

Undergraduate in Science in Botany



Course Syllabus as per NEP 2020

(Academic Session 2023-24 onwards)

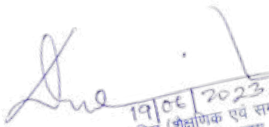
RAJIV GANDHI UNIVERSITY
RONO HILLS, DOIMUKH, ARUNACHAL PRADESH

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EVS-AE-1210 Environmental Studies	
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 (Prof. R. K. Singh) 19.6.2023


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Course Structure for Certificate/ Diploma/ 3 Years/ 4 Years UG Degree with Honours/Honours with Research in Botany

NCrF Credit Level	Semester	Major (CC)		Minor (MC)		Multidisciplinary Course (MD)		Ability Enhancement Course (AE)		Skill Enhancement Course (SE)		Value-Added Course (VA)		Internship/ Dissertation (RP)/ Seminar		Total Credit	
		Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit		
4.5	1 st	BOT-CC-1110: Microbiology and Phycology	3+1 = 4	BOT- MC-1110: Plant Life Forms I: Microbes and Cryptogams	3+1 = 4	BOT-MD-1110: Biodiversity and Conservation	3	<i>Any one from the following courses:</i> ENG-AE-1110: English HIN-AE-1120: Hindi MIL-AE-1130: MIL Communications	4	BOT-SE-0010: Organic Farming	3	XXX-VA-0010	2			20	
	2 nd	BOT-CC-1210: Mycology and Phytopathology	3+1 = 4	BOT- MC-1210: Plant Life Forms II: Phanerogams and Palaeobotany	3+1 = 4	BOT-MD-1210: Food Spices and Culinary Herbs	2+1 = 3	EVS-AE-1210 Environmental Studies	4	BOT-SE-0020: Mushroom Cultivation	3	XXX-VAC-0020	2			20	
Students exiting the programme after securing 44 credits will be awarded UG Certificate in the relevant Discipline /Subject provided they secure 4 credits in work-based vocational courses offered during the summer term or internship / Apprenticeship in addition to 6 credits from skill-based courses earned during the first and second semester.																	
5.0	3 rd	BOT-CC-2310: Bryophytes and Pteridophytes	3+1 = 4	BOT- MC-2310: Global Climate Change and Environmental Issues	4	BOT-MD-2310: Ethnobotany and Community development	3			BOT-SE-0030: Nursery and Gardening	3	XXX-VAC-0030	2			20	
		BOT-CC-2320: Gymnosperms and Palaeobotany	3+1 = 4														
	4 th	BOT-CC-2410: Angiosperm Taxonomy	4	BOT- MC-2410: Biodiversity and Conservation	4												20
		BOT-CC-2420: Biodiversity and Conservation	4														
		BOT-CC-2430: Anatomy and Reproductive Biology of Angiosperms	4														
BOT-CC-2440: Practical	4																
Students exiting the programme after securing 84 credits will be awarded UG Diploma in the relevant Discipline /Subject provided they secure additional 4 credits in skill based vocational courses offered during first year or second year summer term.																	
5.5	5 th	BOT-CC-3510: Economic Botany	4	BOT- MC-3510: Economic Botany	4											2	20
		BOT-CC-352: Biomolecules and Cell Biology	4														
		BOT-CC-3530: Genetics and Evolution	2														
		BOT-CC-3540: Practical	4														
	6 th	BOT-CC-3610: Plant Physiology and Metabolism	4	BOT- MC-3610: Anatomy &	4												20

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		BOT-CC-3620: Molecular Biology and Plant Biotechnology	4	Reproductive Biology of Angiosperms													
		BOT-CC-3630: Plant Ecology and Phytogeography	4														
		BOT-CC-364: Practical	4														
Students who want to undertake 3-year UG programme will be awarded UG Degree in the relevant Discipline /Subject upon securing 124 credits.																	
6.0	7th	BOT-CC-4710: Comparative study of Algae and Fungi	4	BOT- MC-4710: Research Methodology	4											20	
		BOT-CC-4720: Comparative study of Archegoniate: Bryophyte Pteridophyte and Gymnosperm	4														
		BOT-CC-4730: Plant Systematics and Ethnobotany	4														
		BOT-CC-4740: Practical	4														
	8th	BOT-CC-4810: Bioanalytical Techniques and Biostatistics	4	BOT- MC-4810: (Research Publication ethics)	4											*BOT-RP-4800: Dissertation	20
		BOT-DE-4810/4820/4830: Any three from the following courses:	4														
		a) Medicinal & Aromatic plants	4														
		b) Mushroom Cultivation															
		c) Plant pathology															
		d) Floriculture															
e) Biofertilizer and Biopesticide																	
f) Organic Farming																	
g) Nursery techniques																	
h) Fruit & Plantation crops																	
i) Beverages & fermented food																	
			94		32		9		8		9		6		2	160	

*** Students of Four Years UG Degree with Honours & Research in Botany have to opt for BOT-CC-4800 in place of BOT-DE-4810 to 4830.**

