

**Course Title: Advances In Mycology**  
**Course Code: PL PATH 601**  
**Credit Hours: 3(2+1)**

**Theory**

**UNIT I**

General introduction, historical development and advances in mycology. Recent taxonomic criteria, morphological criteria for classification. Serological, chemical (chemotaxonomy), molecular and numerical (computer based assessment) taxonomy. Interaction between groups: Phylogeny, Microconidiation, conidiogenesis and sporulating structures of fungi imperfecti.

**UNIT II**

Population biology, pathogenic variability/ vegetative compatibility. Heterokaryosis and parasexual cycle. Sex hormones in fungi. Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance. Biodegradation.

**UNIT III**

Ultra structures and chemical constituents of fungal cells, functions of cell organelles. Mitosis, meiosis, gene action and regulation. Effects of fungal interaction with host plants and other microorganisms; parasitism, symbiosis and commensalism.

**UNIT IV**

Genetic Improvement of Fungal strains. Fungal biotechnology. Fungi mediated synthesis of nano particles - characterization process and application. Mycotoxins problems and its management.

**PRACTICAL**

Isolation, purification and identification of cultures, spores and mating type determination. Study of conidiogenesis-Phialides, porospores, arthrospores. Study of fruiting bodies in Ascomycotina. Identification of fungi up to species level. Study of hyphal anastomosis. Morphology of representative plant pathogenic genera from different groups of fungi. Molecular characterization of fungi.

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**Course Title: Advances in Plant Pathogenic Prokaryotes**  
**Course Code: PL PATH 603**  
**Credit Hours: 3(2+1)**

**Theory**

**UNIT I**

Prokaryotic cell: Molecular basis for origin and evolution of prokaryotic life, RNA world, prokaryotic cytoskeletal proteins. Flagella structure, assembly and regulation. Structure and composition (**bacteria**) cell wall/envelop, Types of secretion systems (TI to TIV) and their molecular interaction, fimbriae and pili (Type IV pili), Bacterial chromosomes and plasmids, other cell organelles. Growth, nutrition and metabolism in prokaryotes (Embden Meyerh of pathway, Phosphoketolase Pathway and Entner Doudoroff Pathway).

**UNITII**

Current trends in taxonomy and identification of phyto pathogenic prokarya: International code of nomenclature, Polyphasic approach, New/special detection methods for identification of bacterial plant pathogens. Taxonomic ranks hierarchy; Identification, Advances in classification and Nomenclature.

**UNITIII**

Bacterial genetics: General mechanism of variability (mutation), specialized mechanisms of variability. Transposable genetic elements in bacteria-integron and prophages, Mechanism of gene transfer. Pathogenicity islands, horizontal gene transfer, Bacterial Pan-Genome.

**UNITIV**

Bacteriophages: Composition, structure and infection. Classification and use of phages in plant pathology/bacteriology. Host pathogen interactions: Molecular mechanism of pathogenesis: Pathogenicity factors of soft rot, necrosis, wilt, canker etc. Immunization, induced resistance/ Systemic Acquired Resistance, Quorum sensing. Bacterial pathogenicity and virulence: Molecular mechanism of virulence and pathogenesis, bacterial secretion systems, pathogenicity of bacterial enzymes that degrade the cellwalls, Role of hrp/hrc genes and TALE effectors. Synthesis and regulation of EPSs.

**UNITV**

Beneficial Prokaryotes-Endophytes, PGPR, Phylloplane bacteria and their role in disease management. Endo symbionts for host defence. Advances in management of diseases caused by prokaryotes: genetic engineering, RNA silencing; CRISPR cas9.

## **PRACTICAL**

Pathogenic studies and race identification, plasmid profiling of bacteria, fatty acid profiling of bacteria, RFLP profiling of bacteria and variability status, Endospore, Flagella staining, Test for secondary metabolite production, cyanides, EPS, siderophore, specific detection of phytopathogenic bacteria using species/pathovar specific primers. Basic techniques in diagnostic kit development, Molecular tools to identify phyto endosymbionts. Important and emerging diseases and their management strategies.

