



SRI VENKATESWARA UNIVERSITY, TIRUPATHI

B.Sc. Honours-BOTANY: Minor- V semester

w.e.f AY 2025-26

MINOR COURSE STRUCTURE

Year	Semester	Course	Title	No. Hrs./ Week	No. of Credits
III	V	12	Cell Biology and Genetics–(T)	3	3
			Cell Biology and Genetics–(P)	2	1
		13	Plant Physiology and Metabolism–(T)	3	3
			Plant Physiology and Metabolism–(P)	2	1



Course 12: Cell Biology and Genetics

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To look into the ultra-structure of plant cell and its organelle
2. To know the morphology and functions of chromosomes
3. To understand the principles of genetics, structure and functions of gene

II. Learning Outcomes: On completion of this course students will be able to:

1. Sketch the ultra-structural aspects of plant cell and its components.
2. Hypothesize the role of chromosomes in inheritance.
3. Justify the role of genes in inheritance of characters by descent.
4. Correlate the functions of the nucleic acid with their structure.
5. Explain the discoveries led to understand the fine structure of a gene.

III. Syllabus of Theory:

Unit-1: Cell and its organelle

8 Hrs.

1. Cell theory; prokaryotic vs eukaryotic cell; ultra-structure of a plant cell. Origin of eukaryotic cell (Endosymbiotic theory)
2. Ultra-structure of cell wall.
3. Ultra-structure of plasma membrane and various theories on its organization.
4. Polymorphic cell organelles (Plastids); ultra-structure of chloroplast, plastid DNA.
5. Ultrastructure of mitochondria, mitochondrial DNA.

Unit-2: Chromosomes

8 Hrs.

1. Prokaryotic vs eukaryotic chromosome; morphology of a eukaryotic chromosome (general structure and types).
2. Euchromatin and Heterochromatin; Karyotype and ideogram.
3. Brief account of chromosomal aberrations - structural and numerical changes
4. Organization of DNA in a chromosome (nucleosome and solenoid models).



Unit-3: Mendelian and non-Mendelian Genetics

10 Hrs.

1. Mendel's laws of inheritance (monohybrid, dihybrid and test crosses). Incomplete dominance and co-dominance; Multiple allelism (blood grouping inheritance).
2. Complementary, supplementary and duplicate gene interactions (plant-based examples are to be dealt).
3. A brief account of linkage and crossing over; Chromosomal mapping - 2 point and 3 point test cross.
4. Concept of maternal (cytoplasmic) inheritance (Corren's experiment on *Mirabilis jalapa*).

Unit-4: Structure and function of DNA

10 Hrs.

1. DNA as the genetic material: Griffith's and Avery's transformation experiment, Hershey -Chase phage experiment,
2. DNA structure: Watson and Crick model of DNA. Types and functions of DNA and RNA.
3. Genetic code, DNA Replication (Semiconservative method)
4. Regulation of gene expression in Prokaryotes - Lac Operon, Introns, Exons and Jumping genes

Unit-5: Gene concept and Sex determination

9 Hrs.

1. Evolution of gene concept: classical vs molecular concepts of gene.
2. Cis-Trans complementation test for functional allelism, gene as unit of function, mutation and recombination, Lethal genes
3. Pattern of sex determination in plants.
4. Allele and genotype frequencies, Hardy-Weinberg law.

IV. Text Books:

1. Pandey, B.P. (2013) College Botany, Volume-III, S. Chand Publishing, New Delhi
2. Ghosh, A.K., K.Bhattacharya & G. Hait (2011) A Text Book of Botany, Volume-III, New Central Book Agency Pvt. Ltd., Kolkata
3. A.V.S.S. Sambamurthy (2007) Molecular Genetics, Narosa Publishing House, New Delhi
4. S. C. Rastogi (2008) Cell Biology, New Age International (P) Ltd. Publishers, New Delhi

V. Reference Books:

1. P. K. Gupta (2002) Cell and Molecular biology, Rastogi Publications, New Delhi



2. B. D. Singh (2008) Genetics, Kalyani Publishers, Ludhiana
3. Cooper, G.M. & R.E. Hausman (2009) The Cell – A Molecular Approach, A.S.M. Press, Washington
4. Becker, W.M., L.J. Kleinsmith & J. Hardin (2007) The World of Cell, Pearson, Education, Inc., New York
5. De Robertis, E.D.P. & E.M.F. De Robertis Jr. (2002) Cell and Molecular Biology, Lippincott Williams & Wilkins Publ., Philadelphia
6. Robert H. Tamarin (2002) Principles of Genetics, Tata McGraw –Hill Publishing Company Limited, New Delhi.
7. Gardner, E.J., M. J. Simmons & D.P. Snustad (2004) Principles of Genetics, John Wiley & Sons Inc., New York
8. Micklos, D.A., G.A. Freyer & D.A. Cotty (2005) DNA Science: A First Course, I.K. International Pvt. Ltd., New Delhi

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Group discussion on different types of cells and their components.

