DEPARTMENT OF BOTANY

SRI SAI BABA NATIONAL DEGREE COLLEGE ANANTAPUR

ABOUT DEPARTMENT

The Department of Botany was established in 1981. From time to time two teaching faculty and two non teaching faculty were retired. At present there are three faculty members with an average experience of fifteen years. They have been discharging their responsibilities to the best of their abilities, producing well-qualified students to be the members of excellent human resources of the nation. The department offers a UG course of B.Sc. – Botany, Zoology and Chemistry (EM&TM).

The Department has two well-furnished, well-equipped and spacious laboratories. They have modern scientific equipment like Colorimeters, pH meters, 70 microscopes, Stereo microscope, Bright field Binocular and Trinocular microscopes, High Speed cooling Centrifuge, Thermostatic Ovens, Water analyzer, Laminar air flow cabinet, Incubators, Thermostatic water bath, one OHP apart from adequate glassware and chemicals. A Botanical museum with a good number of plant specimens show-cased in glass cabinets and a herbarium prepared by the teachers and students from the plant collections are useful as learning resources for the students.

Laboratory – I

Laboratory – II

Plant Specimen & Herbarium

Binocular, Trinocular & Stereo Microscopes

There is one culture room and one research cabin which caters the needs of students to carry out projects and basic science research. Faculty members are carrying out research in the fields of plant morphology, plant taxonomy (Asteraceae and Freshwater Algae) and Agronomy. The Department is employing both traditional and modern teaching methods supported by modern technology. The faculty uses teaching aids like bio -visual charts covering the entire range of curriculum, Micro slides, herbarium, museum specimens, models and LCD projector to enhance the impact of teaching and learning activity. Botanical tours are made part of the curriculum to enrich the students' knowledge. The tours comprise one field trip to cover the local environs and the other to a place of floristic significance outside the district. More frequently students are taken to local University and Agricultural research station to enhance the subject knowledge. Class seminars on specific topics, group discussions and quiz programmes on the subjects prescribed form part of regular academic activity.

Microscopes

Laminar Air Flow Cabinet

Hot Air Oven & Cooling Centrifuge

Plant Specimens

Visit to Acharya N.G. Ranga Research Station

Field Trip

Botanical Tour

Fresh Water Algal Collection

Blood Donation Camp

Blood Grouping

FACULTY

Dr. C. Prabhakara Raju, M.Sc., Ph.D.,

Dr. Raju, obtained his M.Sc., degree from S.V. University, Tirupati in 1983 and his Doctoral degree in 1995 from S.K. University, Ananthapuramu and joined in the service in 1985. He published 31 research articles in national and international journals. He attended several national seminars/ workshops /conferences and presented papers. He authored a Question Bank for III B.Sc. students. He has also contributed a chapter

on 'Asteraceae' to the volume two of "**Flora of Andhra Pradesh**". His name is enlisted as South Indian Taxonomist in the Directory of Indian Taxonomists. A former NSS programme officer, Dr. Raju has been extensively participated in community service involving various service organizations like the Lions Club, the Indian Red Cross Society, Janavignana Vedika, Nehru Yuva Kendra and District Science Center, Anantapur, apart from his academic activism.

HONORS CONFERRED:

State award to meritorious teachers, Government of Andhra Pradesh – 2004

RESEARCH ARTICLES PUBLISHED:

1) Ravi Prasad Rao.B., **C.Prabhakara Raju**, T.Pulliah and R.R.Venkata Raju 1992. A note on two are and interesting taxa of Asteraceae from Andhra Pradesh. My Forest. 28(2):188-190.
2) **Prabhakara Raju.C**., B.Ravi Prasad Rao and R.R.Vekata Raju 1994. *Pulicaria foliolosa* DC, a new distributional record to peninsular India, Journal of Bombay Natural History Society. 91(3):480-482.
3) **Prabhakara Raju.C** and R.R.Vekata Raju 1995. Additions to the genus *Blumea* in Andhra Pradesh. India Journal of Forestry 18(4):341-342.
4) **Prabhakara Raju.C** and R.R.Venkata Raju 1995. *Bidens cynapiifolia* H.B.K. (Asteraceae) – A new record for Peninsular India. Rheedea 5(1):43-45.
5) **Prabhakara Raju.C** and R.R.venkata 1996. Some rare and interesting Asteraceous taxa from the forests of Andhra Pradesh. Journal of Economic and Taxonomic Botany 20 (2) : 261-265.
6) Venkata Raju.R.R., and **C.Prabhakara Raju** 1996. A new variety of *pentanema indicum (L)* Ling (Asteraceae) from Andhra Pradesh, India. Rheedea 6(2):55-58.
7) Venkata Raju.R.R., and **C.Prabhkara Raju** 1997 two new records of Asteraceae to Andhra Pradesh. Journal of Bombay Natural History Society,94:180-181.
8) **Prabhakara Raju.C** and R.R.Venkata Raju1997. *Conyza japonica* (Thumb.) Less(Asteraceae): An addition to the flora of Andhra Pradesh.Journal of Bombay Natural History Society, 94(2):436-438.
9) **Prabhakara Raju. C** and RR Venkata Raju. 1998. Some interesting plant records from Andhra Pradesh. Higher plants of India sub-continent (Additional series of Indian Journal of Forestry) (No.X) vol.111:233-188

