

Department of Botany

Semester-I

DISCIPLINE SPECIFIC COURSE (DSC)- Plant diversity I (Microbes, Fungi and Algae)

No. of Hours: 75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant diversity I (Microbes, Fungi and Algae)	4	3	0	1	Passed Class XII with Biology	Nil

UNDERGRADUATE CERTIFICATE IN BOTANY

Programme : <i>Undergraduate Certificate in Botany</i>		Year: I	Semester: I
Subject: Botany			
Course: BOT DSC 1	Course Title: Plant diversity I (Microbes, Fungi and Algae)		
Course Outcomes: After the completion of the course the students will be able to: 1. Develop an understanding about the classification and diversity of different microbes Algae, Fungi & Lichens & their economic importance. 2. Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens. 3. Gain knowledge about developing commercial enterprise of microbial products. 4. Learn about the host –pathogen relationship and disease management. 5. Gain Knowledge about uses of microbes in various fields. 6. Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens 7. Gain insight into the structure and replication mechanisms of viruses.			

Credits: 4	Discipline Specific Course
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (45)
1	General characteristics, habitat, ecology and economic importance of microbes, fungi and algae.	9
2	Viruses-discovery, general structure, replication (general account), Lytic and lysogenic cycle, DNA virus (T-phage), RNA virus (TMV). Bacteria-discovery, general characteristics, cell structure, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).	12
3	Range of somatic thallus organization, cell wall composition, nutrition, reproduction and classification of fungi (G.C. Ainsworth); life cycle of <i>Albugo</i> (Mastigomycota) <i>Rhizopus</i> (Zygomycota) <i>Penicillium</i> (Ascomycota), <i>Puccinia</i> , <i>Agaricus</i> (Basidiomycota); <i>Alternaria</i> (Deutromycota), General account of lichen and mycorrhiza.	12
4	Range of thallus organization, reproduction and classification of algae (F. E. Fritsch); morphology and life-cycles of: <i>Nostoc</i> , <i>Chlamydomonas</i> , <i>Volvox</i> , <i>Oedogonium</i> , <i>Chara</i> and <i>Sargassum</i> .	12

Practical/Lab Course BOT DSC 1P
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Unit	Topic	No. of Hours (30)
1	EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle. Types of Bacteria from temporary/permanent slides/photographs; EM of bacterium; Binary Fission; Conjugation; Structure of root nodule; Gram staining technique.	6

2	Study of vegetative and reproductive structures of <i>Nostoc</i> , <i>Chlamydomonas</i> (electron micrographs), <i>Volvox</i> , <i>Oedogonium</i> , <i>Chara</i> and <i>Sargassum</i> through temporary preparations and permanent slides/specimens.	10
3	<i>Rhizopus</i> and <i>Penicillium</i> : Asexual stages from temporary mounts. <i>Alternaria</i> : Specimens/photographs and tease mounts. <i>Puccinia</i> : Herbarium specimens of Black Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on wheat and permanent slides of both the hosts. <i>Agaricus</i> : Specimens of button stage and full grown mushroom.	10
4	Lichens: Study of growth forms of lichens (crustose, foliose and fruticose). Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs).	4

Suggested readings

- Sambamurty, A.V.S.S. (2006). A text book of Algae. I.K International Publishing House,Pvt. Ltd.
- Barsanti, L. and Gualtieri, P. (2014). Algae: Anatomy, Biochemistry and Biotechnology, 2nd Edition. CRC/ Taylor & Francis, NY.
- Lee, R.E. (2018). Phycology, Fifth Edition. Cambridge University Press, Cambridge.
- Marjorie, Kelly and Cowan, Heidi Smith. (2017). Microbiology: A Systems Approach. McGraw Hill New York, 5th edition.
- Pandey, S.N and Trivedi, P.S. (2015). A text book of Botany Vol.I Vikas publishingHouse Pvt/ Ltd, New Delhi.
- Mehrotra, R.S. and K.R. Aneja. (1999). An Introduction to Mycology. New Age International Publisher.
- Pelczar M.J., Chan E.C.S and Kreig N.R. (1997). Microbiology. Tata MacGraw Hill.
- Robert Edward Lee. (2018). Phycology. Cambridge University Press, U.K. 5th edition.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, MacMillanPublishers Pvt. Ltd., Delhi.
- Sharma, O. P. (2011). Algae. Tata McGraw Hill Education Private Limited, U.K. 1st edition.
- Webster, J. and Weber, R. (2007). Introduction to Fungi. Third Edition. Cambridge UniversityPress. Cambridge and New York.
- Willey, J M., Sherwood, L.M. and Woolverton, C.J. (2017). Prescott's Microbiology, 11th Edition, McGraw-Hill, USA.
- Purohit, S.D., Kundra, G. K. and Singhvi, A. (2013). Practical Botany (part I). ApexPublishing House Durga Nursery Road Udaipur, Rajasthan

Semester-I

Undergraduate Certificate in Botany

GENERIC ELECTIVE (GE)- Plant Cell Biology

No. of Hours- 60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Cell Biology	4	4	0	0	Passed Class XII	Nil

UNDERGRADUATE CERTIFICATE IN BOTANY

Programme : <i>Undergraduate Certificate in Botany</i>		Year: I	Semester: I
Subject: Botany			
Course: BOT GE 1	Plant Cell Biology		
Course Outcomes: After the completion of the course the students will be able to: 1. Understand the plant cell structure and its function. 2. Understand the various cell components and the general principles in cell communication and interaction. 3. Study the structure and genome organization of chloroplast and mitochondria.			

Credits: 4	Generic Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Principles of microscopy, cell theory, structural organization of the plant cell and its chemical composition, Cell wall structure and function.	15
2	Plasmamembrane, models, structures and functions, Cytoskeleton, organization and role of microtubules and microfilaments.	15
3	Structure and functions of nucleus, endoplasmic reticulum, golgi apparatus, ribosomes, lysosomes and glyoxysomes, chloroplast and mitochondria.	20
4	Demonstration of types of cells and different cell organelles through slides/photographs .	10

Suggested Readings

- Alberts, B., Hopkin, K., Johnson, A., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2019). Essential cell biology (5th ed.). W. W. Norton & Company, Inc.
- Rastogi, V. B. Cell Biology. Medtech Science Press: A Division of Scientific International.
- Verma, P.S. and Agrawal, V. K.. Cell Biology. (2016) S. Chand and Company, New Delhi.