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Core Courses in Botany

Year	Semester	Course Code	Course Title	Credits			
				L	P	Total	
I	I	BOT-CC-1110	Microbiology and Phycology	3	1	4	
		II	BOT-CC-1210	Mycology and Phytopathology	3	1	4
		III	BOT-CC-2310	Bryophytes and Pteridophytes	3	1	4
	II	III	BOT-CC-2320	Gymnosperms and Palaeobotany	3	1	4
			BOT-CC-2410	Angiosperm Taxonomy	4	-	4
			BOT-CC-2420	Biodiversity and Conservation	4	-	4
		IV	BOT-CC-2430	Anatomy and Reproductive Biology of Angiosperms	4	-	4
			BOT-CC-2440	Practical	-	4	4
			BOT-CC-3510	Economic Botany	4	-	4
	III	V	BOT-CC-3520	Biomolecules and Cell Biology	4	-	4
			BOT-CC-3530	Genetics and Evolution	2	-	2
			BOT-CC-3540	Practical	-	4	4
BOT-CC-3610			Plant Physiology and Metabolism	4	-	4	
III	VI	BOT-CC-3620	Molecular Biology and Plant Biotechnology	4	-	4	
		BOT-CC-3630	Plant Ecology and Phytogeography	4	-	4	
		BOT-CC-3640	Practical	-	4	4	
IV	VII	BOT-CC-4710	Comparative study of Algae and Fungi	4	-	4	
		BOT-CC-4720	Comparative study of Archegoniate: Bryophyte Pteridophyte and Gymnosperm	4	-	4	
		BOT-CC-4730	Plant Systematics and Ethnobotany	4	-	4	
		BOT-CC-4740	Practical	-	4	4	
		BOT-CC-4810	Bioanalytical Techniques and Biostatistics	4	-	4	
IV	VIII	BOT-DE-4810/4820/4830: Any three from the following courses:		4		12	
		a) Medicinal & Aromatic plants	4				
		b) Mushroom Cultivation	4				
		c) Plant pathology					
		d) Floriculture					
		e) Biofertilizer and Biopesticide					
		f) Organic Farming					
		g) Nursery techniques					
		h) Fruit & Plantation crops					
		i) Beverages & fermented food					
OR		*BOT-RP-4800: Dissertation (12 Credit)					
Total Credits of Core courses = 94							

* Students of Four Years UG Degree with Honours & Research in Botany have to opt for BOT-CC-4800 in place of BOT-DE-4810 to 4830.

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BOT-CC-1110: Microbiology and Phycology

Full marks: 100

Terminal marks: 80

L3:T0:P1= 4 Cr

Internal assessment: 20

Course Objective

The objective of the course is to make students gain knowledge about the diverse life forms, life cycles, morphology and importance of microorganisms (Viruses, Bacteria and Algae).

Learning outcomes

On completion of this course, the students will be able to:

- Develop understanding on the concept of microbial nutrition.
- Classify viruses based on their characteristics and structures.
- Develop critical understanding of plant diseases and their remediation.
- Examine the general characteristics of bacteria and their cell reproduction/ recombination.
- Increase the awareness and appreciation of human friendly viruses, bacteria, algae and their economic importance.
- Conduct experiments using skills appropriate to subdivisions.

Key Words: Eubacteria, Archaeobacteria, Viruses, Algae, Economic importance.

Unit I: Introduction to microbial world

10 Lectures

Microbial nutrition, nutritional types, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Unit II: Viruses, Bacteria and Cyanobacteria

13 Lectures

Viruses: General characteristics; classification (Baltimore), structure and replication of DNA virus (T4 and λ), lytic and lysogenic cycle; RNA virus (TMV), viroids and prions.

Bacteria: General characteristics of Archaeobacteria, Eubacteria, wall-less forms (mycoplasmas); Cell structure; Reproduction and recombination (conjugation, transformation and transduction). Binary fission and endospore.

Cyanobacteria: Range of thallus organization; Cell structure; Reproduction of *Spirulina* and *Nostoc*.

Unit III: Algae: Xanthophyta

7 Lectures

Algae: Life histories, cell structure, Classification (by Fritsch), Phylogeny and evolution. Cultivation methods. Economic importance of algae. Algal bioprospecting. Xanthophyta: Range of thallus organization; Reproduction; Morphology and life-cycle of *Vaucheria*.

Unit IV: Algae: Chlorophyta, Phaeophyta and Rhodophyta

10 Lectures

Chlorophyta: General characteristics; Occurrence; Range of thallus organization; Reproduction. Morphology and life-cycles of *Chlamydomonas*, *Volvox*, *Oedogonium*, *Cladophora*, *Ulva*, and *Chara*. Red tides.

Phaeophyta and Rhodophyta: General characteristics; Occurrence; Range of thallus organization; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus*, *Porphyra* and *Polysiphonia*.

Practical

30 Hours

Microbiology

1. Electron micrographs/Models of viruses – T4 and TMV, Line drawings/Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs. Water bloom. Electron micrographs or charts of bacteria, binary fission, endospore, conjugation.
3. Gram-staining of root nodule and curd.
4. Micrometry and counting of cells by Haemocytometer

Phycology

1. Study of phototactic isolation of zooids of *Ulva* through chart.


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2. Microscopic observation of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Spirogyra*, *Coleochaete*, *Chara*, *Vaucheria*, *Sargassum/ Ectocarpus*, *Fucus* and *Polysiphonia*, *Prochloron* through temporary preparations and permanent slides.

