**Annexure-I**

**Batch : 2015-onwards**

# HIMACHAL PRADESH UNIVERSITY SHIMLA-171005

## CHOICE BASED CREDIT SYSTEM (CBCS)-B.Sc. Botany (Major)

## Syllabus and Examination for B.Sc. Botany (Major)

**Under CBCS**

**Semester System**

**June 2016 (IIIrd semester- onwards)**

# HIMACHAL PRADESH UNIVERSITY SHIMLA-1710005

## CHOICE BASED CREDIT SYSTEM (CBCS) IN BOTANY

## CBCS Programme for B.Sc. with Botany (Major) w.e.f. June 2016

**SEMESTER-I**

**Code: BSCBOT0101**

**Phycology, Mycology and Plant Pathology Credits = 3**

Course duration- 40Hours **UNIT-I**

**(Phycology)**

**Subunit-A:** General characters, classification up to orders (Fritsch 1945) and economic importance. _____***02 Hours***

**Subunit-B:** Important features and life history (excluding development) of ***Nostoc*** (Cyanophyceae), ***Oedogonium*** (Chlorophyceae), ***Vaucheria*** (Xanthophyceae), Diatoms (Bacillariophyceae), ***Ectocarpus*** (Phaeophyceae) and ***Polysiphonia*** (Rhodophyceae). Pigment constitution of the above mentioned classes. _____ ***12 Hours***

**UNIT-II (Mycology)**

**Subunit-C:** General characters, classification up to orders (Alexopoulos and Mims1979) and economic importance._____***03 Hour***

**Subunit-D:** Important features and life history (excluding development) of ***Albugo*** (Mastigomycotina) ***Rhizopus*** *(Zygomycotina)*, ***Saccharomyces, Neurospora*** (Ascomycotina), ***Agaricus*** (Basidiomycotina) and ***Colletotrichum*** (Deuteromycotina). _____ ***13 Hour***

**Subunit-E:** **Lichens**(Lichen components and their nature of association; Occurrence; Classification by Hole 1967; Morphology and anatomy of thallus; Special vegetative structures associated with lichen thallus; Reproduction; Ecological and Economic importance)._____ ***03 Hours***

**UNIT- III (Plant Pathology)**

**Subunit-F:** Definitions, symptoms, classification and etiology of following diseases: Late blight of potato, Apple scab, Loose smut of wheat, Black stem rust of wheat, Early blight of potato, Citrus canker; General account of plant disease control (Quarantine, Chemical, Biological and Integrated); losses caused by plant diseases. _____***07 Hours***

**PRACTICAL Code: BSCBOT 0101(P)**

**Phycology, Mycology & Plant Pathology**

**Credit = 1**

1. Study of some laboratory techniques (Whole mounts, Maceration, Smearing, Section cutting, Squash, Light microscopy, Digital image projection and Micrometry).
2. Preparation of Fixing agents (Carnoy's fluid, Formalin-Aceto-Alcohol), Stains (Acetocarmine, Aniline blue, Crystal violet, Fast green, Safranin, Gram's iodine); Grades of Ethanol, Clearing agents and Mounting media (Glycerine jelly, Lactophenol, DPX and Canada balsam).
3. Preparation of Temporary stained mounts of type specimens (Whole mounts, teased mount) as mentioned in theory paper.

## Suggested Readings


- **Phycology:**
  - **a.** Kumar, H.D. and Singh, H.N. 1995. A Text book on Algae. Affiliated East West Press Pvt. Ltd., New Delhi.
  - **b.** Kumar, H.D.1988. Introductory Phycology. Affiliated East West Press Pvt. Ltd., New Delhi.
  - **c.** Vashistha, B.R., Sinha, A.K. and Kumar, A. 2010. Botany for Degree Students-Algae. S.Chand& Co. Ltd.
  - **d.** Bendre, A. and Kumar, A. 2012. A Textbook of Practical Botany. Vol. I. Rastogi Publications.
  - **e.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
- **Mycology:**
  - **a.** Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. John Wiley and Sons, Inc.
  - **b.** Bendre, A. and Kumar, A. 2012. A Textbook of Practical Botany. Vol. I. Rastogi Publications.
  - **c.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
  - **d.** Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology. New Age Intermediate Press.
  - **e.** Sharma, P.D. 2004. Fungi. Rastogi publications.
  - **f.** Sharma, P.D. 2005. Fungi and Allied organisms. Alpha science Intl. Ltd.
  - **g.** Vashistha, B.R. and Sinha, A.K. 2010. Botany for Degree Students-Fungi. S.Chand& Co. Ltd.
  - **h.** Webster, J. and Weber, R.W.S. 2007. Introduction to Fungi. Cambridge University Press.
- **Plant Pathology:**
  - **a.** Agrios, G.N. 2005. Plant Pathology. Elsevier Academic Press
  - **b.** Bendre, A. and Kumar, A. 2012. A Textbook of Practical Botany. Vol. I. Rastogi Publications.
  - **c.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
  - **d.** Pandey, B.P. 2001. Plant Pathology-Pathogen and Plant Disease. S.Chand& Co. Ltd.
  - **e.** Rangaswamy, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India. Prentice Hall of India Pvt. Ltd., New Delhi.


**Code: BSCBOT0102**

**Bryophyta and Pteridophyta**

**Credits = 3**

Course duration- 40Hours

**UNIT- I (Bryophyta)**

**Subunit-A:** General characters, classification up to orders (Proskauer 1957); Economic and Ecological importance. _____ ***04 Hours***

**Subunit-B:** Morphology, anatomy, reproduction (excluding development) and life history of ***Marchantia, Porella, Anthoceros, Sphagnum and Funaria. _____ 15 Hours***

**UNIT- II (Pteridophyta)**

**Subunit-C:** General characters, classification upto order (Sporne1975); Evolution of stele; Brief account of Apogamy and Apospory; Study of fossil plant ***Rhynia._____ 06 Hours***

**Subunit-D:** Morphology, anatomy, reproduction (excluding development) and life history of ***Psilotum, Selaginella, Equisetum, Adiantum*** and ***Marsilea. _____ 15 Hours***

**PRACTICAL Code: BSCBOT 0102(P)**

**Bryophyta & Pteridophyta**
**Credit = 1**

1. Study of morphology, anatomy and reproduction of type specimens as mentioned in theory paper.
2. Section cutting procedure of Bryophyta and Pteridophyta specimens.
3. Preparation of Double stained permanent mount of Pteridophyta sections.

## Suggested Readings


**01. Bryophyta:**

- **a.** Bendre, A. and Kumar, A. 2012. A Textbook of Practical Botany. Vol. I. Rastogi Publications.
- **b.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
- **c.** Parihar, N.S. 1991. Bryophyta. Central Book Depot. Allahabad.
- **d.** Puri, P. 1980. Bryophyta. Atma Ram & Sons. Delhi.
- **e.** Rashid, A. 1998. An Introduction to Bryophyta. VikasPublishing HousePvt. Ltd. New Delhi.
- **f.** Vashistha, B.R., Sinha, A.K. and Kumar, A. 2012. Botany for Degree Students-Bryophyta. S.Chand & Co. Ltd.

**02. Pteridophyta:**

- **a.** Rashid, A. 1999. An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
- **b.** Bendre, A. and Kumar, A. 2012. A Textbook of Practical Botany. Vol. I. Rastogi Publications.
- **c.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
- **d.** Parihar, N.S. 1996. Pteridophyta. Central Book Depot. Allahabad.
- **e.** Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.
- **f.** Vashistha, P.C., Sinha, A.K. and Kumar, A. 2010. Botany for Degree Students-Pteridophyta. S.Chand & Co. Ltd.


**Semester-II**

**Code: BSCBOT0203**

**Palaeobotany and Gymnosperms**

**Credits = 3**

Course duration- 40Hours

**UNIT- I (Palaeobotany)**

**Subunit-A:** Fossils and fossilization process; Type of fossils and their importance; Contribution of Prof. (Dr.) Birbal Sahni._____***09 Hours***

S**ubunit-B:** Reconstruction of fossil plant ***Lyginopteris;*** Geological Time Table (Up to period level with characteristic plant life); Evolution of seed habit. _____ ***09 Hours***

**UNIT-II (Gymnosperms)**

**Subunit-C:** General characters, Classification up to order (Pilger and Melchior's 1954); Economic importance._____ ***05 Hours***

**Subunit-D:** Morphology, anatomy, reproduction and life history of ***Cycas, Pinus,*** and ***Ephedra. _____ 17 Hours***

a. ***Teacher is supposed to prevent students, collecting any type of plants and submitting them in the form of Herbarium for the practical examination, as this practice is destroying the flora and fauna. Instead, the students should be asked to prepare field reports.***
b. ***Teacher should accompany the students for field visit (College campus, local visit, college education tour to Botanical garden).***
c. ***Field visit is ESSENTIAL PART OF THE COURSE.***

**PRACTICAL**

**Code: BSCBOT 0203(P)**

**Palaeobotany & Gymnosperms**

**Credit = 1**

1. Study of morphology, anatomy and reproduction of type specimens as mentioned in theory paper.
2. Preparation of Double stained permanent mount of Gymnosperm sections.
3. Study of Palaeobotany using models, images or rock specimens.

## Suggested Readings

**01. Palaeobotany:**

a. Srivastava, H.N. 2000. Palaeobotany. Pradeep Publications.
b. Stewart, W.N. and Rathwell G.W. 1993. Paleobotany and theEvolution of Plants. Cambridge University Press.

**02. Gymnosperms:**


**a.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.

**b.** Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Pvt. Ltd. Publishers, New Delhi.

**c.** Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson 7 Co. Ltd., London.


**Code: BSCBOT0204**

**Plant Taxonomy and Selected Families of Angiosperms**

**Credits = 3**

Course duration- 40Hours

**UNIT- I (Plant Taxonomy)**

**Subunit-A:** Angiosperms origin and evolution; Taxonomy and Systematics; Aim of taxonomy; Functional components of taxonomy (Alpha, Beta and Omega taxonomy).

**___ 02 *Hours***

**Subunit-B:** Binomial nomenclature, principles and rules; Principle of priority; Role of Chemotaxonomy, Cytotaxonomy and Taximetrics in relation to taxonomy; Type concept and keys to identification of plants; Basic idea of Herbarium preparation and its significance; Botanical gardens and their role ( Royal Botanic Garden, Kew England, Indian Botanic Garden, Calcutta and National Botanic Garden, Lucknow ). _____ ***08 Hours***

**Subunit-C:** Differences among Artificial, Natural and Phylogentic system of classification; Phylogenetic (Evolutionary) principles; Salient features of the systems of classification of Angiosperms proposed by Bentham & Hooker and Engler &Prantl. _____***05 Hours***

**UNIT-II**

**(Selected Families of Angiosperms)**

**Subunit-D:** Floral terminology and type of inflorescence._____ ***03 Hours***

**Subunit-E:** Floral diversity, diagnostic features and economic importance of following families:

**01.Ranunculaceae*(Ranunculus)***

2. **Brassicaceae / Cruciferae*(Brassica)***
3. **Malvaceae*(Hibiscus)***
4. **Rutaceae*(Citrus)***
5. **Fabaceae / Leguminosae(Caesalpinioideae:Cassia; Faboideae: *Pisum;* Mimosoideae:**

***Acacia)***

6. **Cucurbitaceae(Cucurftita)**
7. **Apiaceae / Umbelliferae *(Coriandrum)***
8. **Asteraceae / Compositae(Helianthus)**
9. **Asclepiadaceae*(Calotropis)***
10. **Solanaceae *(Solanum)***

**11. Lamiaceae / Labiatae(Salvia)**

**12. Euphorbiaceae*(Euphorbia)***

**13. Liliaceae*(Allium)***

**14. Poaceae / Gramineae*(Triticum)***

**15. Orchidaceae(Zeuxine) _____*22 Hours***

***Note to Teachers:***

***1.Teacher will demonstrate the methodology of Herbarium preparation.***

***2.Teacher is supposed to prevent students, collecting any type of plants and submitting them in the form of Herbarium for the practical examination, as this practice is destroying the flora and fauna. Instead, the students should be asked to prepare field reports.***

***3.Teacher should accompany the students for field visit (College campus, local visit, college education tour to Botanical garden).***

***4. Field visit is ESSENTIAL PART OF THE COURSE.***

**PRACTICAL**

**Code: BSCBOT 0204(P)**

**Plant Taxonomy and Selected Families of Angiosperms**

**Credit = 1**

1. Study of root, stem and leaf morphology.
2. Study of inflorescence.
3. Botanical description of flowers as specified in the theory paper.