10) **Prabhakara Raju.C** and R.R.Venkata Raju 1998. Note on *Gynura Lycoprsicifolia* DC. (Asteraceae) in India. Proceeding of the National Seminar on Conservation of Eastern Ghats, organized by Environment Protection Training and Research Institute (EPTRI), Hyd. Pp 103-105.
11) Venkata Raju R.R and **C.Prabhakara Raju**. 1999. *Acmellla repens* (walt.) Rich. (Asteracea) – A new distributional record for Old World contries.Rheedea 9(1): 41-44.
12) Venkata Raju.R.R., and **C.Prabhakara Raju** 1999. *Cythocline manilaliana* (Asteraceae), A new species from Andhra Pradesh, India, Rheedea 9(2):151-154
13) Venkata Raju.R.R., and **C.Prabhakar Raju** 2000. On the genus *Sonchus L.* (Asteraceae) in Andhra Pradesh, India, Journal Of Economic and Taxonomic Botany 24(1):93-98.
14) **Prabhakara Raju.C** and R.R.Venkata Raju 1997. Asteraceae(Nom.Alt. Compositae). In "Flora of Andhra Pradesh Vol.2 (T.Pulliah and Alimoulali, Eds) Scientific Publishers, Jodhpur, P.P. 505-43.
15) G.Ramanjaneyulu, P.Seshapani, B.V.Ramana Naidu, D.Jayasimha Rayalu, **Prabhakara raju.C.** and J.Pramoda Kumari. **2010 :**Genome wide analysis and Identification of Genes related to Cyclic nucleotide gated channels in *Oryza sativa;* Bulletin of Pure and Applied Sciences. Vol.29B(No.2) : P.83-91.
16) Jayasimha Rayalu.D, Seshapani.P, MuraliMohan, **C.Prabhakara Raju** and Vinay Sagar Lakka, **2010:** Homology Modeling and Docking Studies of Alphaglucosidase involved in type2 Diabetes; Bio-Science Research Bulletin; Vol.26(No.1) : P.1-11.
17) B.V.Ramana Naidu, D.Haribaburao, P.Subramanyam, **C.PrabhakaraRaju**, D.Jayasimharayalu, **2012**: Ethnobotanical study jof Medicinal Plants used by Tribals in Nallamalla forest area of Kurnool District, AndhraPradesh; International Journal of Plant, Animal and Environmental Sciences Vol.2,Issue 4, PP.xx
18) B.V.Ramana Naidu**,** C.Prabhakara Raju, S.Murali Mohan, Jayasimharayalu Daddam.2014: The Phyto chemical Screening and Antimicrobial Activities of a Medicinal plant ***Zingiber officinale***. International Journal of Analytical, Pharmaceutical and Biomedical Sciences. Volume-3, Issue-3, July – Sep 2014.
19) S.N.Meeravali, G.R.Gandhi, **C.Prabhakara Rajiu** and R.R.Venkata Raju, 2015. Diatom flora of Batrepalli waterfalls, Anantapuramu, Andhra Pradesh, India. J.Algal Biomass Utln.6(4):50-5920.

20) Meeravali.S.N., **Prabhakara Raju**.C. and Venkataraju R.R. 2015. Floristic Studies on Diatom Flora From selected water bodies of Ananthapuramu District, Andhra Pradesh; International Journal of Recent Scientific Research.Vol.6, issue 10, P.6923-6930.
21) Rekha.A, **Prabhakara Raju.C** , Chandrasekhar. A and Sujatha.P.2016. Studies on some chlorococcales from Chittoor District, Andhdra Pradesh, India. International Journal of Plant, Animal and Environmental Sciences. Vol.6.issue-2.p.230-233
22) Meeravali S.N., B.K.S.Mishra, C.Prabhakara Raju and R.R.VenkataRaju. 2017. Diatom flora of Kanekal reservoir,Anantapuramu district, Andhra Pradesh,India. Journal of Algal Biomass Utilization.8 (4): 23-38.
23) Shaik Khaleel Basha, D.N.Parvin, D.Haribaburao and C.Prabhakara Raju.2017. An Ethnobotanical survey of indigenous knowledge on Angiospermic parasiticplants used by the tribal people of ahobilam reserve forest of Kurnool District, AndhraPradesh, India. International Journal of Innovative Science and Research Technology. 2 (12): 323-329.
24) Meeravali S.N., C.Prabhakara Raju and R.R.VenkataRaju.2017. Freshwater Diatom flora of Penukonda region, Ananthapuramu District, Andhra Pradesh,India. Indian Hydrobiology. 17 (1): 1-7.
25) Ramana Naidu.B.V., C.Prabhakara Raju, A.Chandra Sekhar and G.S.Ranganayakulu. 2018. Diversity of the genus *Microcystis* Kutzing ex Lemmermann from Andhra Pradesh, India.J.Algal Biomass.Utln.9(4):48-51.
26) Ramana Naidu.B.V., C.Prabhakara Raju, and G.S.Ranganayakulu. 2018.Taxonomic diversity of *Pediastrum simplex* in Andhra Pradesh. Bulletin of Pure and Applied Sciences.37B (2):84-88.
27) Mallikarjuna, G.Reddy, Raju, C.P., Reddy,P.C., and Sekhar, A.C. 2019. The genus *Tetraedron* Kutzing (Algae-Chlorophyta) from Ananthapuramu District, Andhra Pradesh, India. Indian Hydrobiology.18(1&2):218-226.
28) Mallikarjuna, Gurulakshmi,K., Raju, C.P., Reddy,P.C., Naidu B.V.R., Reddy C.S., and Sekhar, A.C. 2019. Some freshwater algae from YSR Kadapa District, with new distributional records to Andhra Pradesh, India. Indian Hydrobiology.18 (1&2):227-242.
29) Saikiran Reddy, C., B. Shobha Rani, P.Sujatha, B.V.Ramana Naidu and C.Prabhakara Raju. 2019. On the occurrence of *Chroococcus mipitanensis* (Woloszynska) Geitler in India. Indian Hydrobiology.18 (1&2): 243-246.

30) ShobhaRani,B., P. Sujathamma, B.V.Ramana Naidu and C.Prabhakara Raju.2020. The genus *Cosmarium* Corda ex Ralfs from Kurnool District, Andhra Pradesh, India. Indian Hydrobiology. 19(1&2): 123-130.

31) ShobhaRani,B., P. Sujathamma, B.V.Ramana Naidu and C.Prabhakara Raju.2020.The genus *Trachelomonas* Ehr. from Nandyala, Kurnool District, Andhra Pradesh, India. Indian Hydrobiology. 19(1&2): 199-204.