Semester-II

Undergraduate Certificate in Botany

DISCIPLINE SPECIFIC COURSE (DSC)- Plant Diversity II (Bryophyta, Pteridophyta and Gymnosperms)

No. of Hours-75

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Diversity II (Bryophyta, Pteridophyta and Gymnosperms)	4	3	0	1	Passed Class XII with Biology	Nil

UNDERGRADUATE CERTIFICATE IN BOTANY

UNDERGRADUATE CERTIFICATE IN BOTANY		
Programme : <i>Undergraduate Certificate in Botany</i>	Year: I	Semester:II
Subject: Botany		
Course: BOT DSC 2	Course Title: Plant Diversity II (Bryophyta, Pteridophyta and Gymnosperms)	
Course Outcomes: After the completion of the course the students will be able to: 1. Develop a critical understanding of the morphology, anatomy and reproduction of Bryophyta, Pteridophyta and Gymnosperms. 2. Understand plant evolution and their transition to land habitat. 3. Learn the major patterns of diversity among plants, and the characters and types of data used to classify them. 4. Compare different approaches of classification.		

Credits: 4	Discipline Specific Course
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (45)
1	General characteristics, ecological and economic importance of bryophytes, pteridophytes and gymnosperms.	9
2	Classification of Bryophyta (G. M. Smith); Morphology, anatomy and reproduction of <i>Marchantia</i> , <i>Anthoceros</i> and <i>Funaria</i> .	12
3	Classification of Pteridophyta (K. R. Sporne); Morphology, anatomy and reproduction of <i>Selaginella</i> , <i>Equisetum</i> and <i>Pteris</i> ; heterospory and seed habit, stelar evolution, telome theory.	12
4	Classification of Gymnosperm (K. R. Sporne); Morphology, anatomy and reproduction of <i>Cycas</i> , <i>Pinus</i> , <i>Ginkgo</i> and <i>Ephedra</i> .	12

	Practical/Lab Course BOT DSC 2P
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Unit	Topic	No. of Hours (30)
1	<i>Marchantia</i> , <i>Anthoceros</i> : Morphology of thallus, rhizoids and scales, V.S. thallus through gemma cup, gemmae whole mount (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte through slides. <i>Funaria</i> - Morphology, whole mount leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, L.S. capsule and W.M. protonema.	10

2	<i>Selaginella</i>: Morphology, whole mount leaf with ligule, strobilus, microsporophyll and megasporophyll (temporary slides), T.S. stem, L.S. strobilus (permanent slide). <i>Equisetum</i>: Morphology, T.S. of internode, L.S. of strobilus and T.S. Strobilus, whole mount sporangiophore, spores (wet and dry) (temporary slides); T.S. rhizome through permanent slides. <i>Pteris</i>: Morphology and anatomical features of rachis, rhizome and sporophyll through permanent slides.	10
3	<i>Cycas</i>: Morphology (coralloid roots, bulbil, leaf), T.S. coralloid root and rachis, V.S. leaflet and microsporophyll, whole mount spores (temporary slides), L.S. of ovule, T.S. of root (permanent slide). <i>Pinus</i>: Morphology (long and dwarf shoots, male and female cones), T.S. Needle and stem, L.S./T.S. of male cone, whole mount microsporophyll and microspores (temporary slides), L.S. of female cone, T.L.S. and R.L.S. stem (permanent slide).	10

Suggested readings

- Pandey, B.P. (2014). Modern Practical Botany Vol. II. S. Chand and Company Ltd., New Delhi.
- Bendre, A.M. and Kumar A. (2003). Manual of Practical Botany Vol. II. Rastogi Publications, Meerut.
- Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
- Gangulee H.C., Kar, A.K. and Santra S.C. (2011). College Botany Vol II. 4th Edition New Central Book Agency.
- Kaur I.D., Uniyal P.L. (2019). Text Book of Gymnosperms. New Delhi, Delhi: Daya Publishing House.
- Kaur I.D., Uniyal P.L. (2019). Text Book of Bryophytes. New Delhi, Delhi: Daya Publishing House.
- Pandey, B.P. (2010). College Botany Vol II. S. Chand and Company Ltd., New Delhi, India.
- Parihar, N.S. (1976). Biology and Morphology of Pteridophytes. Central Book Depot.
- Parihar, N.S. (1991). An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
- Sharma, O.P. (1990). Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
- The Pteridophyte Phylogeny Group (PPG Classification) (2016): A community –derived classification for extant lycophytes and ferns. Journal of Systematics and Evolution. 54(6): 563-603. Doi:10.1111/jse.12229.
- Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). Bryophyta, S. Chand. Delhi, India.
- Vashishta, P.C., Sinha, A.K. and Kumar, A. (2010). Gymnosperms, S. Chand and Company Ltd., Ramnagar, New Delhi, India.

Semester-II

Undergraduate Certificate in Botany

GENERIC ELECTIVE (GE)- Plant Science – I

No. of Hours- 60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Science – I	4	4	0	0	Passed Class	Nil

UNDERGRADUATE CERTIFICATE IN BOTANY

Programme : *Undergraduate Certificate in Botany*

Year: I

Semester:
II

Subject: Botany

Course: BOT
GE 2

Plant Science – I

Course Outcomes:

After the completion of the course the students will be able to:

1. Develop understanding about the classification and diversity of different microbes (viruses, Algae, Fungi & Lichens) and their economic and ecological importance.
2. Understand the structure and reproduction of certain selected bacteria, algae, fungi and lichens.
3. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
4. Understand the basic concepts of plant taxonomy.
5. Understand plant morphology, anatomy and embryology.

