DEPARTMENT OF BOTANY (NORTH CAMPUS)

UNIVERSITY OF KASHMIR

SEMESTER-IV

Five-Year Integrated Masters Programme (FYIMP) in Botany

DEPARTMENT OF BOTANY (NORTH CAMPUS)
UNIVERSITY OF KASHMIR

SEMESTER-4				
Course Type	**Course Code**	**Course Title**	**Credit**	
			Theory	**Practical**
MAJOR-1	IBOTMJPT0423	Plant Taxonomy	3	1
MAJOR-2	IBOTMJPM0423	Plant Morphology & Anatomy	3	1
MAJOR-3	IBOTMJPT0423	Principles and Techniques in Plant Sciences	3	1
MAJOR-4	IBOTMJCB0423	Cell Biology	3	1
MINOR	IXXXMNIM0423	Immunology	3	1
Total			**20**	

Semester	:	**IV**
Course Type	:	**Major-1**
Course Title	:	**Plant Taxonomy**
Course Code	:	**IBOTMJPT0423**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *To give students understanding about the concept, components and scope of plant taxonomy, classification and identification of plants, importance of herbaria and botanical gardens, and to learn about principles and rules of nomenclature.*

LEARNING OUTCOMES*: The students will know about the various classification systems, systematic position of Generas, Species and, Families. The students develop knowledge about plant nomenclature and world herbaria and botanical gardens.*

Theory (03 Credits)

UNIT I:

Plant Taxonomy and Classifications: Components, aims and phases; types of classification - artificial, natural and evolutionary; phenetics: principles and methods; cladistics: concept, terms and methods; classification systems- Bentham and Hooker (upto series), Angiosperm Phylogeny Group (AGP-IV) (upto order level).

UNIT II

Taxonomic Characters and Institutions: Morphological characters (vegetative and reproductive); Role of anatomical, embryological, cytological, palynological, phytochemical and molecular characters (elementary idea); Herbaria: purpose, preparation and functions, index herbarium; major herbaria of world and India, virtual herbarium; Botanical garden: criteria and uses, important botanical gardens of world and India.

UNIT III

Identification and Nomenclature: Taxonomic literature: flora, monograph, manual, field guides; Taxonomic keys (indented, bracketed and numbered), DNA barcoding (an elementary idea); Scientific names, principles of nomenclature, rules of nomenclature (taxa and ranks, author citation, names of hybrids and cultivated plants), typification (concept and types).

Practical exercises (01 Credit)

- Preparation of herbaria of types of leaves and inflorescences
- Study of different types of flowers.
- Construction of dichotomous identification keys
- Study of the following families: Liliaceae (*Hamerocallis*/*Tulipa*); Poaceae (*Avena*/*Poa*); Ranunculaceae (*Ranunculus*/*Consolida*); Fabaceae (*Trifolium*/*Robinia*); Rosaceae (*Rosa*/*Fragaria*); Asteraceae, (*Helianthus*/ *Taraxacum*); Solanaceae (*Solanum*/*Datura*); Apiaceae (*Daucus*/*Scandix*); Lamiaceae (*Salvia*/*Nepeta*)
- Mounting of a properly dried and pressed specimen of 50 wild plants with herbarium label (to be submitted in the record book).
- Two botanical trip to a natural area.

Suggested Readings

- Pandey, AK and Kasana, S. (2021) *Plant Systematics* (1st ed.). Jaya Publishing House, New Delhi.
- Singh, G. (2021) *Plant Systematics: An Integrated Approach* (4th edition). CRC Press.
- Simpson, MG (2010). Plant Systematics (2nd edition). Elsevier, California, USA.
- Judd, WS et al (2016). Plant Systematics: A Phylogenetic Approach (4th edition). Sinauer Associates, Inc. Sunderland, USA.
- Stuessy, TF (2009) Plant Taxonomy (2nd edition). Columbia University Press. New York.

Semester	:	**IV**
Course Type	:	**Major-2**
Course Title	:	**Plant Morphology & Anatomy**
Course Code	:	**IBOTMJPM0423**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *This part of the course aims at acquainting the students with the basic cell and tissues types that enter into the fundamental organization of plants. It endeavors to make them appreciate the variation in the cellular types and diversity in their functions and to provide them knowledge about the concepts of secondary growth and special structures in plants. .*

LEARNING OUTCOMES: *At the end of the course, the students will know various types of tissues in the plant, their organization and functions. The students will understand how secondary growth takes place in plants.*

Theory (03 Credits)

Unit I:

Plant Morphology: Introduction to plant morphology; Plant habit and life forms; Types and modifications of root and stem; Leaves: Structure, attachment, phyllotaxy, types, shapes, venation and modifications; Types of inflorescence; parts of flower, attachment and symmetry; aestivation.

