BOTANY

16/25

Semester-VI

Core Course XIII: Plant Metabolism
(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

Unit 1: Concept of metabolism **(6 lectures)**

Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes).

Unit 2: Carbon assimilation **(14 lectures)**

Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C_4pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction.

Unit 3: Carbohydrate metabolism **(2 lectures)**

Synthesis and catabolism of sucrose and starch.

Unit 4: Carbon Oxidation **(10 lectures)**

Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

~~Unit 5~~: ATP-Synthesis **(8 lectures)**

Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.

Unit 6: Lipid metabolism **(8 lectures)**

Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.

Unit 7: Nitrogen metabolism **(8 lectures)**

40

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Semester-V

Discipline Specific Elective (DSE –2A):
Plant Breeding – 100 marks
(Credits-6: Theory-4, Practical-2)
THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)
[75 marks (Mid Sem 15 + End Sem 60)]
Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	**Plant Breeding :** Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.	**6 lectures**
Unit-II	**Methods of crop improvement:** Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.	**15 lectures**
Unit-III	**Quantitative inheritance:** Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings.Monogenic vs polygenic Inheritance.	**6 lectures**
Unit-IV	**Inbreeding depression and heterosis:** History, genetic basis of inbreeding depression and heterosis; Applications.	**6 lectures**
Unit-V	**Crop improvement and breeding:** Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.	**7 lectures**

Practical (20 classes, each class of 2h)

Practical	Practical related to theory

Suggested Readings

1. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2ndedition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

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Semester-VI

Core Course XII: Plant Metabolism – 100 marks
(Credits-6: Theory-4, Practical-2)
THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)
[75 marks (Mid Sem 15 + End Sem 60)]
Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	**Concept of metabolism:** Introduction, anabolic and catabolic pathways, regulation of metabolism.	**5 lectures**
	Unit-3: Carbohydrate metabolism: Synthesis and catabolism of sucrose and starch.	**1 lectures**
Unit-II	**Carbon assimilation:** Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C4pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction.	**10 lectures**
Unit-III	**Carbon Oxidation:** Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.	**6 lectures**
	ATP-Synthesis: Mechanism of ATP synthesis, oxidative and photophosphorylation.	**4 lectures**
Unit-IV	**Lipid metabolism:** Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.	**5 lectures**
Unit-V	**Nitrogen metabolism:** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.	**5 lectures**
	Mechanisms of signal transduction: Calcium, phospholipids, cGMP, NO.	**4 lectures**

Practical (20 classes, each class of 2h)

Practical	1. Chemical separation of photosynthetic pigments. 2. Experimental demonstration of Hill's reaction. 3. To study the effect of light intensity on the rate of photosynthesis. 4. Effect of carbon dioxide on the rate of photosynthesis. 5. To compare the rate of respiration in different parts of a plant. 6. To demonstrate activity of Nitrate Reductase in germinationg leaves of different plant sources. 7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination. 8. Demonstration of fluorescence by isolated chlorophyll pigments. 9. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

Semester-VI V

Core Course XI: Plant Physiology – 100 marks
(Credits-6: Theory-4, Practical-2)
THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)
[75 marks (Mid Sem 15 + End Sem 60)]
Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	**Plant water relationship:** Water Potential and its components, water absorption by roots, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap–cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.	6 lectures
	Translocation in the phloem: Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.	5 lectures
Unit-II	**Mineral nutrition:** Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.	5 lectures
Unit-III	**Nutrient Uptake:** Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, facilitated diffusion, active absorption, role of ATP, carrier systems,proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.	5 lectures
Unit-IV	**Plant growth regulators:** Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene.	10 lectures
Unit-V	**Physiology of flowering:** Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.	4 lectures
	Phytochrome: Discovery, chemical nature, role of phytochrome in photomorphogenesis.	5 lectures

Practical (20 classes, each class of 2h)

Practical	1. Determination of osmotic potential of plant cell sap by plasmolytic method. 2. Determination of water potential of given tissue (potato tuber) by weight method. 3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf. 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte. 5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces). 6. To study the phenomenon of seed germination (effect of light). 7. To study the induction of amylase activity in germinating barley grains. **Demonstration experiments** 1. To demonstrate suction due to transpiration. 2. Fruit ripening/Rooting from cuttings (Demonstration). 3. Bolting experiment/*Avena* coleptile bioassay (demonstration).

