SRI VENKATESWARA UNIVERSITY, TIRUPATHI

4 -Year UG Honours in B.Sc. BOTANY: Major in Consonance with Curriculum Frame work w.e.f AY 2026-27

IV Semester

COURSE STRUCTURE (for Semester IV)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	IV	8	Cell and Molecular biology	3	3
			Cell and Molecular biology -Practical	2	1
		9	Genetics and Plant breeding	3	3
			Genetics and Plant breeding -Practical	2	1
		10	Plant Physiology and Metabolism	3	3
			Plant Physiology and Metabolism -Practical	2	1

Signatures of the Board of Studies members

Sl No.	Designation	Name	Signature
1	BOS Chairman	Dr Mohano Behera, Department of Botany, Govt. Degree College, Pakala	
2	Member	Dr L. Md. Bakshu, Department of Botany, Dr YSR Govt. Degree College ,Veduru Kuppam	
3	Member	Dr M. Hemalatha, Department of Botany, SVCR Govt. Degree College, Palamaner	
4	Member	Dr A. Sasikala, Department of Botany, SVCR Govt. Degree College, Palamaner	
5	Member	Smt. S. Padmavathi, Department of Botany, Govt. Degree College, Puttur	
6	Member	Dr P. Sujana, Department of Botany, Govt. Degree College, Puttur	

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COURSE 8: CELL AND MOLECULAR BIOLOGY

Theory **Credits: 3** **3 hrs/week**

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 autocatalysis and heterocatalysis of DNA

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 molecular mechanisms of DNA replication, transcription, translation, and gene regulation.

III. Syllabus of Theory:

Unit-1: Cell and its organelle **8 Hrs.**

1. Cell theory; prokaryotic vs eukaryotic cell; animal vs plant cell; a brief account on ultra-structure of a plant cell.
2. Ultra-structure and functions of cell wall.
3. Ultra-structure and functions of plasma membrane and various models 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. Nucleus-Nuclear membrane, nuclear pore complex
2. Prokaryotic vs eukaryotic chromosome; morphology of a eukaryotic chromosome.
3. Euchromatin and Heterochromatin; Karyotype and ideogram.
4. Organization of DNA in a chromosome (nucleosome and solenoid models).
5. Special types of chromosomes-Lampbrush chromosomes, polytene chromosomes, B chromosomes

Unit-3: Cell cycle and its regulation **10 Hrs.**

1. Cell cycle-phases of cell cycle, amitosis.
2. Mitosis-Phases of mitosis and significance of mitosis.
3. Meiosis-phases of meiosis and significance of meiosis
4. Cell cycle check points, apoptosis

Unit-4: Nucleic acids **10 Hrs.**

1. Experimental evidences for DNA as genetic material
2. Types of Nucleic acids, DNA structure : Primary structure of DNA, Watson and Crick model of DNA, types of DNA
3. Methods of DNA replication, mechanism of DNA replication
4. DNA damage and repair
5. Structure, functions and types of RNA. Differences between DNA & RNA

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Unit-5: Transcription and Translation **9 Hrs.**

1. Transcription: Mechanism of transcription in prokaryotes and eukaryotes
2. mRNA processing –Post transcriptional changes
3. Genetic code: Nature of Genetic code, essential features of genetic code
4. Translation: Process of translation (Peptide chain initiation, Elongation and Termination), post translational modifications, protein trafficking and sorting
5. Regulation of gene expression-Lac, Trp operons

IV. Text Books:

1. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., & Matsudaira, P. (2021). Molecular Cell Biology (9th ed.). W.H. Freeman.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2019). Molecular Biology of the Cell (6th ed.). Garland Science.
3. Karp, G. (2021). Cell and Molecular Biology: Concepts and Experiments (9th ed.). Wiley.
4. De Robertis, E. D. P., & De Robertis, E. M. F. (2006). Cell and Molecular Biology (8th ed.). Lippincott Williams & Wilkins.
5. Cooper, G. M., & Hausman, R. E. (2019). The Cell: A Molecular Approach (8th ed.). Oxford University Press.
6. Verma, P. S., & Agarwal, V. K. (2020). Cell Biology. S. Chand & Company Ltd.