Suggested Readings

- Awasthi, A. K. (2015). Textbook of Algae. Vikas Publishing House Pvt. Ltd.
Dubey, R.C. and Maheswari, D.K. 2005. A Text Book of Microbiology. S. Chand & Company.
Frazier, W.C. and Westhoff, D.C. (2004). Food Microbiology. New Delhi. TMH Publication
Hoek, H.C., D.G. Mann & H.H. Johns. Introduction to Algae, 2nd Edition, Prentice Hall of India, New Delhi.
Kumar, H.D. (1999). Introductory Phycology, 2nd edition. Affiliated East-West. Press Pvt. Ltd. Delhi.
Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th Ed.
Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
Sambamurty, AVVS. (2005). A Textbook of Algae. Wiley India.
Sharma, O.P. (2011), A Text Book of Algae. Tata-McGraw Hill Co., New Delhi.
Singh, R.P. 2018. Microbiology. Kalyani Publishers.
Subha Rao, N.S. (2020). Soil Microbiology, 5th edn. Oxford & IBH Publishers, New Delhi.
Tortora, G.J., Funke, B.R. and Case. C.L. (2007). Microbiology. San Francisco, Pearson Benjamin Cummings. U.S.A.
Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Ed. McGraw Hill International.
Vanderpoorten, Alain & Goffinet, Bernard (Eds.). (2009). Introduction to Bryophytes, Cambridge University Press,

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BOT- MC-1110: Plant Life Forms I: MICROBES AND CRYPTOGAMS

Full marks: 100

Terminal marks: 80

L3: P1 = 4 Cr

Internal assessment: 20

Course Objective

The objective of this paper is to gain knowledge of general characteristics, life cycles of viruses, bacteria, algae, fungi, lichens, bryophytes and pteridophytes and their importance.

Learning outcomes

On completion of this course, the students will be able to:

- Develop understanding about microbial world and their Life Cycle.
- Classify them based on their characteristics and structures.
- Develop critical understanding of Classification, structures and life cycles of Bryophytes and Pteridophytes.
- Conduct experiments using skills appropriate to these organisms.

Keywords: Viruses, Bacteria, Algae, Fungi, Bryophytes and Pteridophytes

Unit I

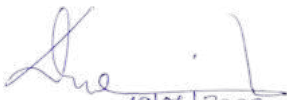
10 Lectures

General characteristics of viruses, types of viruses on the basis of shape and genetic material. Structure and replication of DNA virus (T4 and λ), lytic and lysogenic cycle; RNA virus (TMV), viroids and prions. Economic importance of viruses.

General characteristics of bacteria. Basic concept about Archaeobacteria, Eubacteria and mycoplasma.

Bacterial cell structure; Reproduction and recombination (conjugation, transformation and transduction). Binary fission and endospore. Economic importance of bacteria.


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Unit II

10 Lectures

General characteristics, outline classification and economic importance of algae. Thallus organisation, reproduction and life cycle in *Chlamydomonas*, *Volvox*, *Oedogonium*, *Cladophora*, *Ulva*, and *Chara*, *Ectocarpus*, *Fucus*, *Porphyra* and *Polysiphonia*.

Unit III

10 Lectures

General characteristics, outline classification and economic importance of fungi. Thallus organisation, reproduction and life cycle in *Synchytrium*, *Rhizopus*, *Saccharomyces*, *Penicillium*, *Alternaria*, *Neurospora*, *Peziza*, *Puccinia*, *Ustilago*, *Physarum*, *Phytophthora*, *Albugo*.

Lichens: general characteristics, importance, Growth forms, Methods of reproduction.

Unit IV

10 Lectures

General characteristics, outline classification and comparative study of vegetative and reproductive structures of following genera of bryophytes: *Marchantia*, *Anthoceros* and *Funaria*.

General characteristics, outline classification and life cycles of *Lycopodium*, *Selaginella*, *Psilotum*, *Equisetum* and *Marsilea*.

Practical

30 Lectures

Section A : Morphological study of available algal specimens.

Section B : Study of Fungal specimens as given in the syllabus.

Section C : Work out Bryophytic and Pteridophytic specimens as given in the syllabus.

Suggested Readings

Alam, Afroz (2019) Textbook of Bryophyta. Wiley Publication.

Dube, H.C. (2007). A Text Book of Fungi, Bacteria & Virus. Agrobios India publisher.

Dube, H.C. (2013). A Text Book of Fungi. Scientific Publishers (India)

Gangulee, et al. (2011). College Botany, Vol. II. New Agency, Kolkata.

Kumar, H.D. (1997). Introductory Phycology. Affiliated East-West Press, New Delhi.

Pandey, B.P. (2005). A Text Book of Bryophyta, Pteridophyta and Gymnosperms, I. K. Int. Pub. House Pvt. Ltd.

Sambamurthy (2020). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. Wiley India

Sharma, O.P. (2011), A Text Book of Algae. Tata-McGraw Hill Co., New Delhi.

Singh, S.K. & S. Srivastava (2008) A Text Book of Algae. Gyan Books (P) Ltd.

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BOT-MD-1110: BIODIVERSITY AND CONSERVATION

Full marks: 100

Terminal marks: 80

L3:= 3 Cr

Internal assessment:20

Course Objective

The objective of this paper is to gain knowledge on the Concept and Value of biodiversity, Threats and management of biodiversity, Measurement and Conservation of Biodiversity.