## Suggested Readings


- **Plant Taxonomy and Selected Families of Angiosperms:**
  - **a.** Chopra, G.L. 2001. Angiosperms. Pradeep Publications.
  - **b.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
  - **c.** Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperms Taxonomy. Oliver and Boyd. London.
  - **d.** Heywood, V.H. and Moore, D.M. (eds) 1984. Current concepts in Plant Taxonomy. Academic Press. London.
  - **e.** Jeffery, C. 1982. An introduction to Plant Taxonomy. Cambridge University Press. Cambridge.
  - **f.** Jones, S.B. andjr.Luchsinger, A. E. 1986. Plant Systematics. McGraw-Hill Book Co. New York.
  - **g.** Naik, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill Company Ltd.
  - **h.** Sharma, O.P. 1993. Plant Taxonomy.Tata McGraw-Hill Company Ltd.
  - **i.** Singh, G. 1999. Plant Systematics: Theory and Practical. Oxford and IBH Pvt. Ltd., New Delhi.
  - **j.** Sinha, R.K. 2010. Practical Taxonomy of Angiosperms. I.K. International Publishing House Ltd.
  - **k.** Stace, C. A.1989. Plant Taxonomy and Biosystematics. Edward Arnold. London.
  - **l.** Subrahmanyam, N.S. Modern Plant Taxonomy. 1995. Vikas Publishing House Pvt . Ltd.

**Semester-III**

**Code: BSCBOT0305**

**Economic Botany and Plant Anatomy**

**Credits = 3**

Course duration- 40Hours

**UNIT- I (Economic Botany)**

**Subunit-A:** Brief account about the centres of origin of major economic crops (Rice, Wheat, Maize, Potato, Sugarcane, Mustard, Cotton and Rubber); Knowledge about location of National and International agricultural research centres or institutes of Rice, Wheat, Maize and Potato. _____ ***03 Hours***

**Subunit-B:Distribution, botanical description and brief idea of cultivation and uses of the following:**

**Cereals:** Rice, Wheat and Maize. **Vegetables:** Potato. **Fibres:** Cotton and Jute. **Oils:** Mustard, Groundnut, Sunflower and Coconut. **Medicinal plants:** Opium, ***Rauvolfia, Cinchona***and***Cannabis*.Beverages:** Tea and Coffee. **Rubber*:Hevea.*** **Sugar:** Sugarcane. _____ ***15 Hours***

**Subunit-C:** Spices (Listing of common spices, their Botanical names, families and part used);Timber yielding plants of India with emphasis on Himachal Pradesh (Write only the Botanical names, families, occurrence and few words about wood properties)._____ ***04 Hours***

**UNIT- II (Plant Anatomy)**

**Subunit-D**:Diversity in plant forms-annuals, biennials and perennials; Meristematic and permanent tissues (simple and complex). _____ ***03 Hours***

**Subunit-E (The Shoot System):** Shoot apical meristem and theories about its histological organizations (Monocot and Dicot); Structure of primary monocot (Maize) and dicot stem (Sunflower); Secondary growth in dicot stem; Cambium structure and functions; Characteristics of growth rings; Sap wood and heart wood; Periderm; Anomalous secondary growth with reference to ***Dracaena*** and ***Boerhaavia.*_____*05 Hours***

**Subunit-F (Leaf):** Type of leaves; Phyllotaxy and venation pattern; Anatomy of typical Monocot (Grass / Maize) and Dicot leaf (Sunflower); Examples of cell inclusions in leaves; Stomatal apparatus and their morphological types._____ ***05 Hours***

**Subunit-G (The Root System):** Root apical meristem and theories about histological organization ( Monocot and Dicot); Secondary growth in dicot root; Structural modifications in roots with reference to ***Beta*** (storage), ***Rhizophora*** (respiratory), ***Vanda*** (epiphytic) and root nodules of Leguminous plant (Interaction with microbes). _____***05 Hours***

**PRACTICAL**

**Code: BSCBOT 0305(P)**

**Economic Botany & Plant Anatomy**

**Credit = 1**

1. Study of Economic Botany specimens as mentioned in theory paper.
2. Anatomy of Angiosperms as mentioned in theory paper.
3. Section cutting and preparation of double stained permanent mounts.

## Suggested Readings


**01. Economic Botany:**

- **a.** Kocchar, S.L. 1998. Economic Botany in the Tropics. McMillan India Ltd., New Delhi.
- **b.** Sharma, O.P. 1996. Hills Economic Botany (Late Dr. A.F. Hill adapted by Sharma, O.P.1996), Tata McGraw-Hill Co. Ltd., New Delhi.
- **c.** Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany-Plants in our World. McGraw-Hill. New York.

**02. Plant Anatomy:**

- **a.** Bendre, A. and Kumar, A. 2009. A Textbook of Practical Botany. Vol. II. Rastogi Publications.
- **b.** Cutler, D.F., Botha, T. and Stevenson, D.W. 2007. Plant Anatomy (an applied approach). Blackwell Publishing.
- **c.** Eames, A. J. and MacDaniels, L.H. 1972. An Introduction to Plant Anatomy. Tata McGraw-Hill Co. Ltd., New Delhi.
- **d.** Esau, K. 1977. Anatomy of Seed Plants. John Wiley & Sons, Inc.
- **e.** Evert, F.R. 2006. Esau's Plant Anatomy. John Wiley & Sons, Inc.
- **f.** Fahn, A. 1974. Plant Anatomy. Pergamon Press, Oxford.
- **g.** Pandey, B.P. 2001. Plant Anatomy. S.Chand& Co. Ltd.
- **h.** Rudall, P.J. 2007. Anatomy of Flowering Pants (an introduction to structure and development). Cambridge University Press.

**Code: BSCBOT0306**

**Embryology of Angiosperms Credits = 3**

Course duration- 40Hours

**UNIT- I**

**Subunit-A:** Contribution of Prof.(Dr.) Panchanan Maheshwari; Flower a modified shoot; Functions of various floral parts._____ ***05 Hours***

**Subunit-B:** Microsporangium, its wall and dehiscence mechanism; Microsporogenesis, pollen grains and detailed account of its structure ; Pollen aperture type and NPC system;Pollination (types and agencies); Pollen-pistil interaction; Self incompatibility; Pollen germination and development of male gametophyte._____ ***12 Hours***

**UNIT-II**

**Subunit-C:** Structure of Megasporangium (Ovule); Megasporogenesis and Megagametogenesis(Development of female gametophyte); Examples of female gametophyte (Monosporic, bisporic and tetrasporic); Double fertilization; Endosperm types and its biological importance; Embryogenesis in dicot ***(Capsella)*** and monocot
**(Saggitaria**);Polyembryony;Apomixis (Vegetative reproduction and Agamospermy. _____ ***17 Hours***

**Subunit-D:** Structure of dicot and monocot seed; Fruit types; Dispersal mechanism in fruits and seeds._____***06 Hours***

**PRACTICAL**

**Code: BSCBOT 0306(P)**

**Embryology of Angiosperms**

**Credit = 1**

1. Morphological and Anatomical study of floral parts.
2. Study of pollination behaviour.
3. Morphological study of fruit, seed and their dispersal mechanisms.
4. Study of monocot , dicot embryo and testing their viability by NTC test.

## Suggested Readings • **Embryology of Angiosperms:**

Bhojwani, S.S. and Bhatnagar, S.P.1999. The Embryology of Angiosperms. Vikas Publishing House, Delhi.

**Semester-IV**

**Code: BSCBOT0407**

**Cytogenetics**

**Credits = 3**

Course duration- 40Hours

**UNIT-I**

**Subunit-A (Mendelian Genetics**): Biography of Gregor Johann Mendel; Mendel's experiments on garden pea; Laws of dominance, Segregation, and Independent assortment; Modern genetic terminology. _____***5Hours***

**Subunit-B (Extensions of Mendelian Genetics):** Chromosomal basis of Mendelism; Concept of Linkage and Crossing over; Genetic recombination; Brief idea about chromosome mapping in eukaryotes; Karyotype; Allelic and non-allelic interactions; Multiple alleles; Brief account of Quantitative inheritance.

_____***09 Hours***

**Subunit-C: (Chromosomal alterations / Mutations):** Variations in chromosome structure (Deficiencies, Deletions, Duplications, Translocations, Inversions and Position effects); Giant Polytene chromosomes in Diptera; Variations in chromosome number (Aneuploidy and Polyploidy); Sex chromosomes. _____ ***09 Hours***

**UNIT-II**

**Subunit-D (Genetic Material):** DNA as the genetic material, DNA structure and replication; DNA Protein interaction Satellite and repetitive DNA.

___***05 Hours***

**Subunit-E (Gene Expression):** Modern concept of gene; RNA structure (m-RNA, t-RNA); Ribosome structure; Flow of genetic information; Genetic code; Mechanism of protein synthesis; Gene mutations; Regulation of gene expression in prokaryotes and eukaryotes.

_____ ***09 Hours***

**Subunit-F (Extra Nuclear Inheritance):** Presence and function of Mitochondrial and Plastid DNA; Plasmids._____ ***03 Hours***

**PRACTICAL**

**Code: BSCBOT 0407(P)**

**Cytogenetics**

**Credit = 1**

1. Determination of probability by tossing coins.
2. Demonstration of phenomenon of Segregation.
3. Demonstration of phenomenon of Independent assortment.
4. Study of Cytoplasmic inheritance in *Mirabilis jalapa.*
5. Study of various genetic aspects with the help of models or images.

## Suggested Readings

**Cytogenetics:**


**a.** Brooker, R.J. 2012. Concepts of Genetics. McGraw-Hill.
**b.** Brooker, R.J. 2012. Genetics; Analysis and Principles. McGraw-Hill.
**c.** Daniel, H.L. 2014. Essential Genetics; A Genomics Perspective. Jones and Bartlett Learning.
**d.** Gardner, E.J., Simmons, M.J. and Snustad, D.P. 1991. John Wiley & Sons, Inc.
**e.** Gupta, P.K. 2011. Genetics. Rastogi Publications.
**f.** Hartwell, L.H., Hood, L., Goldberg, M.L., Reynolds, A.E. and Silver, L. M. 2011. Genetics: From Genes to Genomes. McGraw-Hill.
**g.** Klug, W.S., Cummings, M.R., Spencer, C.A. and Palladino, M.A. 2012. Concepts of Genetics. Pearson Benjamin Cummings.
**h.** Krebs, J.E., Goldstein, E.S. and Kilpatric, S.T. 2014. Lewin's Genes XI. Jones and Bartlett Learning.
**i.** Pierce, B.A. 2012. Genetics. A Conceptual Approach. W.H. Freeman and Company. New York.
**j.** Snustad, D.P. and Simmons, M. J. 2012. Principles of Genetics. John Wiley and Sons, Inc.


