DEPARTMENT OF BOTANY (NORTH CAMPUS)

UNIVERSITY OF KASHMIR

SEMESTER-V

Five-Year Integrated Masters Programme (FYIMP) in Botany

DEPARTMENT OF BOTANY (NORTH CAMPUS)
UNIVERSITY OF KASHMIR

SEMESTER-5				
Course Type	**Course Code**	**Course Title**	**Credit**	
			Theory	**Practical**
MAJOR-1	IBOTMJPB0523	Plant Biochemistry	3	1
MAJOR-2	IBOTMJTC0523	Plant Tissue Culture	3	1
MAJOR-3	IBOTMJER0523	Embryology & Reproductive Biology	3	1
MAJOR-4	IBOTMJET0523	Ethnobotany	2	0
INTERNSHIP	IBOTMJIN0523	Internship/Field work/Practical	0	2
MINOR	IXXXMNEN0523	Enzymology	3	1
Total			**20**	

Semester	:	**V**
Course Type	:	**Major-1**
Course Title	:	**Plant Biochemistry**
Course Code	:	**IBOTMJPB0523**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *This course aims to provide students an understanding of the core topics and advanced integrated knowledge in plant biochemistry. It also intends to give students understanding about the structure, properties, functions and synthesis of important biomolecules involved in various biochemical pathways, enzymes and their biological roles.*

LEARNING OUTCOMES: *At the end of the course the students will realize the structure of essential biomolecules and their key role in plants, understand the different pathway of plant anabolism and catabolism.*

Theory (03 Credits)

UNIT I

Basic concepts in plant Biochemistry: Ionization of water, weak acids and weak bases; pH scale, Buffers; Thermodynamics in biochemistry.
Carbohydrates: Classification, occurrence, structure and biological significance of monosaccharides, oligosaccharides and polysaccharides (including sucrose, starch, cellulose and pectin).
Lipids: Occurrence, structure and functions of triacylglycerols and phospholipids; Types, properties and biological significance of fatty acids and steroids.

UNIT II

Amino acids: Structure, properties and biological significance of amino acids.
Proteins: Classification of proteins according to solubility & structure, conjugate proteins.
Nucleotides: Structure, properties and significance of nucleosides and nucleotides.
Nucleic acids: Structure, properties and biological significance of DNA and RNA.

UNIT III

Enzymes: Nature, properties, classification & nomenclature of enzymes; Mode (Lock & key model, Induced-fit hypothesis) and mechanism of enzyme action; Isoenzymes
Enzyme kinetics: Factors affecting enzyme activity; Michaelis-Menten equation; K_m and its significance.
Regulation of enzyme action: Reversible and irreversible inhibition; Competitive, uncompetitive and non-competitive inhibitions; Allosteric inhibition.
Coenzymes: Types and their biological roles.

Practical Exercises (01 Credit):

- Qualitative tests for carbohydrates
- Analytical test for reducing sugars, non-reducing sugars
- To determine the presence of lipids or oils in seeds by stain test.
- Analytical tests for proteins.
- To study the activity of catalase and peroxidase
- To study the effect of pH and temperature on the activity of catalase.

Suggested Reading

- Nelson, D.L., Cox, M.M. and Hoskins, A.A. 2021. Lehninger Principles of Biochemistry (8th Edition). W.H. Freeman and Company, New York, USA.
- Nelson, D.L. and Cox, M.M. 2017. Lehninger Principles of Biochemistry (7th Edition). W.H. Freeman and Company, New York, USA.
- Voet, D., Voet, J. G. and Pratt, C. W. 2016. Fundamentals of Biochemistry: Life at the Molecular Level (5th Edition). John Wiley and Sons, Inc. USA.
- Berg, J.M., Tymoczko, J.L., Gatto, G.J. and Stryer, L. 2015. Biochemistry (8th edition). W.H. Freeman and Company, New York, USA.
- Taiz, L., Moller, M., Murphy, A. andZeiger, E. 2022. Plant Physiology and Development (7th Edition). Sinauer Associates, Inc. Publishers, USA.
- Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. 2015. Plant Physiology and Development (6th edition). Sinauer Associates Inc. USA.
- Walter.H, Heldt and Piechulla.B. (2010). PlantBiochemistry (4th edition). Academic Press
- Poonia, N.S. (2007). Plant Biochemistry.Agrobios (India)
- Campbell, M.K. (2012). Biochemistry (7th ed.). Published by Cengage Learning
- Buchanan, Gruissem and Jones. 2015. Biochemistry and Molecular Biology (2nd edition). Wiley- Blackwell
- Harborne, J.B.1973. Phytochemical Methods. John Wiley & Sons, New York.