RESEARCH PAPERS PRESENTED IN SEMINARS / SYMPOSIA

1) Participated and presented a paper on "Taxonomic censes and systematic survey of Asteraceae in Andhra Pradesh". Proc. National seminar on problems and prospects of Angiosperm Taxonomy in India October, 9/11/1992. Jiwaji University, Gwalior.
2) Participated and presented a paper on "Note on two Asteraceous taxa from Andhra Pradesh, National Symposium on Biodiversity in India". October 28-29,1993. S.K. University, Anantapur.
3) Participated and presented a paper on "Taxonomic significance of Achiene morphology among the members of Heliantheae (Asteraceae) in Andhra Pradesh". National Symposium on new directions in Plant Biodiversity Research, September 27-29, 1995. Bharathidasan University, Tiruchirapalle.
4) Participated and presented a paper on "Some microalgae from Tirumala Hills, Andhra Pradesh, India. National Seminar on Freshwater Algae and utilization. Krishnamurthy institute of Algology and SDNB Vaishnav College, Chennai. 27 and 28 November 2015
5) Participated and presented a paper on "Taxonomic diversity of Pediastrum simplex Mayen in Andhra Pradesh, India. National Seminar on Freshwater Algae and utilization. Krishnamurthy institute of Algology and SDNB Vaishnav College, Chennai. 27 and 28 November 2015.

WORKSHOPS AND TRAININGS ATTENDED:

1) National Level Training Programme for NSS Programme Officers, Rajiv Gandhi National Institute of Youth Development – Sri Perambadur (T.N.). 26-9-2001 to 30-9-2001.
2) Participated in a 9 months' workshop in 3 phases on Leadership for Results – HIV/AIDS Programme organized by United Nations

Development Programme (UNDP) & APSACS – 23-24 Nov.03, 24-26 Feb.04, 2-3 June 2004, Hyd.

3) Twelve days training programme on Global skills enhancement at INFOSIS campus(Training for Mentors of Jawahar Knowledge Centre). 17-09-2007 to 29- 09-2007
4) National Workshop on "Herbal Medicines"conducted by Department of Sericultur S.P.M.V.Vidyalayam, Tirupati. 30-03-2008 & 31-03-2008.
5) National work shop on "Taxonomy of Freshwater Algae" Organized by Krishnamurthy Institute of Algology at the Centre for Advanced study in Botany, University of Madras, Chennai. 6-5- 013 - 11-5-2013

SEMINARS /ORIENTATION PROGRAMMES CONDUCTED:

1) Master Resource Person: Orientation Programme to Guide Teachers of INSPIRE AWARDEES on development of projects to enable them to guide inspire Awardees: SSBN Degree College, Anantapuramu 05-08-2016-06-08-2016.
2) Co-ordinator: Science Academies' Lecture workshop on "Recent trends in Plant Taxonomy, conservation and Ethnobiology..SSBN Degree College, Anantapuramu Dec. 14-15, 2016

SEMINARS AND CONFERENCES PARTICIPATED :

S.NO	DATE	NAME	ORGANISATION
1	26-02-1994	DNA Protein interactions	Department of Biochemistry, S.K. University, Anantapur
2	11-11-2006	State level NSS , Adolescent Quiz 2006	Ministry of Youth Affairs and Sports, Govt. of India
3	03-12-2006	National Seminar on" Recent Trends in Biotechnology"	Department of Biotechnology S.S.B.N. Degree & P.G College, Anantapur.
4	05-02-2008 & 06-02-2008	National Symposium on "Science in 21st Century "	Department of Botany S.K. University, Anantapur.

5	04-12-2009 & 05-12-2009	National Seminar on “Emerging Trends in Biotechnology”	Department of Biotechnology Govt. Arts College, Anantapur.
6	25-03-2011 & 26-03-2011	National Seminar on” Trends in Plant Sciences.”	Department of Botany S.K. University, Anantapur.
7	25-02-2014 to 26-02-2014	Recent trends in Biotechnology	Department of Biotechnology, Yogivemana University, Kadapa
8	10-04-2014	One day workshop on Electrophoretic and culture techniques	Departments of Life Sciences Government College(Men), Ananthapuramu
9	27-02-2014 to 28-02-2014	National Seminar on “Plant Biotechnology for better future”	Department of Botany, Government College, Ananthapuramu
10	09-07-2014 to 10-09-2014	National Seminar on Necessity of Inter Personal Relations for Human Excellence	S.V.G.M. Govt. Degree College, Kalyandurg, Ananthapuramu(Dt)
11	07-1-2015 to 08-01-2015	National Seminar on Sustainability and Management of Aquatic Ecosystems in Semiarid areas	Govt. College, Ananthapuramu
12	29-02-2015	National Seminar on “Recent Trends in Biology and its applications”	SKP Government College, Guntakal, Ananthapuramu (Dist)
13	21-01-2016 to 22-01-2016	National Seminar on “Trends for Advancement of Sericulture”	Department of Sericulture S.K. University, Ananthapuramu
14	14-12-2016 to 15-12-2016	Science academies’lecture workshop on “recent advances in Plant Taxonomy, conservation and Ethnobiology”	S.S,B.N.Degree College, Ananthapuramu
15	16-12-2016 to 17-12-2016	National conference on “ICT Empowered Teaching Learning and Evaluation”	S.S.B.N.Degree College, Ananthapuramu
16	20-01-2017 to 21-01-2017	National Seminar on “Wildlife conservation – Endangered Species”	Department of Zoology, Govt.College for Men, Kadapa

ORIENTATION/ REFRESHER COURSES ATTENDED

1	Orientation Course, Academic Staff College, University of Hyderabad (A.P)	8-4-1991 to 4-5-1991
2	Training and Orientation Center, NSS, Osmania University, Hyderabad, (A.P)	28-1-2002 to 6-2-2002
3	Refresher Course in Environmental Science Department of Botany, S.K. University, Anantapur	3-3-1995 to 25-3-1995
4.	Refresher Course in Environmental Science C.S.R. Sarma College, Ongole	29-12-2000 to 18-1-2001
5	Refresher Course in Applied Botany, Kuvempu University, Shimoga	15-10-2001 to 7-11-2001

RESEARCH GUIDANCE:

M.Phil: Aquatic Algal Diversity in and around Gooty, Anantapur District, A.P, Sri Krishnadevaraya University , Anantapur, A.P. 2011 , -- J.K.Ramu (M 0824026)

R. Madhavi, M.Sc., (Ph.D).,

Assistant Professor joined in service on 01-08-2014 and has 8 years of teaching experience and she attended National Seminars/ Workshops /Conferences and presented papers. She is Pursuing Ph.D., on "Influence of soil fertility on mulberry leaf yield in Ananthapuramu and Chittoor Districts, of Andhra Pradesh"

