 7 + 1)

Habit, nutrition types, cell structure, mycelium – its modifications-Reproduction: vegetative, asexual, sexual, para-sexual; fruiting bodies of sexual and asexual, Life cycle patterns. Salient features of fungal classes - classification (Alexopolus, 1962& R. Whittaker,1959).

Unit 2:Fungal forms(1 + 7 + 1)

Structure and reproduction with reference to the following fungal forms(no developmental stage)*Albugo*, *Rhizopus*, *Aspergillus*, *Saccharomyces*, *Neurospora*and*Peziza.*

Unit 3:Fungal forms(1 + 7 + 1)

Structure and reproduction with reference to the following fungal forms (no developmental stages)*Puccinia*, *Polyporus*and*Colletotrichum.*Lichens:Types, structure, reproduction and economic importance.

Unit 4:Fungal Applications(1 + 7 + 1)

Baker's yeast, YAC vector, penicillin production and Mycorrhiza: Types, identification and importance. Economic importance of fungi in general.

Unit 5:Clinical mycology(1 + 7 + 1)

Structure, reproduction, diagnoses and control measures of the following:Dermatophytoses: (*Trichophyton*); Systemic mycoses (*Candida*), Fungal toxins.

BOOKS FOR STUDY:

1. Vashishta, B.R. 2000. Fungi, Chand & Co. New Delhi
2. Harold C. Bold, 1982. Morphology of plants. Wiley- Eastern Ltd.
3. Sathyanarayana, U. 2010. Biotechnology; Books and allied (P) Ltd. Kolkata.
4. Sundararaj, T. 2000. Microbiology Laboratory Manual, IBMS, University of Madras, Taramani, Chennai.

BOOKS FOR REFERENCE:

1. Gangulee and Khar, 1980. College Botany Vol. II, Tata McGraw Hill, New Delhi.

E- BOOKS:

1. Rogers K.2011. " Fungi, Algae and Protists". First Edition.Britannica educational Publishing.
2. Encyclopaedia Britannica, 2011. " Fungi Biology and applications". Second Edition. Wiley-Blackwell (John Wiley & sons Ltd.).
3. Encyclopaedia Britannica, 2011. Plants, Algae and Fungi". Encyclopaedia Britannica Inc.
4. Webster J. and Weber R. W. S. 2007. Introduction to Fungi.Third edition. Cambridge University Press.

16UPB1MC03– LABORATORY COURSE: I

(ALGAE, BRYOPHYTES AND FUNGI)

SEMESTER: I CREDITS: 3
CATEGORY:MC HOURS /WEEK:3

1. Morphological study of the following algal forms - *Volvox, Chara, Diatoms, Ectocarpus,Sargassum*and *Gracilaria.*
2. Algal Biotechnology: Cultivation of algae in - Chu 10 medium (Demonstration only).
3. Morphological study of the following bryophyte forms - *Marchantia, Anthoceros,* and *Funaria.*
4. Morphological study of the following fungal forms -*Albugo, Rhizopus, Aspergillus, Saccharomyces, Neurospora, Peziza, Puccinia, Polyporus*and*Colletotrichum;* Lichens.
5. Study of economically important products obtained from algae, bryophytes and fungi.
6. Photographs and permanent slides related to clinical mycology.
7. Field visit / trip to collect algal specimens - algae herbaria (5 numbers) to be submitted.
8. Visit to algal and fungal biotechnology laboratories.

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16UZO1AL01ANIMAL DIVERSITY

SEMESTER: I CREDITS: 2
CATEGORY: AL HOURS / WEEK: 4

Objective: To observe the organization, functional morphology and diversity of representative invertebrates and chordates.

UNIT I : PROTOZOAN PARASITES
Structure, organization and life history of *Entamoebahistolytica* ***and*** *Plasmodium vivax*, *Obeliageniculata*.

UNIT II : NEMATODE PARASITES
Structure, organization and life history of ***Taeniasolium,*** Nematode parasites of man – ***Ascaris and Hirudinaria.***

UNIT III : ECHINODERMATA ANS MOLLUSCA
Structure, organization and life history of ***Penaeusindicus, Pilaglobosa and*** Star fish.

UNIT IV : AMPHIBIA, RETILIA AND AVES
Organization of Frog, Calotes, Pigeon and Rat.

UNIT V : EMBRYOLOGY
Types of chordate eggs, extra embryonic membranes and their functions in chick, placentation in mammals.

Text Books

1. EkambaranathaAyyar and T.N.Ananthakrishnan, 2008. A manual of Zoology Vol.I& II (Part 1,2) S.Viswanathan, Chennai.
2. Barnes,R.D 2001. Invertebrate Zoology, W.B.Saunders.
3. Verma, P.S., Agarwal, V.K and Tyagi B.S. 1995. Chordate embryology, S.Chand, New Delhi.
4. Berril, N.J. 1971. Developmental Biology, McGraw Hill, New York.

16UZO1AL02 ANIMAL DIVERSITY LAB COURSE

SEMESTER:I CREDIT: 1
CATEGORY: AL HOURS / WEEK: 2

OBJECTIVE: To observe the organization, functional morphology and diversity of representative invertebrates and chordates

UNIT I :MAJOR DISSECTION
Cockroach: Digestive system, Nervous system. Freshwater mussel /Pilaglobosa: Digestive system Prawn: Nervous system. Frog: Arterial system and venous system.

UNIT II :MINOR DISSECTION
Earthworm: Lateral hearts. Cockroach: Reproductive system

UNIT III :MOUNTING
Cockroach: Mouth parts and salivary apparatus. Earthworm: Body setae. Prawn: Appendages (Cephalic, thoracic and abdomen). Frog: Hyoid apparatus and brain.

UNIT IV :SPOTTERS – INVERTEBRATE
Representatives from each phylum based on structural organization and phylogeny.

UNIT V :SPOTTERS – VERTEBRATE
Representatives from each phylum based on structural organization and phylogeny.

TEXT BOOKS
1. Lai, S.S. 2005. A Text Book of Practical Zoology: Invertebrate, Rastogi, Meerut.
2. EkambaranathaAyyar and T.N.Ananthakrishnan, 2008 A manual of Zoology Vol.I& II (Part 1,2) S.Viswanathan, Chennai.
3. Barnes, R.D 2001 Invertebrate Zoology, W.B.Saunders, London.

16UPB2MC01–PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

SEMESTER:II CREDITS:3
CATEGORY: MC HOURS / WEEK:3

Objectives:
1. *To provide knowledge on the comparative studies of steles, sporangia and gametangia in eusporangiate and leptosporangiate groups.*
2. *To impart knowledge on morphology, anatomy and reproduction of selected Gymnosperms. This course also includes the study of a few representative fossil forms.*

Unit 1: Pteridophytes A(1 + 7 + 1)
General characters of Pteridophytes- Classification (Reimer's,1954)– General structure of eusporangium, leptosporangium and gametangia – life cycle of homosporous and heterosporousPteridophytes – general survey of divisions: Psilophyta – Lycophyta – Sphenophyta and Filicophyta – stelar system in Pteridophytes – heterospory and seed habit – Apospory and apogamy- origin of Pteridophytes.

Unit 2: Pteridophytes B (1 + 7 + 1)
Study of the structure and reproduction in the following forms (no developmental aspects): Sporophyte (morphology, anatomy and reproduction) and gametophyte (structure, sex organs

and mature embryo) of *Psilotum, Lycopodium, Equisetum, Adiantum*and *Marsilea* – Economic importance of Pteridophytes.

Unit 3: Gymnosperms A(1 + 7 + 1)
General characters – Concept of pro-gymnosperms – Classification (Sporne, 1965): Characters up to classes only – salient features of Pteridospermales,*Bennettitales, Cycadales, Cordaitales, Coniferales* and *Gnetales.*

Unit 4: Gymnosperms B (1 + 7 + 1)
Detailed study of structure and reproduction (no developmental aspects) of *Cycas, Pinus*and*Gnetum*- economic importance – Indian contribution to Gymnosperms.

Unit 5: Paleobotany (1 + 7 + 1)
Introduction – fossils – methods of fossilization – types of fossils: unaltered (coal, ice embedded fossils and embedded in Amber) and altered (compression, petrifactions, impressions, moulds and casts) – techniques to study fossils – determination of the age of fossils – geological time scale. Fossils of the vascular plants: Pteridophytes: *Rhynia, Lepidodendron, Calamites*. Gymnosperms: *Williamsonia*.

BOOKS FOR STUDY:

1. Pandey, S.N., Misra, S.P and Trivedi, P.S. 1970. A text book of Botany (Vol II).Vikas Publishing House Pvt. Ltd. Delhi.
2. Reddy, S.M. 1996. University Botany – 1. New age international Pvt. Ltd. Publishers, Delhi.
3. Srivastava, H.N. 2004. Gymnosperms.Pradeep Publications, Jalandar.

BOOKS FOR REFERENCE:

1.Rashid, A.1976. An introduction to Pteridophytes.Vikas Publishing House, New Delhi.
2. Arnold. 1947. An introduction to Paleobotany. McGraw-Hill Book Company. Inc. USA.
3. Sporne, K.R. 1967. The morphology of Gymnosperms.Hutchinson& Co. London.
4. Sporne, K.R. 1975. The morphology of Pteridophytes.Hutchinson& Co. London.
5. Pandey, B.P. 1998. College Botany Vol II. S. Chand and Company Ltd. New Delhi.
6. Vashishta, P.C. 1999. Pteridophytes. S. Chand and Company Ltd.New Delhi.
7. Vashishta, P.C. 1999. Gymnosperms. S. Chand and Company Ltd. New Delhi.

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16UPB2MC02– PLANT ANATOMY AND EMBRYOLOGY

SEMESTER: II CREDITS: 3
CATEGORY: MC HOURS / WEEK:3

Objectives:

1. *To make the student become familiar and to understand the tissues and internal structures of stem, root and leaves.*
2. *This course also enables the students to understand the embryology of angiospermic plants.*

Unit 1:Cell, Tissues and Meristems(1 + 7 + 1)
Structure of a plant cell -Tissues: classification, structure and function of the following tissues: Simple permanent tissues: Parenchyma, collenchyma, sclerenchyma. Fibres and Sclereids; Complex permanent tissues: Xylem and Phloem. Meristems: Classifications- Theories on apical meristem: Apical organization of vegetative shoot and root apex.

Unit 2: Anatomy of stem(1 + 7 + 1) Tissue systems: Dermal tissue system - Fundamental or ground tissue system, Vascular tissue system, Types of vascular bundles.Nodal Anatomy.Primary and Secondary structure of the stem.Anatomy of Dicotyledonous and monocotyledonousstems.Normal secondary growth in dicotyledonous.Anomalous secondary growth in*Bignonia*, *Aristolochia,* (dicot stem) *Dracaena* (monocot stem).

Unit 3: Anatomy of root and leaf(1 + 7 + 1)
The Root - Primary and Secondary anatomy of dicotyledonous roots- Anatomy of monocot roots- Anatomy of storage roots. Secondary growth in dicot roots.Leaf: Anatomy of dicot and monocot leaf – types of stomata in dicots, stomata in monocot- grass type - Leaf abscission.

Unit 4: Embryology I(1 + 7 + 1)
Structure and development of anther, microsporogenesis, structure of mature pollen, Development of male gametophyte.Pollen grains: NPC system of classification. Types, structure and development of ovule, Megasporogenesis, Development of female gametophyte – Monosporic (*Polygonum*), Bisporic (*Allium*)andTetrasporic (*Peperomia*).Pollination types and contrivances.

Unit 5: Embryology II(1 + 7 + 1)
Fertilisation, double fertilization, Triple fusion and post fertilization changes. Endosperm - types (Nuclear, cellularandhelobial), endosperm haustoria.Development of dicot embryo (*Capsella*); Development of monocot embryo (*Luzula*).Apomixis - Polyembryony - Parthenogenesis - Parthenocarpy.Applications of Embryology.

BOOKS FOR STUDY:

1 Pandey, B.P (2009). Plant Anatomy. S. Chand & Company Ltd., New Delhi.
2.Vashista P. C. (1997). Plant Anatomy.Pradeep Publication, Meerut.
3. Fahn, A,1992. Plant anatomy.Pergamon press.
4. Singh, V., Pande, P. C. and Jain, D. K., 1997. Embryology of Angiosperms, Rastogi Publications, Meerut.