Semester	:	**V**
Course Type	:	**Major-2**
Course Title	:	**Plant Tissue Culture**
Course Code	:	**IBOTMJTC0523**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *To enable the students to achieve the skills of growing plant cells, tissues and organs under in vitro conditions. Students will learn about the applications of plant tissue culture in conservation, agriculture, horticulture, and biotechnology; while also gaining practical skills in laboratory procedures. Additionally, the course emphasizes the environmental, ethical, and economic aspects of plant tissue culture in modern science.*

LEARNING OUTCOMES: *After completion of the course, the students are able to understand the principles of plant tissue culture and various in vitro techniques. Student will be proficient for developing haploid and triploid plants through tissue culture protocol and understand the techniques of protoplast isolation, culture and fusion and their application in crop improvements.*

Theory (03 Credits)

Unit I:

Historical perspectives and scope of plant tissue culture
Cellular totipotency: concepts, cytodifferentiation and its mechanism.
Techniques of plant tissue culture: essential requirements of a plant tissue culture laboratory, general composition and preparation of solid and liquid media
Sterilization: medium, glassware, instruments, plant material, transfer area, preparation of explants, aseptic inoculation and incubation; subculture and hardening.
Micro propagation: factors affecting various *in vitro* stages, importance of micro propagation.

Unit II:

Zygotic embryo culture: nutritional requirements and practical applications.
Haploid plant production: Importance of haploid plants, factors influencing anther cultures, merits and demerits of anther culture.
In vitro **pollination and fertilization:** ovary and ovule culture, factors affecting, applications in plant breeding.
Triploid plant production: endosperm culture, applications of triploids in plant improvement.

Unit III:

Suspension culture: batch culture, continuous culture, single cell culture.
Somatic embryogenesis: Factors affecting somatic embryogenesis, synthetic seed production, desiccated and hydrated synthetic seeds, merits and demerits of synthetic seeds.
Somatic hybridization: isolation, culture and fusion of protoplast; selection, regeneration and utility of hybrids and cybrids.
Germplasm conservation: cryopreservation of plant cells and organs, short term and long term storage.

Practical Exercise (01 Credit)

- Preparation of the stock solutions of MS medium,
- Preparation of MS medium from stock solutions,
- Isolation, preparation, sterilization and inoculation of different explants like shoot tip, node, anther, embryo and cambium.
- Dissect out an embryo from any seed and culture it on a suitable solidmedium.

Suggesting Readings

- Barbara M. Reed (2008) Plant Cryopreservation: A Practical Guide. Springer, Heidelberg.
- Bhojwani SS, Razdan MK (1996) Plant tissue culture: Theory and Practice. Elsevier, North Holland
- Colin Ratledge, Bjorn Kristianson (2001) Basic biotechnology. Cambridge University press.
- Dixon RA, Gonzales RA. (2004) Plant cell culture, a practical approach (II Edn). Oxford Press.
- Erica E. Benson (1999) Plant Conservation Biotechnology. Taylor and Francis, USA
- Evans DE, Coleman JOD, Kearns A (2003) Plant Cell Culture. Taylor and Francis, USA.
- Gamborg L, Philips GC (Eds.) (2005) Plant cell, tissue and organ culture: Fundamental methods. Narosa Publishing House, New Delhi.
- Hamish A Collin, Sue Edwards (1998) Plant tissue culture. Bios scientific publishers, India
- Michael R. Davey, Paul Anthony (2010) Plant Cell Culture: Essential Methods. Wiley-Blackwell Publishers, India
- Susan R. Barnum (1998) Biotechnology an introduction. Wadsworth Publishing Company, USA.
- Wang TL, Cuming A. (1996) Embryogenesis the generation of a plant. Bios Scientific Publishers Limited, UK
- William J Thieman, Michael A Palladino (2009) Introduction to biotechnology (II Edn). Pearson.