V. Reference Books:

1. Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2020). Lewin's Genes XII (12th ed.). Jones & Bartlett Learning.
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2013). Molecular Biology of the Gene (7th ed.). Pearson Education.
3. Pollard, T. D., Earnshaw, W. C., & Lippincott-Schwartz, J. (2017). Cell Biology (3rd ed.). Elsevier.
4. Kleinsmith, L. J. (1995). Principles of Cell and Molecular Biology (2nd ed.).
5. HarperCollins College Publishers.
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: Making nucleosome model
Evaluation method: Selecting the best and assigning a grade.
Unit-3: Activity: Observation of cell division in online root tip
Evaluation method: Selecting the best for any stage of cell division. **Unit-4: Activity:** Making models of nucleic acids.
Evaluation method: Selecting the best and assigning a grade.
Unit-4: Activity: Making model for operons
Evaluation method: Selecting the best and assigning a grade.

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COURSE 8: CELL AND MOLECULAR BIOLOGY

Practical **Credits: 1** **2 hrs/week**

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.

II **Laboratory/field exercises:**

1. Study of ultra structure of a plant cell and its organelles using electron microscopic photographs /models.
2. Demonstration of mitosis in *Allium cepa/Aloe vera* roots using squash technique.
3. Observation of various stages of mitosis in permanent slides.
4. Demonstration of meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique.
5. Observation of various stages of meiosis in permanent slides.
6. Illustrations of Giant Chromosomes
7. Study of structure of DNA and RNA
8. Illustrations of DNA Replication

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COURSE 8: CELL AND MOLECULAR BIOLOGY

Suggested Model Paper for Practical Examination

Max Time: 3 Hrs **Max. Marks: 50**

1. Make a cytological preparation of given material **'A'** by squash technique, report any two stages, draw labeled diagrams and write the reasons. 15 M
2. Study the given model (Nucleic acids) Identify the molecules, describe the structural components, Comment on the functional significance. **' B '** 15 M
3. Identify and comment on the given specimens/spotters/slides/photographs 4 x 3=12 M

   C. From Cell Biology

   D. From Cell Biology

   E. From Molecular Biology

   F. From Molecular Biology

4. Record & Viva-voce 5 + 3 = 08 M

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COURSE 9: GENETICS AND PLANT BREEDING

Theory **Credits: 3** **3 hrs/week**

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: Mendelian and non-Mendelian Genetics **10 Hrs.**

1. Introduction, Scope of Genetics, Mendel's laws of inheritance- Law of Dominance, Law of segregation, and Law of independent assortment, Test cross and back cross.
2. Incomplete dominance and co-dominance; Multiple allelism.
3. Complementary, supplementary and duplicate gene interactions (plant-based examples are to be dealt).
4. Gene and alleles: Classical, and modern concepts of gene, structure of a gene

Unit-2: Linkage and crossing over **9 Hrs.**

1. Chromosomal basis for Inheritance, Linkage: Coupling phase and repulsive phase, chromosomal theory of linkage and kinds of linkage
2. Crossing over: Mechanism of crossing over, Significance, theories of crossing over, tetrad analysis
3. Construction of chromosomal maps: 2 point and 3 point test cross.

Unit-3: Mutations **9 Hrs.**

1. Mutation: Types of mutations, mutagens. Gene mutations and types.
2. Chromosomal aberrations-variation in chromosomal number and structure. Polyploidy and its significance,
3. Transposons: types, structure and mechanism of transposition and its significance

Unit-4: Basic concepts of plant breeding **8 Hrs.**

1. Definition, aim, objectives and scope of plant breeding; concepts in plant breeding: genetic variation, heritability, and selection
2. Self-incompatibility in plants – Definition, heteromorphic and homomorphic systems; exploitation of self-incompatibility in hybrid production.
3. Male sterility- Genetic, cytoplasmic and cytoplasmic-genetic sterility, utilization in plant breeding.