5. Ganguly, A. K. and Kumar, N.C., 2008. Developmental and Experimental Embryology of Angiosperms.Emkay Publications, Delhi.
6. Bhojwani,S. S. and Bhatnagar, S. P., 2009. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Esau, K. (1985): Anatomy of Seed Plants - John Willey Eastern Pvt. Ltd. New Delhi.
2. Cutter E.G. (1989): Plant Anatomy - Part 1 - Addison - Wesley Publishing Co
3.Maheswari P. (1991): An introduction to Embryology of Angiosperms. Tata - McGraw Hill Publishing Co. Ltd.
4. Swamy B.G.L and Krishnamoorthy K.V (1990): From flower to Fruits, Tata - McGraw Hill Publishing Co Ltd.
5.Annie Ragland, 2009. Developmental Botany, Saras Publications, Nagercoil.

16UPB2MC03–LABORATORY COURSE: II
(PTERIDO, GYMNO AND PALEOBOT. &PLANTANATOMY AND EMBRYOLOGY)

SEMESTER:II CREDITS:3
CATEGORYE:MC HOURS / WEEK:3

Pteridophytes, Gymnosperms and Paleobotany

1. Comparative study of morphology,anatomy and soral organization in *Psilotum, Lycopodium, Equisetum, Adiantum*and*Marsilea*.
2. Morphological and anatomical studies of the genera mentioned for detailed study: *Cycas, Pinus*and*Gnetum.*
3. Comparative study of wood anatomy of *Cycas, Pinus* and *Gnetum*.
4. Field trip to study fossils.
5. Field trip to an out station to study the flora.
6. Study of economically important Pteridophytes and Gymnosperms and their products.
7. Submission of photographs of atleast 10 different Pteridophytes and Gymnosperms.

Anatomy

1. Tissue types
2. Organization of apical meristems.
3. Anatomy of dicot and monocot stem – Primary structure.
4. Anatomy of dicot rootand monocot root – Primary structure.
5. Anatomy of dicot stem– Secondary structure.
6. Anatomy of dorsiventral leaf (Mango) and isobilateral leaf (Grass).
7. Stomatal types
8. Anomalous secondary growth - *Bignonia*, *Aristolochia, (*dicot stem) *Dracaena* (monocot stem).
9. Nodal anatomy.
10. Maceration of wood samples to study fibres, tracheids and vessels.

Embryology

1. T.S of Anther at various stages of development.
2. Observation of simple (Catharanthus, Hibiscus, Grass) and compound pollen grains (Calotropis, Acacia).
3. Structure of pollen grains using whole mounts (*Catharanthus, Hibiscus, Acacia*,)
4. Pollen viability test using acetocaramine (*Caesalpinia / Crinum*/*Catharanthus/Tradescantia*)
5. Types of ovules (Permanent slides)
6. L.S. of oily endosperm (*Ricinus*), Free nuclear, cellular and Helobial; Rumination
7. Perisperm (*Piper*)
8. Embryo mounting (*Tridax*)
9. L. S. of monocot embryo (Maize)

16UZO2AL01-AGRICULTURAL ENTOMOLOGY

SEMESTER:II CREDITS:2
CATEGORYE:AL HOURS / WEEK:4

Objective: To impart knowledge on insect pests and plant protection to sustain green revolution.

UNIT I : AN OUTLINE CLASSIFICATION OF INSECTS

Causes for insect assuming pest status and methods of collection, preservation and mounting of insect pests.

UNIT II : INSECT VECTORS OF PLANT DISEASES

Insect pests of stored grains their preventive and curative methods – Locust and its control.

UNIT III : COMMON INSECT PESTS

Most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton.

UNIT IV : APICULTURE

Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies of honey bees, diseases of honey bees and conclusion. Sericulture: introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests of silk worm, diseases of silk worm and conclusion.

UNIT V :PEST MANAGEMENT

Elementary knowledge of insecticide, Biological control of Insect pests and Integrated Pest Management.

Text Books

1. Vasanthraj David, B and T. N. Ananthakrishnan, 2004. General and Applied Entomology, Second edition, Tata McGraw hill pubplishing company Ltd., New Delhi, Page 1-1184.
2. Vasanthraj David, B. 2001. Elements of Economic Entomology, Popular book Depot, Chennai.5. Ramawatet al., 2009 Comprehensive Biotechnology, S.Chand&Compy, New Delhi.

Reference Books

1. AbishekShukla, D. 2009. A Hand Book of Economic Entomology, Vedams e Books, New Delhi.
2. Ministry of Agriculture, Government of India, 1995. Manual on Integrated Pest Management in Rice & Cotton.
3. John William S. 1995. Management of Natural Wealth, Loyola College Publications, Chennai.

16UZO2AL02 AGRICULTURAL ENTOMOLOGY LAB COURSE

SEMESTER:II CREDIT: 1
CATEGORYE: AL HOURS / WEEK: 2

Objective: To impart knowledge on plant protection from insect pests.

UNIT I : COLLECTION, PRESERVATION AND MOUNTING

Methods of collection, preservation and mounting of insects.

UNIT II : SURVEY AND IDENTIFICATION

Survey and identification of economically important pests of Paddy, sugarcane, cotton, groundnut and coconut.

UNIT III : LIFE CYCLE OF INSECT

Study of life cycle of Hemimetabolous and Holometabolous insects (at least one example each) – Study of parasitic and predatory insects (at least one example each) in relation to biological control.

UNIT IV : SERICULTURE

Study of silkworm rearing and bee keeping- insecticide formulation and IPM approaches.

UNIT V : Field trip to institutions of Agriculture and Record.

Text Books

1. Vasanthraj David, B and T. N. Ananthakrishnan, 2004. General and Applied Entomology, Second edition, Tata McGraw hill pubplishing company Ltd., New Delhi, Page 1-1184.

2. Vasanthraj David, B. 2001. Elements of Economic Entomology, Popular book Depot, Chennai.
3. Pruthi, H.S. 1969. Text book on Agricultural Entomology, I.C.A.R. Publication, New Delhi.

Reference Books

1. AbishekShukla, D. 2009. A Hand Book of Economic Entomology, Vedams e Books, New Delhi.
2. Ministry of Agriculture, Government of India, 1995. Manual on Integrated Pest Management in Rice & Cotton.
3. John William S. 1995. Management of Natural Wealth, Loyola College Publications, Chennai.

16UPB3MC01–MICROBIOLOGY

SEMESTER:III CREDITS:4
CATEGORY:MC HOURS / WEEK:4

Objectives:

1. *To provide information on the classification, growth, morphology and genetics of microbes and the recent advances in the field of microbiology. The role of microbes as beneficial and as pathogens is also studied.*
2. *To understand the applied aspects of microbiology in dairy industries, pharmaceuticals, food and waste water.*

Unit 1: Introduction (1 + 10 + 1)

History-place of microorganisms in the living world – general groups of microorganisms - major characteristics of microorganisms- Six kingdom classification (CarlWoese, 1977);Bergey's Manual of Systematic bacteriology (major groups) characterization- microscopic examination-staining (simple, differential and special types).

Unit 2: Morphology and fine structure of bacteria (1 + 10 + 1)

Size, shape and arrangement of bacterial cells - ultra structure –Cultivation of bacteria: nutritional types-culture media types -physical conditions- Reproduction: mode of cell division-Growth: normal growth curve, synchronous -Quantitative measurement of bacterial growth. Pure cultures: methods of isolation-maintenance and preservation.

Unit 3: Microbial physiology and Genetics(1 + 10 + 1)

Microbial enzymes and their application -Energy production: anaerobic-fermentation (glycolysis to alcohol production -aerobic respiration (Kreb's cycle)– Bacterial photosynthesis (light and dark reaction - basic aspects only)-Bacterial recombination: conjugation (F^- to F^+, Hfr, merozygotes) – transduction (generalized and specialized) – transformation (mechanism).

Unit 4: Viruses (1 + 10 + 1)
General characteristics – structure – composition. Classification of Plant and Animal viruses – cultivation-replication – Bacteriophages: morphology & structure of T4 and λ phage – classification- viral vaccines: Rabies and HIV.

Unit 5: Applied microbiology(1 + 10 + 1)
Soil microbiology: Interactions of Microbial flora- rhizosphere - Biogeochemical cycles-N, C, P, S- Aquatic microbiology: fresh water, domestic wasteand sewage water treatment process.Food microbiology: microbial flora-microbial spoilage-preservation. Industrial microbiology: Production of Lactic acid and Vinegar.

BOOKS FOR STUDY:

1. Pelczar, Chan and Kreig, 1993. Microbiology – 5th edition, Tata McGraw-Hill Co Ltd. New Delhi.
2. Ananthanarayanan, R and Panicker, C.K.J. 2002. Text book of Microbiology. VI Edition, Orient Longman, Chennai.
3. Prescott, Haley, Klein, 1993. Microbiology-WCB Publishers, England, Second Edition

BOOKS FOR REFERENCE:

1. Buge, E. 1992. Modern Microbiology – Principles and Application – WMC Brown Publishers.
2. Volk Wesley and Wheeler, 1980. Basic Microbiology – J.B. Lippincott and Co. Philadelphia, USA.
3. Perry, J.J. and Staley, J.T. 1997. Microbiology: Dynamics and Diversity, Saunders College Publishing – USA.
4. Powar, C.B. and Daginawala, 1991. General Microbiology Vol I and II – Himalaya Publishing house, Bombay.

E-BOOKS:

1. Benson, 2001. "Microbiological applications, Laboratory manual in general Microbiology". Eight Edition. McGraw –Hill Companies.
2. Scharlau, " Handbook of Microbiological Culture Media". 10th edition.Scharlau.
3. Prescott, H. 2002. Laboratory excercises in Microbiology".5th edition. The McGraw- Hill Companies.
4. Prescott, L. M. 2002. Microbiology, 5th edition. The McGraw- Hill Companies.

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16UPB3MC02– CELL BIOLOGY AND EVOLUTION

SEMESTER: III CREDITS: 4
CATEGORY: MC HOURS / WEEK: 4

Objectives:

1. *To make the student to understand the organization of prokaryotic and eukaryotic cell, structure and function of organelles and cell division.*
2. *To give an insight into evolution of organisms.*

Unit 1: Introduction(1 + 10 + 1)

History, microscopy: Light, dark field, phase contrast, fluorescent, SEM and TEM. Cell Theory – Structure of prokaryotic and eukaryotic cell. Cytoplasm and its properties.

Unit 2: Organelles(1 + 10 + 1)

Structure and function of cell wall, plasma membrane, ribosomes, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus.

Unit 3: Chromosome(1 + 10 + 1)

Chromosomalnomenclature- chromatids, centromere, telomere, satellite, secondary constriction.Organization of chromosomes- Nucleic acid and histones- types and classification.Lampbrush chromosomes and polytene chromosomes- Karyotype and idiogram.

Unit 4:Cell division(1 + 10 + 1)

Cell cycle: G0, G1, S and G2 phases – mitosis: open and closed mitosis – amitosis - meiosis.Mitotic abnormalities.

Unit 5:Evolution(1 + 10 + 1)

Origin of life- theories of organic evolution: Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, Mutation theory and synthetic theory- speciation and isolating mechanisms. Molecular evolution.

BOOKS FOR STUDY:

1. Verma, P.S and V.K. Agarwal, V.K. 2004. Cell Biology, Genetics Molecular Biology, Evolution and Ecology. S. Chand and Co. New Delhi.
2. Karp, G. 2012. Cell and Molecular Biolgy.John Wiley and sons, New York.
3. Roy, S.C and De, K. 1997. Cell Biology, New Central Book Agency (P) Ltd. Calcutta.

BOOKS FOR REFERENCE:

1. Cooper, G. M 1997. The cell – A molecular Approach, ASM Press Washington
2. Lodish,H., Berk, A., Zipursky, S.L., Matsudaira, P., Kaiser, A.. Krieger, Scott and Darnell, J. 2007. Molecular Cell Biology. W.H. Freeman.New York.

3. De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology, 8th Edition. Lippincott Williams and Wilkins, Philadelphia.

16UPB3MC03– LABORATORY COURSE: III
(MICROBIOLOGY, CELL BIOLOGY AND EVOLUTION)

SEMESTER: III CREDITS:4
CATEGORY:MC HOURS / WEEK:4

MICROBIOLOGY

1. Different Microscopy – microbial photographs.
2. Model preparation – shape & arrangement of bacteria.
3. Sterilization: moist heat – dry heat- radiation- filtration.
4. Preparation of culture media, special types of medium.
5. Pour plate- spread plate, streak plate-serial dilution – hanging drop.
6. Microbial examination of different habitats.
7. Smear preparation – Gram staining, endospore staining, capsular staining and fungal staining, IMVIC test.
8. Industrial products as mentioned in theory.
9. Microbial enzyme screening: amylase, protease, lipase, cellulase.
10. Visit to microbiological lab/ microbe based industry.

CELL BIOLOGY & EVOLUTION

1. Study of organelles / inclusions.
2. Microscopy.
3. Micrometry
4. Mitosis (squash)
5. Meiosis (smear)
6. Polytene chromosomes.
7. Measurement of cell dimensions.
8. Spotters on Evolution.