Semester	:	**V**
Course Type	:	**Major-3**
Course Title	:	**Embryology and Reproductive Biology**
Course Code	:	**IBOTMJER0523**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *Basic concepts of plant reproduction including the phenomena of sporogenesis and gametogenesis, fertilization and embryogenesis and seed development have been included in this course to make students understand these vital processes in plant reproduction which shape plant population structure.*

LEARNING OUTCOMES: *The students will develop an understanding of concepts and fundamentals of plant embryology and floral organs, and develop critical understanding on the evolution of concept of male and female gametophyte organization and mechanisms behind development of plant organs.*

Theory (03 Credits)

Unit I:

Modes of reproduction in plants: Vegetative and sexual reproduction-general account
Flower development: floral evocation, floral organ formation, flowering in perennials, seasonal flowering, role of accessory organs.
Male and female gametophyte: Structure of anther, role of tapetum, micro-sporogenesis and development of pollen, female gametophyte development, Organization and ultra structure of mature embryo sac.

Unit II:

Pollination, pollen-pistil interaction and fertilization: Pollination mechanisms, pollination syndromes, structure of pistil, pollen germination and compatible pollen-stigma interactions, sporophytic and gametophytic self-incompatibility, pollen tube growth and guidance, double fertilization,

Unit III:

Embryogeny: Endosperm development and its types; embryogenesis-landmarks of embryo pattern formation, embryogenesis in dicots and monocots, unique embryogenesis in Gramineae, reduced embryos, storage products, polyembryony and apomixes, types and importance.
Seed: Structure, dispersal mechanisms, seed dormancy and its type, methods to overcome seed and bud dormancy

Practical Exercises (01 Credit)

- Study flower as organ of sexual reproduction: accessory vs. essential organs, reproductive apparatus
- Study of diversity of vegetative propagation in plants, its comparison to sexual reproduction
- Study of microsporogenesis and microgametogenesis by making acetocarmine squashes of anthers of different developmental stages.
- Test for pollen viability using stains and *in-vitro* germination.
- Field study of several types of flowers with different pollination mechanisms i.e., pollination effected by wind, insects and birds.
- Estimation of Pollen-Ovule ratio to determine operative mode of pollination.
- Study of seed dormancy and methods to break dormancy.

Suggested Readings

- Bhojwani, S.S. and Bhatnagar, S.P and Dantu. P. K. 2018. The Embryology of Angiosperms, Vikas Publishing House, New Delhi.
- Faegri, K. and Vander-Pijl, L. 1979. The Principles of Pollination Ecology. 3rd edition, Pergamon Press, Oxford.
- Johri, B.M. 2015. Embryology of Angiosperms, Springer
- Atwell, B.J., Knedermann, P.E. and Jumbull, C.G.N. 1999. Plants in Action-Adaption in Nature: Performance in cultivation, MacMillan Education, Sydney, Australia.
- Batygina, T.B. 2020. Embryology of Flowering Plants Terminology and Concepts. Vol.1. Taylor & Francis
- Lersten, N.R. 2004. Flowering Plant Embryology: With Emphasis on Economic Species. Edn.1st. Blackwell Publishing

Semester	:	**V**
Course Type	:	**Major-4**
Course Title	:	**Ethnobotany**
Course Code	:	**IBOTMJET0523**
Credits	:	**Theory: 02**

COURSE OBJECTIVES: *The course will impart students with basic knowledge of ethnobotany with an emphasis on plant-human interactions and also make students familiar with scientific methods of plant collection, identification and curation besides collecting plant-use information from indigenous people.*

LEARNING OUTCOMES: *After the completion of this course, students will be able to understand the importance of ethnobotany and use of traditional knowledge in India. The course also demonstrates how indigenous information contributes to understanding of the usage of plants for various purposes.*

Theory (02 Credits)

Unit I:

Ethnobotany and Traditional Knowledge (TK): Introduction and importance; Traditional Knowledge Resource Classification (TKRC); Traditional plant knowledge of Indian tribes - sources and problems; Traditional Knowledge Digital Library (TKDL); Interaction of humans and plants in the past cultures around the World: archaeo-ethnobotany, paleo-ethnobotany, ethno-history.