Androecium: types, position, number and fusion of stamens; nectaries.

Gynoecium: parts of carpel, carpel fusion and number; ovary attachment and position; placentation and its types; fruit types.

UNIT II:

Tissue systems: classification, distribution and functions of meristematic, Permanent (simple and complex) and secretory tissues.

The root system: Organization of the root apical meristem; structure of monocot and dicot root; differentiation of primary and secondary tissues and their roles; quiescent centre, root cap.

The shoot system: The shoot apical meristem and its histological organization; structure of monocot and dicot stem.

UNIT III:

Secondary growth: Structure and types of cambium; formation of secondary xylem; general account of wood structure; formation of growth rings, sapwood and heart wood; secondary phloem- structure and function; periderm; anomalous secondary growth in *Dracena*

Leaf: Structure of monocot leaf (Wheat, Maize) and dicot leaf (Waterlily and Sunflower); kranz anatomy.

Leaf appendages: Structure and function of hairs, trichomes.

Stomata: Structure and types.

Practical Exercises (01 Credit):

- Study of diversity in leaves.
- Study different parts of flower, aestivation and types of inflorescence.
- Study of anatomy of monocot and dicot roots and stem (Maize and Sunflower).
- Microscopic study of wood in T.S / T.L.S/ R.L.S from prepared slides
- Study of anatomy of isobilateral and dorsiventral leaves.

Suggested Readings

- Singh, V., Pande, P. C. and Jain, D.K. 2010. Structure, Development and Reproduction in Angiosperms. Rastogi Publications, Meerut, India.
- Cutler, D.F., Botha, T. and Stevenson, D.W. 2008. Plant anatomy: An applied approach. Wiley-Blackwell Publishers.
- Evert, R.F. and Esau, K. 2006. Esau's Plant Anatomy. John Wiley and Sons.
- Pandey, B.P. (2001). Plant Anatomy. S. Chand and Company, New Delhi.

Semester	:	**IV**
Course Type	:	**Major-3**
Course Title	:	**Principles and Techniques in Plant Sciences**
Course Code	:	**IBOTMJPT0423**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *This course aims to aware students about various experimental techniques, equipment, glassware and chemicals used in biological laboratories and to apply and use the biological devices more professionally.*

LEARNING OUTCOMES: *After the successful completion of this course students will be able to handle biological instruments and learn about the various types of micro techniques, preparation of plant material for sectioning, staining and permanent mounting and electrophoresis and analysisof proteins and nucleic acids used in molecular biology.*

Theory (03 Credits)

Unit I:

Laboratory Set-up: Working and application of magnetic stirrer, distillation unit/Water Purification System, laminar air flow, autoclave, colorimeter and spectrophotometer. Importance and methods of sterilization, Media preparation-solid and liquid media, nutrient agar slabs, slants and plates.

Unit II:

Microscopy & Histology: Introduction to optics, principles of image formation, magnifiers and microscopes, types of microscopes; simple and compound, bright field and dark field, phase contrast, fluorescence microscopes; FISH & GISH.
Mechanism of fixation, types of fixatives and preservatives-general protocol, mounting and staining (safranine, cotton blue, acetocarmine).

Unit III

Chromatography: Principles, chromatographic performance parameters and applications of thin layer chromatography, ion-exchange chromatography, gas chromatography, high performance liquid chromatography.
Electrophoresis: General principles, support media, electrophoresis of proteins and nucleic acids, capillary, agarose and sodium dodecyl sulfate polyacrylamide gel electrophoresis.

Practical Exercises (01 Credit)

- To identify different glassware used in laboratory for experimentation.
- To study the parts of dissection and compound microscope.
- To prepare various stains and chemicals used in biological experiments.
- To prepare standard curve using spectrophotometer.
- To perform agarose gel electrophoresis of a given DNA sample.

Suggested Readings

- Wilson, k., Hofmann, A., Walker, J.M. and Clokie, S.eds., 2018. Wilson and Wlaker's principles and techniques of biochemistry and molecular biology. Cambridge University Press.
- Skoog, D.S., Holler, F.J. and Crouch, S.R., 2017. Principles of instrumental analysis. Cengage learning.
- Hunt, L., Koenders, A. and Gynnild, V., 2012. Assessing practical laboratory skills in undergraduate molecular biology courses. Assessment & Evaluation in Higher Education, 37(7), pp.861-874.