16UCH3AL03 GENERAL CHEMISTRY FOR BIOLOGY-I

UG Offered to: Adv. Zoology & Plant Biology
Category: AL Credits: 2
Semester: III Hrs/Wk: 4

Objective

To enable the students understand the concepts of chemistry.

Unit 1: Handling of Chemicals and Data Analysis (1+13+1)

1.1 Storage and handling of chemicals: Handling of acids, ethers, toxic and poisonous chemicals. Antidotes, first aid procedure.

1.2 Errors in chemical analysis: Accuracy, precision. Types of error-absolute and relative errors.Methods of eliminating and minimizing errors.

1.3 Separation techniques: Solvent extraction. Principle of adsorption and partition

chromatography, paper chromatography, thin layer chromatography, column chromatography and their applications

Unit 2: Chemical Bonding (1+13+1)

2.1 Ionic Bond: Characteristics of ionic compounds, Structure of NaCl and CsCl, Factors influencing the formation of ionic bond.

2.2 Covalent Bond: Characteristics on covalent compounds. Structure of CH_4, NH_3, H_2O based on hybridisation.

2.3 Coordinate Bond: Nature of coordinate bond. Coordination complexes - Werner's theory.Isomerism in square planar and octahedral complexes.Structure and functions of chlorophyll and hemoglobin.

2.4 Hydrogen Bond: Types, theory and importance of hydrogen bonding. Hydrogen bonding in carboxylic acids, alcohol, amides, polyamides, DNA and RNA.

2.5 Stabilizing forces in protein and DNA, van der Waal's forces, dipole-dipole and dipole-induced dipole interactions.

Unit 3: Volumetric Analysis (1+8+1)

3.1 Methods of expressing concentration: normality, molarity, molality, ppm, ppb.

3.2 Primary and secondary standards: preparation of standard solutions

3.3 Principle of volumetric analysis: end point and equivalence point.

3.4 Strong and weak acids and bases - Ionic product of water, pH, pK_a, pK_b. Buffer solutions, Henderson-Hasselbalch equation and its significance.

Unit 4: Kinetics and Catalysis (1+8+1)

4.1 Chemical Kinetics: Rate, rate constant, rate law, order and molecularity. Derivation of rate expression for the first order reaction.

4.2 Catalysis-Homogeneous and heterogeneous catalysis.

Unit 5: Chemistry of Biomolecules (1+8+1)

5.1 Fats – Occurrence and composition. Hydrolysis of fats.

5.2 Vitamins – Source, provitamin, properties and classification. Structure and function of vitamin A, C, D, K and E

5.3 Hormones – Thyroxin, adrenaline and sex hormones (structure and functions only)

Books for study

1. R. Gopalan, S. Sundaram, *Allied Chemistry*, Sultan Chand & Sons (P) Ltd, 4thedn.,2006.
2. U. N. Dash, *Analytical Chemistry: Theory and Practice*, Sultan Chand and sonsEducational Publishers, New Delhi, 2011.
3. U. Sathyanarayana, *Biochemistry*, Books and allied (P) Ltd, 4thedn.,2013.
4. B.R.Puri and L.R.Sharma, M.S. Pathania,*Principles of physical chemistry*, Vishal Publication Co., 46thedn., 2013.

Books for reference

1. D.A. Skoog, D.M. West, F.J. Holler, *Analytical Chemistry: An Introduction*, Saunders college publishing, 5thedn.,1998.
2. B.R. Puri, L. R. Sharma, K. C. Kalia, *Principles of Inorganic Chemistry*, ShobanLalNaginChand and Co., 2014.
3. G.C. Hill, J.S. Holman, *Chemistry in Context*, ELBS, 1998.
4. W.R. Kneen, M.J.W. Rogers, P. Simpson, *Chemistry – Facts, patterns and principles*, ELBS, 1999.

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16UCH3AL04 CHEMISTRY PRACTICAL FOR BIOLOGY-I

UG Offered to: Adv. Zoology & Plant Biology
Category: AL Credit: 1
Semester: III Hrs/Wk: 2

Objective
To understand the principle and carry out the qualitative organic analysis systematically.

Organic Analysis
a) Detection of nitrogen, sulphur and halogens
b) Tests for aromaticity
c) Tests for saturation
d) Identification of chemical nature (acidic/basic/neutral) and the following functional groups
   i) Carboxylic acid
   ii) Phenols
   iii) Aldehydes
   iv) Ketones
   v) Carbohydrates
   vi) Primary amines
   vii) Amides

Books for study

1. V.Venkateswaran, R.Veeraswamy and A.R.Kulandaivelu, *Basic Principles of Practical Chemistry*, 2nd edn.,S.Chand Publications, New Delhi, 2004.
2. N.S. Gnanapragasam, G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.
3. Raj K.Bansal, *Laboratory Manual of Organic Chemistry*, 4th edn., New AgePublishers, 2001.
4. J.N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry* (Organic), S. Chand and Co., 1987.

16UPB4ES01– BIOLOGICAL TECHNIQUES

SEMESTER: IV CREDITS: 3
CATEGORY: ES HOURS/WEEK: 4

Objectives:
1. *To make the student become familiar and to help understand microtechniques, herbarium preparation and Karyotyping.*
2. *To understand working principle of various instruments used in biological studies.*

Unit 1: Microtechniques I(1 + 10 + 1)
Introduction to microscopy –Plantphotography: Macrophotography, Microphotography and photomicrography-camera lucida- micrometry-Haemocytometer. Microtechniques: selection of material, fixation, dehydration, infiltration of wax, embedding, sectioning (Microtomy), staining

(classification of stains- single, double and triple staining -Nuclear,cytoplasmic and cell wall stains) andmounting.

Unit 2:Microtechniques II(1 + 10 + 1)

Preparation of permanent slide,leaf clearing, smear and squash techniques. Methods for specific materials: (a) Whole mount of Algae and Fungi, (b) Sectioning of Bryophytes, Pteridophytes and Gymnosperms (c) Maceration and sectioning of angiosperm materials.Herbarium: collection, drying, pasting of plant specimen, protection of herbarium and importance. Idiogramand Karyotyping.

Unit 3: pH and Centrifugation(1 + 10 + 1)

pH meter: Principles and instrumentation, Centrifugation : Principles, types of centrifuges, types of rotors, application. Sonication,Freezedrying.

Unit 4: Spectrophotometry(1 + 10 + 1)

Spectrophotometric techniques, Instrumentation: ultraviolet and visible spectrophotometry (single and double beam, double wavelength spectrophotometers), Spectrofluorimetry, Infrared spectroscopy - Atomic emission and atomic absorption spectroscopy - Luminometry – principles and their applications - Mass Spectroscopy- principles of analysis, application.

Unit 5: Chromatography(1 + 10 + 1)

Chromatographic techniques: Principle and applications – Column - thin layer - paper and gas chromatography - Gel filtration - Ion exchange and High performance liquid chromatography - Applications - Basic principles of electrophoresis and PCR.

BOOKS FOR STUDY:

1. Upadhyay A, Upadhyay K, Nath N 2009. Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House, Delhi.
2. Wilson K and Walker J. 2005. Biochemistry and Molecular Biology. Cambridge University Press.
3. Johanson D. A. 1940.Plant Microtechniques.Tata McGraw Hill.
4. Gray P 1964, Hand Book of Basic Microtechniques, McGraw Hill.

BOOKS FOR REFERENCE:

1. Palanivelu P 2009. Analytical Biochemistry and Separation Techniques. Twenty-first Century Publications, Madurai.
2. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
3. K. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn) Edward Arnold, London.
4. Sase John E 1964, Botanical Microtechnique, Oxford IBH
5. Alan Peacock H 1966, Elementary Microtechnique; Edward Arnod Publishers Ltd.
6. Duddington C.L. 1960, Practical Microscopy, Pitman, New York.
7. McCluney C.L 1961, Hand Book of Microscopical Technique, Wafner

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16UPB4ES02–BIOLOGICAL TECHNIQUES LAB

SEMESTER: IV CREDITS:1
CATEGORY: ES HOURS / WEEK:2

1. Drawingusing camera lucida.
2. Measurement of cell size using micrometry.
3. Preparation of whole mounts of algae and fungi.
4. Simple and double staining methods.
5. Study on components of wood materials using maceration technique.
6. Karyotyping
7. Buffer preparation and setting pH using pH meter.
   Demonstration:
8. Separation of cell and tissue components by centrifugation.
9. Separation of aminoacids by paper chromatography.
10. Separation of compounds from crude extracts using thin layer chromatography.
11. Separation of plant compounds from crude extractsusing column chromatography.
12. Absorption spectrum of macromolecules and pigments using spectrophotometer.
13. Separation of proteins using SDS-PAGE.

16UPB4ES03– HORTICULTURE AND LANDSCAPING

SEMESTER: IV CREDITS: 3
CATEGORY: ES HOURS/WEEK: 4

Objectives:

1. *To provide the students a theoretical knowledge of horticulture so as to establish home gardens scientifically.*

Unit 1: Introduction(1 + 10 + 1)

History of gardening in India – some famous gardens of India.Garden implements and accessories.Olericulture: classification of vegetables. Kitchen garden – planning, culture, Pomology: classification, planning, culture, watering, manuring, pruning and fruit picking. Hydroponics.

Unit 2: Nursery structures (1 + 10 + 1)

Store house, potting and packing shed, nursery beds, mist chamber, propagating frames, hot beds, green house and glass house. Nursery management: Vegetative propagation – cuttings, layering, grafting, preparation of grafting clay, wax, solution and cloth. Pot culture: Selection of pots, preparation of soil mixture, potting repotting and pot arrangements and watering. Organic farming: Vermiculture and composting.

Unit3:Garden and its parts(1 + 10 + 1)

Fencing hedge, borders, flower beds, edgings, lawn, steps, drives and paths, water garden, rockery, shrubbery and carpet bedding, roof gardening and Bonsai. Garden adornments:

Terrarium, arches, pergolas, statuettes, tubs, vases, floral clocks. Routine garden operations: Soil sterilization, seed sowing, prickling, planting and transplanting, shading pinching, deshooting, disbudding, defoliation, staking, pruning, wintering, clipping, mulching, topiary.

Unit4: Landscaping(1 + 10 + 1)
Principles, categories and components of landscaping -Planning designs for residential and non-residentialgardens- vertical landscaping-Plants in the landscape - maintenance of lawns.

Unit5: Commercial Floriculture(1 + 10 + 1)
Floral ornaments and flower arrangements: Garlands and other floral ornaments, floral bouquets, rangoli and hair decorations. Cultural practices of rose, jasmine, cut flowers and its importance. Methods to prolong cut flower life. Export potential from Tamil Nadu.

BOOKS FOR STUDY:

1. AnthonyYoudeowei, Ezedinma F.O.C., and Ochapa C. Onazi, 1986. Introduction to Tropical Agriculture (edited). English Language Book Society (ELBS).Longman.
2. George Acquaah, 2002. Horticulture Principles and Practices.2nd edition.Pearson Education (Singapore) Pvt.Ltd.,
3. LateeqFutehally, 1997. Gardens.3rdedition.National Book Trust. India.
4. Randhawa, G.S. and AmitabhMukhopadhyay, 1986. Floriculture in India.Allied Publishers Pvt. Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Edmund, Senn and Andrews (1981). – Fundamentals of Horticulture. Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Percy Lancaster (1979) – Gardening in India. Mohan Makhijani and Rekha Printers, New Delhi.

E-BOOKS:

1. Lang G. M., 2007. The Green World – Horticulture.Chelsea House Publishers.

16UPB4ES04–HORTICULTURE AND LANDSCAPING LAB

SEMESTER: IV CREDIT:1
CATEGORY: ES HOURS / WEEK:2

Practicals
1. Identification of commonand ornamental plants
2. Types of pots and containers
3.Manures, fertilizers, insecticides, fungicides and plant growth regulators.
4.Role of plant growth regulators in rooting of cuttings.
5. Different types of layering and grafting.
6. Flower arrangement - fresh and dry.
7. Decoration using fruits, vegetables and dry plants
8. Identification of common diseases and pests of fruit and vegetable crops
9. Visit to a botanical garden in Chennai and out stations.

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16UPB4MC01–ANGIOSPERM TAXONOMY ANDECONOMIC BOTANY

SEMESTER: IV CREDITS: 4
CATEGORY:MC HOURS / WEEK: 4

Objectives:

1. *To know the basic principles involved in classification, naming and identification of angiospermic plants.*
2. *To expose the students to the diagnostic features of selected families and to know the economically important plantproducts and their utilization.*

Unit 1: Taxonomy- fundamentals(1 + 10 + 1)

Origin of angiosperms - Taxonomy: Objectives, importance and scope –History of classification- Conceptual bases of plant classification: Bentham & Hooker and Angiosperm phylogeny Group (APG) system (outline only) - taxonomic hierarchy - Botanical keys: Construction of dichotomous keys – Indented and bracketed keys – computer aided interactive and identification keys(DELTA System).