Unit II

Economic Importance: Plants used for food, medicine, fibre, materials and spiritual purposes indifferent cultures of the World.

Ethnic Plants: Major cultivated food crops and Wild cereal crops of Kashmir Himalaya, Ethnic uses of plants as spices and as beverages in Kashmir

Ethnobotany and Plant Conservation: Basic concept, Ethnobotany and Germplasm conservation, Diversity, sacred grooves.

Suggested Readings:

- Levitin E and MacMohan K. 2011. Plants and Society. The McGraw-Hill Companies,Inc., 1221, Avenue of the Americas, New York, NY.
- Cunningham, A B. 2001. Applied Ethnobotany: People, Wild Plant Use andConservation. Earthscan Publications Ltd. London and Sterling, VA.
- Gary J Martin 1995. Ethnobotany: A Methods Manual by. Springer-Science+Media,B.V.
- Balick, M. and P A. Cox. 1996. Plants, People, and Culture: The Science ofEthnobotany. Scientific American Library, A division of HPHLP, New York.
- Cotton, C M. 1997. Ethnobotany – Principles and Applications. John Wiley and SonsLimited. New York, USA.
- Jain, SK. 1989. Methods and Approaches in Ethnobotany. Society of Ethnobotanists.Lucknow.
- Schultes, RE., & Reis Sv. 1995. Ethnobotany. Evolution of a discipline. Chapman &Hall. London

DEPARTMENT OF BOTANY (NORTH CAMPUS)

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

Semester	:	**V**
Course Type	:	**Minor-5**
Course Code	:	**IXXXMNEN0024**
Course Title	:	**Enzymology**
Credits	:	**04 (Theory: 03; Practical: 01)**

COURSE OBJECTIVES: *This course has been designed to help students understand the properties, classification and kinetics of enzymes and will help in understanding the pathways which are governed by enzymes. The students will be able to understand the clinical significance of enzymes and their inhibitors*

COURSE OUTCOMES: *Students will acquire knowledge about enzyme classification, nomenclature, enzyme kinetics and significance of various types of enzymes. Students will also understand procedures for enzyme purification, assays, and quantitative evaluation of influencing parameters.*

Theory (03 Credits):

Unit 1:

Historical perspective of enzymes; Nature and Characteristics of enzymes; Enzyme classifications and Nomenclature

Holoenzyme, apoenzyme, coenzyme, prosthetic group and cofactor, Metalloenzymes and metal activated enzymes; Isoforms, isozymes and zymogens; Mechanism of enzyme substrate binding and enzyme catalysis

Unit 2:

Enzyme substrate complex: Concept of E-S complex, binding sites, active site, specificity **Kinetics of enzyme activity**: Michaelis- Menten equation and its derivation, Lineweaver-Burk plot; Determination of K_M and V_{max}. Significance of K_M and $V_{max.}$; Detailed view of techniques studying Enzyme assay. Units of enzyme activity (I.U and Katal)

Unit 3:

Enzyme Inhibition: Enzyme inhibition-reversible (competitive, non competitive and uncompetitive); irreversible inhibition (Suicide Inhibition); Regulation of enzyme action.

Enzyme Purification Techniques: Isolation, crystallization and purification of enzymes; Test of homogeneity of enzyme preparation; Methods of enzyme analysis

Laboratory Exercise (01 Credit):

- Use iodine solution to monitor a reaction between amylase and starch at different pH levels.
- Use iodine solution to monitor a reaction between amylase and starch at different temperatures
- Effect of substrate concentration on acid phosphatase isolated from germinating seeds
- Determination of K_M and V_{max} of Acid phosphatase isolated from germinating seeds.

Suggested Readings:

- Palmer, T. (2001). *Enzymology: A Practical Approach*. Oxford University Press
- Price, N.C., & Stevens, L. (1999). *Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins*. Oxford University Press.
- Voet, D., & Voet, J.G. (2011). *Biochemistry (4th edition)*. John Wiley & Sons.
- Biochemistry by Stryer WH et al., W.H Freeman and company.
- Understanding Enzymes by Trevor Palmer, Prentice Hall Publishers.