



**West Bengal State University**  
Berunanpukuria, Barasat, North 24 Parganas,  
KOLKATA-700126

**SYLLABI**

**FOR**

**THREE YEARS B. Sc. DEGREE COURSE**

**(3 years 1+1+1 Examination System)**

**BOTANY**  
**(WBSU Code 121)**

**2009**

# West Bengal State University

## Barasat

Syllabi for 3 years - B. Sc. Degree Course  
[3 years 1+1+1 Examination System]

### **BOTANY**

(HONOURS/ADVANCE)  
[WBSU Code 1211]  
2009  
[To be effective from 2010 – 2011 Session]

Distribution of Marks

<b>Total Allotment – 800 Marks</b>			
<b>Terminal Examinations</b>	<b>Theoretical Assessment</b>	<b>Practical Assessment [External]</b>	<b>Total Marks</b>
	<b>External</b>		
<b>Part – I First Year</b>	<b>Paper - I [100] 121101</b>	<b>Paper III[50] 121103</b>	<b>200</b>
	<b>Paper - II [50] 121102</b>		
<b>Part – II Second Year</b>	<b>Paper - IV [100] 121104</b>	<b>Paper VI[50] 121106</b>	<b>200</b>
	<b>Paper - V [50] 121105</b>		
<b>Part – III Third Year</b>	<b>Paper - VII [100] 121107</b>	<b>Paper IX[100] 121109</b>	<b>400</b>
	<b>Paper - VIII [100] 121108</b>	<b>Paper X[100] 121110</b>	
<b>Total Marks</b>	<b>500</b>	<b>300</b>	<b>800</b>

# BOTA

## **PART - I [First Year Terminal] : 200 Marks** [Theoretical aspects 150 marks and Practical aspects 50 marks]

### **Paper - I Theoretical 100 Marks [4hr.]** (Code - 121101)

1. Algae ..... 25 Marks [25 Periods]
2. Fungi & Lichen .....25 Marks [25 Periods]
3. Microbiology ..... 25 Marks [30 Periods]
4. Plant Pathology ..... .25 Marks [25 Periods]

### **Paper - II Theoretical 50 Marks [2hr.]** (Code - 121102)

1. Bryophyta ..... 10 Marks [10 Periods]
2. Pteridophyta .....15 Marks [15 Periods]
3. Gymnosperms .....15 Marks [15 Periods]
4. Palaeobotany.....10 Marks [10 Periods]

### **Paper - III Practical 50 Marks [5 hr.]** (Code - 121103)

1. Algae (work out) ..... 10 Marks
  2. Fungi (work out) ..... 10 Marks
  3. Microbiology (work out) ..... 6 Marks
  4. Plant Pathology (work out) ..... 6 Marks
  5. Identification..... [3 specimens x 3 marks each.]..... 9 Marks  
[Not more than one from Algae/Fungi/Lichen/Plant Pathology]
  6. Laboratory Note Books [No Slide]..... 4 Marks
  7. *Viva Voce* ..... [5 Qs. x 1 mark]..... 5 Marks
- [Laboratory Note Book of each section, signed by the respective Teachers  
with date, must be submitted at the time of examination]

**PART - II [Second Year Terminal]: 200 Marks**  
[Theoretical aspects 150 marks and Practical aspects 50 marks (external)]

**Paper - IV Theoretical 100 Marks [4hr.]**  
(Code - 121104)

1. Morphology & Palynology .....20 Marks [15 Periods]
2. Taxonomy of Angiosperms .....50 Marks [45 Periods]
3. Ecology & Plant geography .....30 Marks [25 Periods]

**Paper - V Theoretical 50 Marks [2hr.]**  
(Code - 121105)

1. Anatomy & Embryology .....25 Marks [25 Periods]
2. Biochemistry ..... 25 Marks [25 Periods]

**Paper - VI Practical 50 Marks [5hr.]**  
(Code - 121106)

1. Angiosperms (work out) ..... 10 Marks
2. Anatomy (work out – double staining) ..... 10 Marks
3. Plant recognition (Angiosperm) [genus1+species1+family1].....3 Marks
4. Identification [4 specimens x 3 marks each]..... 12 Marks  
[From Bryophyta, Pteridophyta, Gymnosperms, Palaeobotany, Anatomy; not  
more than two from any group]
5. Laboratory Note Books & Slides..... 4 Marks
6. Field records..... 4 Marks
7. Herbarium ..... 3 Marks
8. *Viva Voce*..... [5 Qs. x 1 mark each]..... 4 Marks

{2Local Excursions, a visit to the BSI/CAL and One Excursion to  
a different Phyto-Geographical Region - are all compulsory}  
[Field Records and Laboratory Note Book of each section, signed by the  
respective Teachers with date, must be submitted at the time of examination]