Unit 2: Nomenclature and Herbarium techniques(1 + 10 + 1)

Plant nomenclature:major provisions of the International Code ofNomenclature (ICN): Effective and Valid publication, Rule of Priority,typification – author citation- rejection and retention of names – Herbarium techniques – Modern trends in Plant taxonomy: Introduction to cladistics and molecular taxonomy.

Unit 3: Type studies – I(1 + 10 + 1)

Detailed study of the diagnostic characteristics and economic importance of the following families: *Nymphaeaceae*, *Annonaceae*, *Rutaceae, Fabaceae, Capparidaceae, Anacardiaceae, Cucurbitaceae.*

Unit 4: Type studies – II(1 + 10 + 1)

Detailed study of the diagnostic characteristics and economic importance of the following followingfamilies:*Rubiaceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae,Amaranthaceae, Euphorbiaceae, Orchidaceae*and*Poaceae.*

Unit 5: Economic Botany(1 + 10 + 1)

A brief study of the following economically important plants: Brief history, botanical name, family, uses(nutritional aspects, active compounds and importance) and morphology of the useful parts of any threeCereals: Rice, Wheat and Maize, Millets: Ragi, Bajra and Jowar,Pulses: Red gram, Black gram and Ground nut;Spices: Cinnamon, Clove and Cardamom;Condiments: Ginger, pepper and Chilli; Essential oils: Sandal wood oil, Eucalyptus oil and Lemon grass oil; Edible oil: Sesame oil, Coconut oil and Sunflower oil;Medicinal plants: Asafoetida, Indian periwinkle and Sweet flag;Fibre: cotton, jute and manilla hemp,Timber: Teak, Shisham and Bijasal;Narcotics: Opium, Ganja and Tobacco and Beverages: Coffee, Tea and Cocoa.

BOOKS FOR STUDY:

1. Rao K.N. and Krishnamurthy, K.V., 1994. Angiosperms. S. Viswanatham& Co.

2. Pandey ,B.P.,1992. Economic Botany. S. Chand & Co, New Delhi.
3. Gurcharan Singh, 2010. Plant Systematics, An integrated approach, Third edition.Science Publishers, Enfield, NH, USA.
4. Kochhar S. L. Economic Botany in the tropics(Fourth edition). Macmillan publishers India Ltd., Delhi.

BOOKS FOR REFERENCE:

1. Simpson, M.G. 2010. Plant Systematics, Second Edition. Academic Press.
2. Simpson, B.B and Ogorzaly, M, C. 2001. Economic Botany: Plants in our world, Third edition. McGraw-Hill Higher Education. New York.
3. Pandey B.P. 2000. Simplified course in Botany. S. Chand and Company Ltd. New Delhi.
4. Mitra J.N. Mitra D and Chowdhuri S.K.1990. Studies in Botany (vol.I) Mont Library, Calcutta.
5. Narayanaswami R.V., Rao K.N. and Raman,A. 2000. Outlines of Botany. S. Viswanathan and Co. Chennai.
6. Verma V.1998. A text book of Economic Botany.Emkay Publications. New Delhi.
7. Albert F Hill; P. P. Sharma, 1996. Hill's Economic Botany. Tata McGraw Hill. New Delhi.

16UPB4MC02–LABORATORY COURSE: IV
(ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY)

SEMESTER: IV CREDITS:2
CATEGORY: MC HOURS / WEEK:2

Taxonomy

1. Description of plants in technical terms.
2. A detailed study of vegetative and reproductive morphology of plants.
3. Study of diagnostic characters mentioned in the theory syllabus (1 material / family) *Nymphaeaceae,Annonaceae, Rutaceae, Fabaceae,CapparidaceaeAnacardiaceae, Cucurbitaceae, Rubiaceae, Apocynaceae, Solanaceae,Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae,Orchidaceae*and*Poaceae*.
4. Submission of field note books and 15 herbarium sheets (1 material from each family). Commonly available plants can be used for herbarium preparation. Herbarium sheets to be prepared and submitted during the semester practical examination.
5. Use of dichotomous key in the classification of the given specimens.
6. Economically important plant products of the families mentioned in unit III and unit IV of the theory syllabus.
7. Field trip to any place within or outside the state for three days to study the plants in their natural habitats. Field report to be submitted during the model practical examination.

Economic Botany:

1. Economically important plant products mentioned in unit V of the theory syllabus.
2. Submission of 5 economically important products with information on binomial, vernacular name and nature of product.

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16UCH4AL03: GENERAL CHEMISTRY FOR BIOLOGY-II

Category: AL | Credits: 2
Semester: IV | Hrs/Wk: 4

Objective

1. To understand the chemistry of biomolecules and natural products.
2. To understand the concepts of agricultural chemistry.

Unit 1: Proteins and Enzymes (1+10+1)

1.1 Amino acids: Classification, preparation and properties, zwitter ions, isoelectricpoint,peptide linkage and peptide synthesis.

1.2 Proteins: Classification based on structure and functions, primary and secondary structure, N-terminal analysis, denaturation and renaturation, test for protein- Ninhydrin Test, Biuret Test.

1.3 Enzymes: Classification, factors affecting enzyme activity, mechanism of enzyme action, kinetics of enzyme reaction. Michaelis-Menten equation (no derivation), types of enzyme inhibition.

Unit 2: Lipids (1+8+1)

2.1 Types and functions of lipids (fatty acids, glycerides, complex lipids and non-glycerides),fats and oils (rancidity,saponification, hydrogenation of oils), waxes, phospholipids (lecithins, cephalins, plasmalogens)

2.2 Steroids: structure and functions cholesterol, types and functions of plasma lipoproteins. Bile salts, steroid hormones.

Unit 3: Nucleic Acids (1+10+1)

3.1 Components of nucleic acids, structure of purine and pyrimidine bases, structure of DNA and RNA.

3.2 Hydrogen bonding in nitrogeneous bases in DNA, properties and types of DNA and RNA,differences between DNA and RNA.

3.3 Replication, translation and transcription of DNA, regulatory metabolism, mutation, genetic engineering, codon.

Unit 4: Carbohydrates (1+10+1)

4.1 Classification and functions of carbohydrates. Structure of glucose and fructose, interconversions, mutarotation.Differences between reducing and non-reducing sugars. Test for carbohydrates.

4.2 Structure of sucrose, inversion of cane sugar.

4.3 Glycolysis, TCA cycle, relationship between glycolysis and respiration, photosynthesis.

Unit 5: Natural Products and Agricultural Chemistry (1+12+1)

5.1 Alkaloids: Classification, isolation and biological importance (mention of papaverine, nicotine, coniine).

5.2 Terpenes: isoprene rule, classification, extraction and biological importance (mention of Camphor, Citral, and α-Pinene).

5.3 Flavones and flavonoids: Structure, isolation and importance.

5.4 Types of soil, soil analysis, fertilizers– role of macro and micro nutrients, NPK fertilizers, urea, superphosphate of lime and potassium nitrate.

5.5 Insecticides [dichlorodiphenyltrichloroethane (DDT) andbenzenehexachloride(BHC)],

herbicides [2,4-Dichlorophenoxyacetic acid (2,4-D) and 2,4,5-Trichlorophenoxyacetic acid(2,4,5-T)], fungicides (bordeauxmixture, lime-sulphur) – structure and uses.

Books for study

1. G.P. Talwar, L.M. Srivatsava and K.D. Moudgil, *Text book of Biochemistry and Human Biology*, Printice-Hall of India Pvt. Ltd.New Delhi, 2003.
2. J.L. Jain, *Biochemistry*, S. Chand & Co., 2004
3. A.Lehninger, D. L. Nelson, M. Cox and M. M. Cox, *Principles of Biochemistry*, MPS Publishers, New York, 2009.
4. A.V.S.S. Rama Rao, *Text Book of Biochemistry*, 9thedn.,U B S Publishers, 2008.
5. Gurudeep R. Chatwall, *Organic chemistry of natural products*, Vol-I&II, Himalaya publishing House Pvt.Ltd, Mumbai, 1981.

Books for reference

1. T.Palmer, P. Bonner, *Enzymes: Biochemistry, Biotechnology, Clinical Chemistry*,2ndedn., First East West Press Pvt Ltd., New Delhi2008.
2. J.M.Herg, J.L. Tymoczko,L. Stryer, 2002. *Biochemistry*, 5thedn., WH-Freeman and Co, New York.
3. KeshavTrehan, *Biochemistry*, Wiley Eastern Ltd, 1987.
4. E.J. Wood, W.R. Piekering, *Introducing Biochemistry*, ELBS, 1984.
5. K.H. Buchel, *Chemistry of Pesticides*, John Wiley & Sons, New York, 1983.

16UCH4AL04: CHEMISTRY PRACTICAL FOR BIOLOGY-II

Category: AL | Credit: 1
Semester: IV | Hrs/Wk: 2

Objectives

1. To understand the concepts of quantitative analysis
2. To understand the separation technique in the analysis of biologically important compounds

Experiments

1. Estimation of ascorbic acid using iodimetric method.
2. Estimation of glucose using benedict's method.
3. Estimation of acetic acid in vinegar.
4. Estimation of glycine.
5. Determination of hardness of water.
6. Determination of strength of H_2O_2.
7. Estimation of calcium in milk.
8. Determination of iodine value of oil.
9. Determination of saponification value of oil.
10. Determination of available chlorine in bleaching powder.
11. Determination of available iodine in table salt.
12. Determination of available CO_2 in baking powder.

Demonstration Experiments:
1. Column chromatography of leaf and flower extract.
2. TLC – Separation of triglycerides.
3. Paper Chromatography – Separation of amino acids.
4. Determination of pH of soil, water.
5. Tests for carbohydrates and amino acids

Books for study
1. R. Veeraswamy, V. Venkateswaran and A. R. Kulandaivelu, *Basic principles of practical Chemistry*, Sultan Chand & Sons, 2nd edn., 2015.
2. N.S. Gnanapragasam, G. Ramamurthy, *Organic chemistry–Lab manual*, S. ViswanathanCo. Pvt. Ltd., 2002.
3. J.N. Gurtu and R. Kapoor,*Advanced experimental chemistry*, S. Chand and Co.,1987.
4. R.Mukhopadhyay, P.Chatterjee, *Advanced practical chemistry*, 3rd edn.,Books and allied P.Ltd., 2007.

16UPB5ES01–PRINCIPLES OF AGRICULTURE

SEMESTER: V CREDITS:3
CATEGORY:ES HOURS / WEEK: 4

Objectives: *To expose students to principles of agriculture and agricultural practices. To have a basic understanding on agriculture in India with relation to soil types, climatic conditions etc.*

Unit 1: **Introduction(1 + 10 + 1)**
Introduction to Agriculture,Agriculture in India, Modern methods of cultivation. - Climatic elements as factors of crop growth, impact of changing environment on cropping pattern as indicators of environment. - Impact of high-yielding and short-duration varieties on shifts in cropping pattern.

Unit 2:Soil Factor (1 + 10 + 1)

Physical,chemical and biological properties - Classification of Indian soils - Mineral and organic constituents of soils and their role in maintaining soil productivity.Essentialplant nutrients and other beneficial elements in soils and plants.Principles of soil fertility - Use of fertilizer. Role of Nitrogen and phosphorus based fertilizers - Organic farming –Biofertilizers.Reclamation of soil.

Unit 3:Crop and water requirement(1 + 10 + 1)
Water-use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water. Drip and sprinkler irrigation.Drainage of water - logged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution.

Unit 4:Agricultural practices (1 + 10 + 1)
Implements, Seed bed preparation, ploughing, harrowing, sowing, weeding, leveling, transplantation.- Inter-cultivation, Crop rotation, harvesting, Post- harvest methods - Cultivation of paddy, ground nut and sugarcane, Kharif and Rabi crops. - Foliar sprays, Seed production.

Unit 5:Weed control(1 + 10 + 1)
Weeds, their characteristics, dissemination and association with various crops; their multiplication; cultural, biological and chemical control of weeds. Insect Pests, their characteristics, types, control measures, biological control, integrated pest management. - Agricultural extension - its importance and role.

BOOK FOR STUDY:
1.Shovan Ray (Ed). 2007. Handbook of Agriculture in India. Oxford University Press. New Delhi.