Semester	:	**IV**
Course Type	:	**Major-4**
Course Title	:	**Cell Biology**
Course Code	:	**IBOTMJCB0423**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *This course will help the student to gain knowledge on the activities in which the macromolecules and miniscule structures that inhabit the cellular world of life are engaged. It will also provide insight into the organization of cell, its features and regulation at different levels.*

LEARNING OUTCOMES: *This course will be able to demonstrate foundational knowledge in understanding of the relationship between the properties of macromolecules, their cellular activities and biological responses. It will also impart understanding of cell metabolism, chemical composition, physiochemical and functional organization of organelles.*

Theory (03 Credits)

UNIT I

The Cell: Characteristics of prokaryotic and eukaryotic cells, Cell theory; Origin of eukaryotic cell (Endosymbiotic theory).
Cell wall: Structure and functions, biogenesis and growth.
Plasma membrane: structure and overview of membrane function; fluid mosaic model; Chemical composition of membranes, membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

UNIT II

Chloroplast and mitochondria: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.
Endoplasmic Reticulum & Golgi Apparatus: Structure and functions of Smooth and Rough ER, targeting and insertion of proteins in the ER, protein folding; Structure and functions Golgi Apparatus: protein sorting and export from Golgi apparatus.
Lysosomes and peroxisomes: Different forms of lysosomes, role in cellular digestion, lysosomal storage diseases; assembly and functions of peroxisomes.

UNIT III

Cytoskeleton: Composition organization and functions of microfilaments, microtubules, intermediate filaments and associated proteins, centrioles and basal bodies.
Nucleus: Nuclear envelope, nuclear pore complex, nuclear lamina, nucleolus.
Chromatin organization: structure and organization of chromatin and chromosomes.
Cell division: Eukaryotic cell cycle, mitosis and meiosis. Regulation of cell cycle

Practical Exercise (01 Credit)

- Study of cell and its organelles with the help of electron micrographs.
- Study of plant cell structure with the help of epidermal peel mount of Onion.
- Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
- Measurement of cell size by the technique of micrometry.
- Study the phenomenon of plasmolysis and deplasmolysis.
- Slide study of various stages of meiotic and mitotic stages.

Suggested Readings

- Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
- Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.
- Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman.
- Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
- Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman and Company.
- Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
- Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
- Cooper, G.M. and Housman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Klein smith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th.

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Minor Courses for Five-Year Integrated Masters Programme (FYIMP) in Botany

Semester	:	**IV**
Course Type	:	**Minor-4**
Course Code	:	**IXXXMNIM0024**
Course Title	:	**Immunology**
Credits	:	**04 (Theory: 03; Practical: 01)**

LEARNING OBJECTIVES: *To acquire knowledge about immunity, innate & acquired, complement system; understand the concept of immune deficiencies, hypersensitivity, and autoimmunity and transplantation immunology.*

LEARNING OUTCOMES: *The student will be able to -. Gain knowledge on different types of antigens, antibodies and how different types of antibodies are produced; out line, compare and contrast the key mechanism of innate and adaptive immunity & apply knowledge in disease diagnosis through serological tests.*

Theory (03 Credits)

Unit I:

Historical background & scope of immunology; Cells, tissues and organs of the immune system; Innate immunity and acquired immunity; Complement system: components & pathways of its activation

Unit II:

Immune deficiencies: primary & secondary; Acquired immunodeficiency syndrome
Tumor immunology: immune surveillance & tumor escape mechanisms
Tumor immunotherapy: antigen non-specific &antigen specific

Unit III:

Concept & classification of hypersensitivity reactions with brief descriptions mechanism of type I and type II hypersensitivity reactions; Introduction to autoimmune (AI) diseases with emphasis on AI anaemia's & rheumatoid arthritis
Transplantation immunology: types of grafts; mechanism of homograft rejection.

Laboratory Exercise (01 Credit):

- Demonstration of lymphoid organs
- Identification of various immune cells by morphology- Leishman and Giemsa staining
- Total leukocytecounts (TLC)
- Differential leukocyte counts (DLC)
- Haem-agglutination reactions- blood grouping,Rh Typing
- Visit to SKIMS, SKUAST-K and Kashmir University laboratories for demonstration of immunological techniques

Suggested Readings:

- Introduction to Immunology by John W. Kinball
- Basic Immunology by Sharon, J. William and Wilkins
- Immunology by F. M. Burnet. Immunology: An Introduction by Ian R Tizard
- Immunology by KubyGoldsby, R., Kindt, T.J. and Osbourne, B.A., W.H. Freeman
- Immunology by P. M. Lydyard, A. Whelan And M. W. Fanger
- Immunology by Roitt, I.M., Brostoff, J. and Male, D. Mosby
- Medical Immunology for Students by Playfair, J.H.L. and Lydyard, P.M. Churchill