Evaluation method: Identifying the best group or performer and giving a reward.

Unit-2: Activity: Observation of chromosomal aberrations in *Allium cepa* root cells exposed to industrial effluent/ heavy metals

Evaluation method: Validation of report and assigning a grade based on a rubric.

Unit-3: Activity: Solving the problems on classical genetics.

Evaluation method: Assessing the accuracy in solving the problems and awarding a grade.

Unit-4: Activity: Making models of nucleic acids.

Evaluation method: Selecting the best and assigning a grade.

Unit-5: Activity: Making a comprehensive report on sex determination in plants by collecting scientific literature.

Evaluation method: Validation of report and assigning a grade based on a specified point scale.



Course 12: Cell Biology and Genetics Practical syllabus

Credits -1

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Identify the stages of mitotic and meiotic cell divisions.
2. Infer the structure and functions of nucleic acids.
3. Predict the consequences of a particular genetic condition.

II. Laboratory/field exercises:

1. Study of ultra-structure of plant cell and its organelles using electron microscopic photographs /models.
2. Study of effect of temperature organic solvent on permeability of cell membrane
3. Giant chromosomes, Lamp brush chromosome
4. Demonstration of mitosis in *Allium cepa*/*Aloe vera* roots using squash technique.
5. Demonstration of meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique.
6. Observation of various stages of meiosis in permanent slides.
7. Study of structure of DNA and RNA molecules using models.
8. Solving problems on monohybrid, dihybrid, back and test crosses.
9. Solving problems on gene interactions (at least one problem for each of the gene interactions in the syllabus).
10. Chromosomes mapping using problems of 3- point test cross data



Course13: Plant Physiology and Metabolism

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To understand the concept of Soil-Plant-Atmosphere continuum based on plant-water relations.
2. To study the anabolic and catabolic processes in plants.
3. To understand the role of plant growth regulators on growth, development and flowering.

II. Learning Outcomes: On successful completion of this course, the students will be able to:

1. Comprehend the importance of water in plant life and mechanisms for transport of water and solutes in plants.
2. Explain the role of minerals in plant nutrition and their deficiency symptoms.
3. Interpret the role of enzymes in plant metabolism.
4. Hypothesize the light reactions and carbon assimilation processes responsible for synthesis of food in plants.
5. Analyze the biochemical reactions in relation to Nitrogen and lipid metabolisms.
6. Evaluate the physiological factors that regulate growth, development and flowering in plants.

III. Syllabus of Theory:

Unit-1: Plant-Water relations

8Hrs.

1. Diffusion, Imbibition, Osmosis. Water potential, Osmotic potential, Pressure potential.
2. Absorption and lateral transport of water; Ascent of sap
3. Transpiration: stomata structure and mechanism of stomatal movements (K^+ ion flux). Anti-transpirants
4. Macro and micro minerals; symptoms of mineral deficiency absorption of mineral ions; passive and active processes, Nano fertilizers

Unit-2: Enzymes and Nitrogen metabolism

10Hrs.

1. Characteristics, nomenclature and classification of Enzymes.
2. Mechanism of enzyme action, enzyme kinetics.
3. Nitrogen metabolism: Asymbiotic and symbiotic nitrogen fixing organisms, Nitrogenase, Biological nitrogen fixation in Legumes
4. Protein synthesis-Transcription and Translation



Unit-3: Photosynthesis and Photorespiration

10Hrs.

1. Photosynthesis: Photo synthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect
2. Concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; photophosphorylation
3. Carbon assimilation pathways (C_3 , C_4 and CAM).
4. Photorespiration- C_2 pathway

Unit-4: Respiration and Lipid Metabolism

9Hrs.

1. Aerobic and Anaerobic respiration; Respiratory Quotient (RQ)
2. Glycolysis and Krebs cycle
3. Electron transport system and mechanism of oxidative phosphorylation,
4. Lipids and Fatty acids- Types, β - Oxidation

Unit-5: Plant growth -development

8Hrs.

1. Growth and Development: Definition, phases and kinetics of growth.
2. Physiological effects of Plant Growth Regulators (PGRs)- Auxins, Gibberellins, Cytokinins, ABA, ethylene
3. Physiology of flowering: Photoperiodism, role of Phytochrome in flowering.
4. Seed germination, Abscission and Senescence.