BOOKS FOR REFERENCE:
1. Kumar Arvind, 2006. Concepts of Tropical Agriculture.Eastern Books Coprporation. India.
2. Sreenivas, Y.S. 2009.Advances in Agricultural Research in India, Oxford Book Company.Jaipur.
3. RamanandSagar 2009.Advances in Agricultural Biotechnology.Cyber Tech Pub. New Delhi.
4. HemantRawat. 2008. Agricultural Biotechnology. Oxford Book Company. Jaipur.
5. Panda, S.C. 2005.Agronomy.Agrobios. Jodhpur.
6. Rajendra Reddy and J.P. Abhay Shankar. 2007. Encyclopaedia of Agriculture. Commonwealth Pub., New Delhi.

16UPB5ES02–PRINCIPLES OF AGRICULTURE LAB

SEMESTER:V CREDIT:1
CATEGORY:ES HOURS / WEEK:2

1. Soil testing: (Physical parameters) pH, salinity, temperature, water holding capacity, moisture Content.
2. Soil testing: (Chemical parameters): NO_3, P, K, Na, Ca, Mg.
3. Agricultural implements
4. Preparation of compost, organic manure, collection of biofertilizers, chemical fertilizers, Biopesticides.
5. Project on: Soil preparation, sowing, weeding, crop management and harvesting.
6. Seed testing: using tetrazolium chloride.

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16UPB5ES03–BIOINFORMATICS AND BIOSTATISTICS

SEMESTER: V | CREDITS: 3
CATEGORY: ES | HOURS / WEEK: 4

Objectives:

1. *To make the learner understand the basics of Bioinformatics and to give an insight into the applications of biological softwares in Biotechnology and related fields.*
2. *To provide details on the application of statistical methods in biology.*

Unit 1 Biological sequences and Databases(1 + 10 + 1)

Biological sequences-nucleotide, proteins, levels of protein structures, Internet basics, Biological databases- Nucleic acid, Proteins, Primary, secondary databases. Online journal databases- Pubmed, Medline.

Unit 2 Sequence analysis and Database searching(1 + 10 + 1)

Sequence alignment Techniques: Pairwise-local, global, Dotplot, Alignment algorithms, Needleman &Wunsch, Smith Waterman, applications of alignments, BLAST &FASTA – principles, types and applications. Multiple sequence alignment-ClustalW and Phylogenetic tree analysis (PHYLIP & MEGA).

Unit 3: Nucleic acid sequence based analysis & Protein sequence analysis and structure based predictions(1 + 10 + 1)

Identification and gene prediction of repeat sequences, orf's, splice site predictions, intron exon identification, genome comparisons and applications. Identification of Motifs, motif based databases, Prosite, Pfam. Visualization and analysis of protein 3D structures using visualizing tools- Rasmol.Molecular modelling - homology modeling and gene prediction.

Unit 4: Biostatistics(1 + 10 + 1)

Collection and presentation of data: Measures of Central Tendency – Mean, Median, Mode - Measures of dispersion – Standard deviation, variance and coefficient of variation.

Unit 5: Biostatistics(1 + 10 + 1)

Population and samples –methods of sampling – Probability - Chi – square – F- test and analysis of variance (One-way analysis) - simple correlation - linear regression analysis.Basics of SPSS, MS Excel.

BOOKS FOR STUDY:

1. Attwood T.K. and Parry Smith D.J. 2002 Introduction to Bioinformatics, Pearson Education Asia.
2. Arthur Lesk, 2002. Introduction to Bioinformatics OxfordUniversity Press
3.Khan and Khanum. 1994. Fundamentals of Biostatistics. Ukaaz Publications, Hyderabad.
4. Aaron Poh, 2015. SPSS Statistics for Dummies, 3rd edition. Wiley India Pvt Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. David W.Mount, 2001 Bioinformatics, University of Arizona, Tucson, Cold Spring Harbor Laboratory Press.
2. Padmanaban D. 2002. Bioinformatics for Beginners. KalaikathirAchchagam, Coimbatore.
3.Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers, Chennai.
4. Annadurai, B. 2007. Text Book of Biostatistics. New Age International, New Delhi.
5. Mariappan, P.2013. Biostatistics – An Introduction. Pearson. New Delhi.

E-BOOKS:

1. Mount, D. W. 2001. Bioinformatics Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press.
2. Lesk, A. M. 2002. Introduction to Bioinformatics. Oxford University Press Inc.
3. Ouellette B.F.F. and Baxevanis, A.D. 2001. Bioinformatics a Practical Guide to the Analysis of Genes and Proteins.2nd edition.Wiley Interscience.

16UPB5ES04–BIOINFORMATICS AND BIOSTATISTICS LAB

SEMESTER: V CREDIT:1
CATEGORY:ES HOURS / WEEK: 2

Bioinformatics

1. Nucleotide Sequence Databases: EMBL, GenBank, DDBJ
2. Basic Local Alignment Search Tool (BLAST)
3. Pairwise Alignment (Global and Local alignment)
4. Multiple Sequence Alignment Tools: Clustal W, phylogenetic tree
5. Protein Sequence Databases – PIR, Protein Family Databases –Pfam, Prosite
6. Protein Structure Databases – PDB, Protein Visualization Tools- Rasmol/Pymol

Biostatistics

1. data collection
2. Basics of SPSS
3. Sampling by random number table
4. Classification of data: Discrete, continuous and cumulative.
5. Statistical Diagrams: Histogram, Frequency curve, Bar chart, and Ogive curve.
6. Measures of central values: Mean, median and mode.
7. Measures of dispersion: Range, Mean deviation and standard deviation.

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16UPB5MC01–PLANT PHYSIOLOGY

SEMESTER: V CREDITS:4
CATEGORY:MC HOURS / WEEK:4

Objective:

To provide an insight into the physico-chemical organization and the functional aspects of plants.

Unit 1: Plant and Water relations (1 + 10 + 1)

Water – Properties and its relation to plants. Laws of thermodynamics and its physiological applications.Movement of water from soil to plants- Imbibition, Diffusion, Osmosis, Plasmolysis and Diffusion Pressure Deficit (DPD).Mechanism of water absorbtion and ascent of sap.Stomatal physiology– Transpiration, Guttation and Antitranspirants.

Unit 2: Mineral nutrition and absorption in plants (1 + 10 + 1)

Essential and non-essential elements, determination of essentiality of mineral elements, general functions of essential elements: specific role and deficiency symptoms. Hydroponics, aeroponics. Absorption and translocation of solutes (organic and inorganic) – active & passive uptake, Donnan's potential.

Unit 3: Photosynthesis (1 + 10 + 1)

Photosynthesis: Definition and its significance. Photosynthetic requirements – chloroplast and its pigments, Absorption of light energy, Excitation of atom or molecules- fluorescence and phosphoresence, Quantum requirements and yield. Red drop and Emmersons enhancement effect, quantosomes, action spectrum – mechanism of photosynthesis: light reaction, photophosphorelation and production of assimilatory power, dark reaction C3 & C4 pathway. CAM pathway, photorespiration.

Unit 4: Respiration and nitrogen assimilation(1 + 10 + 1)

Glycolysis, Krebs cycle and generation of ATP synthesis through oxidative electron transfer chain (Cytochrome system), chemiosmotic regeneration of ATP, Gluconeogenesis,
Sources of nitrogen – plants/soil, nitrogen assimilation and recycling (NR, NiR), symbiotic nitrogen fixation in legumes (N_2ase), amino acid synthesis, reductive and transamination process (GS, GDH, GOGAT). Relation between carbon and nitrogen metabolism.

Unit 5: Plant Growth and Development(1 + 10 + 1)

Growth: definition and kinetics- Hormonal regulation of plant growth and development Auxin, Gibberellic acid, Cytokinin, Ethylene and abscissic acid- Bioassay and mode of action. Physiology of flowering- phytochrome: Photoperiodismtypes– Vernalization– dormancy of seeds, methods of breaking dormancy, mechanism of seed germination– Basics of abiotic stress physiology (salinity, drought).

BOOKS FOR STUDY:
1. Devlin, O.P. 1974. Plant Physiology, Affiliated East West Press Pvt. Ltd. New Delhi.
2. Jain, V.K. 2005. Text Book of Plant Physiology, S. Chand & Company Ltd., New Delhi

BOOKS FOR REFERENCE:
1. Noggle, G.R. & Fritz, G. 1976. Introductory Plant Physiology, Prentice – Hall, India
2. TaizZeiger, Plant Physiology, II edition, 2002, Sinauer Associates, Inc Pub Sunderland, Massachuesetts
3. Salisbury, F.B. & Ross, S. 1974. Plant Physiology, Prentice – Hall, India

E-BOOKS:
1. Hopkins, W.G. and Huner, N.P.A. 2009. Introduction to Plant Physiology.4th edition. John Wiley & Sons, Inc.

16UPB5MC02– GENETICS AND PLANT BREEDING

SEMESTER: V CREDITS: 4
CATEGORY:MC HOURS / WEEK:4

Objectives:

1. To understand the principles of genetics and transfer of hereditary characters.
2. To make the student to understand the mechanisms of gene expression and its regulation.
3. To understand the process of crop improvement and hybridization.

Unit 1: Basic concepts of genetics (1+ 10 + 1)

History; branches of genetics and application of genetics. Epigenetics: introduction and application. Mendelism: Mendel's laws- law of segregation and law of independent assortment. Monohybrid crosses and its modification (incomplete dominance,codominance, heterodominance, lethal genes and pleiotropism)-Dihybrid cross.

Unit 2: Gene interaction and Sex linked inheritance(1+ 10 + 1)

Complementary genes, supplementary genes, epistatic genes, duplicate genes – polygenic gene interaction - sex linked inheritance : haemophilia and colour blindness in man - Sex determination in plants - Multiple alleles - cytoplasmic inheritance – linkage and crossing over – chromosome mapping- Genetic recombination: *Neurospora*tetrad formation.

Unit 3: Molecular Genetics(1+ 10 + 1)

Genetic material in prokaryotes and eukaryotes.DNA as the genetic material; structure and organisation of DNA; Supercoiling of DNA.Replication of DNA; semiconservative model of replication.Gene and its organization; the genetic code; cistron, recon and muton. Protein synthesis in prokaryotes; Regulation of gene expression in prokaryotes (*lac* and*tryp.*operon).

Unit 4: Chromosomal aberrations and Gene Mutations (1+ 10 + 1)

Chromosomal aberrations: duplication, deletion, inversion, translocation; chromosome disorders: Down syndrome and Klinefelters syndrome. Mutation and its significance - Addition, deletions, substitutions: transitions and transversion. Mutagens – physical and chemical agents-

Transposable elements in plants - DNA repair: proof reading – mismatch repair, excision repair, dark reactivation, recombinational repair and SOS- repair mechanisms.

Unit 5: Plant breeding (1+ 10 + 1)

Principles and objectives of Plant Breeding: Importance of plant breeding in India. Domestication and centres of origin of cultivated plants - Plant introduction - Selection methods: mass. Pure line and clonal selection and their importance. Hybridization: types, selection of parents; Methods-emasculation, bagging – heterosis – polyploidy and its role in plant breeding – Genetic erosion: reasons and preventive methods.

BOOKS FOR STUDY:

1. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of plant Breeding. Narosa Publishing House. New Delhi.
2. Singh, B.D. 2005. Plant Breeding, principles and methods (7th Revised and enlarged edition). Kalyani publishers, New Delhi.
3. George M. Malacinski, 2005. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House, New Delhi
4. Gupta,P.K. 2007. Genetics -Classical to modern. Rastogi Publications, Meerut, India.
5. Sambamurty, A.V.S.S., 2005. Genetics- second edition. Narosa publishing House, New Delhi.

BOOKS FOR REFERENCE:

1. George W. Burns, 1969. The Science of Genetics. An introduction to heredity. The Macmillan company. New York.
2. Karp, G. 1996. Cell and Molecular biology. John Wiley and sons Inc. New York, Singapore.
3. Gardener,J, Simmons, H.J and Snustad, D.P. 1991. Principles of Genetics (8th edition), John Wiley & Sons, New York.
4. Daniel Sundarraj and Thulasidas, G. 1972. Introduction to cytogenetics and Plant Breeding (III Edn.) Popular Book Depot. Madras.
5. DarbeshwarRoy, 2012. Plant breeding - A biometrical Approach. Narosa Publishing House, New Delhi.

E-BOOKS:

1.Acquah, G., 2007. Principles of Plant Genetics and Breeding.Blackwell Publishing.
2. Russel, P. J., 2010. Genetics a Molecular Approach.3rd edition. Benjamin Cummings.
3. Murphy, D. 2007. Plant breeding and Biotechnology. Cambridge. www. cambridge. org.

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16UPB5MC03 –ECOLOGY, PHYTOGEOGRAPHY AND FORESTRY

SEMESTER: V CREDITS: 4
CATEGORY: MC HOURS/WEEK: 4

Objective:
To introduce the students to the essential basics of ecology, phytogeography and forestry of India.

