



TRIPURA UNIVERSITY

**(A Central University)
Suryamaninagar-799022**

Syllabus

OF

**Botany (General – Vth Semester
&
Major - Vth & VIth Semester**

2014

Marks Distribution of Vth Semester (Elective)

Semester	Theoretical Marks	Practical Marks	Total Marks
Semester-V	50 (IA-10+ ES-40)	50 (IA-10+ ES-40)	100

*IA= Internal Assessment; *ES = End semester Examination

Course Structure, Vth Semester (Elective)

Course Title	Full Marks
BT – 501(Theory) (Cell and Molecular Biology, Cytogenetics and Plant Breeding, Plant Physiology and Plant Biotechnology)	50
BT – 502 (Practical) Based on Theory Course – BT501	50

SEMESTER – V

BT-501 (Theory) Marks: 100 (Elective)

Internal Assessment: 10

40 Periods

End Semester Examination: 40

20 Periods

Unit – I: Cell and Molecular Biology, Cytogenetics and Plant Breeding

Cell cycle and Cell division, Structure and function of Cell Organelles (Nucleus, Mitochondria, Chloroplast, Ribosome) Chromosome morphology and Organization of eukaryotic Chromosome (Nucleosome concept); Structure, forms and salient features of Nucleic Acids (DNA and RNA); DNA replication, Mechanism of DNA replication in Prokaryotes, Transcription: Initiation, elongation and termination in Prokaryotes. Translation in Prokaryotes: Amino-acylation of tRNA, initiation, elongation and termination of polypeptide chain; Gene Mutation: Transition, Transversion and Frame shift mutation, Lac Operon (brief idea).

Mendelian inheritance; Gene interactions: Incomplete Dominance (1:2:1), Modified dihybrid ratio (12:3:1, 9:3:4, 9:7) Crossing Over: Cytological proof of crossing over (McClintock's experiment); Complete and incomplete linkage, Aneuploidy and Euploidy, role of polyploidy in crop improvement; Chromosomal aberration: deletion, duplication, translocation and inversion; Methods of plant breeding: Introduction, emasculation, Hybridization and Acclimatization; Selection: Mass selection and pure selection; Male sterility: Genetic, Cytoplasmic and Cytoplasmic-genetic male sterility, Heterosis and hybrid vigour.

Unit II: Plant Physiology and Plant Biotechnology

20 Periods

Water potential and its components; Water absorption by roots (apoplastic and symplastic pathways); Photosynthesis: photochemical reactions, Mechanism of electron transport in PS-I and PS-II, Calvin cycle; C₃ and C₄ plants and photosynthetic efficiency, photorespiration, Crassulacean acid metabolism (CAM); Transpiration and anti-transpirant. Respiration: glycolysis, Oxidative Phosphorylation, Mitochondrial ETS; N-metabolism: Assimilation of Nitrogen, Biological Nitrogen fixation: role of nitrogenase in N₂ fixation; Photoperiodism: Photoperiodic responses and classification of plants, Photomorphogenesis; Plant growth regulators, physiological role and modes of action (IAA, Gibberellins and Cyokinins).

Totipotency and concept of plant tissue culture; Function and organization of a typical plant tissue culture laboratory; Techniques of plant tissue culture: cell suspension culture technique, protoplast culture technique; Modes of in vitro regeneration and applications; Callus culture and applications; Haploid and embryo culture; Transformation: *Agrobacterium* mediated gene transfer.

SEMESTER-V

Practical – 502

Full Marks: 50

Internal Assessment: 10

End Semester Examination: 40

1. Mitotic Study: Temporary preparation of metaphase chromosomes from root tips of *Allium cepa*
2. Identification with reasons from permanent slides: Different stages of mitosis and meiosis including abnormalities like Sticky Bridge, laggard chromosome(s), chromosomal fragmentation, ring chromosome, early separation.
3. Study of pollen sterility by Aceto-carmin staining technique.
4. Detection of organic acids: citric, tartaric, oxalic and malic acids from unknown samples.
5. Detection of the nature of carbohydrate: glucose, fructose and sucrose from unknown samples.
6. Determination of released oxygen during photosynthesis.
7. To extract and separate chlorophyll pigment by chromatography.
8. Relationship between transpiration and evaporation.
9. Measurement of oxygen uptake by respiring tissue (per g/hr).
10. Effect of temperature on absorption of water by storage tissue and determination of Q_{10} .
11. Comparison of imbibitions of water by starchy, proteinaceous and fatty seeds.
12. Demonstration and function of autoclave, laminar airflow, pH meter and culture room.
13. Aseptic techniques of explants culture.

