Name of the Programme: M. Sc. (Botany)
Course Code: BOT-527
Title of the Course: Mycorrhizal Biotechnology
Number of Credits: 2
Effective from AY: 2022-23

Prerequisites for the course:	Basic knowledge of Mycology.	
Objective:	To familiarize the students with various aspects of Mycorrhizal fungi, study techniques and their applications.	
Content:	1. **Biofertilizers:** Definition, types, characteristic features, their role and importance in sustainable agriculture. 2. **Mycorrhiza**: Definition and historical perspective; Types of mycorrhizae; classification; Phylogeny; general importance. 3. **Mycorrhizal Techniques:** Isolation and pure culture preparation of ecto- and endo-mycorrhizae; Criteria for identification - generic and specific level; staining techniques; Trap and pure cultures; *in vitro* culture of AM fungi, commercial production of inoculum. 4. **Molecular and cell biology of AM symbiosis:** Fungal partner; Cytological features of AM plant roots. Transfer of nutrients between plants and fungi; Defense reaction during colonization; Signaling pathways in AM fungi. 5. **Phosphate transport and role of AM fungi:** Developmental stages during mycorrhiza formation, Pathways in P uptake; Sources of P, C: N ratio; P uptake from the environment; Plant phosphate transporters. 6. **Phytohormones and AM symbiosis:** Cytokinins, Gibberellins, Ethylene, ABA, Auxins, Salicylic acid, Jasmonic acid; Role of Jasmonates in mycorrhization. 7. **Ecology of AM fungi:** Mycorrhiza formation in field soil; effects of N and micronutrients. Microbial interactions, phytoremediation; Effects on AM fungi – disturbance, agrochemicals and grazing. 8. **Production of ectomycorrhizal fungal inocula and inoculation procedures:** Types of ecto-mycorrhizal inocula; Methods of preparation, inoculum procedures. 9. **Mycorrhizae in phytoremediation:** Phytoremediation – definition, advantages and limitations; Contaminated and uncontaminated soils, heavy metals and their effects in plants; Heavy metal detoxification mechanisms in plants and AM fungi; Phyto-stabilization and phytoextraction; Glomalin and its role; concepts for improving phytoremediation by plant engineering.	**4 hours** **4 hours** **3 hours** **4 hours** **3 hours** **2 hours** **3 hours** **3 hours** **4 hours**
Pedagogy:	Lectures/Assignments/Tutorials/Self study.	
References/ Readings:	**Allan, M. F.** (1991). The Ecology of Mycorrhizae. Cambridge University Press.	

	Bacon, C. W. and White, J. H. (2000). Microbial Endophytes Marcel Dekker, New York. **Dwivedi, B. K. and Pandey, G. (**1994). Biotechnology in India. Allahabad: Bioved Research Society. **Patel, S., Sharma, A., & Batra, N. G.** (2022). Arbuscular Mycorrhizal Fungi-Assisted Bioremediation of Heavy Metals: A Revaluation. In Innovations in Environmental Biotechnology. Springer, Singapore. **Read, D. J., *et al.*** (1996). Mycorrhizas in Ecosystems. Oxford University Press. **Rodrigues, B. F. and Muthukumar, T.** (2009). Arbuscular Mycorrhizae of Goa – A Manual of Identification Protocols. Goa University, Goa. 135 pp. **Satyanarayana, T., Deshmukh, S. K., & Deshpande, M. V.** (2021). Progress in Mycology. Springer Singapore. **Schenck, N. C. (**1982). Methods and principles of mycorrhizal research. St. Paul Minnesota. **Schenck, N.C. and Perez, Y.** (1990). Manual for the identification of VA mycorrhizal fungi. International Culture Collection of VA Mycorrhizal Fungi. Synergistic Publications, Gainesville, Florida, USA. **Sylvia, D. M., et al. (**1987). Mycorrhizae in the next Decade, Practical Applications and Research Priorities. University of Florida. Gainesville, Florida. **Willis, A., *et al.*** (2013). The ecology of arbuscular mycorrhizal fungi. Critical Reviews in Plant Sciences 32:1-20.	
Learning Outcomes:	Better prospects in agro-based industries.	

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