UNIT 1: Ecology I (1 + 10 + 1)
Plant Ecology: scope and importance- Environmental factors: ecological factors: physical, chemical, biotic and edaphic factors.Autecology and Synecology-Ecosystem: concepts – types, structure and function –Kinds of ecosystems: pond ecosystem, forest ecosystems and grass land ecosystem with examples-productivity and energy flow – food chains, food web and ecological pyramids. Gene ecology - basic concepts, ecotype, ecophenes, ecads.

Unit2:Ecology II(1 + 10 + 1)
Vegetation: units of vegetation- formation, association, consociation, faciation, society and clan.Development of vegetation: Migration- ecesis, colonization. Methods of study of vegetation: Quadrats and line transect. Plantsuccession- hydrosere and xerosere. Ecological classification of plants; morphological and anatomical features of plants and their correlation to the habitat factors – Biodiversity and its conservation- IUCN red list categories.

Unit3:Phytogeography(1 + 10 + 1)
Types of plant distribution: Continuous and Discontinuous distribution; Endemic distribution: theories on endemism and types of endemics-Theory of land-bridge and theory of continental drift, theory of polar oscillations or Shifting of poles, glaciations. Centers of origin and distribution of plants; Methods of dispersal, migrations and isolation; Factors influencing plant distribution; Floristic regions of the world;Biogeographical regions of India and vegetational types of Tamil Nadu.

Unit 4: Forestry I(1 + 10 + 1)
Silvics and Silviculture: principles; ecological and physiological factors influencing vegetation; natural and artificial regeneration of forests; nursery techniques; seed technology: collection, storage, pre-treatment and germination; establishment and tendings. Social forestry: objectives, scope, methods and necessity.Destructive forces: Shifting cultivation, fire losses and bad grazing practices. Destructive agencies: insect-pests and disease. Forest protection: Forest enemies, poaching, encroachment, improper management, damages by animals, birds, parasitic plants and climatic factors. Forest conservation:Sanctuaries, National parks and Biosphere reserves-Sacred groves(Community conservation)- Role of tribals.

Unit 5: Forestry II(1 + 10 + 1)
Forest Measurements: measurements of tree diameter, height, tree age and growth rate, and timber stand volume. Forest management:objectives,principles and techniques-forest inventory; aerial survey and remote-sensing techniques.Forest utilisation: Logging and extraction techniques ; transport, storage and sale of non-timber and major forest product- Policies and

Legislation:Indian Forest Policy of 1894 and 1952-Forest laws; necessity; general principles; Indian Forest Act, 1927; Forest Conservation Act, 1980; Wild-life (Protection) Act, 1972.

BOOKS FOR STUDY:

1. McManus B. Collins and Fred M White, 1981. *ElementaryForestry*. Reston Publishing Company, Inc., Reston, Virginia.
2. MacDonald, G.2003. Biogeography: Introduction to Space, Time and Life. John Wiley & Sons, Inc.
3. Sagreiya, K.P., 1967. *Forests and Forestry.* National Book Trust, India.
4. Odum E. P. 1983. Basic Ecology, Holt Saunders International Editions.
5. Kumar H. D 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.

BOOKS FOR REFERENCE:

1. Dwivedi, A.P., 1993. *A Text Book of Silviculture*. International Book Distributors, Dehra Dun.
2. Lal, J.B., 2003. *TropicalSilviculture*: *NewImperatives*: *NewSystems*, International Book Distributors, Dehra Dun.
3. Longman, K.A. and Jenik, J., 1987. *Tropical forest and its Environment*: ELBS, 2nd edn. London.
4. Shanmughavel, P., 2003: *Techniques in Forestry*,Pointer, Jaipur.
5. Simmons, I. G. 1979. Biogeography: Natural and Cultural. Edward Arnold Ltd.
6. Tiwari, K.M. and Singh, R.V., 1984. *Social Forestry Plantations*. Oxford & IBH Publishing Co., New Delhi.

7. Prabodh K. Maiti and Mait, P., 2011. Biodiversity: Perception, peril and preservation. PHI Learning Private Limited, New Delhi.

8. Asthana, D. K. and MeeraAsthana, 2006. Environment, Problems and solutions.S.Chand& Company Ltd. New Delhi.

16UPB5MC04–LABORATORY COURSE: V
(PLANT PHYSIOLOGY)

SEMESTER: V CREDITS: 2
CATEGORY:MC HOURS / WEEK: 2

1. Potato / Papaya petiole - osmoscope.
2. Determination of water potential by Dye method.
3. Determination of osmotic pressure.
4. Determination of relative water content.
5. Transpiration pull / Ganong'spotometer
6. Estimation of chlorophyll and carotenoids.
7. Separation of leaf pigments by paper chromatography.
8. Wiltmott's Bubbler on photosynthesis using different light and carbon di oxide concentration.
9. Estimation of carbohydrates, protein and total lipids
10. Ganong'sRespiroscope- Demonstration
11. Separation of leaf pigments by column chromatography - Demonstration.

12. Plant growth regulators- Demonstration.
13. Assay of Nitrate reductase and amylase

16UPB5MC05- LABORATORY COURSE: VI

(GENETICS AND PLANT BREEDING & ECOLOGY, PHYTOGEOGRAPHY AND FORESTRY)

SEMESTER: V CREDITS: 4
CATEGORY: MC HOURS / WEEK: 4

Genetics and Plant Breeding

1. Collection of Data(continuous and discrete); Arithmetic mean, standard deviation and standard error.
2. Chi square analysis.
3. Problems on Mendelian Genetics:Monohybrid crossand modification. Dihybridcross and modification.
4. Mapping of chromosomes.
5. Percent seed germination study.
6. Demonstration on emasculation.
7. Spotters related to plant breeding
8. Chromosomal abnormality using onion root tip.
9. Visit to plant breeding station.

Ecology, Phytogeography and Forestry

1. Vegetation analysis – Quadrat and line transect method.
2. Vegetation analysis using software (Biodiversity Pro and PAST).
3. Study of the morphological and anatomical features of hydrophytes, mesophytes, xerophytes, halophyte, epiphyte and parasite.
4. The light and dark bottle experiment for primary productivity study in the aquatic ecosystem.
5. Map of phytogeographical regions of India.
6. Identification of forest products: Wood, honey, latex, lacquer, resin, turpentine and gums.
7. Field trip.

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16UPB5SK01 –PRODUCTION OF MUSHROOM, BIOFERTILIZERS AND SINGLE CELL PROTEIN

SEMESTER: V CREDITS: 6
CATEGORY: SK HOURS/WEEK: 6

Objectives:

1. *To help the students to learn mushroom cultivation, bio-composting and biofertilizer production through hands- on- experience.*
2. *To enable the students to become self- employed/ entrepreneur.*

PRACTICAL

Mushroom Cultivation

1. Training on sterilization techniques (Glass wares, Medium, and Laboratory).
2. Microscopical observation of Mushrooms.
3. Media preparation; Isolation and purification of mushroom fungus.
4. Spawn preparations.
5. Cultivation of mushroom – conditions for cultivation of mushroom
6. Spawn running for *Pleurotus*spp and *Calocybe* spp.
7. Harvesting and preservation.
8. Determination of nutritional value: Proteins, sugars, lipids, crude fiber and ash contents.
9. Composting of solid waste generated in mushroom cultivation.

Biofertilizer Production

1. Isolation and mass cultivation of the following
   - *i.* *Rhizobium*
   - *ii.* *Azospirillum*
   - *iii.* Blue green alga (*Anabaena /Nostoc*)
2. Packaging of biofertilizers with carrier material.
3. Isolation and morphological characterization of VA mycorrhiza from soil.
4. Isolation and culture of Phosphate solubilizing microbes.

SCP production and quality testing:

1. Cultivation of *Chlorella* / *Spirulina*

Evaluation:

(i) I and II CA Practical tests with other components : 100
(ii) Regular lab assessment, report and viva-voce : 100
Average Total : 100

BOOKS FOR STUDY:

1. Nita Bahl, 2002. Hand Book on Mushroom Cultivation. 4th Edition, Vijay Primlani for Oxford & IBH Publishing Co., Press, New York, New Delhi.

2. Biswas, S, Datta, M and Nagachan, S.V. 2012. Mushrooms- A manual for cultivation. PHI Learning Private Limited, New Delhi.
3. Krishnamoorthy, 1999. Hand Book of Mushroom Cultivation. TNAU Publications, Coimbatore, TN, India.
4. SubbaRao, N. S., 1988, Biofertilizers in agriculture. Oxford & IBH Publishing Company, New Delhi.
5. SubbaRao, N. S., 1977, Soil microorganisms and Plant Growth. Oxford & IBH Publishing Company, New Delhi.
6. SubbaRao, N. S., 1998, Biofertilizers in agriculture and forestry. India Book House Ltd. New Delhi.

BOOKS FOR REFERENCE:

1. Chang, T.S. and Hayes, W.A. 1978. The Biology and Cultivation of Edible Mushrooms. Academic Press, New York.
2. M.C. Nair, C. Gokulapalan and Lulu Das, 1997. Topics on Mushroom Cultivation. Scientific Publishers, Jodhpur, India.

E-BOOKS:

1. "Training Manual on Mushroom Cultivation Technology. UNESCAP.www.unapcaem.org

16UPB6MC01– PLANT DISEASES AND MANAGEMENT

SEMESTER: VI CREDITS:4
CATEGORY:MC HOURS / WEEK:4

Objectives:

1. *To study about the plant diseases with special reference to southern India.*
2. *To understand the diseases, symptoms, causal organisms – etiology of the diseases and control measures.*

Unit 1: Plant Diseases (1 + 10 + 1)

Introduction, Concept, importance, history, classification, diagnosis and identification – Koch's postulates. Basic concepts of infection: Inoculum, inoculum potential, predisposition, penetration, infection, invasion, growth, reproduction and dispersal – Methods of infection: Mechanical forces and chemical weapons (enzymes, toxins and growth regulators). Pathogenic impacts: changes in the host (morphological, anatomical, physiological and biochemical).

Unit 2:Defence mechanisms(1 + 10 + 1)

Environmental impacts on disease development and epidemics Light, temperature, humidity and soil. Defence mechanisms: *Innate*: surface structures – structure of natural openings – inhibitors – suberised, lignified tissue – gum deposition – phenols – phenolic glycosides. *Induced*: hypersensitivity – histological – cork – abscission – biochemical: phenols and phytoalexins. Fundamental concepts on cross protection and induced resistance.

Unit 3: Symptomatology (1 + 10 + 1)

Study of the following diseases with reference to their incitants, symptom manifestation and control measures.Fungal diseases:Damping off of Mustard seedling, Club root of

cabbage,Powdery mildew of cucurbits, Ergot of Rye,Smut of *Sorghum*,Rust of wheat, Blast of Rice, Wilt of tomato andTikka of Groundnut.

Unit 4: Symptomatology (1 + 10 + 1)

Study of the following diseases with reference to their incitants, symptom manifestation and control measures.Bacterial diseases: Bacterial blight & Citrus canker, Mycoplasmaldisease: Little leaf of brinjal, Viral diseases :Bunchy top of Banana and Tungro disease of Rice, Nematode disease : Root knot disease of Potato, Insect disease: Galls, Other parasitic diseases of plants:*Cuscuta.*

Unit 5: Plant disease control (1 + 10 + 1)

Concepts on prophylaxis.Exclusion: Legislation – plant quarantine principles.Eradication – crop rotation, field sanitation, elimination of alternate hosts, soil treatment and seed treatments.Management strategies: chemical, environmental and – Disease forecasting.Microbial antagonists: Bacterial, Fungal and viral (mode of action, mass production and field application). Engineered resistance against fungal, viral and bacterial pathogens.

BOOKS FOR STUDY:

1. Mehrotra. R.S. 1980. Plant pathology. Tata McGraw Hill, New Delhi.
2. Rangaswamy, G. 1975. Diseases of crop plants in India. 2nd Edn. Prentice Hall, India

BOOKS FOR REFERENCE:

1. Bilgrami, K.S. and Dube, H.C. 1976. A text book of modern plant pathology.Vikas Publishing House Pvt. Ltd., New Delhi.
2. Pandey B.P. 1989. A text book of plant pathology, pathogen and plant diseases. S. Chand and Company Ltd., New Delhi.
3. Mukerji, K.G. &Bhasin , J. 1972. Plant diseases of India – A source book.Tata McGraw Hill, New Delhi.