### **Suggested Reading**

- Dale JW & Simon P. 2004. *Molecular Genetics of Bacteria*. JohnWiley & Sons, New York.
- GarrityGM, Krieg NR & Brenner DJ. 2006. *Bergey's Manual of Systematic Bacteriology: The Proteo bacteria*. Vol.II. Springer Verlag, NewYork.
- GnanamanickamSS.2006. *Plant-Associated Bacteria*. Springer Verlag, New York.
- Mount MS & Lacy GH. 1982. *Plant Pathogenic Prokaryotes*. Vols. I, II. Academic Press, NewYork. SigeeDC.1 993. *Bacterial Plant Pathology: Cell and Molecular Aspects*. Cambridge Univ. Press, Cambridge. StarrMP.1992. *The Prokaryotes*.Vols.I–IV.SpringerVerlag,NewYork.

**Course Title: Advances In Plant Virology**  
**Course Code: PL PATH 602**  
**Credit Hours: 3(2+1)**

**Theory**

**UNIT I**

Origin, evolution and interrelationship with animal viruses. Virus morphology, structure, architecture, replication (overview of host and viral components required), assembly and virus specific cytological effects in infected plant cells. Mechanisms leading to the evolution of new viruses/strains: mutation, recombination, pseudo-recombination, component re-assortment etc.

**UNIT II**

Major vector groups of plant viruses and their taxonomy, virus-vector relationship, molecular mechanism of virus transmission by vectors. Terminologies used in immunology and serology. Classification, structure and functions of various domains of Immunoglobulins. Production of Polyclonal and monoclonal antibodies for detection of viruses. Immuno/serological assays (Slide agglutination tests, Test tube precipitation test, Double agar diffusion test, ELISA (DAC, DAS, TAS), Dot Immuno Binding Assay, and nucleic acid based assays for detection of plant viruses.

**UNIT III**

Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR, Nested PCR, Real time/q PCR) and non PCR based: LAMP, Fluorescent *in situ* hybridization (FISH), dot blot hybridization. Plant virus genome organization (General properties of plant viral genome- information content, coding and non-coding regions), replication, transcription and translational strategies of pararetroviruses, geminiviruses, tobamo-, poty-, bromo, cucumo, ilar, tospoviruses, satellite viruses and satellite RNA.

**UNIT IV**

Gene expression, regulation and viral promoters. Genetic engineering with plant viruses, viral suppressors, RNAi dynamics and resistant genes. Virus potential as vectors, genetically engineered resistance, transgenic plants. Techniques and application of tissue culture for production of virus free planting materials. Phylogenetic grouping system based on partial/complete sequences of virus genomes and using of next generation sequencing technology in plant virus discovery.

**PRACTICAL :**

Purification of viruses, SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation. Acquaintance with different serological techniques (i) DAC- ELISA (ii) DAS-ELISA (iii) DIBA (iv) Western blots (v) (ab) 2-ELISA. Nucleic acid isolation, DOT-blot, southern hybridization, probe preparation, and autoradiography. PCR application and viral genome cloning of PCR products, plasmid purification, enzyme digestion, sequencing, annotation of genes, analysis of viral sequences (use of gene bank, blast of viral sequences and phylogeny). Bioinformatics analysis tools for virology (ORF finder, Gene mark, Gene ontology, BLAST, Clustal X/W, Tm pred and Phylogeny programs).

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**Course Title: Molecular Basis Of Host-Pathogen Interaction**  
**Course Code: PL PATH 604**  
**Credit Hours: 3 (2+1)**

**Theory**

**UNIT I**

History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in plant pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

**UNIT II**

Different forms of plant-microbe interactions and nature of signals/effectors underpinning these interactions. Plant innate immunity: PAMP/DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

**UNIT III**

Induction of defence responses- HR, Programmed cell death, reactive oxygen species, systemic acquired resistance, induced systemic resistance, pathogenesis related proteins, phytoalexins and virus induced gene silencing. Molecular basis of gene-for-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes. Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Coevolution-arms race and trench warfare models, Metapopulations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance.

**UNIT IV**

Pathogen population genetics and durability, viruses vs cellular pathogens. Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

**PRACTICAL**

Protein, DNA and RNA isolation, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation. Gene mapping and marker assisted selection. Development and use of molecular markers in identification and characterization of resistance to plant pathogens and their management.

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