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Unit-5: Breeding methods in plants **9 Hrs.**

1. Plant introduction-objectives plant introduction agencies in India, procedure, merits and demerits
2. Selection-natural and artificial selection; pureline, clonal and mass selection, advantages, disadvantages and achievements
3. Hybridization-objectives, procedure, advantages, disadvantages and achievements and Heterosis and its significance.
4. Mutational breeding –method, advantages, limitations and achievements
5. DNA markers and their applications in plant breeding: RFLP, RAPD

IV. Text Books:

1. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (2020). Introduction to Genetic Analysis (12th ed.). W. H. Freeman and Company.
2. Snustad, D. P., & Simmons, M. J. (2019). Principles of Genetics (7th ed.). Wiley.
3. Klug, W. S., Cummings, M. R., Spencer, C. A., & Palladino, M. A. (2022). Concepts of Genetics (12th ed.). Pearson Education.
4. Acquaah, G. (2021). Principles of Plant Genetics and Breeding (3rd ed.). Wiley-Blackwell.
5. Singh, B. D. (2020). Plant Breeding: Principles and Methods (11th ed.). Kalyani Publishers.
6. Allard, R. W. (1999). Principles of Plant Breeding (2nd ed.). Wiley.

V. Reference Books:

1. Hartl, D. L., & Ruvolo, M. (2020). Genetics: Analysis of Genes and Genomes (9th ed.). Jones & Bartlett Learning.
2. Strickberger, M. W. (2012). Genetics (3rd ed.). PHI Learning Pvt. Ltd.
3. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (2006). Principles of Genetics (8th ed.). Wiley India Pvt. Ltd.
4. Chaudhari, H. K. (2022). Elementary Principles of Plant Breeding (Oxford & IBH).
5. Sharma, J. R. (2015). Principles and Practice of Plant Breeding. Tata McGraw-Hill Education.
6. Jain, H. K., & Kharkwal, M. C. (Eds.). (2004). Plant Breeding: Mendelian to Molecular Approaches. Narosa Publishing House.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Solving the problems on classical genetics.
Evaluation method: Assessing the accuracy in solving the problems and awarding a grade.
Unit-2: Activity: Construction of chromosomal maps
Evaluation method: Selecting the best and assigning a grade.
Unit-3: Activity: Hands on activity of making models for chromosomal aberrations
Evaluation method: Selecting the best and assigning a grade.
Unit-4: Activity: Field trip to an agriculture or a horticulture research station to learn hybridization techniques.
Evaluation method: Active participation and learning skills on production of hybrid plants. **Unit-5: Activity:** Case studies of modern applications of molecular techniques in crop improvement.
Evaluation method: Based on a rubric with specified criteria and performance levels of the learner.

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COURSE 9: GENETICS AND PLANT BREEDING

Practical **Credits: 1** **2 hrs/week**

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

1. Apply Mendelian principles to solve genetic problems and analyze segregation and independent assortment using monohybrid and dihybrid crosses.
2. Conduct experiments to determine linkage, recombination, and gene mapping using test cross and three-point test cross data.
3. Perform emasculation and artificial hybridization techniques in self-pollinated and cross- pollinated crops.

II. Laboratory/field exercises:

1. Solving problems on monohybrid, dihybrid, back and test crosses.
2. Solving problems on gene interactions (at least one problem for each of the gene interactions in the syllabus).
3. Chromosomes mapping using problems of 3- point test cross data.
4. Floral biology in a self and a cross-pollinated plant species.
5. Practicing emasculation technique.
6. Practicing selfing and crossing techniques.

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COURSE 9: GENETICS AND PLANT BREEDING

Suggested Model Paper for Practical Examination

Max Time: 3 Hrs **Max. Marks: 50**

1. Solve the given Genetic problem and write the conclusions. **'A'** 15 M
2. Explain the process of plant hybridization in the perspective of plant breeding **' B '** 15 M
4. Identify and comment on the given specimens/spotters/slides/photographs 4 x 3=12 M

   C. Genetics

   D. Genetics

   E. Plant breeding

   F. Plant breeding
5. Record & Viva- voce 5 + 3 = 08 M

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COURSE 10: PLANT PHYSIOLOGY AND METABOLOSM

Theory **Credits: 3** **3 hrs/week**

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

1. Understand the concept of Soil-Plant-Atmosphere continuum based on plant-water relations.
2. Discuss the anabolic and catabolic processes in plants.
3. Explain 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. Hypothesize the light reactions and carbon assimilation processes responsible for synthesis of food in plants.
4. Analyze the biochemical reactions in relation to Nitrogen and lipid metabolisms.
5. Evaluate the physiological factors that regulate growth, development and flowering in plants.

III. Syllabus of Theory:

Unit – 1: Plant-Water relations **8 Hrs.**

1. Importance of water to plant life, physical properties of water, 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).
4. Mechanism of phloem transport; source-sink relationships.