Laboratory records:

2. Laboratory note book of each section must be signed by the respective teacher with date during practical classes.

Semester-V
Practical - Paper 502

End Semester Examination – 40

Questions pattern:

1. Mitotic Study: Temporary preparation of metaphase chromosomes from root tips of material provided 08
2. Identification with reasons (any two – Identification- 1, Reasons -1) (2X2) = 04
3. Experiment on biochemical works as per practical workout 05
4. To perform a major physiological experiment from the list of the experiments as per contents of practical syllabus 10
5. Demonstration on Plant tissue culture technique 05
6. Practical Note Book 04
7. *Viva voce* 04

Marks Distribution of Vth & VIth Semester (Major)

Semester	Theoretical Marks	Practical Marks	Total Marks
Semester-V	100 (IA-20+ ES-80)	100 (IA-200+ ES-800)	200
Semester-VI	100 (IA-20+ ES-80)	100 (IA-200+ ES-800)	200
Total	200	200	400

*IA= Internal Assessment; *ES = End semester Examination

Course Structure, Vth & VIth Semester (Major)

Course Title	Full Marks
BT – 501(Theory) (Cell Biology, Molecular Biology, Cytogenetics, Plant breeding & Biostatistics)	100
BT – 502 (Practical) Based on Theory Course – BT501	100
BT – 601 (Theory) (Biochemistry, Plant Physiology, Pharmacognosy, Plant Biotechnology)	100
BT – 602 (Practical) Based on Theory Course – BT601	100

SEMESTER – V (MAJOR)

BT – 501 (Theory) Marks: 100

Internal Assessment: 20

56 Periods

End Semester Examination: 80

Unit – I: Cell Biology:

14 Periods

Cell cycle and Cell division, equational and reductional division with respect to 'C' value, Cell cycle regulation, Theories of anaphasic movement; Structure and function of Cell Organelles (Nucleus, Mitochondria, Chloroplast, ER, Golgi Apparatus, Peroxisomes and Glyoxysomes, Ultra-structure of ribosome in Prokaryotes and Eukaryotes,) Plasma membrane – Structure (Fluid mosaic model) and function; Chromosome morphology and Organization of eukaryotic Chromosome (Nucleosome concept); Centromere and telomere – structure and function; Organization of cp and mt DNA and their significance; Apoptosis.

Unit – II: Molecular Biology:

14 Periods

Structure, forms and salient features of Nucleic Acids (DNA and RNA); DNA replication - Semi-conservative replication in Prokaryotes with proof (Meselson and Stahl's Experiment), Mechanism of DNA replication in Prokaryotes, Genetic code: Properties, deciphering of genetic code; Transcription: Initiation, elongation and termination in Prokaryotes. Translation in Prokaryotes: Amino-acylation of tRNA, initiation, elongation and termination of polypeptide chain; Gene Mutation: Transition, Transversion and Frame shift mutation, Effects of chemical mutagens (Base analogues and Nitrous acid) Physical agents (UV rays); DNA damage and repair, Concept of Lac Operon (Positive and Negative control). Restriction enzymes: types and function; PCR and its application (A brief idea)

Unit – III: Cytogenetics

14 Periods

Mendelian inheritance; Gene interactions: Incomplete Dominance (1:2:1), Modified dihybrid ratio (12:3:1, 9:3:4, 9:7, 9:6:1, 13:3), Atavism, Pleiotropism; Polygenic inheritance in plant(15:1); Crossing Over: Cytological proof of crossing over (McClintock's experiment); Molecular basis of Crossing Over; Complete and incomplete linkage, Three point test cross, Problems on Gene Mapping; Sex linked trait and sex linked inheritance; Aneuploidy and Euploidy, role of polyploidy in crop improvement; Chromosomal aberration: Types and meiotic behavior of deletion, duplication, translocation and inversion; Molecular mapping- FISH technique; Bioinformatics: Genomics and proteomics (A brief idea).

Unit- IV: Plant Breeding and Biostatistics:

14 Periods

Methods of plant breeding: Introduction, emasculation, Hybridization and Acclimatization; Selection: Mass selection and pure selection; Male sterility: Genetic, Cytoplasmic and Cytoplasmic-genetic male sterility; Heterosis and hybrid vigour; Collection of data (Variable and attribute, Primary and Secondary data, Population and sample); Types of charts and diagrams: Frequency distribution (Simple, Grouped and Cumulative); Measures of Central tendency: Mean Mode and Median; Measure of dispersion: Mean deviation and Standard Deviation; Standard Error; Correlation and Coefficient of Correlation (r); .Student t- test; Chi Square test for goodness of fit; Classical definition of Probability, Addition and Multiplication rules.

Pattern of Question Setting
(Major)
BT-501 & BT-601

1. Short Questions 10 marks- Compulsory

From the rest of 70 marks, there would 2 questions of 14 marks each from each unit, Candidate will answer any five questions taking at least one from each unit.