**Code: BSCBOT0409**

**Cell Biology**

**Credits = 3**

Course duration- 40Hours

**UNIT-I**

**Subunit-A (Overview of Cells**): ell theory; Prokaryotic and Eukaryotic cells._____ ***02 Hours***

**Subunit-B (Chemistry of the Cell):** Chemical and physical properties of water; Importance of water; Basics of macromolecules (Carbohydrates, Proteins, Lipids and Nucleic acids). _____**04 Hours**

**Subunit-C (Brief account of Basic Techniques used in Cell Biology):** Principles of fixation and type of fixatives; Embedding; Staining methods; Resolving power and magnification of microscope; Differences between light and electron microscope and their types (Bright field, Dark field, Phase-contrast, Fluorescence, TEM and SEM); X-ray diffraction; Autoradiography; Cell fractionation; Methods of studying microorganisms._____ ***08 Hours***

**UNIT- II**

**Subunit-D (Viruses and Bacteria**):General account and classification of viruses; Structural detail of TMV, HIV and ^-Bacteriophage; General account of Mycoplasma; Detailed ultra structureutrition, reproduction and economic importance of bacteria. _____ ***08 Hours***

**Subunit-E (Eukaryotic Cell Structure):** Ultrastructure, chemical composition and functions of cell wall and plasma membrane; Ultrastructure, chemical composition and functions of

Nucleus, Mitochondria, Chloroplast, Golgi bodies, Endoplasmic reticulum, Ribosomes, Lysosomes, Peroxisomes, cytoskeleton and Vacuole._____***10 Hours***

**Subunit-F (Chromosomes and Cell Division**):Packaging of DNA in chromatin and chromosomes (Nucleosome model); Type of chromosomes on the basis of centromere position;Cell cycle and its regulation; Mitosis and Meiosis; Significance of cell division; Apoptosis; General account of Cancer and its molecular basis. _____ ***08 Hours***

**PRACTICAL**

**Code: BSCBOT 0409(P)**

**Cell Biology**

**Credit = 1**

1. Study of some laboratory techniques (Maceration, Smearing, Squash and Micrometry).
2. Preparation of Fixing agents (Carnoy's fluid, Formalin-Aceto-Alcohol), Stains (Acetocarmine, Aniline blue, Crystal violet, Fast green, Safranin, Gram's iodine) and Mounting media (Glycerine jelly, Lactophenol).
3. Study of Mitosis by preparing Acetocarmine squash of onion root tip.
4. Study of Meiosis by smear preparation using Acetocarime stain.
5. Study of instrumentation used in Cell Biology (Equipment or Equipment image).

## Suggested Readings

- **Cell Biology:**


**a.** Alberts, B., Johanson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. 2008. Molecular Biology of The Cell. Garland Science (Taylor & Francis Group).

**b.** Hardin, J., Bertoni, G. and Kleinsmith, L.J. 2012. Becker's World of The Cell. Pearson Benjamin Cummings.

**c.** Karp, G. 2010. Cell and Molecular Biology (concepts and experiments). John Wiley and Sons, Inc.

**d.** Lodish, H., Arnold, B., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P. 2013. Molecular Cell Biology. W. H. Freeman and Co. New York.

**Semester-V**

**Code: BSCBOT0510**

**Biochemistry**

**Credits = 3**

Course duration- 40Hours

**UNIT- I**

**Subunit A (Thermodynamic Principles):**First law of thermodynamics; Second law of thermodynamics; Concept of free energy and chemical equilibrium. _____***03 Hours***

**Subunit B (Chemical Foundations):**pH scale; Acids, Bases and Buffers; Weak interactions (Hydrogen bonds,Ionic teractions, Hydrophobic interactions and Vander Waal interactions);

***09 Hours***

**Subunit C (Basics of Enzymology):** Discovery and characteristics of enzymes; International classification of enzymes; Important terms in Enzymology (Enzyme unit, Specific activity and Turnover number);Proenzymes; Concept of holoenzyme, apoenzyme, coenzyme and co-factors; Mode and mechanism of enzyme action; Enzyme kinetics (Michaelis-Menten equation); Enzyme inhibition (Competitive, Noncompetitive and Uncompetitive);Brief account of regulatory enzymes and Isoenzymes. _____***12 Hours***

**UNIT- II**

**Subunit D (Carbohydrate Metabolism):** Aerobic and anaerobic respiration; ATP as Biological energy currency; Glycolysis, Gluconeogenesis, Krebs cycle and Electron transport mechanism; Redox potential; Mechanism of oxidative phosphorylation (Chemo-osmotic theory);Pentose phosphate pathway. _____ ***08 Hours***

**Subunit E (Lipid Metabolism):** Saturated and unsaturated fatty acids; Fatty acid biosynthesis; Alpha and Beta oxidation. _____***03 Hours***

**Subunit F Protein Metabolism**):Transamination; Deamination; Biology of nitrogen fixation; Importance of Nitrate reductase; Ammonium ion assimilation. _____***05 Hours***

**PRACTICAL**

**Code: BSCBOT 0510(P)**

**Biochemistry**

**Credit = 1**

**1.** Study of lab safety.
**2**.Qualitative analysis of Amino acids, Proteins, Carbohydrates, Lipids and Nucleic acids.
**3**.Demonstration of enzyme activity (Alpha-amylase, Invertase, Protease and Catalase) from plant or animal sources. **4**.Separation of Amino acids by Paper Chromatography.
**5**.Study of equipments used in Biochemistry ( Equipment or Equipment image).

## Suggested Readings


- **Biochemistry:**
  - **a.** Berg, J.M., Tymoczko, J.L. and Stryer, L. 2012. Biochemistry. W. H. Freeman and Co. New York.
  - **b.** Conn, E.E., Stumpf, P.K., Bruening, G. and Doi, R.H. 1987. Outlines of Biochemistry. John Wiley and Sons, Inc.
  - **c.** Jain, J.L., Jain, S. and Jain, W. 2004. Fundamentals of Biochemistry. S.Chand& Co. Ltd.
  - **d.** Nelson, D.L. and Cox, M.M. 2012. Lehninger Principles of Biochemistry. W. H. Freeman and Co. New York.
  - **e.** Voet, D. and Voet, J.G. 2011. Biochemistry. John Wiley and Sons, Inc.


**Code: BSCBOT0511**

**Biotechnology**

**Credits = 3**

Course duration- 40Hours

**UNIT- I**

**Subunit A (Introduction to Biotechnology):** Some selected definitions; Historical development of biotechnology; Traditional biotechnology; Modern biotechnology; Biotechnology as an interdisciplinary pursuit; Scope and importance of biotechnology; Biotechnology in India and global trends._____***06 Hours***

**Subunit B (Genetic Engineering Methods):** Aim of genetic engineering in biotechnology; Vectors and Restriction enzymes; Technique of making Recombinant DNA; Polymerase chain reaction; DNA fingerprinting. _____***11 Hours***

**UNIT- II**

**Subunit C (Plant Biotechnology**):Historical background; Organization of plant tissue culture laboratory; Common type of culture media (MS, B5 and White's media)and their composition; Maintenance of aseptic conditions; Cell culture; Cellular totipotency; Somatic embryogenesis; Haploid production; Somatic hybridization and Cybridisation; Gene transfer techniques using ***Agrobacteriumtumefaciens,*** electroporation andmicro projectile gun;Transgenic plants for crop improvement; Cryopreservation._____***13 Hours***

**Subunit D (Industrial and Microbial Biotechnology):** Required laboratory facilities;Techniques of microbial culture; Procedures of microbial culture; Types of microbial culture; Measurement of microbial growth; Fermentation; Vessels for microbial culture

(Baffle flasks, shakers, fermenters); Microbial products (Primary and Secondary metabolites); Downstream processing; Single cell protein (SCP); Biofertilizers; Biopesticides; Outline of Hybridoma technology and production of monoclonal antibodies._____***10 Hours***

**PRACTICAL**

**Code: BSCBOT 0511(P)**

**Biotechnology**

**Credit = 1**

1. ***Demonstration of Equipments:** Spectrophotometer; Centrifuge; Electrophoresis unit; pH meter; Water bath; Incubator; Hot air oven; Shaker; Magnetic stirrer; Test tube shaker; Heating plate; Distillation plant; Autoclave; Laminar air flow; PCR; Analytical digital balance; Single-pan balance; Good quality microscope with projection system.
2. Sterilization techniques (Physical and Chemical methods).
3. *Media preparation for growing Bacteria.
4. *Preparation of Petri plates and Slants for culture.
5. Gram staining of Bacteria.
6. Isolation of milk proteins.
7. Cell viability assay by FDA and Evan's Blue method.
8. Preparation of MS medium for tissue culture

***Subject to the availability of lab facilities. Teacher may demonstrate with the help of images.**

## Suggested Readings

- **Biotechnology:**


**a.** Dubey, R.C. 2007. A Textbook of Biotechnology. S.Chand & Co. Ltd.
**b.** Gupta, P.K. 2010. Elements of Biotechnology. Rastogi Publications.
**c.** Ignacimuthu, S. 1995. Basic Biotechnology. Tata McGraw-Hill Education.
**d.** Razdan, M. K. 1993. An Introduction to Plant Tissue Culture. Oxford & IBH Pulishing Co. Pvt. Ltd.
**e.** Smith, J. E. 2002. Biotechnology. Cambridge University Press.

**Semester-VI**

**Code: BSCBOT0613**

**Ecology**

**Credits = 3**

Course duration- 40Hours

**UNIT-I**

**Subunit-A (Introduction to Ecology):** History of ecology; Definition, scope and importance; Ecology as synthetic discipline. _____***1 Hours***

**Subunit-B (Environmental Factors):** Climatic; Topographic; Biotic (species interactions); Fire and Edaphic (soil profile, physicochemical properties); Soil erosion and conservation.