**PART - III [Third Year Terminal] : 400 Marks**  
[Theoretical aspects 200 marks and Practical aspects 200 marks]

**Paper - VII Theoretical 100 Marks [4hr.]**  
(Code - 121107)

1. Plant Physiology ..... 60 Marks [50 Periods]
2. Pharmacognosy.....20 Marks [15 Periods]
3. Plant Biotechnology.....20 Marks [15 Periods]

**Paper - VIII Theoretical 100 Marks [4hr.]**  
(Code - 121108)

1. Cell Biology .....25 Marks [20 Periods]
2. Genetics & Molecular Biology .....55 Marks [45 Periods]
3. Plant Breeding & Biometry .....20 Marks [15 Periods]

**Paper - IX Practical 100 Marks [6 hr.]**  
(Code - 121109)

1. Plant Physiology (Major & Minor) ..... 30 Marks
  2. Biochemistry (Qualitative & Quantitative) .....35 Marks
  3. Pharmacognosy (Two Experiments) ..... 15 Marks
  4. Laboratory Note Books ..... 10 Marks
  5. *Viva Voce* ..... 10 Marks
- [Laboratory Note Book of each section, signed by the respective Teachers with date, must be submitted at the time of examination]

**Paper - X Practical 100 Marks [6 hr.]**  
(Code - 121110)

1. Study of Mitotic Chromosomes ..... 25 Marks
  2. Study of Meiotic Chromosomes ..... 15 Marks
  3. Study of Mitotic Index ..... 10 Marks
  4. Biometry ..... 15 Marks
  5. Identification..... [5 specimens x 3 marks each]..... 15 Marks  
(Specimens / Slides: - as prescribed in the syllabus)
  6. Laboratory Note Books & Slides ..... 10 Marks
  7. *Viva Voce* ..... 10 Marks
- [Laboratory Note Book of each section, signed by the respective Teachers with date, and Slides, must be submitted at the time of examination]

# **PART - I : 200 Marks**

## **Paper - I Theoretical 100 Marks (Code - 121101)**

- 1. Algae ..... 25 Marks [25 Periods]**
- 2. Fungi & Lichen ..... 25 Marks [25 Periods]**
- 3. Microbiology ..... 25 Marks [30 Periods]**
- 4. Plant Pathology.....25 Marks [25Periods]**

### **Algae**

1. General account: - 1.1 Thallus organization; 1.2 Ultra-structure of Plastid, Flagella and Flagellar roots; 1.3 Ultra-structure of Heterocyst and Nitrogen fixation; 1.4 Origin and Evolution of sex, and Alternation of Generations.
2. Classification: - 2.1 Classification by Bold & Wynne (1996) - upto class with characters and examples; 2.2 Salient features of Chlorophyceae, Charophyceae, Xanthophyceae, Phaeophyceae and Rhodophyceae.
3. Cyanophyceae: - 3.1 Ultra-structure of cell; 3.2 Reproduction; 3.3 Systematic position in the biological world.
4. Bacillariophyceae [Diatoms]: - 4.1 Salient feature and Cell structure; 4.2 Reproduction & Auxospore formation.
5. Thallus organization, Reproduction (including the development of zygote) and Alternation of Generations in - *Oedogonium*, *Chara*, *Vaucheria*, *Laminaria* and *Polysiphonia*.
6. Economic Importance: - 6.1 Food, Fodder & Phycocolloid (Agar-Agar, Algin & Carrageenan); 6.2 Diatomite; 6.3 Production of SCP & Biofertilizer; 6.4 Algal toxins.

### **Fungi & Lichen**

1. General account: - 1.1 Habits; 1.2 Ultra-structure of cell; 1.3 Spore forms and spore liberation; 1.4 Homothallism & Heterothallism; 1.5 Anamorph, Teleomorph, Degeneration of sex and Parasexuality; 1.6 Aflatoxins; 1.7 Mycorrhiza - salient features, and role in agriculture and forestry.
2. Classification: - 2.1 Concept of Kingdoms - Protists/Protozoa, Stramenopila and Fungi/Mycota; 2.2 Classification of kingdom Fungi & Stramenopila, following Hawksworth *et al.* (1995), upto phylum with characters and examples.
3. Representatives of diverse groups: - 3.1 Reproduction, Life cycle pattern and systematic position (following any system prescribed after 1975) of the following genera - *Synchytrium*, *Rhizopus*, *Ascobolus* and *Agaricus*.

4. Lichen: - 4.1 Types; 4.2 Reproduction; 4.3 Economic importance. 4.4 Role of Lichens in plant succession and pollution monitoring.