Academic Qualifications:

Exam Passed	Board/University	Subject	Year	Division / Grade
Higher Secondary or Pre Degree	Board of Intermediate, Hyderabad.	Biology & Physical Sciences	2004-2006	First
Bachelor's Degree (s)	S.S.B.N. Degree College (Anantapur)	Botany Zoology Chemistry.	2006-2009	First
Degree of Bachelor of Education	S.S.B.N. Degree college (Anantapur)	Biological sciences	2009-2010	First
Master's Degree (s) M.Sc.,	PVKK College (Anantapur)	Botany	2012-2014	First

(Ph.D.).,	Sri Padmavathi Mahila University, Tirupati.	Pursuing Ph.D., on **Influence of soil fertility on mulberry leaf yield in Anantapur and ChittoorDistricts, of Andhra Pradesh**		
Computer proficiency	P.G.D.C.A			

Seminars, Workshops and Conferences Participated

1) Participated in National work shop on Post Harvest Technologies For Horticultural Produce 23/2/2017 SPMVV, Tirupati.
2) Participated in National Workshop on Women Entrepreneurship (NWWE-2017) ON 23/12/2017 SSBN Degree college Anantapur.
3) Participated in Lecture Workshop on New Vistas in Biology on 26/7/2018 SSBN Degree college Anantapur.
4) Participated in Workshop on Personality Development and Women Empowerment on 22-08-2019SSBN Degree college Anantapur.
5) Participated in Lecture Workshop on Recent Advances in Plant Taxonomy, Conservation and Ethnobiology on 15-12-2016 SSBN Degree college Anantapur.
6) Participated in National Seminar on Entrepreneurship in Sericulture and presented a paper on Soil fertility assessment and mapping of mulberry growing areas of Anantapur district. S.K. University Anantapur.

M.Chandra kala, M.Sc.

Assistant Professor has 2 years of teaching experience and she attended National seminars.

NON-TEACHING STAFF

U. C Narasimhulu, Lab-Assistant

CURRICULUM

B.Sc., Botany Course Structure under CBCS

Year	Semester	Course	Title of the Course	Marks	No of hours Per Week	No of Credits
I	I	I	Fundamentals of Microbes and Non- Vascular plants	100	4	3
			Lab Course -I	50	2	2
II	II	II	Basics of Vascular plants and Phytogeography	100	4	3
			Lab Course -II	50	2	2
III	III	III	Anatomy and Embryology of Angiosperms, Plant ecology and Biodiversity	100	4	3
			Lab Course -III	50	2	2
IV	IV	IV	Plant Physiology and Metabolism	100	4	3
			Lab Course -IV	50	2	2
	IV	V	Cell biology ,Genetics and Plant breeding	100	4	3
			Lab Course – V	50	2	2

Skill Development Courses (SDC)

Year	Semester	Title of the Course	No of hours per week	Marks			Credits allotted
				External	Internal	Total	
I	I	Plant Nursery	2	30	20	50	2
I	II	Biofertilizers	2	30	20	50	2
II	III	Plant diversity and human welfare	2	30	20	50	2
II	III	Mushroom culture Technology	2	30	20	50	2

I B.Sc. – SEMESTER –I: BOTANY THEORY PAPER – I

COURSE-I : FUNDAMENTALS OF MICROBES AND NON-VASCULAR PLANTS (VIRUSES, BACTERIA, FUNGI, LICHENS, ALGAE AND BRYOPHYTES)

Unit – 1: Origin of life and Viruses **12Hrs.**

1) Origin of life, concept of primary Abiogenesis; Miller and Urey experiment. Five kingdom classifications of R.H. Whittaker
2) Discovery of microorganisms, Pasteur experiments, germ theory of diseases.
3) Shape and symmetry of viruses; structure of TMV and Gemini virus; multiplicationof TMV; A brief account of Prions and Viroid's.
4) A general account on symptoms of plant diseases caused by Viruses. Transmission of plant viruses and their control. 5. Significance of viruses in vaccine production, bio-pesticides and as cloning vectors.

Unit – 2: Special groups of Bacteria and Eubacteria **12Hrs.**

1) Brief account of Archae bacteria, Actinomycetes and Cyano bacteria.
2) Cell structure and nutrition of Eubacteria.
3) Reproduction- Asexual (Binary fission and endospores) and bacterial recombination (Conjugation, Transformation, Transduction).
4) Economic importance of Bacteria with reference to their role in Agriculture and industry (fermentation and medicine).
5) A general account on symptoms of plant diseases caused by Bacteria; Citrus canker.

Unit – 3: Fungi & Lichens **12 Hrs.**

1) General characteristics of fungi and Ainsworth classification (up to classes).
2) Structure, reproduction and life history of(a) Rhizopus (Zygomycota)and (b) Puccinia (Basidiomycota).
3) Economic uses of fungi in food industry, pharmacy and agriculture.
4) A general account on symptoms of plant diseases caused by Fungi; Blast of Rice.
5) Lichens- structure and reproduction; ecological and economic importance.

Unit – 4: Algae **12 Hrs.**

1) General characteristics of Algae (pigments, flagella and reserve food material); Fritsch classification (up to classes).
2) Thallus organization and life cycles in Algae.
3) Occurrence, structure, reproduction and life cycle of (a) Spirogyra (Chlorophyceae) and (b) Polysiphonia (Rhodophyceae).
4) Economic importance of Algae.

Unit – 5: Bryophytes **12 Hrs.**

1) General characteristics of Bryophytes; classification up to classes.
2) Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life cycle of (a) Marchantia (Hepaticopsida) and (b) Funaria(Bryopsida).
3) General account on evolution of sporophytes in Bryophyta.

Books for Reference:

- Dubey, R.C. &D.K. Maheshwari (2013) A Text Book of Microbiology, S. Chand& Company Ltd., New Delhi.
- Pelczar Jr., M.J., E.C.N. Chan &N.R. Krieg (2001) Microbiology, Tata McGraw Hill Co, New Delhi.
- Kevin Kavanagh (2005) Fungi; Biology and Applications John Wiley & Sons, Ltd., West Sussex, England
- John Webster & R. W. S. Weber (2007) Introduction to Fungi, Cambridge University Press, New York
- Fritsch, F.E. (1945) The Structure & Reproduction of Algae (Vol. I & Vol. II) Cambridge University Press Cambridge, U.K.