_____ ***05 Hours***

**Subunit-C (Biogeochemical Cycles):** Carbon; Nitrogen; Phosphorous; Sulphur andHydrological cycle. _____ ***03 Hours***

**Subunit-D(Adaptations of Plants to Water and Salinity):** Morphological and anatomical features of Hydrophytes, Xerophytes and Halophytes. _____ ***03 Hours***

**Subunit-E(Law of Liebig, Shelford and Limiting factors):** Liebig's law of minimum; Shelford's law of tolerance; combined concept of limiting factors; Importance of limiting factors. _____ ***02 Hours***

**Subunit-F(Population Ecology):** Introduction; Population characteristics, Genecology (Ecads, ecotypes and ecospecies). _____ ***04 Hours***

**Subunit-G (Community Ecology):** Introduction; Qualitative, Quantitative and Synthetic characteristics; Methods of analysis._____ ***04 Hours***

**UNIT-II**

**Subunit-H (Ecological Succession):**Concept of climax; Type of succession, features and causes; detailed account of Hydrosere and Xerosere. _____ ***04 Hours***

**Subunit-I (Ecosystem Ecology):** Structure (components) and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow)._____***04 Hours***

**Subunit-J (Phytogeography):** Definitions;Outline of Phyto-geographical regions of world and India; Botanical regions of India; Vegetation types of India. _____***04 Hours***

**Subunit-K (Environmental Pollution):** Environmental pollutants; Kinds of pollution (Air, water, solid waste,noise and radioactive); Biomagnification; Cost of pollution; General account of Toxicology and Ecotoxicology. _____ ***03 Hours***

**Subunit-L (Climate Change):** Greenhouse effect and its impact; Carbon trading; El Nino and La Nina effects; Ozone layer depletion and its impact._____***03 Hours***

**PRACTICAL**

**Code: BSCBOT 0613(P)**

**Ecology**

**Credit = 1**

1. Study the physical characteristics (Temperature, colour and texture) of the soil sample.
2. Determination of water holding capacity of the soil.
3. Determination of field capacity of the soil.
4. Study the chemical characteristics of the soil (Test the soil for Moisture content, Chloride, Nitrate, Carbonate, Phosphate, Sulphate, Potassium and Phosphorous).
5. Determine the base deficiency and pH of the soil sample.
6. Recording of temperature, relative humidity, light intensity, wind speed and rainfall of the atmosphere.
7. Determination of the minimum size of the quadrant by Species-Area-Curve method.
8. Determination of density, abundance and frequency of species by quadrant method.
9. Measurement of water quality, based on hardness and total alkalinity.
10. Measurement of water quality, based on dissolved oxygen and free carbon dioxide levels in water samples.
11. Morphological and anatomical features of hydrophytes, xerophytes, halophytes and parasites in relation to their habitats.

## Suggested Readings

- **Ecology:**


  - **a.** Bhatia, A.L. 2010. Text Book of Environmental Biology. I.K.International Publishing House Pvt. Ltd.
  - **b.** Bhatia, K.N. 2002. A Treatise on Plant Ecology. Pradeep Publications.
  - **c.** Dash, M.C. 2001. Fundamentals of Ecology. Tata McGraw-Hill Education.
  - **d.** Jr. Miller, G.T. and Spoolman, S.E. 2011. Essentials of Ecology. Brooks / Cole. CENGAGE Learning.
  - **e.** Jr. Molles, M.C. Ecology; Concepts and Applications. 2008. McGraw-Hill.
  - **f.** Kormondy, E.J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd. New Delhi.
  - **g.** Odum, E.P.1971. Fundamentals of Ecology. Saunders, Philadelphia.
  - **h.** Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology. Thomson Brooks / Cole.
  - **i.** Sharma, P.D. 2012. Ecology and Environment. Rastogi Publications.

**Code: BSCBOT0614**

**Plant Physiology**

**Credits = 3**

Course duration- 40Hours

**UNIT-I**

**Subunit-A (Plant Water Relations):** Overview of plant cell structure and its chemical constituents; importance of water to plant life; Water as Biological solvent, physical and chemical properties of water; Solutions and Colloids; Diffusion and osmosis; Water potential and DPD; Absorption and transport of water; Transpiration and physiology of stomata.

____ ***06 Hours***

**Subunit-B (Mineral Nutrition):** Criteria of essentiality of minerals; Macro and micro elements and their role; Mechanism of mineral uptake; Deficiency and toxicity symptoms.

____ ***03 Hours***

**Subunit-C (Photosynthesis):** Significance; Historical aspects; Photosynthetic pigments; Photosynthetically active radiations; Absorption and action spectra; Red drop and enhancement effect; Concept of two photosystems; Z-Scheme of photosynthetic electron transport chain; Theories of photophosphorylation; Types of photophosphorylation; C-3, C-4 pathway of Carbondioxide fixation; CAM plants; Photorespiration; Law of limiting factors.

__***10 Hours***

**UNIT-II**

**Subunit-D (Transport of Organic Solutes):** Mechanism of phloem transport; Source sink relationship; Factors affecting translocation._____ ***03 Hours***

**Subunit-E (Plant Growth):** Definitions; Phases of growth and development; Kinetics of growth; Measurement of growth. _____ ***02 Hours***

**Subunit-F (Plant Growth Hormones):** History, discovery, physiological role and mechanism of action of Plant growth hormones: Auxins, Gibberellins, Cytokinins, Abscisicacid and Ethylene; Physiology of senescence._____ ***07 Hours***

**Subunit-G (Photomorphogenesis):** Definition; Discovery of Phytochromes, physiological role and mechanism of action; Cryptochromes and their role in development; Concept of Photoperiodism; Physiology of flowering and Florigen concept; Biological clocks;General account of Signal transduction. _____***04 Hours***

**Subunit-H (Seed Germination and Dormancy**):Definitions; Physiology of seed germination; Type of seed dormancy; Factors affecting seed dormancy; Methods of breaking seed dormancy; Significance of seed dormancy; Concept of vernalization. _____***02 Hours***

**Subunit-I(Plant Movements):** Overview of plant movements; detailed account of Phototropism, Gravitropism and Nastic movements. _____ ***03 Hours***

**PRACTICAL**

**Code: BSCBOT 0614(P)**

**Plant Physiology**

**Credit = 1**

1. Methods of expressing the strength of a solution (Percent solution, Molar solution, Molal solution and ppm solution).
2. Demonstration of Tyndall phenomenon.
3. Preparation of suspension, emulsion, suspenoid and emulsoid.
4. Demonstration of diffusion and Brownian movement.
5. Observation of streaming movement of the protoplasm.
6. Demonstration of Imbibition and Imbibition pressure.
7. Demonstration of Osmosis, Exosmosis and Endosmosis.
8. Measurement of Osmotic pressure of a plant cell.
9. Demonstration of effect of temperature and organic solvents on membrane permeability.
10. Demonstration of water movement through xylem.
11. Demonstration of root pressure and guttation.
12. **Stomatal studies:** Calculation of stomatal index; Effect of light and dark; Effect of Potassium ions and ABA.
13. Demonstration of transpiration, its water lifting power and loss of weight during transpiration.
14. Study of relative rates of transpiration from the upper and lower surfaces of the leaf; A mparative study (Four leaf method; Cobalt chloride method and bell-jar method).
15. Measurement of transpiration rate by Simple, Ganong, Farmer and Bose photometers.
16. Preparation of nutrient solution for water culture experiments (Study of mineral deficiency).
17. Test of Phosphate, Nitrate, Potassium, Calcium and Iron in plant tissues.
18. Isolation of photosynthetic pigments by differential solubility method and Paper chromatography technique (Ascending & Horizontal).
19. Determination of Absorption spectrum of Chlorophyll-a and Chlorophyll-b.
20. **Light reaction of Photosynthesis:** Effect of different wavelengths; Ganong's light screen; Chlorophyll essentiality; Oxygen evolution and its measurement (Wilmott bubbler &Ganong'sphotosynthometer); Hill reaction demonstration.
21. **Dark reaction of Photosynthesis:** Carbon dioxide essentiality; Starch synthesis in chloroplasts.
22. Test the presence of Carbohydrates, Amino acids, Proteins, Lipids and Nucleic acids in plant tissues.
23. Demonstration of Catalase activity, Effect of temperature, pH, and Substrate concentration.
24. **Translocation of Carbohydrates:** Translocation out of leaves; Phloem as translocation channel.
25. **Respiration:** Demonstration of anaerobic and aerobic respiration; Fermentation (Kuhne's fermentation vessel); Release of carbon dioxide and use of oxygen during aerobic respiration;
26. **Respiratory quotient (RQ):** Measurements by Ganong'srespirometer and Double respiroscopes.
27. **Growth**:Axial stem growth measurement by Arc-auxanometer and Pfeffer's (Automatic) auxanometer; Rooting effect of Auxins (IBA); Effect of Gibberllins (GA) on plant growth; Delaying of senescence by Cytokinins and fastening by Abscisic acid (ABA); Demonstration of etiolation in germinating seeds; Determination of seed viability by NTC test; Plant movements study (Phototropism, Geotropism, Hydrotropism and Seismonasty).

## Suggested Readings

- **Plant Physiology:**


**a.** Bhatia, K.N. and Prashar, A.N. 1985. Plant Physiology. Trueman Book Company.

**b.** Buschanan, B., Gruissem, W., Jones, R. (Eds). 2002. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists.

**c.** Devlin, R.M. and Witham, F.H. 1983. Plant Physiology. Willard Grant Press.

**d.** Hopkins, W.G. and Hunner, N.P.A. 2009. Introduction to Plant Physiology. John Wiley and Sons, Inc.

**e.** Pandey, S.N. and Sinha, B.K. 2009. Plant Physiology. VikasPublishing HousePvt. Ltd. New Delhi.

**f.** Salisbury, F. and Ross, C. 1991. Plant Physiology. Wadsworth Pub. Co.

**g.** Taiz, L. and Zeiger, E. 2012. Plant Physiology. Sinauer Associates.


**CORE ELECTIVE**

**Theory = 3 Credits Practicals = 1 Credit**

In Core Electives, the teacher will conduct practicals based on theory course

**Code: BSCBOT0408**

**Evolutionary Biology**

**Credits = 3**

Course duration- 40Hours

**UNIT-I**

**Subunit-A (Origin of Life on Earth)**:Primitive earth; Major events in the history of life; Modern (Chemosynthetic) theory of life origin; Miller's experiment; Geological Time Table (Up to Epoch level with characteristic life form).Phylogenetic tree of life as defined by comparative rRNA gene sequencing. _____***05 Hours***

**Subunit-B (Palaeontology):** Definition of fossils, Sub fossils, Pseudo fossils, Living fossils and Index fossils; Rocks and their types (Igneous, Sedimentary and Metamorphic rocks); fossilization process; Kinds of fossils and mode of their preservation; Techniques of study and reconstruction of fossils; Age determination of fossils by Radiocarbon dating technique.

_____***15 Hours***

**UNIT-II**

**Subunit-C (Organic Evolution):** Meaning and evidences (Anatomical, Embryological, Physiological and Paleontological). _____***03 Hours***

**Subunit-D (Evolutionary and Population Genetics):**Lamark's theory of inheritance of acquired characters; Darwin's theory of natural selection; Hardy-Weinberg principle and its applications; Macro, Micro and Molecular evolution; Molecular clocks;Agents of evolutionary change (Mutation, Gene flow, Non-random mating, Genetic drift and Selection); Co-evolution; Cataclysmic evolution; Enzyme polymorphism; Species concept (Biological, Evolutionary and Ecological); Isolating mechanisms and type of speciation; Modern interpretation of Darwinism. _____***17 Hours***

**PRACTICAL**

**Code: BSCBOT 0408(P)**

**Evolutionary Biology**

**Credit = 1**

1. Study of Homologous , Analogous and vestigial organs in plants.
2. Study of atavism with reference to plants.
3. Study of Evolutionary Biology with the help of models and images.

## Suggested Readings


**• Evolutionary Biology:**

**a.** Brooker, R.J. 2012. Concepts of Genetics; **(Chapter-27: Evolutionary Genetics).** McGraw-Hill.

**b.** Gardner, E.J., Simmons, M.J. and Snustad, D.P. 1991. Principles of Genetics; **(Chapter-22: Evolutionary Genetics).** John Wiley & Sons, Inc.

**c.** Kay, L.E.1993. The Molecular Vision of Life. 1993. Oxford University Press.

**d.** Klug, W.S., Cummings, M.R., Spencer, C.A. and Palladino, M.A. 2012. Concepts of Genetics; **(Chapter-25: Population and Evolutionary Genetics).** Pearson Benjamin Cummings.