5. Economic & Medicinal Importance: - 5.1 Mushrooms - Food value & binomials of the Indian cultivars of the genera - *Agaricus*, *Calocybe*, *Pleurotus* and *Volvariella*; 5.2 Fungal sources and uses of - SCP, Baker's yeast, Ethanol, Citric acid, Tryptophan, -Amylase, Riboflavin, Griseofulvin, Nystatin and Cyclosporin; 5.3 Medical Mycology - Definition of Mycosis; Causal Organisms and Antibiotic used in the mycoses as 'Ring worm' or Trichophytosis and Candidiasis.

## Microbiology

1. Microorganisms and study of Microbiology – Primary concept; 1.1 Classification of Microorganisms and Kingdoms of Prokaryotes (Prokaryotae) and Eukaryotes (G. E. Murray 1968 & R. H. Whittaker 1969)[Preliminary idea]; 1.2 Molecular basis of modern Classification, Signature Codons, Three Domain Concept of classification (Carl R. Woese 1978) and Concept of Universal Phylogenetic Tree (Norman R. Pace 1997)[Only basic concept].

2. Archaea: - 2.1 Characteristics (brief outline); 2.2 Cell wall; 2.3 Occurrence.

3. Bacteria: - 3.1 General features; 3.2 Bacterial Growth - Binary fission, Exponential growth & Growth curve (general pattern in a closed system with a single carbon source – single phase) 3.3 Chemical natures, ultra-structures and functions of Glycocalyx, Slime layer, Flagella, Pili, & Fimbriae; 3.4 Cell wall – chemical nature and differences between Gram positive and Gram negative bacteria; 3.5 Bacterial Genome and Plasmid; 3.6 Genetic Recombination – Transformation [general process, natural and induced competence & mechanism of DNA uptake], Conjugation ['F' factor, F<sup>+</sup> & Hfr males, and chromosome mobilization] and Transduction [General concept and applicability]; 3.7 Bacterial Diversity – General concept and Systematic Position of the following groups: - Photosynthetic bacteria (blue-green, purple & green bacteria, concept of oxygenic and anoxygenic groups), Chlamydiae, Nitrogen fixing bacteria (symbiotic & non-symbiotic), Firmicutes & Mollicutes, Endospore forming bacteria & structure of Endospore, and Actinomycineae.

4. Viruses: - 4.1 Types of viruses and Plant viruses; 4.2 Transmission of plant virus; 4.3 TMV – physicochemical characteristics and its mode of multiplication; 4.4 T4 Phage – structure, infection and lytic cycle; 4.5 Lambda ( ) Phage - mechanism & significance of Lysogeny; 4.6 Viroids and Prions.

5. Applied Bacteriology: - 5.1 Sources (names only) & uses of – Bacitracin, Neomycin, Streptomycin, Chloramphenicol, Amphotericin B, Amylase, Cellulase, Protease, Lysine, & Dextran; 5.2 Bacteria used (only names) in the production of Biofertilizer, Bio-gas & Bio-pesticides ; 5.3 Causal organisms (only names) of Cholera, Bacterial dysentery, Typhoid, Diphtheria, Tuberculosis, Plague and Pneumonia.

## Plant Pathology

1. Terms and Definitions: - 1.1 Parasite, Pathogen & Vector; 1.2 Primary & Secondary inocula; 1.3 Infection; 1.4 Susceptibility & Virulence; 1.5 Symptoms; 1.6 Necrotroph & Biotroph; 1.7 Disease, Disease Triangle, Disease Cycle (monocyclic, polycyclic & polyetic); 1.8 Sporadic, Endemic, Epidemic & Pandemic diseases; 1.9 Koch's Postulates.

2. Host - Parasite Interaction: - 2.1 Mechanism of Infection (Pre- & Post-penetration, Mechanical & Biochemical tools of the pathogens; 2.2 Role of Pathotoxins; 2.3 Host Defense - roles of Phytoalexins & Phytoanticipins; 2.4 Resistance - Acquired and Induced systemic resistance.

3. Disease Management: - 3.1 Management Planning; 3.2 Employing Methods (Chemical, Biological & Integrated); 3.3 Quarantine; 3.4 Disease Diagnosis and Disease forecasting (preliminary ideas)

4. Disease Study: - 4.1 Study of symptoms, causal organisms, disease cycles and control measures of the following diseases - (a) Tungro Virus disease of rice, (b) Bacterial Blight of rice, (c) Late Blight of potato (d) Black Stem Rust of wheat (e) Nematode Root knot of *Brassica*.