Credits: 4

Generic Elective

Max. Marks: As per Univ. rules

Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Microbes: General characteristics, economic and ecological importance of bacteria and viruses. Algae: General characteristics; range of thallus, reproduction and economic importance Fungi: General characteristics, reproduction, ecology and significance.	15
2	Bryophytes: General characteristics, reproduction and economic importance. Pteridophytes: General characteristics, ecological and economic importance. Gymnosperms: General characteristics, ecological and economic importance. Introduction to Plant taxonomy, ICN, Herbarium and botanical garden.	20
3	Plant Embryology: Embryo, types of ovules and embryo sacs; endosperm; types of endosperm; dicot and monocot embryo, pollination, fertilization. Plant Anatomy: Types of tissues, root and shoot apical meristems, simple, complex and secretory tissues, structure of dicot and monocot root, stem and leaf.	15
4	Demonstration of representative specimens of each group. Demonstration of types of embryo, ovules and cells through slides/photographs.	10

Suggested Readings

- Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition. Singapore, John Wiley and Sons (Asia).
- Kumar, H.D. (1999). Introductory Phycology, 2nd edition. Delhi, Delhi: Affiliated East-West. Press Pvt. Ltd.
- Bhatnagar, S.P., Moitra, A. (1996). Gymnosperms. New Delhi, Delhi: New Age International (P) Ltd Publishers.
- Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Prayagraj: U.P.: Central Book Depot.

- Tortora, G.J., Funke, B.R., Case, C.L. (2007). Microbiology. San Francisco, U.S.A: Pearson Benjamin Cummings.
- Raven, P.H., Evert, R.F., Eichhorn, S.E. (1999). Biology of Plants. New York, NY: W.H. Freeman and Company Worth Publishers.
- Singh, G. (2012). Plant Systematics: Theory and Practice, 3rd edition. Oxford and IBH Pvt.Ltd. New Delhi.

Semester-III

Undergraduate Diploma in Botany

No. of Hours- 75

DISCIPLINE SPECIFIC COURSE (DSC)- Plant Systematics and Developmental Biology (Angiosperm, Embryology and Anatomy)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Systematics and Developmental Biology (Taxonomy, Embryology and Anatomy)	4	3	0	1	Undergraduate certificate in Botany	Nil

UNDERGRADUATE DIPLOMA IN BOTANY

Programme : Undergraduate Diploma in Botany			Year: II	Semester: III
Subject: Botany				
Course: BOT DSC 3	Course Title: Plant Systematics and Developmental Biology (Angiosperm, Embryology and Anatomy)			

Course Outcomes:

After the completion of the course the students will be able to:

1. Learn the major patterns of diversity among plants, and the characters and types of data used to classify plants.
2. Compare the different approaches of classification with regard to the analysis of data.
3. Become familiar with major taxa and their identifying characteristics, and to develop indepth knowledge of the current taxonomy of major plant families.
4. To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications.
5. Understand plant morphology, anatomy and embryology.
6. Understand the role of tissues in plant functions.
7. Understand the composition, modifications, internal structure and architecture of plants.
8. Understand reproduction and developmental changes in plants.

Credits: 4	Discipline Specific Course
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (45)
1	Identification, classification, nomenclature of plants, functions of herbarium, overview of important herbaria and botanical gardens of the India and world. Important floras, botanical nomenclature [principles and rules (ICN)]; ranks and names, binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations). Classification: Types of classification-artificial, natural and phylogenetic, Bentham and Hooker's (up to series), Hutchinson's classification and Angiosperm Phylogeny Group (APG IV) classification.	15
2	Salient features of families; Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Apiaceae, Asteraceae, Solanaceae, Lamiaceae, Euphorbiaceae, Orchidaceae and Poaceae.	10
3	Pollination, structure of anther and pollen, development of male and female gametophytes, types of ovule, polygonum type of embryo sac, double fertilization.	10

	Endosperm; types of endosperm, dicot and monocot embryo.	
4	Types of tissues; root and shoot apical meristems, simple, complex and secretory tissues, RAM and SAM theories. Structure of dicot and monocot root, stem and leaf, root-stem transition, vascular tissue and secondary growth, abnormal or anomalous secondary growth.	10

Practical/Lab Course BOT DSC 3P

Unit	Topic	No. of Hours (30)
1	Taxonomic Identification: Description of an angiospermic plant (one plant per family), study of vegetative and floral characters (description, V.S. of flower, section of ovary, floral diagram/s, floral formula/e) and systematic position of the following families (Ranunculaceae, Malvaceae, Fabaceae, Asteraceae, Solanaceae and Poaceae) according to Bentham and Hooker's system of classification.	10
2	Herbarium techniques: Plant collection, preservation and mounting of two properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book), digital/virtual herbarium.	5
3	Structure of anther (young and mature). Types of ovule: anatropous, orthotropous, circinotropous, amphitropous, campylotropous. Female gametophyte: Polygonum (monosporic) type of embryo sac development (permanent slide/photograph), Pollination types and seed dispersal mechanism (photograph and specimens).	8
4	Study of meristems through permanent slides and photographs. Tissues (parenchyma, collenchyma and sclerenchyma), complex and secretory tissues. Anatomy of monocot and dicot stem leaf and root. Anomalous secondary growth (<i>Dracaena</i> , <i>Nyctanthus</i>).	7

Suggested readings

- Angiosperm Phylogeny Group (APG-2016). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society 181: 1-20.

- Beck, C.B. (2010). An Introduction to Plant Structure and Development, II edition.
- Bhatnagar S.P, Dantu, P.K. Bhojwani S.S. (2018). The embryology of Angiosperms. Vikas Publ. House. New Delhi.
- Bhojwani, S.S. and Bhatnagar, S.P. (2010). The Embryology of Angiosperms. VikasPublication House Pvt. Ltd. New Delhi. 5th edition.
- Johri, B.M. (1984). Embryology of Angiosperms. Springer-Verlag, Berlin.
- Leins, P., Tucker, S.C. and Endress, P.K. (1988). Aspects of floral development. J. Cramer. Germany.
- Maheshwari, P. (1971). An Introduction to Embryology of Angiosperms. McGraw HillBook Co. London.
- Pandey, B.P. (2001) Plant Anatomy. S. Chand and Company Ltd., New Delhi.
- Raghwan, (1997). Molecular embryology of flowering plants. Cambridge Univ. Press. Cambridge.
- Sharma, M.K. (2013) Plant Structures (An Introduction to Plant Anatomy). Vayu Education of India.
- Sambamurty, A.V.S.S. (2010). Taxonomy of Angiosperms. I.K. International Pvt. Ltd.
- Saxena N.B. and Saxena S. (2012). Plant Taxonomy Pragati Prakashan.
- Sharma O.P. (2013). Plant Taxonomy. MC GRAW HILL INDIA.
- Sharma, P.C. (2017). Text Book of Plant Anatomy. Arjun Publishing House.
- Shivanna, K.R. (2003). Pollen Biology and Biotechnology, Science Publishers. Verlag.
- Pandey, B.P. (2014). Modern Practical Botany Vol. II. S. Chand and Company Ltd. Ramnagar, New Delhi.
- Pandey, B.P. (2001). Plant Anatomy. S. Chand and Company Ltd., Ram Nagar, New Delhi.
- Sundara, R.S. (2002). Practical Manual Anatomy and Embryology. Anmol Publisher, New Delhi.