Learning Outcomes:

- On successful completion of this course, the students will be able to:
- Explain origin of life on the earth.
- Illustrate diversity among the viruses and prokaryotic organisms and can categorize them.
- Classify fungi, lichens, algae and bryophytes based on their structure, reproduction and life cycles.
- Analyze and ascertain the plant disease symptoms due to viruses, bacteria and fungi. Recall and explain the evolutionary trends among amphibians of plant kingdom for their shift to land habitat.
- Evaluate the ecological and economic value of microbes, thallophytes and bryophyte

I SEMESTER PRACTICAL SYLLABUS:

1) Knowledge of Microbiology laboratory practices and safety rules.
2) Knowledge of different equipment for Microbiology laboratory (Spirit lamp, Inoculation loop, Hot-air oven, Autoclave/Pressure cooker, Laminar air flow chamber and Incubator) and their working principles. (In case of the non-availability of the laboratory equipment the students can be taken to the local college/clinical lab. with required infrastructural facilities or they can enter a linkage with the college/lab for future developments and it will fetch credits during the accreditation by NAAC).
3) Demonstration of Gram's staining technique for Bacteria.
4) Study of Viruses (Corona, Gemini and TMV) using electron micrographs/ models.

5) Study of Archaebacteria and Actinomycetes using permanent slides/ electron micrographs/diagrams. 6. Study of Anabaena and Oscillatoria using permanent/temporary slides. 7. Study of different bacteria (Cocci, Bacillus, Vibrio and Spirillum) using permanent or temporary slides/ electron micrographs/ diagrams.
6) Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts: a. Fungi : Rhizopus,PenicilliumandPuccini

Course Outcomes: On successful completion of this practical course, student shall be able to;

1) Demonstrate the techniques of use of lab equipment, preparing slides and identify the material and draw diagrams exactly as it appears.
2) Observe and identify microbes and lower groups of plants on their own.
3) Demonstrate the techniques of inoculation, preparation of media etc
4) Identify the material in the permanent slides etc

I B.Sc. – SEMESTER –II: BOTANY THEORY PAPER – II

Course II Basics of Vascular plants and Phytogeography (Pteridophytes, Gymnosperms, Taxonomy of Angiosperms and Phytogeography)

Unit – 1: Pteridophytes **12 Hrs.**

1) General characteristics of Pteridophyta; classification of Smith (1955)uptodivisions.
2) Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of (a) Lycopodium (Lycopsida) and (b) Marsilea (Filicopsida).
3) Stelar evolution in Pteridophytes;
4) Heterospory and seed habit

Unit – 2: Gymnosperms **14 Hrs.**

1) General characteristics of Gymnosperms; Spore classification up toclasses.
2) Occurrence, morphology, anatomy, reproduction (developmental details are not needed) and life history of (a) Cycas (Cycadopsida) and (b) Gnetum (Gnetopsida).
3) Outlines of geological time scale.
4) A brief account on Cycadeoidea.

Unit – 3: Basic aspects of Taxonomy **13Hrs.**

1) Aim and scope of taxonomy; Species concept: Taxonomic hierarchy, species, genus and family.
2) Plant nomenclature: Binomial system, ICBN- rules for nomenclature.

3) Herbarium and its techniques, BSI herbarium and Kew herbarium; concept of digital herbaria.
4) Bentham and Hooker system of classification;
5) Systematic description and economic importance of the following families: (a) Annonaceae (b) Curcurbitaceae

Unit – 4: Systematic Taxonomy **13 Hrs.**

1) Systematic description and economic importance of the following families:
    a) Asteraceae
    b) Asclepiadaceae
    c) Amaranthaceae
    d) Euphorbiaceae
    e) Arecaceaeand
    f) Poaceae
2) Outlines of Angiosperm Phylogeny Group (APG IV).

Unit – 5: Phytogeography **08 Hrs.**

1) Principles of Phytogeography, Distribution (wides, endemic, discontinuous species)
2) Endemism – types and causes.
3) Phytogeographic regions of World
4) Phytogeographic regions of India.
5) Vegetation types in Andhra Pradesh

Books for Reference:

- Smith, G.M. (1971) Cryptogamic Botany Vol. II., Tata McGraw Hill, New Delhi
- Sharma, O.P. (2012) Pteridophyta. Tata McGraw-Hill, New Delhi
- Bhatnagar, S.P. & AlokMoitra (1996)Gymnosperms. New Age International, New Delhi
- Coulter, J.M. & C.J. Chamberlain (1910) Morphology of Gymnosperms, The University of Chicago Press, Chicago, Illinois
- Govil, C.M. (2007) Gymnosperms: Extinct and Extant. KRISHNA Prakashan Media (P) Ltd. Meerut& Delhi

Learning Outcomes:

- On successful completion of this course, the students will be able to:
- Classify and compare Pteridophytes and Gymnosperms based on their morphology, anatomy, reproduction and life cycles.
- Justify evolutionary trends in tracheophytes to adapt for land habitat.

- Explain the process of fossilization and compare the characteristics of extinct and extant plants.
- Critically understand various taxonomical aids for identification of Angiosperms.
- Analyze the morphology of the most common Angiosperm plants of their localities and recognize their families.
- Evaluate the ecological, ethnic and economic value of different tracheophytes and summarize their goods and services for human welfare.
- Locate different phyto geographical regions of the world and India and can analyze

II SEMESTER PRACTICAL SYLLABUS :

1) Study/ microscopic observation of vegetative, sectional/anatomical and reproductive structures of the following using temporary or permanent slides/ specimens/ mounts: a. Pteridophyta: Lycopodium and Marsilea b. Gymnosperms: Cycas and Gnetum
2) Study of fossil specimens of Cycadeoidea and Pentoxylon (photographs /diagrams can be shown if specimens are not available).
3) Demonstration of herbarium techniques.
4) Systematic / taxonomic study of locally available plants belonging to the families prescribed in theory syllabus. (Submission of 30 number of Herbarium sheets of wild plants with the standard system is mandatory).
5) Mapping of phyto geographical regions of the globe and India

Course Outcomes: On successful completion of this course students shall be able to:

1) Demonstrate the techniques of section cutting, preparing slides, identifying of the material and drawing exact figures.
2) Compare and contrast the morphological, anatomical and reproductive features of vascular plants.
3) Identify the local angiosperms of the families prescribed to their genus and species level and prepare herbarium.
4) Exhibit skills of preparing slides, identifying the given twigs in the lab and drawing figures of plant twigs, flowers and floral diagrams as they are.
5) Prepare and preserve specimens of local wild plants using herbarium techniques.