**e.** Raven, P.H., Johnson, G.B., Mason, K.A., Losos, J.B. and Singer, S.R. 2014. Biology; **(Part-IV: Evolution).** McGraw-Hill.

**f.** Snustad, D.P. and Simmons, M. J. 2012. Principles of Genetics; **(Chapter-24: Evolutionary Genetics).** John Wiley and Sons, Inc.

**g.** Savage, J.M. 1969. Evolution. Oxford & IBH Publishing House.

**h.** Verma, P.S. and Agarwal, V.K. 2012. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S.Chand& Co. Ltd.

**i.** Volpe, E.P. 1992. Understanding Evolution. Universal Book Stall.

**Code: BSCBOT0512**

**Molecular Biology**

**Credits = 3**

Course duration- 40Hours

**UNIT-I**

**Subunit-A (Major classes of Biological Molecules):** Proteins; Nucleic acids; Polysaccharides and Lipids;some common methods used to study macromolecules (Ultracentrifugation, Electrophoresis, Chromatographyand Electron microscopy).

***____ 05 Hours***

**Subunit-B (Brief account of common experimental organisms used in Molecular Biology):** Viruses; Bacteria; *Musmusculus (Mice); Drosophila melanogaster(Fruit fly);Caenorhabditiselegans (Roundworm);Daniorerio(Zebra fish);Saccharomyces Cerevisiae* (Yeast)*;Neurosporaand Arabidopsis thaliana.* ***_____01 Hours***

**Subunit-C(Basic Molecular Genetic Mechanisms):** DNA as the genetic material; DNA structure; Forms of DNA (A, B, C, D, E, Pand Z); DNA replication; DNA Protein interaction and Nucleosome model; Satellite and repetitive DNA;Modern concept of gene; RNA structure (m-RNA and t-RNA); Ribosome structure; Flow of genetic information; Genetic code; Mechanism of protein synthesis; Regulation of gene expression in prokaryotes and eukaryotes.***_____08Hour***

**UNIT-II**

**Subunit-D (Recombinant DNA Technology):** Gene cloning using vectors (Plasmids, cosmids, viruses, transposons, YAC, BAC and PAC); Binary and shuttle vectors; Restriction enzymes used in cloning; Complementary DNA; Polymerase chain reaction and gene amplification; DNA library; Colony hybridization; Blotting techniques (Southern blotting, Northern blotting and Western blotting); DNA sequencing (Maxam and Gilbert method;Sanger's method) and site directed mutagenesis; DNA fingerprinting; DNA foot printing.

***_____15 Hours***

**Subunit-E (Genomics and Proteomics**):Definition; Type of genomics (Structural, functional and comparative);Introduction to genome sequencing and its significance; Human genome project; Outline of gene sequencing methods (Direct sequencing of Bacterial artificial chromosome, Random shotgun sequencing, Whole genome shotgun sequencing, Expressed sequence tag approach); Definition and objectives of proteomics; Relationship between gene and protein; Types of proteomics. ***_____ 08 Hours***

**Subunit-F (Bioinformatics):** Definition; Historical background; Database; Classification of database; Brief outline of sequences and nomenclature; Information sources (NCBI, GBD and MGD).Use of Bioinformatics tools in analysis. ***_____ 03 Hours***

**PRACTICAL**

**Code: BSCBOT 0512(P)**

**Molecular Biology**

**Credit = 1**

1. ***Demonstration of Equipments:** Spectrophotometer; Centrifuge; Electrophoresis unit; pH meter; Water bath; Incubator; Hot air oven; Shaker; Magnetic stirrer; Test tube shaker; Heating plate; Distillation plant; Autoclave; Laminar air flow; PCR; Analytical digital balance; Single-pan balance; Good quality microscope with projection system.
2. Isolation of Genomic DNA.
3. *DNA detection by Gel electrophoresis.

***Subject to the availability of lab facilities. Teacher may demonstrate with the help of images.**

## Suggested Readings

- **Molecular Biology:**
  - **a.** Brown, T.A. 2006. Genomes 3. Garland Science.
  - **b.** Freifelder, D. 1987. Molecular Biology. Jones and Bartlett Publishers.
  - **c.** Tropp, B.E. 2012. Molecular Biology: Genes to Proteins. Jones and Bartlett Learning.
  - **d.** Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. 2007. Molecular Biology of The Gene. Pearson Benjamin Cummings.
  - **e.** Weaver, R.F. 2012. Molecular Biology. McGraw-Hill.

**Code: BSCBOT 0615**

**Plant Pathology**

**Credits = 4**

Course duration- 40Hours

- **Introduction:** Definitions and terms used in plant pathology; Classification of plant diseases on the basis disease spread and major causal agent; Indian contribution to plant pathology. ***02 hours***
- **Disease Inciting Agents:** Fungi; Bacteria; Mycoplasma; Algae; Phanerogamic parasites; Nematodes; Viral; Deficiency and toxicity of minerals; Pathogenesis. _____ ***02 hours***
- **Symptoms of Pant Diseases:** Symptoms caused by Fungi, Bacteria, Plant viruses, Mycoplasma and Nematodes. _____ ***05 hours***
- **Dissemination of Plant Pathogens and Virus Transmission:** Dissemination by air, water, animals and man; Transmission of plant viruses. _____ ***02 hours***
- **Plant Disease Forecasting:** Methods used in forecasting._____***01 hours***
- **Host parasite Inter-relationship and Interaction:** Mechanism of infection; Enzymes, growth regulators and toxins in plant disease. _____***04 hours***
- **Effect of Climatic Conditions on Plant Diseases:** General account; Predisposing factors. ***01 hour***
- **Defence Mechanism:** General account; Structural and biochemical defence; Biochemical defence induced by the attacking pathogen; Inactivation of pathogen enzyme; Detoxification of pathogen toxins. ***05hours***
- **Principles of Plant Disease Control:** Culturalmethods; Chemical methods; Breeding for disease resistance. _____ ***05 hours***

- **Specific diseases:** White rust of crucifers; Late blight of potato; Apple scab; Loose smut of wheat; Rust of wheat; Early blight of potato; Tikka disease of groundnut; Red rot of sugarcane and Citrus canker. ***13 hours***

**Code: BSCBOT 0616**

**Microbiology**

**Credits = 4**

Course duration- 40Hours

- **Introduction to Microbiology:** Origin of microorganisms; Organisms of microbial world; Differences between prokaryotic and eukaryotic cells; Contribution of Antony van Leeuwenhoek, Louis Pasteur and Robert Koch; Scope of microbiology; Microbial evolution; Classification of microorganisms. _____ ***04hours***
- **Microbiological Methods:** Sterilization methods; Media preparation; Isolation methods; Maintenance and preservation of cultures; Light and Electron microscopy; Gram's staining of bacteria. ***04hours***
- **Structure and Function of Bacterial Cells:** Size, shape and ultrastructure of bacterial cell; Bacterial nutrition; Bacterial photosynthesis; Endospore structure; Locomotion in bacteria. ***05hours***
- **General account of Viruses, Viroids and Prions.**_____ ***03hours***
- **Basic Molecular Genetic Mechanisms and Microbial Genetics :** DNA as the genetic material; DNA structure; RNA structure (m-RNA and t-RNA); Ribosome structure; Flow of genetic information; Genetic code; Mechanism of protein synthesis; Gene mutations at molecular level; Regulation of gene expression in prokaryotes; Bacterial genetic recombination (Transformation, Conjugation and Transduction).

____ ***09hours***

- **Recombinant DNA Technology:** Gene cloning using vectors (Plasmids, cosmids, viruses, transposons); Binary and shuttle vectors; Restriction enzymes used in cloning; Complementary DNA; Polymerase chain reaction and gene amplification;

DNA library; Colony hybridization; Blotting techniques (Southern blotting, Northern blotting and Western blotting). _____***09hours***

- **Economic Importance of Microbes:** Role of microbes in Industry, Health, Agriculture and Environment._____ ***03hours***
- **Microbial Ecology:** Microbial interactions; Extremophiles; General account of Soil,

Air and Water microbiology. _____ ***03hours***

## Suggested Readings

- **Microbiology:**
  - **a.** Dubey, R.C. and Maheshwari, D.K. 2005. A Textbook of Microbiology. S.Chand& Co.
  - **b.** Madigan, M.T., Martinko, J.M., Stahl, D.A. and Clark, D.P. 2012. Brock Biology of microorganisms. Benjamim Cummings.
  - **c.** Powar, C.B. and Daginawala, H.F. 2003. General Microbiology (Vol. I & II). Himalaya Publishing House.
  - **d.** Tortora, G.J., Funke, B.R. and Case, C.L. 2013. Microbiology-An Introduction. Benjamin Cummings.
  - **e.** Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2013. Prescott, Harley and Klein's Microbiology. McGraw-Hill.

**Code: BSCBOT 0617**

**Techniques in Biological Research**

**Credits = 4**

Course duration- 40Hours

- **Basic Principles:** Lab safety and hygiene; Units of measurements; Basic statistical concepts for biochemical analysis. ***03 hours***
- **pH and Buffers:** pH Scale; pH Meter; Buffers and their types. ***03hours***
- **Cell Culture Techniques:** Introduction; Organisation of cell culture laboratory; Equipments; maintenance of aseptic environment; Media preparation for bacteria and stem cell culture. ***04 hours***
- **Microscopy Techniques:** Light microscopy, Electron microscopy and their types; Sample preparation for light and electron microscopy; Imaging of living cells and tissues. ***06hours***
- **Centrifugation Techniques:** Basic principles; Preparative and Analytical centrifugation. ***02hours***
- **Spectroscopy Techniques:** Basic principles; Ultraviolet and Visible spectroscopy; Brief account of Infrared and Raman spectroscopy; EPR, NMR and XRD. ***07 hours***
- **Chromatographic Techniques:** Principles of Chromatography; Gas chromatography; High-Performance liquid chromatography. ***05hours***
- **Electrophoretic Techniques:** General principles; Capillary electrophoresis; Electrophoresis of proteins and nucleic acids. ***04hours***
- **Immunochemical Techniques:** Fluorescent activated cell sorting (FACS). ***03hours***
- **Mass spectrometric Techniques:** Introduction; Ionisation; Mass analysers and detectors. ***03 hours***

## Suggested Readings

- **Biological Techniques:**


**a.** Sadasivam, S. and Manickam, A. 2009. Biochemical Methods. New Age International Pvt. Ltd. Publishers.

**b.** Plummer, D.T. 1971. An Introduction to Practical Biochemistry. McGraw-Hill.

**c.** Wilson, K. and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.

**Code: BSCBOT 0618**

**Utilization of Plants**

**Credits = 4**

Course duration- 40Hours

- **Introduction:** Origin of Cultivated plants; Importance of plant and plant products to mankind. _____***01hours***
- **Fibres and Fibre Plants:** Classification of fibres; Cotton; Flax; Hemp; Jute; Ramie; Sisal; Coconut and Kapok. _____***04 hours***
- **Cereal Crops:** Wheat; Rice; Maize; Barley; Oats and Rye. _____***04 hours***
- **Sugars, Starches and Cellulose Products:** Sources of sugars; Sugarcane and sugar beet; Starches and starch products; Cellulose products; Paper and paper making. ***03 hours***
- **Legumes:** Legumes; Forage crops; Tree legumes._____***02hours***
- **Fatty oils and Waxes:** Sources of fatty oils; Waxes and Soap substitutes. _____***03 hours***
- **Fruits:** Classification of fruits; Common fruits of Indian subcontinent; Fruits of temperate and tropical regions; Important fruit plants of Himachal Pradesh; Preservation of fruits. ***04 hours***
- **Vegetables:** Common vegetables of Indian subcontinent; Earth vegetables; Herbage vegetables and Fruit vegetables. _____ ***03hours***
- **Spices, Condiments and other Flavouring materials**:Common Spices, Condiments and flavouring materials of Indian subcontinent; Spices obtained from bark, flower and flower buds, fruits, seeds and leaves; Other spices and flavouring materials. . ***03hours***
- **Beverages**:Tea; Coffee and Cocoa. _____ ***04hours***
- **Forest Products:** Importance, structure and mechanical properties of wood; Factors influencing the mechanical properties of wood; Uses of wood; Indian forests; Important timber plants of India and their identification; Timber wealth of Himachal Pradesh.***03 hours***
- **Rubber and Other Latex Products**:Para rubber; Substitutes for Para rubber; Synthetic rubber. _____ ***03hours***
- **Medicinal Plants**:History of medicinal plants; Drug plants; Classification of drugs; psychoactive drugs. _____***03 hours***

## Suggested Readings

- **Utilization of Plants:**


**a.** Kocchar, S.L. 1998. Economic Botany in the Tropics. McMillan India Ltd., New Delhi.

**b.** Sharma, O.P. 1996. Hills Economic Botany (Late Dr. A.F. Hill adapted by Sharma, O.P.1996), Tata McGraw-Hill Co. Ltd., New Delhi.