E-BOOKS:

1. Agrios, G.N. 2005. Plant Pathology.5th edition.Elsevier academic Press.

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16UPB6MC02–HERBAL SCIENCES AND ETHNOBOTANY

SEMESTER: VI CREDITS:4
CATEGORY:MC HOURS / WEEK:4

Objectives:

1. *To know the elementary treatment of various morphological, anatomical and biochemical parameters used in the identification and utilization of medicinal plants in general.*
2. *To provide an overview of ethnobotany, methods of herbal preparation, tribal medicine and their importance in present day drug research.*

Unit 1: Pharmacognosy(1 + 10 + 1)

Introduction - history of Pharmacognosy - definitions and terms - Basic concepts: Preparation of drugs for commercial market - Organoleptic evaluation of drugs - Microscopic evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs - Classification of drug plants - individual drugs - drug adulteration & substitution.Export potential of herbs.

Unit 2:Organoleptic Study(1 + 10 + 1)

Detailed organoleptic study of *Adhatodavasica, Andrographispaniculata, Azadirachtaindica, Coriandrumsativum, Datura metal, Ecliptaalba, Emblicaofficinalis, Ocimum sanctum, Phyllanthusamarus, Ricinuscommunis, Vincarosea* and *Zingiberofficinale*. Plants in primary health care: common medicinal plants: *Tinospora, Acorus, Ocimum, Turmeric and Aloe*.

Unit 3: Herbal Preparations (1 + 10 + 1)

Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and gruel - Suppositories - Teas. Outline of occurrence, isolation, identification tests, therapeutic effects and pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.

Unit 4:Ethnobotany I(1 + 10 + 1)

Introduction, origin and basic notion of ethnobotanical study - Ethnobotany as an emerging science and its scope - Ethnobotany in India: Areas and recent studies - Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotanyin Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CIMAP and CARI.

Unit 5:Ethnobotany II(1 + 10 + 1)

Basic knowledge of tribes in India with special reference to Tamil Nadu - Todas, Irulas and Paliyars. Tribal economy - Schemes of state forests department for tribal development - Tribal knowledge towards disease diagnosis, treatment, medicinal plants. Traditional knowledge and IPR.Ethics of documentation.

BOOKS FOR STUDY:

1. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.

3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
4. SharolTilgner, N. D. 1999. Herbal medicine - From the heart of the earth.Edn. 1, Printed in the USA by Malloy Lithographing Inc.

BOOKS FOR REFERENCE:

1. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. NayaPrakash Publishers, Calcutta.
2. Datta&Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.
3. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
4. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
5. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi.

E-BOOKS:

1. Pharmacognosy, 2015. Wikipedia, the free encyclopaedia.
2. The Siddha Pharmacopoeia of India. Part-1, Volume-1 , 1st edition. Government of India, Ministry of Health and Family Welfare, Department of Ayurvda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (Ayush).

16UPB6MC03 – MICROBIAL TECHNOLOGY

SEMESTER: VI CREDITS:4
CATEGORY:MC HOURS / WEEK:4

Objective:

To provide information on the fundamentals of the fermentation process, strain improvement and culture, and the use of different microorganism for the production of avariety of industrial products.

Unit 1: Introduction to fermentation technology(1 + 10 + 1)

Chronology and components of fermentation processes - A general account on microbial biomass, enzymes, metabolites and recombinant products - Range of fermentation processes - Transformation processes.Isolation, preservation, optimization and improvement of industrially important microorganisms.

Unit 2: Fermentor and Media(1 + 10 + 1)

Fermentor - basic functions - body construction - aerators, agitators (impellers and spargers) - asepsis - containment - valves and steam traps - types of fermentors. Substrates for media preparation - Medium formulation – Sterilization of medium.Steps and methods in recovery of products.

Unit 3: Food dairy, beverages (1 + 10 + 1)

Single cell proteins (SCP)- SCP as food and feed – mass cultivation of *Spirulina*– Mycoprotein - Yogurt and cheese production.Alcoholic beverages – Beer and wine fermentation.

Unit 4: Pharmaceutical and related industries(1 + 10 + 1)
Antibiotics- sources and types- production of Penicillin and Streptomycin.Production of insulin and Hep B vaccine.Transformation of steroids. Vitamins- Production of vitamin B_{12}

Unit 5: Enzymes, Amino acids, Organic acids and other products(1 + 10 + 1)
Microbial enzymes- Production and application of amylase, protease, and lipase. Microbes used for amino acid production- production of L- glutamic acids - Organic acids: citric acid, acetic acid production - Bioplastics and Exopolymer production - Biofertilizers and biofuels.

BOOKS FOR STUDY:
1. Crueger F and AnnelieseCrueger, 2000. Biotechnology: Industrial Microbiology Panima publishing Corporation, New Delhi.
2. Stanley, P. F., Whittaker, A. and Hall, S.J., 1995. Principles of Fermentation technology First edn, Pergamon Press, UK.
3. Balasubramanian, D., Bryce, C. F. A., Dharmalingam, K., Green, J. and KunthalaJayaraman, 1998. Concepts in Biotechnology, COSIST Publications, India.
4. Adams, M.R. and Moss, M.O., 1995. Food Microbiology. New Age International Publishers, New Delhi.
5. Casida, L. E. Jr. 1996. Industrial Microbiology. New Age International Publishers, New Delhi

BOOKS FOR REFERENCE:
1. Alexander N. Glazer and Hiroshi Nikaido, 1994. Microbial Biotechnology: Fundamentals of Applied microbiology. W.H. Freeman and Co., New York.
2. Satyanarayana U. 2010. Biotechnology, Books and Allied (P) Ltd. Kolkata.

E-BOOKS:
1. Stanbury, P.F., Whitaker, A. Hall, S. J. Principle of Fermentation Technology. 2nd edition, Butterworth Heineman.

16UPB6MC04 – ENVIRONMENTAL BIOTECHNOLOGY

SEMESTER:VI CREDITS:4
CATEGORY:MC HOURS / WEEK:4

Objectives:
1. *To give an insight intoenvironmental pollution and microbial processes in the environment.*
2. *To provide knowledge on the use of microbes for a safe environment and in the treatment of hazardous waste using biotechnological processes.*

UNIT 1: Environment (1 + 10 +1)
Component of the environment: atmosphere, hydrosphere, lithosphere and biosphere. Impacts of biosphereon the environment.Pollution and its causes: Air pollution, water pollution (heavy metal pollution and thermal pollution) and soil pollution (pesticide pollution).Types of pollutants and their fate in the environment- Global climate change.

UNIT 2: Bioremediation(1 + 10 +1)
Introduction to bioremediation – types of bioremediation – factors influencing bioremediation – bioremediation mechanisms – microbes in bioremediation – Bioremediation techniques: e*x situ* and *in situ* bioremediation –Phytoremediation - Types of reactors/plants used in bioremediation.

UNIT 3: Treatment of Polluted water and effluents (1 + 10 +1)
Biological treatment of sewage - characteristics of sewage and objectives in sewage treatment- Biological treatment: attached growth system- Biofilm kinetics - Trickling filters – Rotating biological contactors – Suspended growth system: Activated sludge process - Anaerobic digestion- Oxidation ponds. Tertiary treatment: nitrogen and phosphorus removal- disinfection - removal of heavy metals and pesticides by biosorption - Removal of oil spills by microbes.

UNIT 4: Treatment of Polluted Soil and air(1 + 10 +1)
Soilpollution by xenobiotics.Biodegradation of xenobiotics- Pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.Pollution by radionuclides - uptake of radionuclides from polluted sites - Purification of polluted air using biofilters.

Unit 5:Biometallurgy, Clean energy and fuel from biomass(1 + 10 + 1) Biomineralization-Biomining and Bioleaching: chemistry and types of bioleaching; Examples of bioleaching(Copper, Uranium and Gold) Bioenergy from biomass: production of bioethanol, biofuels,biogas and hydrogen-Biodegradable plastics- Biopesticides- Non-conventional energy resources.

BOOKS FOR STUDY:
1. Dubey, R.C. 2004. A text book of Biotechnology. S.Chand& Company Ltd. New Delhi.
2. Joseph, C, Daniel. 1996. Environmental aspects of microbiology. British Sun Publication.
3. Monica Jain, 2014. Environmental Biotechnology. NarosaPublishingHouse Pvt. Ltd. New Delhi.
4. Rajendran, P and Gunasekaran, P. 2007. Microbial Bioremediation. MJP Publishers. A unit of Tamil Nadu, Book House, Chennai.
5. Sharma,P.D. 2005. Environmental Microbiology. NarosaPublishing House Pvt. Ltd. New Delhi.
6. Sharma, P.D. 2009. Ecology and Environment. Rastogi Publications, Meerut- New Delhi.

BOOKS FOR REFERENCE:

1. Raina, M. Maier, Ian L.Pepper, Charles P. Gerba ,2000. Environmental Microbiology. Academic Press. UK.
2. Alexander N. Glazer and Hiroshi Nikaido, 1994. Microbial Biotechnology: Fundamentals of Applied microbiology W.H. Freeman and Co., New York.
3. Special Issue on Bioremediation & Biodegradation. *Indian Journal of Experimental Biology,* September 2003. Vol.41(9). National Institute of Science Communication and Information Resources, CSIR, New Delhi.
4. Prabodh K. Maiti and Mait, P., 2011. Biodiversity: Perception, peril and preservation. PHI Learning Private Limited, New Delhi.
5. Rana, S.V.S., 2010. Environmental Biotechnology. Rastogi Publications, Meerut, India.
6. Alan Scragg, 1999. Environmental Biotechnology. Pearson Education Limited.
7. Asthana, D. K. and MeeraAsthana, 2006. Environment, Problems and solutions.S.Chand& Company Ltd. New Delhi.

E-BOOKS:

1.Cheremisinoff, N. P. 1996. Biotechnology for waste and waste water treatment. Noyes Publications.
2. Evans, G. M. and Furlong, J. C. 2003. Environmental Biotechnology Theory and Application.John Wiley and Sons, Ltd.,
3. Jordening, H. J. and Winter, J, 2005. EnvironmentalBiotechnologyConcepts and Applications. Wiley-VCH VerlagGmbM& Co. KGaA

16UPB6MC05–LABORATORY COURSE: VII
(PLANT DISEASES AND MANAGEMENT; HERBAL SCIENCES AND ETHNOBOTANY)

SEMESTER: VI CREDITS: 4
CATEGORY: MC HOURS / WEEK: 4

Plant Diseases and Management

1. Study on the incitants, symptoms of locally available fungal, bacterial and viral diseases.
2. Preparation of PDA, NA and Nutrient Broth.
3. Isolation of plant pathogens from infected tissues and verification (Demonstration).
4. Evaluation of fungicide: Slide germination technique and inhibition zone technique.
5. Estimation of flavonoids and phenols in diseased and healthy plants.
6. Spotters: Botanicals, Microbial pesticides; Predators and parasites; Chemicals (Organic and inorganic).
7. A survey of plant diseases in and around Chennai – Specimen collection and Herbarium preparation (10).

Herbal Sciences and Ethnobotany

Organoleptic studies of plants mentioned in the theory in the following aspects.

1. Morphological studies of vegetative and floral parts.

2. Microscopic preparations of root, stem and leaf.
3. Stomatal number and stomatal index.
4. Vein islet number.
5. Palisade ratio.
6. Fibres and vessels (maceration).
7. Starch test.
8. Proteins and lipid test.
9. Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.
10. Calcium oxalate crystals in powdered crude drug.
11. Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins & resins.
12. Any 5 herbal preparations.
13. Documentation of local knowledge on medicinal plants – report submission.

16UPB6MC06 –LABORATORY COURSE: VIII
(MICROBIAL TECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY)

SEMESTER: VI CREDITS: 4
CATEGORY: MC HOURS / WEEK: 4

Microbial Technology

1. Sterilization, media preparation.
2. Screening of microbes for various products (Enzymes).
3. Demonstration of Fermentor operation.
4. Batch culture Technique a) Still culture & b) Shake culture.
5. Growth measurement in batch fermentation.
6. Cultivation yeast – biomass production.
7. Ethanol production.
8. Wine fermentation.
9. Citric acid production.
10. Glutamic acid production.
11. Visit to Biotech Industries.

Environmental Biotechnology

1. Estimation of Dissolved oxygen.
2. Estimation of BOD.
3. Potability of water (MPN Technique).
4. Determination of acidity of water.
5. Determination of alkalinity of water.
6. Determination of hardness of water.
7. Hydrolysis of starch.
8. Biodegradation of Petroleum hydrocarbons.
9. Field visit to sewage treatment plant.

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16UPB6MS01– PLANT BIOTECHNOLOGY

SEMESTER: VI CREDITS: 3
CATEGORY: MS HOURS / WEEK: 4

Objectives:

1. *To understand the fundamental aspects of plant tissue culture and molecular biology of plants for the production of transgenics.*
2. *To understand the concepts of modern technology pertaining to large scale production of agricultural products.*

Unit 1: Plant Molecular Biology (1 +10 + 1)

Organization and expression of nuclear genome(*Arabidopsis thaliana*), mitochondrial and chloroplast genome.Transcription and post-transcriptional modifications in plants.Translation and post-translational modifications in plants.