II B.Sc. – SEMESTER –III: BOTANY THEORY PAPER – III

Course III : Anatomy and Embryology of Angiosperms, Plant ecology and Biodiversity

Unit – 1: Anatomy of Angiosperms 12 Hrs.

1) Organization of apical meristems: Tunica-carpus theory and Histogen theory.
2) Tissue systems–Epidermal, and vascular tissue systems
3) Anomalous secondary growth in *Boerhaavia* and *Dracaena.*
4) Study of timbers of economic importance - Teak, Red sanders and Rosewood.

Unit – 2: Embryology of Angiosperms 12 Hrs.

1) Structure of anther, anther wall, types of tapetum. Microsporogenesis and development of male gametophyte.
2) Structure of ovule, mega sporogenesis; monosporic (Polygonum), bisporic (Allium) and tetrasporic (Peperomia) types of embryo sacs.
3) Outlines of pollination, pollen – pistil interaction and fertilization.
4) Endosperm - Types and biological importance - Free nuclear, cellular, helobial and ruminate.
5) Development of Dicot (Capsella bursa-pastoris) embryo.

Unit – 3: Basics of Ecology 12 Hrs.

1) Ecology: definition, branches and significance of ecology.
2) Ecosystem: Concept and components, energy flow, food chain, food web,
3) Ecological pyramids.
4) Plants and environment: Climatic (light and temperature), edaphic and biotic factors.
5) Ecological succession: Hydrosere and Xerosere

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Unit – 4: Population, Community and Production Ecology 12 Hrs.

1) Population ecology: Natality, mortality, growth curves, ecotypes, ecads
2) Community ecology: Frequency, density, cover, life forms, biological spectrum
3) Concepts of productivity: GPP, NPP and Community Respiration
4) Secondary production, P/R ratio and Ecosystems.

Unit – 5: Basics of Biodiversity 12 Hrs.

1) Biodiversity: Basic concepts, Convention on Biodiversity - Earth Summit.
2) Value of Biodiversity; types and levels of biodiversity and Threats to biodiversity
3) Biodiversity Hot spots in India. Biodiversity in North Eastern Himalayas and
4) Western Ghats.
5) Principles of conservation: IUCN threat-categories, RED data book
6) Role of NBPGR and NBA in the conservation of Biodiversity.

Text books:

- Botany – III (Vrukshasastram-I) : Telugu Akademi, Hyderabad
- Botany – IV (Vrukshasastram-II) : Telugu Akademi, Hyderabad
- Pandey, B.P. (2013) *College Botany, Volume-II,* S. Chand Publishing, New Delhi
- Pandey, B.P. (2013) *College Botany, Volume-III,* S. Chand Publishing, New Delhi
- Bhattacharya, K., G. Hait&Ghosh, A. K., (2011) *A Text Book of Botany, Volume-II,* New Central Book Agency Pvt. Ltd., Kolkata

Books for Reference:

- Esau, K. (1971)*Anatomy of Seed Plants.* John Wiley and Son, USA.
- Fahn, A. (1990)*Plant Anatomy*, Pergamon Press, Oxford.

Learning outcomes: On successful completion of this course, the students will be able to;

- Understand on the organization of tissues and tissue systems in plants.
- Illustrate and interpret various aspects of embryology.
- Discuss the basic concepts of plant ecology, and evaluate the effects of environmental and biotic factors on plant communities.

- Appraise various qualitative and quantitative parameters to study the population and community ecology.
- Correlate the importance of biodiversity and consequences due to its loss.
- Enlistthe endemic/endangered flora and fauna from two biodiversity hot spots in India and assess strategies for their conservation.

III SEMESTER PRACTICAL SYLLABUS

1) Tissue organization in root and shoot apices using permanent slides.
2) Anomalous secondary growth in stems of Boerhavia and Dracaena.
3) Study of anther and ovule using permanent slides/photographs.
4) Study of pollen germination and pollen viability.
5) Dissection and observation of Embryo sac haustoria in Santalumor Argemone.
6) Structure of endosperm (nuclear and cellular) using permanent slides / Photographs.
7) Dissection and observation of Endosperm haustoria in Crotalaria or Coccinia.
8) Developmental stages of dicot and monocot embryos using permanent slides / photographs.
9) Study of instruments used to measure microclimatic variables; soil thermometer, maximum and minimum thermometer, anemometer, rain gauze, and lux meter. (visit to the nearest/local meteorology station where the data is being collected regularly and record the field visit summary for the submission in the practical).
10) Study of morphological and anatomical adaptations of hydrophytes and xerophytes (02 each).
11) Quantitative analysis of herbaceous vegetation in the college campus for frequency, density and abundance.
12) Identification of vegetation/various plants in college campus and comparison with Raunkiaer's frequency distribution law.
13) Find out the alpha-diversity of plants in the area
14) Mapping of biodiversity hotspots of the world and India

Course Outcomes: On successful completion of this practical course students shall be able to:

1) Get familiarized with techniques of section making, staining and microscopic study of vegetative, anatomical and reproductive structure of plants.
2) Observe externally and under microscope, identify and draw exact diagrams of the material in the lab.
3) Demonstrate application of methods in plant ecology and conservation of biodiversity and qualitative and quantitative aspects related to populations and communities of plants.

II B.Sc.: BOTANY SYLLABUS : SEMESTER –IV

Paper IV: Plant physiology and metabolism

Unit – 1: Plant-Water relations 10 Hrs.

1) Importance of water to plant life, diffusion, imbibitions, osmosis. Water potential, osmotic potential , pressure potential.
2) Absorption and transport of water.
3) Transpiration: stomata structure and mechanism of stomatal movements (K^+ionflux).
4) Mechanism of phloem transport; source-sink relationships.