IV. Text Books:

1. Pandey, B.P. (2013) College Botany, Volume-III, S. Chand Publishing, New Delhi
2. Ghosh, A. K., K. Bhattacharya & G. Hait (2011) A Text Book of Botany, Volume III, New Central Book Agency Pvt. Ltd., Kolkata

V. Reference Books:

1. Aravind Kumar & S.S. Purohit (1998) Plant Physiology – Fundamentals and Applications, Agro Botanica, Bikaner
2. Datta, S.C. (2007) Plant Physiology, New Age International (P) Ltd., Publishers, New Delhi
3. Hans Mohr & P. Schopfer (2006) Plant Physiology, Springer (India) Pvt. Ltd., New Delhi



4. Hans-Walter heldt (2005) Plant Biochemistry, Academic Press, U.S.A.
5. Hopkins, W.G. & N.P.A. Huner (2014) Introduction to Plant Physiology, Wiley India Pvt. Ltd., New Delhi
6. Noggle Ray & J. Fritz (2013) Introductory Plant Physiology, Prentice Hall (India), New Delhi
7. Pandey, S.M. & B.K. Sinha (2006) Plant Physiology, Vikas Publishing House, New Delhi
8. Salisbury, Frank B. & Cleon W. Ross (2007) Plant Physiology, Thomsen & Wadsworth, Australia & U.S.A
9. Sinha, R.K. (2014) Modern Plant Physiology, Narosa Publishing House, New Delhi
10. Taiz, L. & E. Zeiger (2003) Plant Physiology, Panima Publishers, New Delhi.
11. Verma, V. (2007) Text Book of Plant Physiology, Ane Books India, New Delhi.

VI. Suggested activities and evaluation method

Unit-1: Activity: Observe and tabulate the water content of different plant parts and justify the importance of the water based on the morphological nature.

Evaluation method: Assess the report and assign the grade points based on a rubric.

Unit-2 Activity: Survey report on various inorganic and organic fertilizers available in the local markets.

Evaluation method: Assess the record and award the grades on a specified point scale.

Unit-3 Activity: Identify the C4 plants from their locality and make a report.

Evaluation method: Assessing the clarity, organization, and effectiveness of the report's presentation and communication based on a rubric.

Unit-4 Activity: Group discussion on various Nitrogen fixing microbes.

Evaluation method: Assessing the group members' ability to think critically and analyze the topic being discussed.

Unit-5 Activity: A critical assignment on photoperiodic responses in plants in their locality.

Evaluation method: Evaluating the logical coherence and reasoning in the assignment.



Course 13: Plant Physiology and Metabolism Practical syllabus

Credits -1

I. Course outcomes: On successful completion of this practical course, students shall be able to:

1. Conduct lab and field experiments pertaining to plant physiology.
2. Estimate the quantities and qualitative expressions using experimental results and calculations
3. Interpret the factors responsible for growth and development in plants.

II. Laboratory/field exercises:

1. Determination of osmotic potential of plant cell sap by plasmolytic method using *Rhoeo tradescantia* leaves.
2. Stomata Structure in Dicots and Monocots
3. Calculation of stomatal frequency of a mesophyte, a hydrophyte and xerophyte.
4. Determination of rate of transpiration using Cobalt chloride method/Ganong's potometer (at least for a dicot and a monocot).
5. Study of mineral deficiency symptoms using plant material/photographs.
6. Demonstration of amylase enzyme activity and study the effect of substrate and Enzyme concentration.
7. Separation of chloroplast pigments using paper chromatography technique.
8. Comparative anatomy of C3 and C4 leaves.
9. Minor experiments— Osmosis, Arc-Auxonometer, ascent of sap through xylem, cytoplasmic streaming
10. Study of respiration in germinating seeds



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Suggested Model Paper for Theory Question Papers

Common pattern for Question Paper for Theory Examination(s) at Semester end

Max. Time: 3 Hrs.

Max. Marks: 75 M

Section – A

Answer any Five of the following questions. Draw a labeled diagram wherever necessary
5 x 5 = 25 M

- ✓ Two questions should be given from each Unit in the syllabus.

Section – B

Answer any five of the following questions. Draw a labelled diagram wherever necessary.
5 x 10 = 50 M

- ✓ Two questions (a & b) are to be given from each Unit in the syllabus (internal choice in each unit). Student has to answer 5 questions by choosing one from a set of questions given from a Unit.

Note: Questions should be framed in such a way to test the understanding, analytical and creative skills of the students. All the questions should be given within the frame work of the syllabus prescribed.

Suggested Model Paper for Practical Examination

Common pattern for Question Paper for Practical Examination(s) at Semester end

Max Time: 3 Hrs.

Max. Marks: 50

1. Experiment-1 (Major Experiment)	15 M
2. Experiment-2 (Minor Experiment)	10 M
3. Spotters	3 x 5 = 15 M
4. Record + Viva-voce	7 + 3 = 10 M