Unit 2: Genetic Engineering(1 +10 + 1)

Restriction enzymes, Cloning Vectors: plant viruses, bacteriophages, yeast, artificial vectors pBR 322 YAC, binary vectors, shuttle vectors, gene library, cDNA library, molecular probes. Molecular techniques: Electrophoresis, Southern, Northern, Western & Slot blots. Polymerase Chain Reaction.DNA sequencing.

Unit 3: Plant transformation(1 +10 + 1)

Gene delivery system: Particle gun bombardment, microinjection, electroporation. Genetic transformation of plants by *Agrobacterium*: Genetic organization of Ti plasmids - Functions encoded by integrated T- DNA. Molecular mechanism involved in transformation of plants by *Agrobacterium tumefaciens.*Promoter and marker genes in plant transformation.Criticism regarding the use of different promoters and markers.

Unit 4: Plant Tissue Culture (1 +10 + 1)

Definitions, scope & history of plant tissue culture.Importance of plant tissue culture & biotechnology. In vitro culture techniques: Sterilization methods, Culture media – composition, types of medium and role of hormones in *in-vitro* culture. Inoculation, incubation and acclimatization.Callus, Suspension culture and its significance.Organ culture: Anther, Embryo & shoot tip culture. Somatic embryogenesis and synthesis of artificial seeds.Protoplast culture.Plant protoplasmic fusion in hybrid production.Somaclonalvariation.

Unit 5: Crop Improvement(1 +10 + 1)

Plant genome mapping: Molecular markers and its applications.Transgenic plants for resistance to insect, herbicide tolerance, delay in fruit ripening. Plant Molecular Farming: Production of antibodies and pharmaceuticals.Biosafety and bioethics.

BOOKS FOR STUDY:

1. Gupta P. K. 1994. Elements of Biotechnology. Rastogi Publications. Meerut.
2. Ignacimuthu , S., 2003. Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

3. Kalyan Kumar De., 1997. Plant Tissue Culture – New Central Book Agency (P) Ltd., Calcutta.
4. Mascarenhas A.F., 1991. Hand book of Plant Tissue Culture. Indian Council of Agricultural Research. New Delhi.

BOOKS FOR REFERENCE:

1. Grierson, D and Convey, S.N., 1988. Plant Molecular Biology Published in the USA by Chapman and Hall, New York.
2. Dubey, R.C.1993. Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi.
3. Ignacimuthu, S.1997. Plant Biotechnology . Oxford Publishing Co. Pvt. Ltd., New Delhi.
4. Trivedi P.C. 2001. Algal Biotechnology.
5. Rashid, A. 2009. Molecular physiology and Biotechnology of Flowering plants. Narosa Publishing House Pvt. Ltd., New Delhi.

E-BOOKS:

1. Primrose, S. B. and Twyman, R. M. 2006. Principles of Gene Manipulation and Genomics. 7th edition.Blackwell Publishing.
2. Caldentey, K.M.O. &Barz, W. H. 2002. Plant Biotechnology and Transgenic Plants. Marcel Dekker. Inc.
3. Doyle, A. and Griffiths, J. B., 1999. Cell and Tissue Culture: Laboratory procedures in Biotechnology.John Wiley & Sons Ltd.,
4. Alberts, B., Johnson, A., Lewis,J., Raff,M., Roberts, K., and Walter, P., 2008. The Molecular Biology of the cell.5th edition. Garland Science Taylor and Francis Group.

16UPB6MS02–LABORATORY COURSE: IX
(PLANT BIOTECHNOLOGY)

SEMESTER: VI CREDIT: 1
CATEGORY:MS HOURS / WEEK:2

Basic Techniques in Plant tissue culture:

1. Preparation of MS and Modified White's Medium.
2. In vitro seed germination and explants preparation.
3. Callus culture.
4. Embryo culture.
5. Meristem Culture and axillary budculture.
6. Preparation of Nitsch Medium and Anther Culture.
7. Isolation of Protoplast from leaves (mechanical and Enzymatic method)

Molecular Techniques

8. Extraction and separation of Plant protein by SDS-PAGE.(In batches)
9. Extraction and separation of plant DNA by agarose gel electrophoresis (In batches)

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PLANT BIOLOGY ALLIED OFFERED TO OTHER DEPARTMENTS

16UPB1AL01– BASICS OF PLANT BIOLOGY

(Offered to students of Advanced Zoology and Biotechnology)

SEMESTER: I CREDITS: 2
CATEGORY: AL HOURS / WEEK: 4

Objectives:

1. *To provide information on the diversity of plants and their significance.*
2. *To provide suitable knowledge on the taxonomy of angiosperms, their economic importance and anatomy.*
3. *To provide details on the physiology, reproduction and lifecycle of various plant forms.*

Unit I: Plant Diversity (1 + 10 + 1)

Structure and reproduction (No developmental studies)

Algae : *Ectocarpus*
Fungi : *Puccinia*
Bryophytes :*Funaria*
Pteridophytes :*Selaginella*
Gymnosperms :*Cycas*

Unit II: Taxonomy and Economic Botany (1 + 10 + 1)

Detailed studies of the following families: *Annonaceae, Rutaceae, Cucurbitaceae, Lamiaceae, Euphorbiaceae andPoaceae.*

Economic Botany: Common name, binomial, family, the morphology of the useful parts and uses of – vegetables (beet root, potato)- fruits (banana, papaya) – cereals (rice, wheat)- pulses (green gram, pigeon pea) – edible oil yielding plants (sesame oil, coconut oil) - fibre yielding plants (cotton, jute) – medicinal plants (vinca, asafoetida) – narcotic plants (tobacco, cannabis) – timber yielding plants (teak, sal) – spices (cardamom, cloves) – condiments (ginger, turmeric) – essential oils (sandalwood oil, eucalyptus oil) – beverages: alcoholic (wine, beer) and non-alcoholic (tea, coffee).

Unit III: Anatomy (1 + 10 + 1)

Classification of tissues - Characteristics and classifications of meristems. Anatomy of root, stem and leaf (monocot and dicot). Normal secondary growth in dicot stem. Stomatal types: Anomocytic, anisocytic, paracytic and grass type.Excretory system: Hydathodes, salt glands, nectaries; cavities, lithocysts andlaticifers.

Unit IV: Embryology (1 + 10 + 1)

Microsporangium, microsporogenesis and male gametophyte.Megasporangium, megasporogenesis and female gametophyte.Fertilization – double fertilization and triple fusion.Endosperm types: Nucellar, cellular, helobial and ruminate.Embryogenesis: Embryo development in dicotyledons (*Capsella*).

Unit V: Plant Physiology(1 + 10 + 1)

Absorption of water - Transpiration - Absorption and translocation of solutes – active & passive uptake. Photosynthesis - light reaction - Calvin cycle. Respiration - Glycolysis, Kreb's cycle -

electron transport system.Role of growth hormones – auxins, gibberellins and cytokinins - their applications.

TEXT BOOKS:

1. Mitra, J. N., Mitra, D. and Chowdhri, S. K. 1990. Studies in Botany Vol II.Moulick Library, Calcutta.
2. Narayanaswami, R. V., Rao, K. N. and Raman, A. 1996. Outlines of Botany – S. Viswanathan Publishers, Chennai.
3. Devlin, O.P. (1974) Plant Physiology, Prentice-Hall, India.
4. Jain, V.K. (2005) Textbook of Plant Physiology. S. Chand and Company Ltd. New Delhi.
5. Kochhar S. L. Economic Botany in the tropics (Fourth edition). Macmillan Publishers India Ltd., Delhi.

BOOKS FOR REFERENCE:

1. Pandey, B.B. 1995. Taxonomy of Angiosperms, S. Chand and Co. Ltd. New Delhi.
2. Pandey, B.B. 1978. Plant Anatomy, S. Chand and Co. Ltd. New Delhi.
3. Singh, V., Pandey, P.C. and Jain, D.K. 1998. Anatomy of seed plants.Rastogi Pub. Meerut, India.
4. Tayal, M.S. 1987. Plant Anatomy.Rastogi Pub. Meerut, India.
5. Bhojwani and Bhatnakar. 1985. Embryology of Angiosperms, Vikas Publications.
6. Pandey, B.P. 1980. Economic Botany. S. Chand & Co., New Delhi.
7. Datta, S.C.2010. Plant Physiology.New Age International Publishers. New Delhi

16UPB1AL02– ALLIED PRACTICAL I
(BASICS OF PLANT BIOLOGY)

SEMESTER: I CREDIT: 1
CATEGORY:AL HOURS / WEEK: 2

1. Microscopic study of plants mentioned in theory syllabus.
2. Study of families mentioned in the theory syllabus.
3. Economic Botany.
4. Anatomy of stem, root and leaf in dicots and monocots.
5. Observation of slides on microsporogenesis, megasporogenesis and embryo.
6. Transpiration pull.
7. Potato osmoscope.
8. Wilmott's bubbler on photosynthesis using different light and carbon dioxide concentration
9. Separation of photosynthetic pigments using paper chromatography.

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16UPB2AL01– APPLIED MICROBIOLOGY

(Offered to students of Advanced Zoology and Biotechnology)

SEMESTER: II CREDITS: 2
CATEGORY: AL HOURS / WEEK: 4

Objectives:

1. *To provide information on the classification, growth, morphology and genetics of microbes and the recent advances in the fieldof microbiology.*
2. *To understand the fundamentals of the fermentation process, strain improvement and culture.*
3. *To understand the use of different microorganisms for manufacture of a variety of industrial products.*

Unit 1: Introduction (1 + 10 + 1)

Classification of microbes - A general account of characteristics and classification of bacteria, fungi, Mycoplasma and viruses.

Unit 2: Morphology, physiology and genetics of bacteria (1 + 10 + 1)

Bacterial morphology, physiology: Structure of bacterial cell – capsule, cell wall, plasma membrane, Structure and function of flagella, fimbriae and pili – Microbial growth and its measurements – Pure cultures and their maintenance – Nutritional requirement and types of media.Nature of genetic material in bacteria – Replication and gene expression – gene regulation (*lac* operon), Reproduction: transformation, transduction and conjugation in bacteria.

Unit 3: Fermentation (1 + 10 + 1)

Fermentor – Basic functions – body construction – aerators, agitators – asepsis – containment – valves and steam traps – Substrates for industrial fermentation – strain improvement – an outline on fermentation and product recovery.

Unit 4: Industrial microbiology (1 + 10 + 1)

Microbial enzymes (Amylase), Organic acid (Citric acid), fermented products (cheese production), beverages (wine), General account on biofertilizers, biopesticides, biopolymers, biosensors, antibiotics (penicillin), vitamins.

Unit 5: Environmental Microbiology (1 + 10 + 1)

Bioremediation – Domestic sewage and waste water treatment – Biodegradation of xenobiotics – Biomineralization – Biomining and bioleaching – Biofuels.

TEXT BOOKS:

1. Dubey, R. C. and Maheshwari, D.K. 2005. A text book of Microbiology. S. Chand & Co. Ltd., New Delhi.
2. Powar, C.B. and Daginawala, 1991. General Microbiology Vol. I and II – Himalaya Publishing House, Bombay.
3. Pelczar, Chan and Kreig, 1993. Microbiology – 5th Edition, Tata McGraw-Hill & Co. Ltd. New Delhi.
4. Crueger,F. and AnnelieseCrueger, 2000. Biotechnology: Industrial Microbiology Panima publishing Coporation New Delhi

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1. Joanne, M. Willey, Linda M. Sherwood and Christopher, J. Woolverton, 2008. Microbiology – McGraw – Hill International Edition (Seventh edition).
2. Daniel Lim, 1998. Microbiology (2nd edition) WCB/ McGraw-Hill.
3. Tortora ,Funke and Case, 2006. Microbiology- An Introduction. Pearson Education.
4. Alexander N. Glazer and Hiroshi Nikaido, 1994. Microbial Biotechnology: Fundamentals of Applied microbiology. W.H. Freeman and Co., New York.

16UPB2AL02– ALLIED PRACTICAL –II
(APPLIED MICROBIOLOGY)

SEMESTER:II CREDIT:1
CATEGORY:AL HOURS / WEEK:2

1. Sterilization – Preparation of culture media – nutrient broth and agar - Potato dextrose agar.
2. Permanent slides of bacteria, fungus, algae – morphological features.
3. Pour plate, spread plate and Streak plate techniques – serial dilution.
4. Hanging drop method.
5. Antibiotic sensitivity assay
6. Staining method – Gram staining technique.
7. Demonstration of Fermentor operation.
8. Ethanol production and estimation.
9. Wine fermentation
10. Citric acid production
11. Glutamic acid production
12. Biofertilizers – Isolation of *Rhizobium*, VAM