Unit–2: Mineral nutrition, Enzymes and Respiration 14 Hrs.

1) Essential macro and micro mineral nutrients and their role in plants; symptoms of mineral deficiency
2) Absorption of mineral ions; passive and active processes.
3) Characteristics, nomenclature and classification of Enzymes. Mechanism of enzyme action .
4) Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, Pentose Phosphate Pathway(HMP Shunt)

Unit–3: Photosynthesis and Photorespiration 12 Hrs.

1) Photosynthesis: Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect
2) Concept of two photo systems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation
3) Carbon assimilation pathways (C3,C4 and CAM);
4) Photorespiration -C2 pathway

Unit–4: Nitrogen and lipid metabolism 12 Hrs.

1) Nitrogen metabolism: Biological nitrogen fixation –symbiotic and asymbiotic nitrogen fixing organisms, Nitrogenase enzyme system.
2) Lipid metabolism: Classification of Plant lipids, saturated and unsaturated fatty acids.
3) Anabolism of triglycerides, β-oxidation of fatty acids, Glyoxylate cycle.

Unit–5: Plant growth – Development and stress physiology 12 Hrs.

1) Growth and Development: Definition, phases and kinetics of growth.
2) Physiological effects of Plant Growth Regulators (PGRs)-auxins,

gibberellins, cytokinins, ABA, ethylene and brassinosteroids.

3) Physiology of flowering: Photoperiodism, role of phytochrome in flowering.
4) Seed germination and senescence; physiological changes.

Textbooks:

- Botany– IV (Vrukshasastram-II):Telugu Academy, Hyderabad
- Pandey, B.P.(2013)*College Botany, Volume-III,* S.Chand Publishing, NewDelhi
- Ghosh,A.K.,K.Bhattacharya & G.Hait (2011) *A Text Book of Botany, Volume-III,* New Central Book Agency Pvt.Ltd., Kolkata

Books for Reference:

- Aravind Kumar & S.S. Purohit (1998) *Plant Physiology – Fundamentals and Applications,* Agro Botanica, Bikaner
- Datta, S.C. (2007) *Plant Physiology,* New Age International (P) Ltd., Publishers, NewDelhi
- Hans Mohr & P. Schopfer (2006) *Plant Physiology*, Springer (India) Pvt.Ltd., NewDelhi
- Hans-Walterheldt(2005) *Plant Biochemistry,* Academic Press, U.S.A.

Learning outcomes: On successful completion of this course,the students will be able to;

- Comprehend the importance of water in plant life and mechanisms for transport of water and solutes in plants.
- Evaluate the role of minerals in plant nutrition and their deficiency symptoms.
- Interpret the role of enzymes in plant metabolism.
- Critically understand the light reactions and carbon assimilation processes responsible for synthesis of food in plants.
- Analyze the biochemical reactions in relation to Nitrogen and lipid metabolisms.
- Evaluate the physiological factors that regulate growth and development in plants.
- Examine the role of light on flowering and explain physiology of plants under stress conditions.

IV - SEMESTER (PAPER-IV) : PRACTICAL SYLLABUS

1) Determination of osmotic potential of plant cell sap by plasmolytic method using Rhoeo/ Tradescantia leaves.

2) Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
3) Determination of rate of transpiration using Cobalt chloride method / Ganong's potometer (at least for a dicot and a monocot).
4) Effect of Temperature on membrane permeability by colorimetric method.
5) Study of mineral deficiency symptoms using plant material/photographs.
6) Demonstration of amylase enzyme activity and study the effect of substrate and Enzyme concentration.
7) Separation of chloroplast pigments using paper chromatography technique.
8) Demonstration of Polyphenol oxidase enzyme activity (Potato tuber or Apple fruit)
9) Anatomy of C3, C4 and CAM leaves
10) Estimation of protein by biuret method/Lowry method
11) Minor experiments – Osmosis, Arc-auxanometer, ascent of sap through xylem

Course outcomes: On successful completion of this practical course, students shall be able to:

1) Conduct lab and field experiments pertaining to Plant Physiology, that is, biophysical and biochemical processes using related glassware, equipment, chemicals and plant material.
2) Estimate the quantities and qualitative expressions using experimental results and calculations
3) Demonstrate the factors responsible for growth and development in plants.

II B.Sc.: BOTANY SYLLABUS : – SEMESTER –IV

Course – V: Cell biology, Genetics and Plant breeding

Unit– 1: The Cell **12 Hrs.**

1) Cell theory; prokaryotic Vs eukaryotic cell; animal Vs plant cell; a brief account onultra-structure of a plant cell.
2) Ultra-structure of cell wall.
3) Ultra-structure of plasma membrane and various theories on its organization.
4) Polymorphic cell organelles (Plastids); ultra structure of chloroplast. Plastid DNA.

Unit–2: Chromosomes **12 Hrs.**

1) Prokaryotic Vs Eukaryotic chromosome. Morphology of aeukayotic chromosome.
2) Euchromatin and Heterochromatin; Karyotype and ideogram.
3) Brief account of chromosoma laberrations-structural and numerical changes
4) Organization of DNA in a chromosome (solenoid and nucleosome model)

Unit–3: Mendelian and Non-Mendelian genetics **14Hrs.**

1) Mendel's laws of inheritance. Incomplete dominance and co-dominance; Multiple allelism.
2) Complementary, supplementary and duplicate gene interactions (plant based examples are to be dealt).
3) A brief account to flinkage and crossing over; Chromosomal mapping-2 point and 3 point test cross.
4) Conceptofmaternalinheritance(Corren'sexperimenton*Mirabilisjalapa*);M itochondrial DNA.

Unit :4 Structure and functions of DNA **12 Hrs.**

1) Watson and Crick model of DNA. Brief account on DNA Replication (Semi-conservative method).
2) Brief account on Transcription, types and functions of RNA. Gene concept and genetic code and Translation.
3) Regulation of gene expression in prokaryotes- Lac Operon.

Unit–5: Plant Breeding **12 Hrs.**

1) Plant Breeding and its scope; Genetic basis for plant breeding. Plant Introduction and acclimatization.
2) Definition, procedure; applications and uses; advantages and limitations of :(a) Mass selection, (b) Pure line selection and (c)Clonal selection.
3) Hybridization–schemes and technique; Heterosis (hybrid vigour).
4) A brief account on Molecular breeding – DNA markers in plant breeding. RAPD,RFLP.