Semester-III

Undergraduate Diploma in Botany

Discipline Specific Elective: Plant Tissue Culture

No. of Hours- 60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
Plant Tissue Culture	4	4	0	0	Undergraduate certificate in Botany	Nil

UNDERGRADUATE DIPLOMA IN BOTANY

Programme : *Undergraduate Diploma in Botany*

Year: II

Semester: III

Subject: Botany

Course: BOT
DSE 1

Plant Tissue Culture

Course Outcomes:

The successful students will be able to:

1. Learn the basic concepts, principles and processes in plant cell and tissue culture.
2. Understand the use of tissue culture techniques in plant improvement.
3. Apply the concepts and principles of plant cell and tissue culture in biotechnological and agricultural fields.

Credits: 4

Discipline Specific Elective

Max. Marks: As per Univ. rules

Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Introduction and historical background of Plant tissue culture. Principle, scope, utility and advantage of plant tissue culture, totipotency, general laboratory techniques, equipments (autoclave, laminar air flow, and incubator shaker) and their working principle, sterilization techniques, media preparation, plant growth regulators.	15
2	Callus and its types, callus differentiation and organogenesis, callus culture. Concept of clonal propagation, <i>In-Vitro</i> root and shoot propagation, different types of cultures (solid and suspension cultures).	15
3	Somatic embryogenesis and synthetic seeds, protoplast isolation and culture, somatic hybridization, somaclonal variation, cryopreservation.	15
4	Demonstration of tools and techniques used in plant tissue culture laboratory. Sterilization of media, instruments, and explants, formulation of Murashige and Skoog (MS) medium.	15

Suggested Readings

- Bhojwani, S. S. and Dantu, P. K. (2013). Plant Tissue Culture: An Introductory Text Springer
- Bhojwani, S. S. and Razdan, M. K. (1996). Plant Tissue Culture: Theory and Practice, Revised Edition, Elsevier
- Bhojwani, S.S, Bhatnagar, S.P. (2015). The Embryology of Angiosperms, 6th edition. New Delhi, Delhi: Vikas Publication House Pvt. Ltd.
- Bhojwani, S.S. (1990). Plant Tissue Culture: Applications and Limitations (Elsevier).
- Collins, H.A. and Edwards, S. (1998). Plant Cell Culture. Bioscientific Publishers, Oxford, UK.
- Jain, S.M., Sopory, S.K. and Veilleux, R.E. (1996). In Vitro Haploid Production in Higher Plants, Vols, 1-5., Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, The Netherland.
- Kartha, K.K. (1985). Cryopreservation of Plant Cells and Organs. CRC

Press, Boca Raton. Florida, USA.

- Newmann, Karl-Hermann (2020). Plant Cell and Tissue Culture: A Tool in Biotechnology, 2nd Edition Springer.
- Vasil, I.K. and Thorpe, T.A. (1994). Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

Semester-III

Undergraduate Diploma in Botany

No. of Hours- 60

Generic Elective: Plant Science – II

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Science – II	4	4	0	0	Passed Class	Nil

UNDERGRADUATE DIPLOMA IN BOTANY

Programme : *Undergraduate Diploma in Botany*

Year: II

Semester: III

Subject: Botany

Course: BOT
GE 3

Plant Science – II

Course Outcomes:

After the completion of the course the students will be able to

1. Understand the basic biochemical and physiological process in plants.
2. Understand the fundamentals of plant tissue culture techniques used in molecular biology.
3. Understand the concept of biodiversity and its conservation.
4. Understand the concepts of plant breeding methods and crop evolution.

Credits: 4	Generic Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Plant Physiology and Biochemistry: Photosynthesis, respiration, nitrogen fixation, carbohydrates, proteins, lipids and secondary metabolites.	15
2	Plant Biotechnology: Plant tissue culture, recombinant DNA technology and techniques used in molecular biology. Plant breeding methods and evolution of major crop plants, economics and utilization of plant resources.	15
3	Biodiversity and Conservation: Species, population, ecosystem, ecological succession, environmental pollution, biodiversity, In situ and ex situ conservation, International Union for Conservation of Nature (IUCN), Climate change and its consequence.	15
4	To test the presence of protein, carbohydrate and lipids in given sample. Preparation of MS medium for tissue culture. Visit to some in-situ and ex-situ conservation sites.	15

Suggested Readings

- Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
- Frankel O.H, Brown A.D.H. and Burdon J.J. (1995). The Conservation by Plant Diversity Technical guidelines for the site movement of Germplasm (1989) by FAO IBPGR.
- Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley and Sons, U.S.A. 4th Edition.
- Kochhar S.L. (2016). Economic Botany. Cambridge University Press, London.
- Pandey, B.P. (1999). Economic Botany. S. Chand, New Delhi.
- Paroda R.S. and Arora R.K. (1991). Plant genetic resources Conservation and Management. International Board for Plant Genetic

Resources, (IBPGR), Rome, (Italy)

- Shantharam, S. and Montgomery, J.F. (1999). Biotechnology, Biosafety and Biodiversity. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
- Taiz, L., Zeiger, E., (2014). Plant Physiology. Sinauer Associates Inc., U.S.A. 6th Edition.
- Vasil, I.K. and Thorpe, T.A (1994). Plant Cell and Tissue Culture. Kluwer Academic Publishers, Netherlands.