Learning outcomes

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

- Develop understanding of the importance of biodiversity
- Identify the causes and implications of major threats of biodiversity
- Estimate the biodiversity
- Utilize various strategies for the conservation of biodiversity

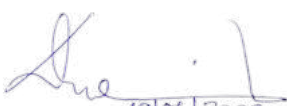
Keywords: Biodiversity loss, Hotspots, Biodiversity management, Conservation,

Unit I: Concept and Value of biodiversity

6 Lectures

Concept of biodiversity, genetic, species and ecosystem diversity, Biogeographical classification of India; Value of biodiversity: Economic values, ecological (role in hydrological and biogeochemical cycling) and ecosystem services (social, aesthetic, consumptive, and ethical values of biodiversity).


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Unit II : Threats and management of biodiversity**8 Lectures**

Natural and anthropogenic threats; Over-exploitation, Habitat destruction, Fragmentation and Species extinctions; IUCN threatened categories; Red data book; Invasions: causes and impacts; Biodiversity Hotspots: concepts, distribution and significance;

Unit 3: Measurement of Biodiversity**8 Lectures**

Biodiversity estimation: Floristic sampling strategies and surveys; qualitative and quantitative methods: scoring, richness, density, frequency, abundance, evenness, diversity, community diversity estimation: alpha, beta and gamma diversity.

Unit 4: Conservation of biodiversity**6 Lectures**

In-situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries); *Ex-situ* conservation (botanical gardens, zoological gardens, gene banks and tissue culture); role of traditional knowledge system in conservation; ecological restoration; afforestation; social forestry; agroforestry; joint forest management. Organizations associated with biodiversity management: IUCN, UNEP, WWF, UNESCO, NBPGR. Biodiversity Acts.

Suggested Readings

- Gaston, K J. and Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London, UK.
Heywood V.H. and Watson R.T. (Ed). 1995. Global Biodiversity Assessment: UNEP. Cambridge University Press.
Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
Laha, R. 2017. Biodiversity conservation and utilization of natural resources with reference to North East India. Panima Publishing Corporation, India.
Magurran, Anne E. 2003. Ecological diversity and its measurements. Blackwell Publications.
Mahanty, S. and Srivastava, A. 2016. Biodiversity and It's Conservation. Disha International Publishing House, India.
Myneni, S.R. 2020. Law of Biodiversity Protection. New Era Law Publication, India.
Primack, R.B. 2002. Essentials of Conservation Biology (3rd edition). Sinauer Associates, Sunderland, USA.
Rajak, A. 2020. Textbook of Biodiversity. 1st edition, Notion Press, India.
Singh, J.S., Singh, S.P. and Gupta, S.R.. 2008. Ecology, Environment and Resource Conservation. Anamaya Publications (New Delhi).
Sodhi, N.S., Gibson, L. and Raven, P.H. 2013. Conservation Biology: Voices from the Tropics. Wiley-Blackwell, Oxford, UK.

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BOT-SE-1110: ORGANIC FARMING

Full marks: 50

Terminal marks: 40

L3 = 3 Cr

Internal assessment: 10

Course Objective

The objective of the course is to make students gain knowledge on Organic Agriculture and farming and use of eco-friendly biofertilizers like *Azospirillum*, *Azotobactor*, and mycorrhizae, their identification, multiplication and recycling of the organic waste.

Learning outcomes

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

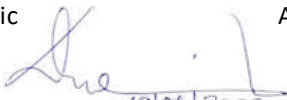
- Develop their understanding on the concept of Organic agriculture, Certification Process, Product Labeling and Regulatory Mechanisms.
- Identify the different forms of Organic Manures and biofertilizers, methods of their production and application for better crop production and their uses.

Keywords: Organic agriculture, Certification, Product Labeling, Organic Manures, Biofertilizers

Unit I**10 Lectures**


Organic Agriculture – Concept and origin; Principles of Organic Agriculture; Comparative perspective of Organic and Conventional Agriculture; Organic Agriculture in the


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Unit II**10 Lectures**

Organic Certification– Certification Process, Product Labeling; Regulatory Mechanisms for Organic Certification in India. National Standards for Organic Production.

Unit III**10 Lectures**

Organic Manures– Types and advantages of organic manures, Humification. Composting– types and factors influencing composting; Vermi-composting and Benefits. Bio-compost – Preparation, application and storage using organic waste materials.

Unit IV**10 Lectures**

Bio-fertilizers–Methods of Biofertilizer production (*Azospirillum*, *Azotobacter*) and its applications; Advantages and disadvantages of Biofertilizer.

(Note: *Students' visit to a local organic composting production facility and organic farming plot should be arranged by the Institution*)

Suggested Readings

Alexander Mc Gregor, Lynn Pugh and Jerry Larson (2009). Fundamental of Organic Farming and Gardening. Georgia Organics.

Ann Larkin Hansen (2010). The Organic Farming Manual (A Comprehensive Guide to Starting and Running a Certified Organic Farm). Storey Publishing LLC.

Peter V. Fossil (2007). Organic Farming: Everything You Need to Know. Voyageur Press.

Richard Wishwall (2009). Organic Farmer's Business Handbook: A Complete Guide to Managing Finances, Crops, and Staff and Making a Profit. Chelsea Green Publishing.

Sathe, T.V. (2004). Vermiculture and Organic Farming. New Delhi, Delhi: Daya publishers.