**c.** Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany-Plants in our World. McGraw-Hill. New York.

**Code: BSCBOT 0619**

**Ethnobotany**

**Credits = 4**

Course duration- 40Hours

- Scope and aim of ethnobotanyin developing world; Father of Indian ethnobotany. . ***01hours***
- Ethnoecology / Traditional resource management.. __ ***02hours***
- Agriculture: origins, traditional, industrialized, sustainable. ***03hours***
- Crop domestication, evolution, and conservation of genetic diversity. ***04hours***
- Interactions of humans and plants in the past: archaeobotany, paleoethnobotany, ethnohistory. _____***04hours.***
- Indigenous knowledge, linguistic ethnobotany, and ethnobiological classification.. ***04hours***
- Quantitative ethnobotany and survey field methods. ***04hours***
- Plants in symbolism, ritual, and religion..___***01hours***
- Plants in material culture / fibers, plant structure related to uses._***02hours***
- Plants in nutrition and dietary patterns / Fermented foods.__***02hours***
- Systems of traditional medicine in India; Medicinal floral wealth of Himachal Pradesh. ***04hours***
- Phytochemistry / Human uses of plant secondary metabolites / Foods as medicines; Psychoactive plants. ***03 hours***
- Global movement of plants and human cultures. __ ***02hours***
- Non-timber forest products / plants and markets. __ ***02hours***
- Plants and Indigenous cultures of India with special reference to Himachal Pradesh.. ***02hours***

## Suggested Readings

- **Ethnobotany:**


**a.** Cotton, C.M. 1996. Ethnobotany; Principles and Applications.John Wiley and Sons, Inc.

**b.** Schultes, R.E. and Reis, S.V. 2008. Ethnobotany; Evolution of a Discipline. Timber Press.

**c.** Medicinal Plants Traditional Knowledge. Editor: P.C.Trivedi.2006 I.K. International Publishing House Pvt. Ltd.

**Code: BSCBOT 0620**

## Plant breeding

**Credits = 4**

Course duration- 40Hours

- **Nature and Scope of Plant Breeding:** History of plant breeding; Definitions; Aims and objectives. _____ ***04hours***
- **Mode of Reproduction in Relation to Plant Breeding:** Importance; Methods of reproduction; Mode of reproduction. _____ ***04hours***
- **Methods of Crop Improvement:** Selection; Hybridization; Introduction and acclimatization. ***04hours***
- **Mass Selection:** Definition; Procedure; Applications and uses; Advantages and limitations. ***04hours***
- **Pure line and Pure line Selection:** Definitions; Characters; Field technique; Uses; Advantages and disadvantages. _____***04hours***
- **Clone and Clonal Selection:** Definitions; Characters; Importance; Field technique; Uses; Advantages and disadvantages. _____ ***02hours***
- **Hybridization:** Definition and types; Applications and objectives; Prerequisites; Advantages and disadvantages. _____***05hours***
- **Heterosis and Hybrid Vigour.** _____ ***05hours***
- **Plant Introduction and Acclimatization.** _____ ***03hours***
- **Mutation Breeding and Breeding for Disease Resistance.** _____ ***05hours***

## Suggested Readings

- **Plant Breeding:**


**a.** Allard, R.W. 1999. Principles of Plant Breeding. John Wiley and Sons, Inc.

**b.** Chaudhari, H.K.1971. Elementary Principles of Plant Breeding.


**Code: BSCBOT 0621**

**Biodiversity**

**Credits = 4**

Course duration- 40Hours

- **Biodiversity Science:** Introduction; Biodiversity concept and definition; Biodiversity hot spots; Scope of biodiversity. _____***03hours***
- **Genetic Diversity**: Nature and origin of genetic variations; Determination of genetic diversity. _____***02hours***
- **Species Diversity:** Species inventory; Species diversity. _____ ***03hours***
- **Agrobiodiversity and Cultivated Taxa:** Origin and evolution of cultivated species diversity; Diversity in domesticated species; Wild plants; Feral plants; Domesticated microbes. ***05hours***
- **Ecosystem Diversity:** Classification of ecosystems; Measurement of ecosystem diversity; Major ecosystem types of the world._____ ***05hours***
- **Values and Uses of Biodiversity:** Biodiversity values; Ethical and aesthetic values; Precautionary principle; Methods of biodiversity valuation; Uses of plants._____***05hours***
- **Loss of Biodiversity:** Loss of genetic diversity; Loss of species diversity; Loss of ecosystem diversity; Loss of agrobiodiversity. _____***05hours***
- **Biodiversity Conservation:** Need of biodiversity conservation; Conservation of genetic, species, and ecosystem diversity; *In-situ* and *ex-situ*con sevations; Management of plant biodiversity; Role of women. _____ ***09 hours***
- **Role of Biotechnology:** Biotechnology in utilization of biodiversity; Adverse impacts of biotechnology on biodiversity. _____ ***03 hours***

## Suggested Readings

- **Biodiversity:**

Krishnamurthy, K.V. 2003. Textbook of Biodiversity. Science publishers, Inc.

**Code: BSCBOT 0622**

**Bioinformatics**

**Credits = 4**

Course duration- 40Hours

- **Introduction to Bioinformatics:** Definition;Importance and scope._____ ***02hours***
- **Genetic Engineering Methods:** Introduction to genetic engineering; Vectors and Restriction enzymes; Technique of making Recombinant DNA. _____ ***05hours***

- **Database:** Introduction to database; Sequence databases; Structure databases; Genome mapping databases; Biological culture and stock collection databases; Enzyme and metabolic pathways databases; Information retrieval from biological databases; Information sources. ***05hours***
- **Sequence Alignment and Database Searching:** Introduction to sequence alignment; Pairwise alignment; Significance of sequence alignment and types; Evolutionary basis of sequences alignment. ***05hours***
- **Phylogenetic Methods:** Phylogenetic models; Phylogenetic data analysis; Tree building methods; Phylogenetic software. _____***05hours***
- **Predictive methods:** Predictive methods using nucleotide and protein sequences. . ***04hours***
- **Genomics and Proteomics:** Definition; Type of genomics (Structural, functional and comparative); Introduction to genome sequencing and its significance; Human genome project; Outline of gene sequencing methods (Direct sequencing of Bacterial artificial chromosome, Random shotgun sequencing, Whole genome shotgun sequencing, Expressed sequence tag approach); Definition and objectives of proteomics; Relationship between gene and protein; Types of proteomics. _____***12hours***
- **Bioinformatics Software and its Applications. _____*02hours***

## Suggested Readings

- **Bioinformatics:**
  - **a.** Attwood, R.E. and Smith-Pary, D.J. and Phukan,S. 1999. Introduction to Bioinformatics. Pearson Education Ltd.
  - **b.** Harisha, S. 2007. Fundamentals of Bioinformatics. I.K. International Publishing House Ltd.

## OPEN ELECTIVE COURSES

**Theory = 3 Credits Practicals = 1 Credit**

In Open Electives, the teacher will conduct practicals based on theory course

**Code: BSCBOT 0623**

**Floriculture**

**Credits = 4**

Course duration- 40Hours

- **Introduction:** History of gardening; Importance and scope of floriculture and landscape gardening. _____***02hours***
- **Nursery Management and Routine Garden Operations:** Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators. ***08hours***
- **Ornamental Plants:** Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai. ***09hours***
- **Principles of Garden Designs:** English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India. ***05 hours***
- **Landscaping Places of Public Importance:** Landscaping highways and Educational institutions. ***05hours***
- **Commercial Floriculture:** Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, *Chrysanthemum, Dahlia, Gerbera, Gladiolous*, Marigold,Rose, *Lilium*, Orchids). ***07hours***
- **Diseases and Pests of Ornamental Plants. _____04 *hours***

## Suggested Readings

- **Floriculture:**

Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

**Code: BSCBOT 0624**

**Mushroom Cultivation**
**Credits = 4**

Course duration- 40Hours

**Introduction:** History and introduction; Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. _____ ***05hours***

**Classification:** Systematic position, morphology, distribution, structure and life cycle of ***Agaricus;*** Types of mushroom._____ ***03hours***

**Cultivation**:Equipments for mushroom spawn, Laboratory, culture room, spawn production mushroom farm layout and mushroom shed;
Paddy straw mushroom - substrate, spawn making; Methods - bed method, polythene bag method, field cultivation. Oyster mushroom cultivation -substrate, spawning, pre-treatment of substrate.Maintenance of mushroom. Cultivation of white button mushroom - spawn, composting, spawning, harvesting.
***__20hours***

**Disease Management**:Diseases- Common pests, disease prevention and control measures.

**____ 05*hours***

**Processing:** Blanching, steeping, sun drying, canning, pickling, freeze drying. **05 *hours.***

**Storage:** short term and long term storage. **_____02 *hours***

## Suggested Readings

- **Mushroom Cultivation:**


**a.** Bahl, N. 1988. Handbook of Mushroom. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi

**b.** Krishnamoorthy, A.S., Marimuthu, T. and Nakkern, S. 2005 **Mushroom Biotechnology .** TNAU Press, Coimbatore, India

**c.** Harander, S. 1991. Mushrooms. The Art of Cultivation Sterling Publishers.

**d.** Tripathi, D.P. 2005. Mushroom Cultivation. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

**GENERAL INTEREST COURSES**

**Code: BSCBOT 25**

**Psychoactive Plants and Society**

**Credits = 1**

Course duration- 40Hours

- **Introduction:** Historical aspects;Definition of psychoactive plants; Distribution of psychoactive principle in plant groups. _____ ***04hours***
- **Some Examples of Psychoactive Plants :** ***Atropa belladonna, Cannabis sativa, Datura metel, Erythroxylon coca, Lophophora williamsii, Mandragora officinarum, Nicotiana tabacum, Ipomea violacea, Papaver somniferum, Amanita muscaria, Psilocybe mexicana;*** Psychoactive plants with reference to Himachal Pradesh.