Semester-IV

Undergraduate Diploma in Botany

No. of Hours- 75

DISCIPLINE SPECIFIC COURSE (DSC)- Cytology, Genetics and Biotechnology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Cytology, Genetics and Biotechnology	4	3	0	1	Undergraduate certificate in Botany	

UNDERGRADUATE DIPLOMA IN BOTANY

Programme : <i>Undergraduate Diploma in Botany</i>			Year: II	Semester: IV
Subject: Botany				
Course: BOT DSC 4	Course Title: Cytology, Genetics and Biotechnology			

Course Outcomes:

After the completion of the course the students will be able to:

1. Understand the structure and chemical composition of chromatin and concept of cell division.
2. Interpret the Mendel's principles; acquire knowledge of cytoplasmic inheritance and sex-linked inheritance.
3. Understand cell structure, nucleic acids, organization of DNA in prokaryotes and eukaryotes, DNA replication mechanism, genetic code and transcription process.
4. Understand the basic tools and techniques used in Plant tissue culture.

Credits:		Discipline Specific Course
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules
Unit	Topic	No. of Hours (45)
1	An overview of cells and cell theories, prokaryotic and eukaryotic cells, cell organelles (nucleus, mitochondria, chloroplast, ER, golgi body, lysosomes, peroxisomes, glyoxysomes), nucleus, chromatin, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure, cell membrane and cell wall; models of plasma/cell membrane. Cell cycle and cell division (overview of mitosis and meiosis). Eukaryotic chromosome: structure, composition, karyotype analysis. Structure and function of Polytene and Lampbrush chromosomes.	15
2	Brief life history of Mendel, laws of Inheritance, chromosomal theory of inheritance, modified Mendelian ratio, lethal genes, co-dominance, incomplete dominance, multiple allelism, sex-determination and sex-linked inheritance, cytoplasmic inheritance.	10
3	Linkage: concept and history, complete and incomplete linkage, Bridges experiment, Crossing over: Concept and significance, cytological proof of crossing over, mutations and chromosomal aberrations (types of mutations, effects of physical and chemical mutagens, numerical chromosomal changes: (euploidy, polyploidy and aneuploidy); structural chromosomal changes: (deletions, duplications, inversions and translocations).	10

4	Introduction to Biotechnology: Role in modern life, history and ethical issues associated with Biotechnology. Recombinant DNA Technology, enzymes and vectors involved in genetic engineering, gene cloning.	10
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Practical/Lab Course BOT DSC 4P

Unit	Topic	No. of Hours (30)
1	Structure of prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs. Study of the photomicrographs of cell organelles, structure of plant cell through temporary mounts. Study of mitosis and meiosis (temporary mounts and permanent slides).	8
2	Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square. Monohybrid cross (dominance and incomplete dominance) Dihybrid cross and gene interactions.	10
3	Study of polyploidy in plants. Photographs/permanent slides showing translocation ring, laggards and inversion bridge.	5
4	Contribution of G. J. Mendel, H. G. Khurana, Watson and Crick, Griffith, Harshey and Chase, Kary Mullis. Instruments used in Biotechnology.	7

Suggested readings

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. (2014). Molecular Biology of the Cell. Garland Publishing Inc., New York. 6th edition.
- Berk, A., Kaiser, C.A., Lodish, H., Amon, A., Ploegh, H, Bretscher (Author), Monty Krieger, A., Martin, K.C. (Eds). (2016) Molecular Cell Biology. Freeman & Co., USA.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Gardner, E.J., Simmons, M.J. and Snustad, D.P. (1991). Principles of Genetics, John Wiley & Sons.
- Rastogi, V.B. (2019). Genetics. 4th Edition. MEDTECH: A Division of Scientific International.

- Russel P. J. (2010). Genetics-A Molecular Approach, Pearson Education Inc.
- Singh R. J. (2002). Plant Cytogenetics, CRC Press
- Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
- Singh, R.J. (2021). Practical Manual on Plant Cytogenetics. CRC Press, Taylor and Francis Group, Routledge.

Semester-IV

Undergraduate Diploma in Botany

	DISCIPLINE SPECIFIC ELECTIVE (DSE)- Ethnobotany
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No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Ethnobotany	4	4	0	0	Undergraduate certificate in Botany	

UNDERGRADUATE DIPLOMA IN BOTANY		
Programme : Undergraduate Diploma in Botany		Year: II Semester: IV
Subject: Botany		
Course: BOT DSE 2	Ethnobotany	

Course Outcomes:

The successful students will be able to:

1. Learn the proper documentation and presentation of traditional knowledge about plants.
2. Use important plants used by the tribal communities for various purposes.
3. Learn the conservation of wild growing plants and their socio-economic impacts.

Credits: 4	Discipline Specific Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Introduction, concept, scope and objectives of ethnobotany; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals/tribes of India with special reference to Uttarakhand and their life styles. Plants used by the tribal communities.	15
2	Importance of a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places e) Indigenous knowledge system in ethnobotanical studies. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).	15
3	Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) <i>Azadirachta indica</i> b) <i>Ocimum sanctum</i> c) <i>Vitex negundo</i> d) <i>Gloriosa superba</i> e) <i>Tribulus terrestris</i> f) <i>Pongamia pinnata</i> g) <i>Cassia fistula</i> h) <i>Indigofera tinctoria</i> . Role of ethnobotany in modern medicine <i>Rauvolfia serpentina</i> , <i>Trichopus zeylanicus</i> , <i>Artemisia</i> , <i>Withania</i> as example.	15

4	Visit to local sites for documentation of ethnobotanically important plants. Preparation of ethnobotanical profile of a tribal community, listing and identification of plants used by tribal communities. Documentation of herbal remedies used by local healers.	15
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Suggested Readings

- Colton C.M. (1997). Ethnobotany-Principles and applications. John Wiley and sonsChichester.
- Jain S.K. (1981). Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi.
- Jain S.K. (1989). Methods and approaches in ethnobotany. Society of Ethnobotanists,Lucknow, India.
- Jain S.K. (1990). Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
- Jain S.K. (1995). Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- Rajiv K. Sinha (1996). Ethnobotany The Renaissance of Traditional Herbal Medicine –INA –SHREE Publishers, Jaipur).
- Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in AndhraPradesh, India. Botanical Survey of India. Howrah.