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BOT-CC-1210: MYCOLOGY AND PHYTOPATHOLOGY

(Credit Distribution L3:P1 = 4 Credits)

Full marks: 100

L3:P1= 4Cr

Terminal marks: 80

Internal assessment: 20

Course Objective

The objective of the course is to make students gain knowledge about the various types of fungi and allied organisms, and their life cycle, morphology and economic importance.

Learning outcomes

On completion of this course, the students will be able to;

- Identify true fungi and demonstrate the principles and application of plant pathology in the control of plant disease.
- Demonstrate skills in laboratory, field and glasshouse work related to mycology and plant pathology.
- Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies
- Identify the common plant diseases according to geographical locations and device control measures

Key Words: Ascomycota, Zygomycota, Basidiomycota, Etiology, Chytridiomycota, Oomycota

Unit I

10 Lectures

Introduction to fungi and classification: General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

Chytridiomycota and Zygomycota: Characteristic features; significance; Thallus organisation; Reproduction; Life cycle with reference to *Synchytrium*, *Rhizopus*.

Ascomycota: General characteristics (asexual and sexual fruiting bodies); Life cycle, Heterokaryosis and parasexuality; Thallus structure and Life cycle with reference to *Saccharomyces*, *Penicillium*, *Alternaria*, *Neurospora* and *Peziza*.

Unit II

10 Lectures

Basidiomycota, Allied fungi and Oomycota: General characteristics; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Mushroom Cultivation.

Allied fungi: General characteristics; Status of Slime molds, Physarum. Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. Oomycota: General characteristics; Life cycle and classification with reference to *Phytophthora*, *Albugo*.

Unit III

10 Lectures

Symbiotic associations: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

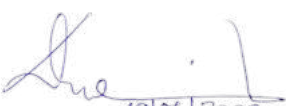
Applied Mycology: Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical Mycology.

Unit IV

10 Lectures

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.


(Prof. R. K. Singh) 19.6.2023


19.06.2023
संयुक्त कुलसचिव (शैक्षणिक एवं सम्मेलन)
राजीव गांधी विश्वविद्यालय
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Practical

30 Hours

Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).

1. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
2. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
3. *Peziza*: sectioning through ascocarp.
4. *Alternaria*: Specimens/photographs and temporary mounts.
5. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
6. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
7. Study of phaneroplasmodium from actual specimens and /or photograph. Study of *Stemonitis* sporangia.
8. *Phytophthora* and *Albugo*: Study of symptoms of infected plants; asexual phase study through section/temporary mounts and sexual structures through permanent slides.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs).
10. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

Suggested Readings

Agrios, G.N. (1997). Plant Pathology, 4th edition, Academic Press, U.K.

Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology. John Wiley & Sons (Asia) Singapore.

Deacon, J. W. (1988). Introduction to Modern mycology E. Arnolds.

Dube, H.C. (2013). A Text Book of Fungi, 4th Edition. Scientific Publishers (India)

Moore, C.J.– Landecker Fundamentals of the Fungi, 4th Edition (1996), Prentice Hall.

Rangaswami, G. Diseases of crop Plants of India, 3rd edition 1988, Prentice Hall, India.

Sethi, I.K. and Walia, S.K. (2011). Textbook of Fungi and Their Allies, Macmillan Publishers India Ltd.

Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

Singh, R.S. Plant Diseases, Oxford & IBH, New Delhi.

Webster, J. and Weber, R. (2007). Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.

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BOT- MC-1210: Plant Life Forms II: PHANEROGAMS AND PALAEOBOTANY

Full marks: 100

Terminal marks: 80

L3:P1= 4 Cr

Internal assessment:20

Course Objective

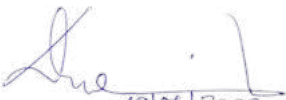
The objective of this paper is to gain knowledge on gymnosperms; palaeobotany; Identification, classification, morphology, anatomy, reproduction, phylogeny and economic importance of Angiosperms.

Learning outcomes

On completion of this course, the students will be able to:

- Develop understanding about Phanerogams and their classification and nomenclature.
- Know the morphology, anatomy and reproductive features and phylogeny of Gymnosperm and Angiosperm.
- Develop understanding on salient features, general characters and phylogeny of some selected angiosperm plant families.


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- Develop understanding about paleobotany and fossil types.
- Conduct experiments using skills appropriate these groups.

Keywords: Gymnosperm; Palaeobotany; Angiosperms; Taxonomy & Systematics; ICN; Classification system; Angiosperm families; Salient features; Phylogeny

Unit I

10 Lectures

Gymnosperm: Classification, distribution, morphology, anatomy, gametogenesis, embryology, and economic importance of *Cycas*, *Pinus* and *Gnetum*.

Unit II

06 Lectures

Paleobotany: Concept of palaeobotany, Process of fossilization, Fossil types; study of following fossil types: *Rhynia*, *Lyginopteris*, *Williamsonia*, *Pentoxylon*

Unit III

12 Lectures

Angiosperm: Systems of classification; Concept of plant taxonomy & systematics; taxonomic hierarchy; binomial nomenclature, principles of ICN.

Organization of root and shoot systems; general forms and modification of stem, leaf and root; adaptability of modified forms; tissue organization; General concept of angiospermic flower and floral anatomy, Pollination, Self- incompatibility, Apomixis.