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Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.

Unit 8: Mechanisms of signal transduction **(4 lectures)**

Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade.

Practical

1. Chemical separation of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

Sem-III Semester - VI

Class - XIII (13)

Biochemistry - Covalent and Non-Covalent bonds, Hydrogen bonds, Water, structure, properties and Biological significance, pH, Henderson - Hasselbalch equation, Buffers and Biological significance.

Unit-IV Biochemistry: - Energy flow and Enzymology: - Laws of thermodynamics, Concept of free energy, Endothermic and Exothermic reactions, Classification, Nomenclature and properties of enzymes - Enzymes, multienzyme complex, significance of Km (Michaelis - Menten hypothesis). Mechanism of enzyme action, Factors effecting enzyme activities.

Generic Elective - (III)

Unit-I Bacteria: - General characters, classification, structure, reproduction and Economic importance.

Virus: - General characters, structure (TMV), reproduction (replication of Bacteriophages), Transmission, etc.

Unit-II plant pathology: - Types of plant diseases, Biological control of diseases: Blight of rice and powdery mildew of pea.

Unit-III Cell Biology: - structure of prokaryotic and Eukaryotic cell, cellwall, cell membrane, mitochondria,

Unit-IV: Cell Biology: nucleus, chromosome.

Unit-V: Cell division: Mitosis and Meiosis

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Sem - VI

Core Course XIV: Plant Biotechnology

(Credits: Theory-4, Practical-2)

THEORY

Lectures: 60

Unit 1: Plant Tissue Culture **(16 lectures)**

Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).

Unit 2: Recombinant DNA technology **(12 lectures)**

Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).

Unit 3:Gene Cloning **(10 lectures)**

Recombinant DNA. Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR

Unit 4: Methods of gene transfer **(8 lectures)**

Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit 5: Applications of Biotechnology **(14 lectures)**

Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

Practical

1. (a) Preparation of MS medium.

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(b) Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.

2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
3. Isolation of protoplasts.
4. Construction of restriction map of circular and linear DNA from the data provided.
5. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
7. Isolation of plasmid DNA.
8. Restriction digestion and gel electrophoresis of plasmid DNA.

Suggested Readings

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

24.8.16

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G.1

+3 II Year – G.E- 2.1 (Theory)

Semester- IV

Botany

Mark- 100 (60 End + 15Mid Sem + 25 Practical)

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Unit- I

Microbiology: Prokaryotes and Eukaryotes, Bacteria (Structure, Reproduction and Economic importance), Virus (TV, Bacteriophage, Replication of Bacteriophage).

Unit- II

Molecular Biology: DNA Replication, DNA polyoa, polymexases, RNAs and its role in cell.

Unit- III

Embryology: Microsporogenesis, Megaspor ogenesis, Male gametophyte, Female gametophyte, Fertilisation.

Unit- IV

Anatomy: Classification of tissues, Simple and complex tissues, Types of vascular bundles, Secondary growth in Dicot stem, penderm.

Unit – V

Economic Botany: A general account of Rice, Jute, Sugarcane cultivation.
Economic importance of cereals, Pulses, Oils, Medicines, Spices, Beverages.

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Practical:

1. Temporary Preparation of Dicot stem.
2. Collection and submission of Economic plant products (2 items in each category: Cereals, Pulses, Oils, Medicines, Spices)
3. Spots:
   a) Embryotogy
   b) Economic Botany
   c) Microbiology
4. Viva- voce
5. Records and Collections

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