Semester-IV

Undergraduate Diploma in Botany

Generic Elective: Inheritance in Plant Biology

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Inheritance in Plant Biology	4	4	0	0	Passed class	Nil

UNDERGRADUATE DIPLOMA IN BOTANY			
Programme : <i>Undergraduate Diploma in Botany</i>		Year: II	Semester: IV
Subject: Botany			
Course: BOT GE 4	Inheritance in Plant Biology		
Course Outcomes: After the completion of the course the students will be able to			
1. Understand the concepts and principles of inheritance and sex determination.			
2. Students will get familiarized with causal agents of genetic changes (mutations).			
3. Learn how genetic information is used to detect diseases and also to establish unique identity of an individual.			

Credits: 4	Generic Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Chromosomal Inheritance: Principles of Mendelian inheritance, Incomplete dominance and co- dominance; Multiple allelism; lethal alleles; Linkage and crossing over. Extra-chromosomal Inheritance: Chloroplast Inheritance, Cytoplasmic inheritance.	15
2	Chromosome structure and alterations in chromosome: Structural alterations in chromosome: duplication, deficiency, inversion and translocation Numerical alterations in chromosome: Euploidy, Aneuploidy and Polyploidy.	20
3	Mutation: spontaneous and induced mutation; physical and chemical mutagens; Consequences of mutation.	15

4	Demonstration of different structures of chromosomes and changes in chromosome structure	10
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Suggested Readings

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2020). Introduction to Genetic Analysis, 12th edition. New York, NY: W.H. Freeman and Co.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2020). Concepts of Genetics, 12th edition. San Francisco, California: Benjamin Cummings.
- Campbell, N.A., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V., Reece, J.B. (2020). Biology, 12th Edition. Harlow, England : Pearson

Semester-V

Bachelor of Science in Botany

No. of Hours-75

	DISCIPLINE SPECIFIC COURSE (DSC)- Plant Physiology and Biochemistry
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CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Physiology and Biochemistry	4	3	0	1	Undergraduate diploma in Botany	Nil

BACHELOR OF SCIENCE IN BOTANY		
Programme : Bachelor of Science in Botany	Year: III	Semester: V
Subject: Botany		

Course: BOT DSC 5	Course Title: Plant Physiology and Biochemistry
Course Outcomes: After the completion of the course the students will be able to: 1. Understand the role of physiological and metabolic processes for plant growth and development. 2. Learn the symptoms of mineral deficiencies in crops and their management. 3. Assimilate knowledge about the biochemical composition of plant diversity. 4. Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants.	

Credits: 1		Discipline Specific Course
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules
Unit	Topic	No. of Hours (45)
1	Plant water relations, water potential and its components, diffusion and osmosis, transpiration and its significance, factors affecting transpiration, root pressure and guttation. Mineral nutrition: Essential elements, macro and micronutrients; criteria of essentiality of elements, role of essential elements; transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.	12
2	Photosynthesis: photosynthetic Pigments (Chl a, b, xanthophylls, carotene), photosystem I and II, electron transport and mechanism of ATP synthesis, C ₃ , C ₄ and CAM pathways of carbon fixation, photorespiration. Respiration: glycolysis, anaerobic respiration, TCA cycle, oxidative phosphorylation and glyoxylate cycle.	13
3	Biological nitrogen fixation, nitrate and ammonia assimilation Plant growth regulators: discovery and physiological roles of auxins, gibberellins, cytokinins, abscisic acid and ethylene.	10
4	General introduction to carbohydrates, lipids and proteins. Enzymes (structure and properties, mechanism of enzyme catalysis and enzyme inhibition, factors affecting enzyme action), Michaelis-Menten kinetics.	10

Practical/Lab Course BOT DSC 5P

Unit	Topic	No. of Hours (30)
1	Demonstration of process of diffusion, osmosis and plasmolysis. Demonstration of transpiration in dorsiventral leaf by four leaf and cobalt chloride method. Determination of rate of transpiration by Ganong's/Farmer's potometer.	10
2	Demonstration of the effect of light intensity and bicarbonate concentration on O ₂ evolution in photosynthesis by Wilmott's bubbler Determination of R.Q. of different respiratory substrates by Ganong's respirometer. Demonstration of anaerobic respiration in germinating seeds.	14
3	Test of carbohydrates, proteins and fats.	6

Suggested Readings

- Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
- Buchanan, B., Gruissem, G. and Jones, R. (2000). Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, USA.
- Davies P J. (2004). Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
- Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley and Sons, U.S.A. 4th Edition.
- Nelson, D.L., and Cox, M.M. (2008). *Lehninger Principles of Biochemistry* (5th ed.). W.H. Freeman & Co., New York.
- Taiz, L., Zeiger, E., (2014). Plant Physiology. Sinauer Associates Inc., U.S.A. 6th Edition
- Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.

Semester-V

Bachelor of Science in Botany

No. of Hours-60

DISCIPLINE SPECIFIC ELECTIVE (DSE)- Conservation and Management of Natural Resources

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Conservation and Management of Natural Resources	4	4	0	0	Undergraduate diploma in Botany	Nil

BACHELOR OF SCIENCE IN BOTANY

Programme : *Bachelor of Science in Botany*

Year: III

Semester:
V

Subject: Botany

Course: BOT
DSE 3

Conservation and Management of Natural Resources

Course Outcomes:

The successful students will be able to:

1. Understand the importance, benefits and services of biodiversity.
2. Learn the strategies for the conservation of biodiversity.

Credits: 4

Discipline Specific Elective

Max. Marks: As per Univ. rules

Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Plant diversity and its scope- Genetic diversity, Species diversity, ecosystem diversity, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation. Loss of Biodiversity; Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss.	15
2	Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, red and green data book, Biodiversity information management and communication.	15
3	Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, <i>In situ</i> and <i>ex situ</i> conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. Role of plants in Human Welfare: a) Importance of forests their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important cereals, pulses, vegetables, fruits, fibers, oils, spices, medicinal plants and their commercial importance. Wood and its uses. National and state institutes related to the activity.	15
4	Visit to a biodiversity-related institution (e.g., herbarium, botanic garden, forest department nursery) or in situ conservation site (e.g., sacred grove, national park) and ex situ conservation site (e.g., seed bank, botanical garden, nursery). Identification and ethnobotanical documentation of at least 10 important plants used for food (cereals, pulses, fruits, spices), fiber, oil, beverages, and medicine.	15

Suggested Readings

- Barbour, M.G., Burk, J.H. and Pitts, W.D. (1987). Terrestrial Plant Ecology. Benjamin/Cummings Publication Company, California
- Baskin and Baskin, (2001). Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination Elsevier
- Kormondy, E.J. (2017). Concept of Ecology. Pearson India.
- Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
- Odum, E.P. (1983). Basic Ecology Saunders, Philadelphia
- Singh, J.S. Singh S.P. and Gupta, S.R. (2014). Ecology, Environment and Resource Conservation. S. Chand and Company Pvt. Ltd., New Delhi.
- Smith, R.L. (1996). Ecology and Field Biology Harper Collins, New York.