Unit IV

12 Lectures

Angiosperm Families: General characters, salient features, phylogeny and economic importance of following angiosperm families: Liliaceae, Orchidaceae, Magnoliaceae, Malvaceae, Rosaceae, Asteraceae, Fabaceae.

Practical

30 Hours

Section A: Phanerogams

- Vegetative, reproductive and anatomical studies of following genera: *Cycas*, *Pinus* and *Gnetum*.
- Study of modified angiospermic plant parts.
- Study of essential parts and symmetry of some angiospermic flowers and some special types of inflorescences.
- Pollen viability test by hanging-drop technique in an angiosperm.
- Study of some fossil types.

Section B: Anatomy

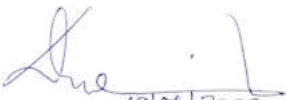
- Anatomy of primary structure in stems and roots using double staining technique.
- Study of primary and secondary anomalous structures.
- Study of photosynthetic and mechanical tissues.

Suggested Readings

Bhatnagar, SP & Moitra, A (1998). Gymnosperms. New Age International Publisher, New Delhi.
 Bhojwani, S.S & S.P. Bhatnagar. The Embryology of Angiosperms. Vikas Publishing House, New Delhi.
 Chambertain, C.J. Gymnosperms, Structure and Evolution, CBS Publishers & Distribution, New Delhi.
 Dublisch, P.K. & Agarwal, D.K. An Introduction to Gymnosperms, Kedarnath Ramnath, Meerut.
 Esau, K. (1997). Anatomy of Seed Plants. John Wiley and Sons. New York.
 Johri, B.M. Embryology of Angiosperms, Springer-Verlag, Berlin.
 Maheshwari, P. An Introduction to the Embryology of Angiosperms. McGraw-Hill edition.
 Pandey AK & Das AP. Plant Taxonomy: Advances & Relevances, Bishen Singh & Mahindra Pal Singh, Dehradun.
 Pandey, B.P. Embryology of Angiosperms. S. Chand Limited.
 Pandey, B.P. Plant Anatomy. S. Chand Limited.
 Shukla, A.C. and Mishra, S.P. Essentials of Palaeobotany. Vikas Publishing House Pvt. Ltd., New Delhi.
 Singh, Gurcharan (2021) Plant Systematic: Theory & Practices, 4th Edition. Oxford & IBH, New Delhi
 Wilson NS & Rothwell WG (2005). Paleobotany & Evolution of Plants. Foundation Books Pvt Ltd, New Delhi.

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BOT-MD-1210: SPICES AND CULINARY HERBS

Full marks: 100

Terminal marks: 80

L2: P1 = 3 Cr

Internal assessment: 20

Course Objective

The objective of the course is to make students aware about the cultivation, production disease management and marketing of spices and condiments at the global, national and regional levels and their importance and uses.

Learning outcomes

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

- Gain knowledge on various resources of spices and condiments and their culinary therapeutic and medicinal importance.
- Know the distribution and abundance of spices and condiments
- Learn method of cultivation, crop management, and post-harvest management.

Keywords: Spices, culinary herbs, nutritional and medicinal values, cropping and post-harvest management

Unit I

4 Lectures

Spices: Definition, concept and characteristic features. Importance of spices: nutritional and medicinal values. Global and national production of spices and marketing, Prospect of Spice, Cultivation in Arunachal Pradesh.

Unit II

6 Lectures

Taxonomy of Spices, Types of Spices: Commercial varieties and distribution in India and North East India. Climatic conditions and soil type requirements for cultivation. Cultivation Techniques of Spices: Site selection, layout and plotting, sowing method, time and season of sowing, irrigation, fertilization and crop management.

Unit III

18 Lectures

Cultivation methods of popular varieties of Spices: Black Pepper (*Piper nigrum*); Turmeric (*Curcuma longa*); Green Cardamom (*Elleteria cardamomum*); Black Cardamom (*Amomum subulatum*); Mace and Nutmeg (*Myristica fragrans*); Star anise (*Illicium verum*); Cinnamon (*Cinnamomum verum*); Bay leaves (*Cinnamomum tamala*); Ginger (*Zingiber officinale*); Garlic (*Allium sativum*); Onion (*Allium cepa*); Cumin (*Cuminum cyminum*); Carom seeds (*Trachyspermum ammi*); Red chilly (*Capsicum annum*) and *Zanthoxylum armatum*. Common fungal, bacterial and insect pest diseases of spices and their management.

Unit IV

12 Lectures

Culinary Herbs: Definition, concept and characteristic features; Importance of Culinary Herbs: nutritional and medicinal values of some ethnobotanical local herbs. Global and national production of Culinary Herbs and its marketing. Taxonomy and Cultivation: Habit, distribution, climatic conditions and soil type requirements, cultivation techniques and crop management.

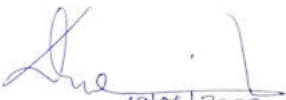
Cultivation of popular varieties of Culinary Herbs: Coriander (*Coriandrum sativum*); Rosemary (*Rosmarinus officinalis*); Basil (*Ocimum basilicum*); Thyme (*Thymus vulgaris*); Spear mint (*Mentha spicata*); Lemon grass (*Cymbopogon flexuosus*). Common fungal, bacterial and insect pest diseases of Culinary Herbs and their management

Practical

30 Hours

1. Crop management, fertilizer application and harvesting techniques of cultivated seed spices.
2. Crop management, fertilizer application and harvesting techniques of cultivated culinary herbs.
3. Culinary Herbs: Identification and Collection and preservation method of propagative parts.
4. Documentation of disease symptoms and Identification of common fungal and bacterial, insect pest diseases of Common fungal, bacterial and insect pest diseases of Culinary Herbs and their management.