_____***14hours***

- **Type of Psychoactive Drugs:** Stimulants, Hallucinogens and Depressants; Medicinal use; Designer drugs. _____ **06** ***hours***
- **Chemical Nature ofPsychoactive Drugs:** Alkaloids and THC. _____ ***06hours***
- **Drug Abuse:** Development of drug abuse anddrug addiction; Methods of taking drugs (Powders and Snuffs, Smoking, External application); Deterioration of health; De-addiction; Illegal trade names of Opium;Drug trafficking._____ ***06hours***
- **Legislation:** Highlights of NDPS Act-1985. _____ ***04hours***

## Suggested Readings

- **Psychoactive Plants and Society:**

**a.** Kocchar, S.L. 1998. Economic Botany in the Tropics. McMillan India Ltd., New Delhi.
**b.** Sharma, O.P. 1996. Hills Economic Botany (Late Dr. A.F. Hill adapted by Sharma, O.P.1996), Tata McGraw-Hill Co. Ltd., New Delhi.
**c.** Shultes, R.E. 1976. Hallucinogenic Plants. A Golden Guide. Western Publishing Company.
**d.** Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany-Plants in our World. McGraw-Hill. New York.

**Code: BSCBOT 26**

**Credits = 1**

**Digital Photography**

Course duration- 40Hours

- **Introduction:** Digital camera features; Advantages of digital photography; Point and shoot camera; DSLR camera; Digital video camera; Image sensor; Image processor. ***05hours***
- **Basic Camera Operation:** Camera settings (Quality settings, white balance, ISO); Aperture and shutter speed; Built in flash and external flash. ***05hours***
- **Some Useful Accessories:** Camera bags, flash units, Tripods, monopods and other stabilizers; Battery and memory cards. ***03hours***
- **Lenses:** Basics of lens; Understanding the lens optics; Standard, zoom, wide-angle, telephoto and speciality lenses; Lens filters. ***03hours***
- **Digital Photography Techniques:** Metering mode selection; choosing the proper exposure; Creative techniques. ***05 hours***
- **Image Editing:** File formats (TIF, JPEG and RAW); Advantages and disadvantages of RAW format; Basic colour correction; Adjusting exposure and sharpening of images;Cropping. ***06hours***
- **Tackling Photographing Subjects:** Photographing people, sports, nature and landscapes. ***06hours***
- **Digital Photography for Research and Documentation.** ***04hours***
- **Techniques for Unusual Images:** Moving water and firework display. ***03hours.***

## Suggested Readings

- **Digital Photography:**

a. Simon, D. 2004. Digital Photography Bible. Wiley Publishing.
b. Canfield, J. 2007. The Digital SLR Guide. Peachpit Press.

**Annexure-I**

**Batch : 2015-onwards**

# HIMACHAL PRADESH UNIVERSITY SHIMLA-171005

## CHOICE BASED CREDIT SYSTEM (CBCS)-B.Sc. Botany (Major)

**Syllabus and Examination for B.Sc. Botany (Major)**

**Under CBCS**

**Semester System**

**June 2016 (IIIrd semester- onwards)**

| Approved in BOS meeting in the Subject of Botany held on 21 April 2016 | Annexure-I of BOS Meeting |
|---|---|

# BIOSCIENCES DEPARTMENT
## HIMACHAL PRADESH UNIVERSITY

**OUT LINES OF SYLLABI AND COURSES OF READING**

**IN THE SUBJECT OF BOTANY FOR B. Sc. WITH MAJOR IN BOTANY AND MINORELECTIVE IN BOTANY (2016-2017 onwards)**

### (A) Structure Outline of Major in Botany (Minimum Credits to be Earned=56)

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Categorywise |
|---|---|---|---|---|---|
| I (Odd) | | Compulsory Course I | To be Selected from the list of Compulsory Courses | 3 | Compulsory – 6<br>**Core – 8**<br>Elective – 8<br>GI & H – 1<br>Total – 23 |
| | | Compulsory Course II (Skill Based) | To be Selected from the list of Compulsory Courses (Skill Based) | 3 | |
| | **BSCBOT0101** | Major Core Course I | **Phycology,Mycology and Plant Pathology** | **3** | |
| | **BSCBOT0102** | Major Core Course II | **Bryophyta and Pteridophyta** | **3** | |
| | | Minor Elective Course I (a) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | | Minor Elective Course I (b) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | **BSCBOT0101(P)** | Major Core Lab Course I | **Phycology,Mycology and Plant Pathology** | **1** | |
| | **BSCBOT0102(P)** | Major Core Lab Course II | **Bryophyta and Pteridophyta** | **1** | |
| | | Minor Elective Lab Course I (a) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | Minor Elective Lab Course I (b) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | GI and H Course I | To be Selected from the list GI and Hobby Courses | 1 | |

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Categorywise |
|---|---|---|---|---|---|
| **II (Even)** | | Compulsory Course III | To be Selected from the list of Compulsory Courses | 3 | Compulsory – 6 (12)<br>**Core – 8 (16)**<br>Elective – 8 (16)<br>GI & H – 1 (2)<br>Total 23 (46) |
| | | Compulsory Course IV(Skill Based) | To be Selected from the list of Compulsory Courses (Skill Based) | 3 | |
| | **BSCBOT0203** | Major Core Course III | **Palaeobotany and Gymnosperms** | **3** | |
| | **BSCBOT0204** | Major Core Course IV | **Plant Taxonomy and Selected Families of Angiosperms** | **3** | |
| | | Minor Elective Course II (a) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | | Minor Elective Course II (b) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | **BSCBOT0203(P)**<br>**BSCBOT0204(P)** | Major Core Lab Course III<br>Major Core Lab Course IV | **Palaeobotany and Gymnosperms**<br>**Plant Taxonomy and Selected Families of Angiosperms** | **1**<br>**1** | |
| | | Minor Elective Lab Course II (a) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | Minor Elective Lab Course II () | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | GI and H Course II | To be Selected from the list GI and Hobby Courses | 1 | |
| **III (Odd)** | | Compulsory Course V | To be Selected from the list of Compulsory Courses | 3 | Compulsory – 6 (18) (Complete)<br>**Core – 8 (24)**<br>Elective – 8 (24)<br>GI & H – 1 (3) (Complete)<br>Total 23 (69) |
| | | Compulsory Course VI | To be Selected from the list of Compulsory Courses (Skill Based) | 3 | |
| | **BSCBOT0305** | Major Core Course V | **Economic Botany and Plant Anatomy** | **3** | |
| | **BSCBOT0306** | Major Core Course VI | **Embryology of Angiosperms** | **3** | |

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Categorywise |
|---|---|---|---|---|---|
| | | Minor Elective Course III (a) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | | Minor Elective Course III(b) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | **BSCBOT0305(P)** | Major Core Lab Course V | **Economic Botany and Plant Anatomy** | **1** | |
| | **BSCBOT0306(P)** | Major Core Lab Course VI | **Embryology of Angiosperms** | **1** | |
| | | Minor Elective Lab Course III(a) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | Minor Elective Lab Course III(b) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | GI and H Course III | To be Selected from the list GI and Hobby Courses | 1 | |
| **IV (Even)** | **BSCBOT0407** | Major Core Course VII | **Cytogenetics** | **3** | **Core – 12 (36)**<br>Elective – 8 ((32)<br>Core / Elective (additional) - 4<br>Total 24 (93) |
| | **BSCBOT0409** | Major Core Course IX | **Cell Biology** | **3** | |
| | | Minor Elective Course IV (a) | To be Selected from the list for Minor Elective Subject other than Botany | 4 | |
| | | Minor Elective Course IV (b) | To be Selected from the list for Minor Elective Subject other than Botany | 4 | |
| | **BSCBOT0407(P)** | Major Core Lab Course VII | **Cytogenetics** | **1** | |
| | **BSCBOT0409(P)** | Major Core Lab course IX | **Cell Biology** | **1** | |
| | | Minor Elective Lab Course IV (a) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Categorywise |
|---|---|---|---|---|---|
| | | Minor Elective Lab Course IV(b) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | Core / Elective Course (Additional)* | | 4 | |
| V (Odd) | **BSCBOT0510** | Major Core Course X | **Biochemistry** | **3** | **Core – 12 (48)**<br>Elective – 8 (40)<br>(Complete)<br>Core / Elective (additional) - 4<br>Total 24 (117) |
| | **BSCBOT0511** | Major Core Course XI | **Biotechnology** | **3** | |
| | | Minor Elective Course V(a) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | | Minor Elective Course V(b) | To be Selected from the list for Minor Elective Subject other than Botany | 3 | |
| | **BSCBOT0510(P)** | Major Core Lab Course X | **Biochemistry** | **1** | |
| | **BSCBOT0511(P)** | Major Core Lab Course XI | **Biotechnology** | **1** | |
| | | Minor Elective Lab Course V (a) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | Minor Elective Lab Course V (b) | To be Selected from the list for Minor Elective Subject other than Botany | 1 | |
| | | Core / Elective Course (Additional)* | Any one of the Additional or open elective courses | 4 | |
| VI (Even) | **BSCBOT0613**<br>**BSCBOT0614** | Major Core Course XIII<br>Major Core Course XIV | **Ecology**<br>**Plant Physiology** | **3**<br>**3** | **Core – 8 (56)**<br>Core / Elective (additional) – 20*<br>Total 28 (145) |
| | **BSCBOT0613(P)** | Major Core lab Course XIII | **Ecology** | **1** | |
| | **BSCBOT0614(P)** | Major Core lab Course XIV | **Plant Physiology** | **1** | |
| | BSC(Or Other than Science) BOT(or other than Botany) 06** | Core / Elective Course (Additional)* | Any one of the Additional or open elective courses | 4 | |

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Category wise |
|---|---|---|---|---|---|
| | BSC(Or Other than Science) BOT(or other than Botany) 06** | Core / Elective Course (Additional)* | Any one of the Additional or open elective courses | 4 | |
| | BSC(Or Other than Science) BOT(or other than Botany) 06** | Core / Elective Course (Additional)* | Any one of the Additional or open elective courses | 4 | |
| | BSC(Or Other than Science) BOT(or other than Botany) 06** | Core / Elective Course (Additional)* | Any one of the Additional or open elective courses | 4 | |
| | BSC(Or Other than Science) BOT(or other than Botany) 06** | Core / Elective Course (Additional)* | Any one of the Additional or open elective courses | 4 | |

**Note: Students in VI semester can opt any of the following courses.**

***Additional Elective Courses offered by Biosciences Department in Botany (can be chosen for earning credits over and above 56 Major subject credits, 40 Minor elective credits, 9 (Min.) Compulsory course credits and 1 (Min.) 3GI & H Course credits i.e. total 106 credits; for getting B.Sc. Degree a learner has to earn a minimum of 120 credits.) Students in VI semester can opt any of the following courses.**