Semester-V

Bachelor of Science in Botany

Generic Elective: Medicinal Plants of Uttarakhand

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Medicinal Plants of Uttarakhand	4	4	0	0	Passed Class	Nil

BACHELOR OF SCIENCE IN BOTANY

Programme : <i>Bachelor of Science in Botany</i>			Year: III	Semester: V
Subject: Botany				
Course: BOT GE 5	Medicinal Plants of Uttarakhand			

Course Outcomes:

After the completion of the course the students will be able to:

1. Understand the diversity and distribution of medicinal plants in Uttarakhand
2. Study the techniques/methods for the sustainable utilization of the medicinal plants.
3. Understand the economic importance of medicinal plants of Uttarakhand.

Credits: 4	Generic Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	General idea of Indian systems of medicine (Ayurveda, Siddha, Unani, Tibetan, Yoga and Naturopathy) and the traditional medicinal system of Uttarakhand. Brief history, prospects and uses of important medicinal plants of Uttarakhand Himalaya, scope and importance of medicinal plants, challenges in medicinal plant sector.	20
2	Diversity, distribution, assessment and indigenous uses of threatened medicinal plants of Uttarakhand. Collection and processing of medicinal plants; methods for documentation of traditional medicine knowledge.	15
3	Promotion of medicinal plant sector at national level: National Medicinal Plant Board and State Medicinal Plant Boards - objectives and functions. Other organizational initiatives for promotion of MAPs at National and International levels. Demand and supply of medicinal plants. Conservation, threats, IUCN Red list criteria and management of threatened medicinal plants of Uttarakhand.	15
4	Demonstration and identification of some important medicinal plants	10

Suggested Readings

- Anonymous. (2014). Herbal Wealth of Uttarakhand Vol. I & II. Central Council for Research in Ayurvedic Sciences, New Delhi.
- Arber, A. (1999). Herbal plants and Drugs. Mangal Deep Publications.
- Arya, D., Joshi, G.C. and Tewari, L.M. 2018. Crude drugs plants of Uttarakhand. Indu Book Services Pvt. Ltd. (Publishers & Distributors) New Delhi.
- Bhatt, D., Joshi, G.C., Tewari, L.M. and Pandey, N.C. (2020). Traditional Medicinal Systems and Threatened Medicinal Plants of Kumaun, Western Himalaya, India. Indu Book Services Pvt. Ltd. (Publishers & Distributors) New Delhi.
- Chhetri, D.R. (2015). Medicinal Plants of the Himalaya: Production Technology and Utilization. Agrobios (India).
- Chopra, R.N., Nayar S.L. and Chopra, I.C. (1956). Glossary of Indian Medicinal Plants, C.S.I.R, New Delhi.
- Kala, C.P. (2010). Medicinal Plants of Uttarakhand: Diversity, Livelihood and Conservation, Biotech Books.
- Pandey, P.C., Tewari, L. and Pande, H.C. (2006). Folk Medicine and Aromatic Plants Of Uttaranchal, Bishen Singh Mahendra Pal Singh, Dehradun.
- Sah, R. (2004). Nature's Medicinal plants of Uttarakhand: Herbs, Grasses and Ferns. Vol. II. Gyandodaya Prakashan, Nainital.
- Sah, R. (2004). Nature's Medicinal plants of Uttarakhand: Tree, shrubs and Climbers. Vol. I. Gyandodaya Prakashan, Nainital.
- Tewari, L.M., Singh, N., Upreti, K. and Pangtey, Y.P.S. (2008). Medicinal Plants of Ranikhet Consul Book Depot, Nainital.

Semester-VI

Bachelor of Science in Botany

No. of hours-75

DISCIPLINE SPECIFIC COURSE (DSC)- Plant Ecology and Biostatistics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Plant Ecology and Biostatistics	4	3	0	1	Undergraduate diploma in Botany	Nil

BACHELOR OF SCIENCE IN BOTANY

Programme : *Bachelor of Science in Botany*

Year:
III

Semester: VI

Subject: Botany

Course: BOT
DSC 6

Plant Ecology and Biostatistics

Course Outcomes:

After the completion of the course the students will be able to:

1. Acquaint with complex interrelationship between organisms and environment;
2. Understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
3. Understand the strategies for sustainable natural resource management and biodiversity conservation.
4. Develop practical knowledge of the different statistical tools and techniques.

Credits: 4	Discipline Specific Course
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (45)
1	Plant adaptation in relation to water (Hydrophytes and xerophytes), light (Sciophytes and heliophytes) and temperature. Pollution: water, soil and radioactive.	12
2	Ecosystem: Types, structure, energy flow, trophic organization, food chains and food webs, ecological pyramids, ecological factors and ecosystem productivity. Biogeochemical cycles: Cycling of carbon, nitrogen and phosphorous.	12
3	Population: Characteristics, Growth curves, Ecotypes and Ecads, Plant communities: Characteristics, plant succession, biological spectrum.	9
4	Definition and scope of statistics, sampling techniques, representation of grouped and ungrouped data. Measures of dispersion: range, mean deviation, variation, standard deviation; Chi-square test, regression analysis. Measures of central tendency: Arithmetic mean, mode, median.	12

Practical/Lab Course BOT DSC 6P

Unit	Topic	No. of Hours (30)
1	Observation and study of different ecosystems mentioned in the syllabus. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, rain gauge and lux meter. Determination of pH, and analysis of soil samples for soil moisture, organic carbon, nitrogen and phosphorus.	10