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5. Site selection, plotting and layout, Planting method of commercially important culinary herbs- Coriander (*Coriandrum sativum*); Rosemary (*Rosmarinus officinalis*); Basil (*Ocimum basilicum*); Thyme (*Thymus vulgaris*); Spear minth (*Mentha spicata*); Lemon grass (*Cymbopogon flexuosus*).
6. Spices: Seed Identification, collection and preservation methods.
7. Spices: Site selection, plotting and layout, sowing and irrigation method of commercially important spices- Black Pepper (*Piper nigrum*), Cinnamon (*Cinnamomum verum*); (*Gingiber officinale*); Garlic (*Allium sativum*); Onion (*Allium cepa*); Cumin (*Cuminum cyminum*); Carom seeds (*Trachyspermum ammi*) and Red chilly (*Capsicum annum*).

Suggested Readings

- Alam, Afroz. 2020. A Textbook of Economic Botany and Ethnobotany. IK International Publishing House.
- Andrew Chevallier. (1996). The Encyclopaedia of Medicinal Plants. A Practical Reference Guide to over 550 Key Herbs and their Medicinal Uses. Dorling Kindersley Ltd.
- Craker, E. and Simon, James. (1986). Herbs, Spices, and medicinal Plants: Recent Advances in Botany, Horticulture & Pharmacology, Volume I. CBS Publisher Spices & Condiments Indian Spices Markets: Trends and Opportunities.
- Farrell, K. T. (2000). Spices, Condiments and Seasoning. 2nd Ed. Springer.
- Jain, S.K. (1980): Glimpses of Indian Ethnobotany. Oxford & IBH Publication New Delhi.
- Jain, S.K. 1995. Manual of Ethnobotany, Scientific Publishers, Jodhpur
- Jill Norman (1990). The Complete Book of Spices: A Practical Guide to Spices and Aromatic Seeds. RD Press, Montreal.
- Jill Norman (2002). Herbs & Spices. Dorling Kindersley Ltd., Penguin Random House.
- Kumar, N. (1995). Spices, Plantation Crop, Medicinal & Aromatic Plants. Oxford & IBH, New Delhi.
- Pandey, B.P. (1999): Economic Botany. S. Chand & Co., New Delhi.
- Patil, D.A. and Dhale, D.A. 2013. Spices and Condiments: Origin, History and Applications. Daya Publishing House, Delhi.
- Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd Ed. Agrobios, India.
- Purthi, J.S. (2006). Spices and Condiments. National Book Trust, New Delhi.
- Sarah Garland (1979). The Complete Book of Herbs & Spices: an illustrated guide to grow and using aromatic, cosmetic, culinary and medicinal plants. The Viking Press.
- Sarma. O.P. (1996). Hill's Economic Botany. Tata McGraw Hill Publishmg Company Ltd.
- Sood, S.K., Bhatnagar, A.K., Kharwal, A. and Lakhnupal, T. N. 2014. Ethnobotany Himalayan Region, 1/e. IK International Publishing House

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EVS-AE-1210: ENVIRONMENTAL STUDIES

Credits: L4:T0:P0 = 4 Credits

Lecture Hours: 50

Course Objective

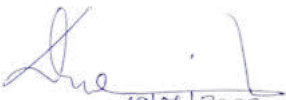
The objective of this paper is to provide basic concept of on Environment, Ecology, Natural Resources, Importance of biodiversity and need for their conservation along with various environmental issues and Govt. policies, and Environmental movements.

Learning outcomes

- Learners will be able to understand environment science and its importance.
- Learners will understand the various types of pollution and hazards caused by them.
- Learners will understand ways to monitor environment and the various green technologies.
- Learners will know the various Acts enacted for the protection of the environment.

Key Words: Environment, Ecosystem, Natural Resources, Biodiversity, Environmental Issues and Policies


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Unit I: Basic Concept of Environment**10 Lectures**

Environment: Definition, scope and importance; Physical and biological components of environment and their interactions; Multidisciplinary nature of environmental studies. Ecosystem concept, Ecosystem structure, function and services.

Unit II: Natural Resources**10 Lectures**

Land as a resource, land degradation, soil erosion and desertification, Forest Resources and their utilization, Deforestation - causes and impacts on environment; Water resources, Use and over-exploitation of surface and ground water; Energy Resources, Renewable and non-renewable energy sources, growing energy needs and use of alternate energy sources.

Unit III: Biodiversity and Conservation**10 Lectures**

Biodiversity: Definition, levels (genetic, species and ecosystem diversity) and values; Biogeographic zones of India; Biodiversity hot spots. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit IV: Environmental Issues and Policies**20 Lectures**

Environmental pollution: types, causes, effects and controls of air, water, soil, and noise. Global environmental issues: Climate change, ozone layer depletion, and desertification. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Convention on Biological Diversity (CBD) and Nagoya Protocol; Convention on Climate Change, and Paris agreement.