Text books :

- Botany–III (Vrukshasastram-I):Telugu Academy, HyderabadPandey, B.P.(2013)*College Botany, Volume-III,* S.Chand Publishing, NewDelhiGhosh, A.K.,K.Bhattacharya & G.Hait (2011)*A Text Book of Botany, Volume-III,* New Central Book Agency Pvt.Ltd., KolkataChaudhary, R. C. (1996) *Introduction to Plant Breeding,* Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi

Books for Reference:

- S. C. Rastogi (2008) *Cell Biology,* New Age International (P) Ltd. Publishers, New Delhi
- P.K.Gupta (2002) *Cell and Molecular biology,* Rastogi Publications, New Delhi
- B.D.Singh (2008) *Genetics,* Kalyani Publishers, Ludhiana
- A.V.S.S.Sambamurty(2007) *MolecularGenetics,*NarosaPublishingHouse, NewDelhi

II B.Sc. SEMESTER – IV

BOTANY PRACTICAL (LAB COURSE) –V : SYLLABUS

PAPER – V : CELL BIOLOGY, GENETICS AND PLANT BREEDING

Practical Syllabus:

- Study of ultra structure of plant cell and its organelles using Electron microscopic photographs /models.
- Demonstration of Mitosis in *Allium cepa*/*Aloe vera* roots using squash technique; observation of various stages of mitosis in permanent slides.
- Demonstration of Meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique; observation of various stages of meiosis in permanent slides.
- Study of structure of DNA and RNA molecules using models.
- Solving problems monohybrid, dihybrid, back and testcrosses.
- Solving problems on gene interactions (atleast one problem for each of the gene interactions in the syllabus).
- Chromosome mappingusing3-point test cross data.
- Demonstration of emasculation, bagging, artificial pollination techniques for hybridization.

SKILL DEVELOPMENT COURSE (SDC)

Offered by Department of Botany for Non-Botany Students

I Semester

Plant Nursery

Marks: External evaluation : 30 Internal evaluation : 20

Unit-1: Introduction to plant nursery (10 Hrs)

1) Plant nursery: Definition, importance.
2) Different types of nurseries –on the basis of duration, plants produced, structure used.
3) Basic facilities for a nursery; layout and components of a good nursery.
4) Plant propagation structures in brief.
5) Bureau of Indian Standards (BIS-2008) related to nursery.

Unit- 2: Necessities for nursery (10 Hrs)

1) Nursery beds – types and precautions to be taken during preparation.
2) Growing media, nursery tools and implements, and containers for plant nursery, in brief
3) Seeds and other vegetative material used to raise nursery in brief.
4) Outlines of vegetative propagation techniques to produce planting material.
5) Sowing methods of seeds and planting material.

Unit-3: Management of nursery (10 Hrs)

1) Seasonal activities and routine operations in a nursery.
2) Nursery management – watering, weeding and nutrients; pests and diseases.
3) Common possible errors in nursery activities.
4) Economics of nursery development, pricing and record maintenance.
5) Online nursery information and sales systems.

SKILL DEVELOPMENT COURSE (SDC)

Offered by Department of Botany for Non-Botany Students

II Semester

Biofertilizers

Marks: External evaluation : 30 Internal evaluation :20

Unit – 1 : 10 Hrs

1) Manures and Biofertilizers: Types of fertilizers, manures. Manure composition. Manures for crop productivity.
2) Differences between fertilizers and biofertilizers: pH changes and water contamination.
3) Bacterial Biofertilizers: General account on the microbes used as biofertilizer.

Unit – 2 : 10 Hrs

1) Fungal Biofertilizers: Mycorrhizal association, types of mycorrhizal association, occurrence and distribution, phosphorus nutrition, growth and yield,
2) Algal Biofertilizers: Associative effect of different microorganisms. Azolla and Anabaena-azollae association, nitrogen fixation, factors affecting growth, Azolla in rice cultivation.
3) Colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Unit – 3 : 10 Hrs

1) Organic Farming: Green manuring and organic fertilizers, Recycling of bio-degradable municipal, agricultural and industrial wastes.
2) Bio compost making- types, method of vermin composting, Panchakavya. Biological pest control (neem)

SKILL DEVELOPMENT COURSE (SDC)

Offered by Department of Botany for Non-Botany Students

III Semester

Plant Diversity and Human Welfare

Marks: External evaluation : 30 Internal evaluation : 20

Unit 1: Plant Diversity **(10 Hrs)**

a) Plant diversity: Genetic diversity Species diversity, and Ecosystem diversity
b) Agro biodiversity and cultivated plant taxa, wild taxa.
c) Values and uses of Biodiversity Ethical and aesthetic Values
d) Uses of microbes
e) Loss of Biodiversity: Genetic, Species and Agro-Biodiversity

Unit 2: Conservation of Biodiversity: **(12 Hrs)**

a) Conservation of genetic diversity, species diversity and ecosystem diversity,
b) *Insitu* and *exsitu* conservation, Social approach esto conservation
c) Biodiversity awareness programmes, Sustainable development
d) Organizations associated with Biodiversity : IUCN, WWF, NBPGR

Unit 3: Role of plants in relation to Human Welfare; **(8 Hrs)**

a) Importance of forestry their utilization and commercial aspects
b) Avenue trees
c) Ornamental plants of India.
d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

SKILL DEVELOPMENT COURSE (SDC)

Offered by Department of Botany for Non-Botany Students

III Semester

Mushroom Culture Technology

Marks: External evaluation : 30 Internal evaluation :20

Unit1: Introduction **10 Hrs**

History. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India-*Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus*. Cost benefit ratio - Marketing in India and abroad, Export Value.

Unit 2: Cultivation Technology: **10 Hrs**

Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation Low cost technology, Composting technology in mushroom production.

Unit 3: Storage and nutrition: **10 Hrs**

Short-term storage (Refrigeration-upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition - Proteins –amino acids, mineral elements nutrition - Carbohydrates, Crude fiber content-Vitamins. Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level.
(10 Lecturer