*M Sc biotechnology course of study*

**Course Title: Agriculture Biotechnology**

**Course No.: BT 614**
**Credits: 3**

**General Objective**
Students are expected to gain knowledge about application of biotechnology in agriculture sector.

**Specific objectives:**

The students should be able to:

- produce and utilize organic and bio-fertilizers
- know the importance of stresses in plant productivity
- apply methods of plant health testing
- know the use of DNA marker in plant breeding
- produce transgenic crop plant
- produce bio-pesticides
- apply preservation techniques like Cryo-preservation and lyophilization (freeze-drying) techniques for organisms of commercial importance

**Organic farming** **2 hr**
Soil management and organic fertilizers. Composting and vermicomposting.

**Plant-beneficial microbe interaction at molecular level** **10 hr**
Nitrogen metabolism, Biochemistry, Genetics, and Physiology of biological nitrogen fixation; Process of nodule formation in Rhizobium-legume Symbiosis, Regulation and functions of rhizobial nodulation genes, Nitrogen-fixation in root nodule. Mycorrhizal association, Use of mycorrhizae for enhancing crop productivity, Phosphate solubilizing microorganisms. PGPR acting via plant hormones (auxins) and enhancement of water and mineral uptake (*Azospirillum*, *Herbaspirillum, and mycrorrhiza*). Nitrogen fixing microorganisms and blue green algae as bio-fertilizer, Azolla as bio-fertilizer in rice field.

**Algal biotechnology** **2hr**
Mass cultivation of micro-algal species of commercial value: *Spirulina*, *Dunaliella*, *Chlorella*and others,Micro-algae for human and animal consumption; and waste-water treatment.

**Plant health** **14 hr**
**a. Biotic stress** **8 hr**
*Plant disease*: disease epidemic, Plant pathogen interaction, the plant defense system. Phytoalexins and Immune system in plant, Innate immunity: PAMP*-triggered immunity (PTI) and effector-triggered immunity (ETI). The gene-for-gene model and the hypersensitive response (HR). Systemic acquired resistance (SAR). D*isease diagnosis*: Traditional methods, Immunological methods: Diffusion, Agglutination, Enzyme linked immuno sorbent assay (ELISA), Immunofluorescence techniques. Molecular techniques: Polymerase chain reaction (PCR), real time-PCR, Randomly amplified polymorphic DNA (RAPD), Restriction fragment length polymorphism, 16s rDNA. *Crop protection*: Chemical control by Pesticides and its Pros and cons, *Biological control*: Management of plant diseases caused by fungi, Bacteria, virus, nematodes and insects; Microbial herbicides; Bacterial biopesticides;

Production of biopesticides; Fungal biopesticides; Entomo-pathogenic fungi, benefits of biological control, Integrated pest management,Maintainingvirus free plants.
*Genetic control*:, Making plant resistance by breeding and Genetic engineering.
*Pathogen associated molecular pattern

**b. Abiotic stress** **5hr**

iEnvironmental factors as stress: Abiotic and biotic stresses, perception to stress and creation of signal, Plant reactions to stress, Structural and physiological adaptation and molecular control to different stresses: light, Temperature, water (drought and flooding), salt and heavy metal, Engineering stress tolerant plant.

**c. Post harvest stress** **1 hr**

**Aspects of plant health related to post-harvest. Biotic and abiotic stresses at storage**

**Plant as source of energy (Biofuels)** **2 hr**

Plant biomass as source of renewable fuel, Cellulose, hemicellulose lignin degrading and bioethanol producing microorganisms. Technology, prospect, pros and cons to use biomass for production of bioalcohol, biodisel and biogas.

**Crop Improvement** **9 hr**

**a. Plant breeding** **4 hr**

Methods and use of classical plant breeding. Molecular marker technology,Marker assisted selection in plant breeding. **QTL (Quantitative Trait Loci)**, Genetic analysis and characterization of crops with various DNA markers and isozymes. Application of Biotechnology in plant breeding programs., Testing GM crops

**b. Genetic modification** **5 hr**

*Crop improvement*: Genetic engineering for making crop plants resistance to bacteria, fungi, virus and insects (Rice, Tobacco, Bt cotton etc.); herbicide resistance (glyphosate resistance soybean), Modification of phyto-nutrients in crops (Golden rice etc.), tolerance to stresses; Gene subtraction: Antisense technology, Modification of ripening of fruits and vegetables (Tomato). Termination technology, *Molecular farming*: Use plant as chemical and pharmaceutical factories for the production of novel products. *Problem with GMO*: public concern and safety concern.

**Mushroom Biotechnology** **7hr**

Poisonous andnon poisonous mushroom, Introduction to wild and cultivated mushrooms of Nepal and their economic importance.. *Reproduction*: Mating system in fungi,.Homothallism, Secondary homothallism, Heterothallism (bipolar and tetrapolar). Life cycle of mushroom, *Mushroom cultivation*: Effect of genetic factors, temperature, light, humidity, medium on cultivation of mushrooms. Techniques of Commercial cultivation of some important mushrooms, Single spore isolation/pure culture and spawn production techniques, Present situation and prospect of mushroom cultivation in Nepal. *Medicinal values of mushroom*: Medicinal mushrooms, Medicinal importance chemicals like Polysaccharides, Gluco-peptides. Steriods. Bioactive compounds such as nucleosides, cordycepinetc found in mushroom

**Agro Genetic Resources conservation** **2 hr**

Phytosanitory aspects of plant germplasm conservation. Cryopreservation. Cataloging, characterization, evaluation and utilization of genetic resources. National seed policy, Seed: seed health, diseases, quality, viability and storage