Each a unit of 14 marks may be subdivided into 2 to 3 parts having a maximum of eight marks for a part

SEMESTER – V
Practical Paper– 502
Full Marks: 100

Internal Assessment: 20

End Semester Examination: 80

1. Mitotic Study: Temporary preparation of metaphase chromosomes from root tips of *Allium cepa* and *Lens esculenta* and determination of their somatic chromosome number.
2. Study of mitotic index in *Allium cepa* L.
3. Meiotic Study: Temporary preparation of prophase I (Diplotene and diakinesis), Metaphase – I and Anaphase -I from flower buds of *Allium cepa*, *Rhoeo sp* and *Datura sp*.
4. Identification with reasons from permanent slides: Different stages of mitosis and meiosis including abnormalities like Sticky Bridge, laggard chromosome(s), chromosomal fragmentation, ring chromosome, early separation.
5. Study of pollen sterility by Aceto-carmin staining technique.
6. Demonstration of emasculation technique.
7. Graphical representation of statistical Data
8. Statistical analysis of Mean, Mode, Median, Standard deviation, Standard error and T-Test.
9. Determination of goodness of fit in normal and modified dihybrid ratios.

Laboratory records:

1. Laboratory note book of each section must be signed by the respective teacher with date during practical classes.

Semester-V
Practical - Paper 502

End Semester Examination - 80

1. Mitotic Study: Temporary preparation of metaphase chromosomes from root tips of material provided and determination of their somatic chromosome number. 16

2. Study of mitotic index in *Allium cepa* L.

Or

Temporary preparation of meiosis from the supplied material (Any one stage from the suggested practical works) 10

Or

3. Identification with reasons (any three – Identification- 1. Reasons -2) (3X3) = 9

4. Study of pollen sterility by Aceto-carmin staining technique.

Or

Demonstration of emasculation technique 10

5. Statistical analysis of the experimental data as included in the syllabus 15

6. Practical Note Book and Submission of permanent cytological slides (7+3) = 10

7. *Viva voce* 10

BT – 601 (Theory) Marks: 100 (Major)

SEMESTER – VI

Internal Assessment: 20

56 Periods

End Semester Examination: 80

Unit- I: Biochemistry

14 Periods

Structure and properties of water, co-valent and non-covalent bonds, hydrogen bonds, Vander Waal's forces, pH, buffer and isoelectric points; Carbohydrate: Classification, structure and properties; Lipids: Classification and function; Protein: Classification and structure (Primary, Secondary, Tertiary and Quaternary structure); Amino acids: Structure, charge and polarity; essential amino-acids; Enzyme: Classification and function, Isozymes, Allosteric enzymes and Coenzymes; Glycolysis, conversion of pyruvic acid to Acetyl Co-A, TCA cycle; Membrane chemistry, transport and mechanism of ion uptake; Signal transduction pathway and second messenger concept- G protein.

Plant physiology:

14 Periods

Water potential and its components; Water absorption by roots (apoplastic and symplastic pathways); Photosynthesis: Components of photosynthesis, Types of chlorophyll and carotenoids and their structures and functions; Red drop effect and Enhancement effect, Antenna complex, photochemical reactions, Mechanism of electron transport in PS-I and PS-II, Calvin cycle; HSK pathway; C₃ and C₄ plants and photosynthetic efficiency, photorespiration, Crassulacean acid metabolism(CAM); Stomatal physiology: role of CO₂ ions, ABA and light, transpiration and anti-transpirant. Respiration: Oxidative Phosphorylation, Mitochondrial ETS and uncouplers, PP pathway; N-metabolism: Assimilation of Nitrogen, Biological Nitrogen fixation: symbiotic fixation; 'nod' genes and 'nif' genes, role of nitrogenase in N₂ fixation; Photoperiodism: Photoperiodic responses and classification of plants, Circadian Clock Photomorphogenesis; Phytochromes as photoreceptor in Photoperiodism, Vernalization, Florigen and transition to flowering; Plant growth regulators, physiological role and modes of action (IAA, Gibberellins and Cyokinins), Brassinosteroids, polyamines.

Unit – III: Pharmacognosy:

14 Periods

Importance of pharmacognosy in modern medicine; Drugs: crude and commercial drugs; Method of commercial drug production, drug adulteration; Classification and evaluation of drugs:

organoleptic, microscopic, chemical and physical evaluation; Secondary metabolites and secondary metabolic biosynthetic pathways; Major types of secondary metabolites with source plants: Flavonoids, steroids, terpenoids, resins, phenolics and alkaloids; Organoleptic study of whole plant of *Andrographis paniculata*, Bark of *Alstonia* sp., Rhizome of Ginger, Tuber of *Dioscoria* sp., Leaves of *Adhatoda* sp.