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Category wise |
|---|---|---|---|---|---|
| **VI** | **BSCBOT0408** | Core Elective | **Evolutionary Biology** | 3 | |
| **VI** | **BSCBOT0408(P)** | | **Evolutionary Biology** | 1 | |
| **VI** | **BSCBOT 0512** | Core Elective | **Molecular biology** | 3 | |
| **VI** | **BSCBOT0512(P)** | | **Molecular biology** | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| **VI** | **BSCBOT0615** | Core / Elective Course (Additional)* | **Plant Pathology** | 4 | |
| **VI** | **BSCBOT0616** | Core / Elective Course (Additional)* | **Microbiology** | 4 | |
| **VI** | **BSCBOT0617** | Core / Elective Course (Additional)* | **Techniques in Biological Research** | 4 | |
| **VI** | **BSCBOT0618** | Core / Elective Course (Additional)* | **Utilization of Plants** | 4 | |
| **VI** | **BSCBOT0619** | Core / Elective Course (Additional)* | **Ethnobotany** | 4 | |
| **VI** | **BSCBOT0620** | Core / Elective Course (Additional)* | **Plant Breeding** | 4 | |
| **VI** | **BSCBOT0621 (also Open in IV semester)** | Core / Elective Course (Additional)* | **Biodiversity** | 4 | |
| **VI** | **BSCBOT0622 (also Open in V Semester)** | Core / Elective Course (Additional)* | **Bioinformatics** | 4 | |

*Open Elective Courses offered by Botany Department

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Categorywise |
|---|---|---|---|---|---|
| **VI** | **BSCBOT0623** | Open /Core Elective Course (Additional)* | **Floriculture** | 4 | |
| **VI** | **BSCBOT0624** | Core / Elective Course (Additional)* | **Mushroom Cultivation** | 4 | |

## General Interest Courses Offered by Botany Department

| Semester | Course Code | Course Type | Course Name | Credit(s)/ week | Cumulated Credits Categorywise |
|---|---|---|---|---|---|
| **I/II/III** | **BSCBOT**25** | GI/H | **Psychoactive Plants and Society** | 1 | |
| **I/II/III** | **BSCBOT**26** | GI/H | **Digital Photography** | 1 | |
| **I/II/III** | | | **Botanical Garden & Herbaria** | | |
| **I/II/III** | | | **Diversity In Orchids** | | |
| **I/II/III** | | | **Mechanism of pollination in plants** | | |
| **I/II/III** | | | **Bioluminescence & Insectivorous plants** | | |

**(B) Structure Outline of Minor Elective in Botany for other than Major Botany Students (Minimum Credits to be Earned=20). Other than Botany Major Learner can do Double major by earning 34 more credits over and above 20 credits of Minor Elective.**

| Semester | Course Code | Course Name | Course Name | Credit(s)/ week | Cumulated Credits Category-wise |
|---|---|---|---|---|---|
| I (Odd) | | Compulsory Course I | | 3 | Compulsory – 6<br>Core – 8<br>**Minor Elective 1(a) – 4(4)**<br>Minor Elective 1(b)=4<br>Total Minor Electives – 8 (8)<br><br>GI & H – 1<br>Total – 23 |
| | | Compulsory Course II (Skill Based) | | 3 | |
| | | Major Core Course I | | 3 | |
| | | Major Core Course II | | 3 | |
| | **BSCBOT0101** | **Minor Elective Course I (a)** | **Phycology, Mycology and Plant Pathology** | 3 | |
| | | Minor Elective Course I (b) | | 1 | |
| | | Major Core Lab Course I | | 1 | |
| | | Major Core Lab Course II | | 1 | |
| | **BSCBOT0101(P)** | **Minor Elective Lab Course I (a)** | **Phycology, Mycology and Plant Pathology** | **1** | |
| | | Minor Elective Lab Course I (b) | | 1 | |
| | | GI and H Course I | | 1 | |
| II (Even) | | Compulsory Course III | | 3 | Compulsory – 6 (12)<br>Core – 8 (16)<br>**Minor Elective 1I(a) – 4 (8)**<br>Minor Elective 1I(b) – 4 (8)<br>Total Minor Electives – 8 (16)<br><br>GI & H – 1 (2)<br>Total 23 (46) |
| | | Compulsory Course IV(Skill Based) | | 3 | |
| | | Major Core Course III | | 3 | |
| | | Major Core Course IV | | 3 | |
| | **BSCBOT0203** | **Minor Elective Course II (a)** | **Palaeobotany and Gymnosperms** | **3** | |
| | | Minor Elective Course II (b) | | 3 | |
| | | Major Core Lab Course III | | 1 | |
| | | Major Core Lab Course IV | | 1 | |
| | **BSCBOT0203(P)** | **Minor Elective Lab Course II (a)** | **Palaeobotany and Gymnosperms** | **1** | |
| | | Minor Elective Lab Course II | | 1 | |
| | | GI and H Course II | | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| III (Odd) | | Compulsory Course V | | 3 | Compulsory – 6 (18) (Complete) Core – 8 (24) **Minor Elective III(a) – 4 (12)** |
| | | Compulsory Course VI | | 3 | |
| | | Major Core Course V | | 3 | |
| | | Major Core Course VI | ------ | 3 | |
| **Semester** | **Course Code** | **Course Name** | **Course Name** | **Credit(s)/ week** | **Cumulated Credits Category-wise** |
| | **BSCBOT0102** | **Minor Elective Course III (a)** | **Bryophyta and Pteridophyta** | **3** | Minor Elective III(b) – 4 (12) Elective – 8 (24) GI & H – 1 (3) (Complete) Total 23 (69) |
| | | Minor Elective Course III (b) | ------ | 3 | |
| | | Major Core Lab Course V | ------ | 1 | |
| | | Major Core Lab Course VI | ------ | 1 | |
| | **BSCBOT0102(P)** | **Minor Elective Lab Course III(a )** | **Bryophyta and Pteridophyta** | **1** | |
| | | Minor Elective Lab Course III (b) | ------ | 1 | |
| | | GI and H Course III | ------ | 1 | |
| IV (Even) | | Major Core Course VII | ------ | 4 | Core – 12 (36) **Minor Elective IV(a) – 4 (16)** Minor Elective IV(b) – 4 (16) Total Minor Electives – 8 (32) Core / Elective (additional) - 4 Total 24 (93) |
| | | Major Core Course VIII | ------ | 4 | |
| | | Major Core Course IX | ------ | 4 | |
| | **BSCBOT0204** | **Minor Elective Course IV (a)** | **Plant Taxonomy and Selected Families of Angiosperms** | **4** | |
| | | Minor Elective Course IV (b) | ------ | 4 | |
| | | Major Core Lab Course VII | ------ | 1 | |
| | | Major Core Lab Course VIII | ------ | 1 | |
| | **BSCBOT0204(P)** | **Minor Elective Lab Course IV (a)** | **Plant Taxonomy and Selected Families of Angiosperms** | **1** | |
| | | Minor Elective Lab Course IV (b) | ------ | 1 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| V (Odd) | | Major Core Course X | ------ | 3 | Core – 12 (48)<br>**Minor Elective V(a) – 4 (20)**<br>Minor Elective V(b) – 4 (20)<br><br>Total Minor Electives – 8 (40)<br>(Complete) Core / Elective (additional) - 4 |
| | | Major Core Course XI | ------ | 3 | |
| | | Major Core Course XII | ------ | 3 | |
| | **BSCBOT0305** | **Minor Elective Course V(a)** | **Economic Botany and Plant Anatomy** | **3** | |
| | | Minor Elective Course V (b) | ------ | 3 | |
| | | Major Core Lab Course X | ------ | 1 | |
| | | Major Core Lab Course XI | ------ | 1 | |
| **Semester** | **Course Code** | **Course Name** | **Course Name** | **Credit(s)/ week** | **Cumulated Credits Category-wise** |
| | | Major Core Lab Course XII * | ------ | 1 | Total 24 (117) |
| | **BSCBOT305(P)** | **Botany Lab V** | **Economic Botany and Plant Anatomy** | **1** | |
| | | Minor Elective Lab Course V (b) | ------ | 1 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |
| VI (Even) | | Major Core Course XIII | ------ | 4 | Core – 8 (56)<br>Core / Elective (additional) – 20*<br>Total 28 (145) |
| | BSCBOT0614 | Minor Core Course | Plant Physiology | 4 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |
| | | Core / Elective Course (Additional)* | ------ | 4 | |

**Annexure-I**

**Batch : 2015-onwards**

# HIMACHAL PRADESH UNIVERSITY SHIMLA-171005

## CHOICE BASED CREDIT SYSTEM (CBCS)-B.Sc. Botany (Major)

**Syllabus and Examination for B.Sc. Botany (Major)**

**Under CBCS**

**Semester System**

**June 2016 (IIIrd semester- onwards)**

**HIMACHAL PRADESH UNIVERSITY, SHIMLA-171005 CHOISE BASED CREDIT SYSTEM (CBCS) IN BOTANY CBCS Programme for B.Sc. with BOTANY (Major)**

**June 2016**

| | Code | Core Course (Hard Core) | Teaching Hrs. | Credits |
|---|---|---|---|---|
| SEMESTER I | BSCBOT0101 | Phycology,Mycology and Plant Pathology | 40 | 3+1=4 |
| | BSCBOT0102 | Bryophyta and Pteridophyta | 40 | 3+1=4 |
| SEMESTER II | BSCBOT0203 | Palaeobotany and Gymnosperms | 40 | 3+1=4 |
| | BSCBOT0204 | Plant Taxonomy and Selected Families of Angiosperms | 40 | 3+1=4 |
| SEMESTER III | BSCBOT0305 | Economic Botany and Plant Anatomy | 40 | 3+1=4 |
| | BSCBOT0306 | Embryology of Angiosperms | 40 | 3+1=4 |
| SEMESTER IV | BSCBOT0407 | Cytogenetics | 40 | 3+1=4 |
| | BSCBOT0409 | Cell Biology | 40 | 3+1=4 |
| SEMESTER V | BSCBOT0510 | Biochemistry | 40 | 3+1=4 |
| | BSCBOT0511 | Biotechnology | 40 | 3+1=4 |
| SEMESTER VI | BSCBOT0613 | Ecology | 40 | 3+1=4 |
| | BSCBOT0614 | Plant Physiology | 40 | 3+1=4 |
| **Core Elective** | | | | |
| | BSCBOT0615 | Plant Pathology | 40 | 3+1=4 |
| | BSCBOT0616 | Microbiology | 40 | 3+1=4 |
| | BSCBOT0617 | Techniques in Biological Research | 40 | 3+1=4 |
| | BSCBOT0618 | Utilization of Plants | 40 | 3+1=4 |
| | BSCBOT0406 | Evolutionary Biology | 40 | 3+1=4 |
| | BSCBOT0512 | Molecular Biology | 40 | 3+1=4 |
| | BSCBOT0619 | Ethnobotany | 40 | 3+1=4 |
| | BSCBOT0620 | Plant Breeding | 40 | 3+1=4 |
| | BSCBOT0621**(also Open in IV semester)** | Biodiversity | 40 | 3+1=4 |
| | BSCBOT0622 **(also Open in V semester)** | Bioinformatics | 40 | 3+1=4 |
| | BSCBOT0623 | Floriculture | 40 | 3+1=4 |
| | BSCBOT0624 | Mushroom Cultivation | 40 | 3+1=4 |
| | | General Interest / Hobby | | |
| | BSCBOT**25 | Psychoactive Plants and Society | 40 | 1 |
| | BSCBOT**26 | Digital Photography | 40 | 1 |

**Scheme of Examinations for every major /minor and additional course:**

End semester examination = **40** marks Time 3 hrs

Internal Assessment= **30** Marks (Unit Test= 15 Marks, Assignment=10 Marks & Attendance= 5 Marks)

Practicals of every major/minor/additional course **30** Marks Time 3 hrs

General Interest and Hobby Courses = **50** marks

CCA 15 Marks (Assignment =10 Marks & Attendance=5 Marks)

ESE 35 Marks