2	Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats. Study of ecological adaptations in hydrophytes and xerophytes. Study of biotic interactions of stem parasite (<i>Cuscuta</i>), root parasite (<i>Orobanche</i>), epiphytes, predation (insectivorous plants) through specimen or diagrams.	8
3	Determination of minimum quadrat size for the study of herbaceous vegetation by species area curve method (species to be listed). Quantitative analysis of herbaceous vegetation in the college campus for frequency, density, abundance and A/F ratio. Population structure of dominant tree species of the locality.	8
4	Analysis of statistical data: mean, median and mode by analyzing the given data of individual, discrete and continuous series, standard deviation and error.	4

Suggested readings

- Banerjee, P.K. (2006). Introduction to Biostatistics. S. Chand and Company Ltd., RamNagar, New Delhi.
- Chapman, J.L. and Reiss, M.J. (2003). Ecology: Principles and Applications. Second Edition. Cambridge University Press, UK. ISBN 0 521 58802 2. 335 pages.
- Khan, I.A., Khanum, A., Khan S., (2020). Fundamentals of Biostatistics, 6th edition. Ukaaz Publications, Hyderabad, India.
- Odum, E.P. (2011). Fundamental of Ecology. 5th Edition. Saunders. ISBN 9780030584145. 613 pages.
- Rastogi, V.B. (2015). Biostatistics. Medtech, 3rd Edition.
- Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
- Shukla, R.S. and Chandel P.S. (2005). A text book of Plant Ecology. S. Chand and Company Ltd., Ram Nagar, New Delhi.
- Singh, J.S. Singh S.P. and Gupta, S.R. (2014). Ecology, Environment and Resource Conservation. S. Chand and Company Pvt. Ltd., New Delhi.
- Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
- Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

Semester-VI

Bachelor of Science in Botany

DISCIPLINE SPECIFIC ELECTIVE (DSE)- Fundamentals of Molecular Biology

No. of hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Fundamentals of Molecular Biology	4	4	0	0	Undergraduate diploma in Botany	Nil

BACHELOR OF SCIENCE IN BOTANY

Programme : <i>Bachelor of Science in Botany</i>		Year: III	Semester: VI
Subject: Botany			
Course: BOT DSE 4	Fundamentals of Molecular Biology		
Course Outcomes: The successful students will be able to: • Understand the structure of nucleic acids and their types. • Understand key events of Molecular biology comprising mechanism of DNA replication, transcription and translation in Prokaryotes and Eukaryotes. • Learn about the genomes and gene structure.			

Credits: 4	Discipline Specific Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	Nucleic acids as genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Structure and functions of Nucleic acids. Genome and its organization: (genes, coding sequence, regulatory sequence, intron, exon, nucleosome structure and packaging of DNA into higher order structures).	15
2	DNA replication, genetic code, principles of gene regulation, negative and positive regulation, concept of lac and trp operons, and regulation of gene expression. Damage and repair of DNA: Causes (spontaneous, chemical agent, radiation) and types of DNA damage and mechanism of DNA repair.	15
3	Genomes and gene structure: gene families, transcriptomics, proteomics and biological databases. Genome sequencing techniques and applications: Sequencing strategies, the shotgun method, massively parallel sequencing and its applications, and next-generation sequencers. Cloning: Cloning vectors, c-DNA synthesis and cloning, genomic DNA and c-DNA libraries, Enzymes used in recombinant DNA techniques, and molecular markers, Polymerase Chain Reaction, Electrophoresis, DNA fingerprinting and blotting techniques.	15
4	Introduction to biological databases (NCBI, EMBL, DDBJ, UniProt): searching for gene/protein sequences and Basic BLAST analysis to find sequence similarity. Demonstration of PCR (Polymerase Chain Reaction) and Agarose gel electrophoresis – loading, running, and analyzing DNA.	15

Suggested Readings

- Lodish, H., Berk, A., Zipursky, S.L. Maztsudaira, P., Baltimore, Dand Darnell, I. (2016). Molecular Cell Biology (8th Edition). W.H. Freeman and Co., New York, USA.
- Alberts, B., Bray,D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. (2014). Molecular Biology of the Cell. Garland Publishing Inc., New York.6th edition.
- Watson, J.D. (2013).Molecular Biology of the Genes, Benjamin.7th Edition.
- Buchanan, B.B., Gruissem, W. and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
- Lewin, B. (2000). Genes VII. Oxford University Press, New York.
- Wolfe, S.L. (1993).Molecular and Cellular Biology. Wadsworth Publishing Co.California.
- Stent, G.S.(1986).Molecular genetics. Bishen Singh Mahendra Pal Singh, Dehradun.
- Barry, J.M. and Barry. B.M. (1973). Molecular Biology, Prentice Hall of India. New Delhi.

Semester-VI

Bachelor of Science in Botany

GENERIC ELECTIVE (GE): Global Climate Change

No. OF Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the course(if any)
		Lecture	Tutorial	Practical/Practice		
Global Climate Change	4	4	0	0	Passed Class	Nil

BACHELOR OF SCIENCE IN BOTANY

Programme : <i>Bachelor of Science in Botany</i>			Year: III	Semester: VI
Subject: Botany				
Course: BOT GE 6	Global Climate Change			

Course Outcomes:

After the completion of the course the students will be able to:

1. Understand the global climate changes and global warming.
2. Learn about the measures being taken for the mitigation of climate changes.

Credits: 4	Generic Elective
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Unit	Topic	No. of Hours (60)
1	General concept of Global climate change, Impact of global warming and climate change, Greenhouse effect, Greenhouse gases, Carbon foot print, Carbon trading, Carbon sequestration.	15
2	Introduction to climate change adaptation, Mitigation strategies for global warming, International initiative for mitigating global climate changes; Inter governmental panel on climate change (IPCC); United Nation Framework convention on Climate change (UNFCCC).	15
3	Climate change policy and international solutions, Conference of Parties (COP), Kyoto protocol; Montreal protocol; Paris Pact; India's initiatives for mitigating climate change.	15
4	To assess the carbon foot print and carbon sequestration potential of different forest types.	15

Suggested Readings

- Singh, S., Singh, P., Rangabhashiyam, S. and Srivastava, K. K. (2021). Global Climate Change, Elsevier.
- Singh, J.S. Singh S.P. and Gupta, S.R. (2014). Ecology, Environment and Resource Conservation. S. Chand and Company Pvt. Ltd., New Delhi.
- Mathez, E. A. and Smerdon, J. (2009). Climate Change- The Science of Global Warming and Our Energy Future, Columbia University Press.