Unit – 2: Mineral nutrition, Enzymes and Respiration **10 Hrs.**

1. Essential macro and micro mineral nutrients and their role in plants; symptoms of mineral deficiency
2. Absorption of mineral ions; passive and active processes.
3. Characteristics, nomenclature and classification of Enzymes. Mechanism of enzyme action, enzyme kinetics.
4. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, energy production in aerobic and anaerobic respirations.

Unit – 3: Photosynthesis and Photorespiration **10 Hrs.**

1. Photosynthesis: Photosynthetic 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 (C3, C4 and CAM).
4. Photorespiration - C2 pathway

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Unit – 4: Nitrogen and lipid metabolism **9 Hrs.**

1. Nitrogen metabolism: Biological nitrogen fixation – asymbiotic and symbiotic nitrogen fixing organisms. Nitrogenase enzyme system.
2. Lipid metabolism: Classification of Plant lipids, saturated and unsaturated fatty acids.
3. Anabolism of triglycerides, β-oxidation of fatty acids, Glyoxylate cycle

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 and ethylene.
3. Physiology of flowering: Photoperiodism, role of phytochrome in flowering.
4. Seed germination and senescence; physiological changes during seed germination.

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, VolumeIII, New Central Book Agency Pvt. Ltd., Kolkata

V. Reference Books:

1. Hans Mohr & P. Schopfer (2006) Plant Physiology, Springer (India) Pvt. Ltd.,New Delhi
2. Hopkins, W.G. & N.P.A. Huner (2014) Introduction to Plant Physiology, Wiley India Pvt. Ltd., New Delhi
3. Noggle Ray & J. Fritz (2013) Introductory Plant Physiology, Prentice Hall (India),New Delhi
4. Salisbury, Frank B. & Cleon W. Ross (2007) Plant Physiology, Thomsen & Wadsworth, Austalia&U.S.A
5. Taiz, L.&E. Zeiger (2003) Plant Physiology, Panima Publishers, New Delhi.
6. 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.

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COURSE 10: PLANT PHYSIOLOGY AND METABOLISM

Practical **Credits: 1** **2 hrs/week**

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:
Major experiments:

1. Determination of osmotic potential of plant cell sap by plasmolytic method using *Rhoeo/ Tradescantia* leaves.
2. Calculation of stomatal index and stomatal frequency of a mesophyte, a hydrophyte and a xerophyte.
3. Determination of rate of transpiration using Cobalt chloride method / Ganong's potometer (at least for a dicot and a monocot).
4. Effect of temperature on membrane permeability by colorimetric method.
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.

Minor experiments:

1.Osmosis
2. Compare Dicot and Monocot stomata
2. Arc-auxanometer
3.Ascent of sap through xylem
4. Anatomy of C3, C4 and CAM leaves.

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COURSE 10: PLANT PHYSIOLOGY AND METABOLISM

Suggested Model Paper for Practical Examination

Max Time: 3 Hrs **Max. Marks: 50**

1. Conduct the Major Experiment **(Experiment A).** Write the aim, principle, materials and apparatus, procedure. Tabulate the results, and draw a conclusion. 20 M
2. Demonstrate **Experiment 'B'** (Minor Experiment). Write the principle, procedure, and inference. 10 M
3. Identify and comment on the given specimens/spotters/slides/photographs 4 x 3=12 M
   C. Plant Water relations
   D. Mineral nutrition / Enzymes /Respiration
   E. Photosynthesis
   F. Nitrogen metabolism / Plant growth – Development
4. Record & Viva- voce 5 + 3 = 08 M

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Suggested Model Question Paper for Theory Examinations

Common pattern of Theory Question Paper for Semester-End Examinations.

Max. Time: 3 Hrs. **Max.Marks:75M**

Section–A

Answer any Five of the following questions. Draw labeled diagrams wherever necessary
5 x 3 = 15 M

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

Section–B

Answer any Five of the following questions. Draw labeled diagrams wherever necessary
5 x 12 = 60 M

✓ Two questions (a and b) will be given from each unit in the syllabus, providing internal choice (a or b) within each unit. Students must answer a total of five questions, selecting one question from each unit.

Note: *Questions should be framed to test the students' understanding, analytical, and creative skills. All questions must be set strictly within the prescribed syllabus framework.*

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