Suggested readings

- Acar, S., Yeldan, A.E. (2019). Handbook of Green Economics. Elsevier Science. Netherlands.
 Ahluwalia, V.K.. Environmental Studies. 2nd Ed. TERI Press.
 Ambasht, R. S. and Ambasht, N.K. 2017. A textbook of Plant Ecology. 15th Ed. CBS Publishers and Distributors, New Delhi.
 Ambasht, R. S. and Ambasht, P.K. 2017. Environment and Pollution an Ecological Approach 5th Ed. CBS Publisher and Distributors.
 Bharucha, E. 2020. Textbook for Environmental Science for undergraduate students. University Grants Commission, New Delhi.
 Gupta Abhik and Gupta Susmita. 2021. Environmental Studies: Principles and Practices. 344 pages, SAGE Texts.
 Kaushik Anubha and Kaushik, C.P. 2018. Perspectives in Environmental Studies. 6 th Ed. New Age International Pvt. Ltd.
 Krishnamurthy, K. V. 2020. An advanced textbook on Biodiversity: Principles and Practice. CBS Publisher and Distributors
 Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
 Zhou, S. W. W. (2020). Carbon Management for a Sustainable Environment. Germany: Springer International Publishing.

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BOT-SE-1210: MUSHROOM CULTIVATION

Full marks: 100

Terminal marks: 80

L2:T0:P1= 3 Cr

Internal assessment: 20

Course Objective

The objective of the course is to make students aware about the importance of edible mushrooms, their cultivation methods, disease management, and prospects at the global, national and regional levels.

Learning outcomes

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

- Learn the importance, prospect and suitable cultivation techniques for various types and categories of mushrooms.

R. K. Singh
 19.6.2023
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 19.06.2023
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- Understand the role of nutritional and environmental factors in mushroom production, and management the diseases of mushrooms
- Know the Government Schemes and Policies for mushroom cultivation

Keywords: Edible mushrooms, Cultivation techniques, Diseases, Post-harvest handling of produces, Government Policies and Funding.

Unit I

04 Lectures

Edible mushrooms – Types, nutritional and medicinal importance, wild edible mushrooms; Global and National Scenario of mushroom production and marketing; Mushroom production: nutritional and environmental factors; Prospect of Mushroom Cultivation in Arunachal Pradesh.

Unit II

06 Lectures

Basic techniques and steps in Mushroom cultivation – Starter culture, Spawn production and substrate preparation techniques. Substrate supplementation. Casing soil: preparation technique.

Unit III

10 Lectures

Methods of commercial cultivation for Button (*Agaricus bisporus*), Oyster (*Pleurotus* sp.), Paddy straw (*Volvariella volvacea*) and Shiitake mushrooms (*Lentinula edodes*). Common fungal and bacterial diseases of mushrooms and their management

Unit IV

06 Lectures

Post-harvest handling and marketing of mushrooms. Farm designs for Button, Oyster, Paddy straw and Shiitake mushrooms. Government Schemes and Policies for mushroom cultivation Entrepreneurships and funding agencies.

Practical

20 Hours

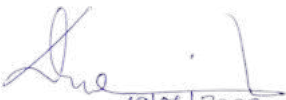
1. Laboratory techniques and handling of various equipment for Starter culture, Master spawn and commercial spawn production, preservation and handling of spawn.
2. Culture Maintenance and Preservation Techniques
3. Substrate preparation, steam sterilization and chemical treatment method of paddy straw and other locally available cereal straw.
4. Method of wheat straw-based Compost; Casing Soil.
5. Mushroom Cultivation of: Oyster mushrooms and Button Mushroom.
6. Identification of common fungal and bacterial diseases of Oyster/Button Mushrooms.
7. Documentation of wild edible **local** mushrooms from the area.

(Note: *Students' visit to a local Mushroom farm should be arranged by the Institution*)

Suggested Readings

- Kapoor, J.N. (1999). Mushroom cultivation. Publications and Information Division, ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi-1100012
- Kaul, T.N. (1999) Introduction to Mushroom science (systematic). Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi And Calcutta
- Purkayastha, R.P. and Andrilla Chandra. Manual of Indian Edible Mushrooms. Today & Tommorrow's Printers and Publishers, 24-B/5, Desh Bandhu Gupta Road, New Delhi-1100005
- Sharma, V.P. and Kumar, S. (2011). Competitor moulds and diseases in mushroom production and their management. In: M. Singh, B. Vijay, S. Kamal & G.C. Wakchaure (eds.) Mushrooms Cultivation, Marketing and Consumption, Directorate of Mushroom Research (ICAR), Chambaghat, Solan (HP).
- Singh, M. Vijay, B. Kamal S. and Wakchaure G. C. (2011). Mushrooms Cultivation, Marketing and Consumption: Directorate of Mushroom Research (ICAR), Solan (HP)
- Tewari, R. P. (1986). Mushroom cultivation. Extension Bulletin. Indian Institute of Horticulture Research, Bangalore, India.
- Upadhyay, R.C. (2007). Cultivation of Oyster Mushroom (*Pleurotus* spp.) In: National Training Course on Mushroom Production Technology for Entrepreneurs, 19-28 April, NRCM – Solan, India. In: Wakchaure (eds.) Mushrooms Cultivation, Marketing and Consumption, Directorate of Mushroom Research (ICAR), Solan (HP).


(Prof. R. K. Singh) 19.6.2023


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