Unit – IV: Plant Biotechnology

14 Periods

Totipotency and concept of plant tissue culture; Function and organization of a typical plant tissue culture laboratory; Techniques of plant tissue culture: cell suspension culture technique, protoplast culture technique, Meristem tip culture technique; Modes of *in vitro* regeneration and applications; *In vitro* exudation and remedial Measures; Callus culture and applications; Haploid and embryo culture; Prokaryotic vector system and marker genes; Transformation: *Agrobacterium* mediated gene transfer, Particle Bombardment method.

Practical BT-602 (H)

Full marks-100

Internal Assessment: 20

End Semester Examination: 80

SECTION : A

1. Detection of organic acids: citric, tartaric, oxalic and malic acids from unknown samples.
2. Detection of the nature of carbohydrate: glucose, fructose, sucrose and starch from unknown samples.
3. Detection of Ca, Mg, Fe and S from plant ash sample.
4. Estimation of acidity from lemon by titration method.
5. Colorimetric estimation of protein by Folin phenol reagent.

SECTION: B

6. Estimation of Catalase activity in plant samples.
7. Effect of CO₂ on the rate of photosynthesis.
8. To extract and separate chlorophyll pigment by chromatogram.
9. Determination of loss of water per stomata per hour.
10. Relationship between transpiration and evaporation.
11. Measurement of oxygen uptake by respiring tissue (per g/hr).
12. Determination of the RQ of germinating seeds.
13. Measurement of osmotic pressure of *Rhoeo* leaf by plasmolytic method.
14. Effect of temperature on absorption of water by storage tissue and determination of Q₁₀.
15. Comparison of imbibitions of water by starchy, proteinaceous and fatty seeds.

SECTION : C

16. Study of Palisade ratio and Vein islet no.
17. Chemical tests for Steroids and Alkaloids.
18. Powder microscopy of the plant samples as per contents of the syllabus.

SECTION: D

19. Demonstration and function of autoclave, laminar airflow, pH meter and culture room.
20. Aseptic techniques of explants culture.

Laboratory records:

1. Laboratory note book of each section must be signed by the respective teacher with date during practical classes.

Practical BT-602

Full marks-100

End Semester Examination: 80

- | | |
|---|----|
| 1. Experiment on biochemical works as per practical workout (A) | 14 |
| 2. To perform a major physiological experiment from the list of the experiments as per contents of practical syllabus (B) | 22 |
| 3. Work out on pharmacognosy (C) | 12 |
| 4. Demonstration on Plant tissue culture technique (D) | 12 |
| 5. Practical Note Book | 10 |
| 6. <i>Viva voce</i> | 10 |

Books and references:

1. Plant Cell Tissue and Organ Culture. O.L. Gamborg and G.C. Phillips. Narosa, 1995. ISBN. 81-7319-1018. New Delhi.
2. Plant T Culture: Basic and Applied. T.B. Jha and B. Ghosh. Universities Press. Pvt. Ltd. ISBN.81-73714886. Hyderabad.
3. Plant Tissue Culture. M.K. Razdan. Oxford & IBH Pub. LTD.ISBN. 81-2041571-X.New Delhi.
4. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis, E.D.P. and De Robertis, E.M.F. 2006 Cell and Molecular Biology. 8th edition.
6. Lippincott Williams and Wilkins, Philadelphia.
7. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM
8. Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
10. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular
11. Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
12. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Rafi, Keith Roberts, and Peter Walter. 2008. Molecular biology of the cell, 5th ed., Garland science, Taylor & Francis Group, LLC, 270 Madison Avenue, NewYork NY f 0016, USA.
13. B.B. Buchanan, W.Gruissem and R.L. Jones . USA (2000).Biochemistry and Molecular Biology of Plants. Ed. ASPP Press.
14. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
15. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
16. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition.Benjamin Cummings.
17. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
18. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
19. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
20. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis. W. H. Freeman and Co.
21. Gupta, P.K., A Text Book of Cytology, Genetics and Evolution, , Rastogi Publication, Meerut
22. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta. 5. Goon A.M., Gupta M.K. and Dasgupta B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta. N.G. Das. Principles of Statistics. Vol I&II.

23. Taize, L & Zeiger, E., 2011, Plant Physiology, Sinauer associates Inc. Publishers, Sunderland, Massachusetts, USA.
24. Hopkins, W.G. , Huner, N.P.A., 2011, Introduction to Plant Physiology, Wiley International Edition, John Wiley & Sons, USA.
25. Srivastava, H.S., 2008, Plant Physiology & Biochemistry, Rastogi publications, Meerut, India.
26. Hopkins, W.G., and Hunter, NPA, 2011, Introduction to Plant Physiology, Wiley International Edition, John Wiley & Sons, USA.
27. Srivastava, H.S., 2008, Plant Physiology & Biochemistry, Rastogi publications, Meerut, India.
28. Buchanan, B., Gruissem, W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.