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## Bibliography

### Algae

1. Chapman, V.J. & Chapman, D.J. .... The Algae [Macmillan, London]
2. Lee, R.E. .... Phycology [Cambridge Univ. Press]
3. Kumar, H.D. & Singh, H.N. .... Introductory Phycology [East-West Press Pvt. Ltd]
4. Sharma, O.P. .... text Book of Algae [Tata McGraw Hill]
5. Smith, G.M. .... Cryptogamic Botany Vol. 1 [McGraw Hill]
6. Vashistha, B.R., Singh, A.K. & Singh, V.P. .... Algae [S. Chand & Co. Pvt. Ltd.]
7. Bold, H.C. & Wynne, M.J. .... Introduction to Algae: Structure & Reproduction [Prentice Hall]
8. Ganguly, H.C. & Kar, A.K. .... College Botany Vol.-II [New Central Book Agency]
9. Chopra, G.L. .... A text book of Algae [S. Nagin & Co. New Delhi]
10. Hoek, C., Mann, D.G. & Jahns, H.M. 1995 .... Algae: an. .... [Cambridge Univ. Press]

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### Fungi

1. Ainsworth, G.C., Sparrow, F.K. and Sussman, A.S. (Eds).... The Fungi: An Advanced Treatise Vol. IVA & B, [Academic Press]
2. Hawksworth, D.L., Kirk, P.M., Pegler, D.N. and Sutton, B.C. 1995.....Ainsworth & Bisby's Dictionary of Fungi, 8<sup>th</sup> Ed. [CAB International]
3. Webster, J. .... Introduction to Fungi [Cambridge University Press]
4. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. .... Introductory Mycology [John Wiley & Sons Inc]

5. Moore-Landecker, E. ....Fundamentals of the Fungi 4<sup>th</sup> Ed [Prentice Hall]
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  10. Chopra, G.L. and Verma, V. ....A text Book of Fungi [Pradeep Publication]
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1. Atlas, R.M. .... Principles of Microbiology [McGraw Hill]
  2. Willey, M.J., Sherwood, L.M. & Woolverton, C.J..... Prescott, Harley and Klein's  
Microbiology [McGraw Hill]
  3. Madigan, M.T., Martinko, J.M. & Parker, J. ....Brock Biology of Microorganisms  
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[New Central Book Agency]
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  2. Singh, R.S. .... Plant Diseases [Oxford & IBH Co.]
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  5. Bilgrami, K.S. and Dubey, H.C. ..A Text Book of Modern Plant Pathology  
[Vikas Pub. House]
  6. Mehrotra, R.S. ....Plant Pathology [Tata-McGraw-Hill]
  7. Rangaswami, G. ....Diseases of Crop Plants in India [Prentice Hall India]
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## Paper - II Theoretical 50 Marks (Code - 121102)

1. Bryophyta ..... 10 Marks [10 Periods]
2. Pteridophyta .....15 Marks [15 Periods]
3. Gymnosperms.....15 Marks [15 Periods]
4. Palaeobotany.....10 Marks [10Periods]

### Bryophyta

1. General account: - 1.1 Characteristic features; 1.2 Amphibian nature; 1.3 An outline idea of classification system following Proskauer (1957) upto class.
2. Hepaticopsida: - 2.1 Class characters; 2.2 Characteristic features of gametophytes and sporophytes of *Marchantia*;
3. Anthocerotopsida: - 3.1 Class characters; 3.2 Gametophytic and Sporophytic features of *Anthoceros*. 3.3 Development of sporophyte.
4. Bryopsida: - 4.1 Class characters; 4.2 Characteristic features of gametophytes and sporophytes of *Sphagnum* and *Funaria*.
5. Specialized topics: - 5.1 Origin of Bryophytes; 5.2 Alternation of generations in different classes and Evolution of Sporophytes (Progressive and Regressive concepts), 5.3 Roles of Bryophytes in plant succession and pollution monitoring.

### Pteridophyta

1. General account: - 1.1 Characteristics; 1.2 Classification (Sporne, 1975) - upto class with characters and examples.
2. Morphology and Anatomy of vegetative body, and reproductive organs of sporophytes, and alternation of generations in - *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum* and *Dryopteris*.
3. Fossil study: - 3.1 Characteristic features of *Rhynia*; 3.2 Structural and anatomical features of *Lepidodendron* and *Calamites*.
4. Progymnosperms: - 4.1 Diagnostic features of the group; 4.2 Vegetative and reproductive features of *Archaeopteris*.
5. Specialized topics: - 5.1 Life cycle patterns in Homosporous and Heterosporous forms; 5.2 Alternation of generations and origin of sporophyte (Antithetic & Homologous theories); Telome concept (Zimmermann's hypothesis) and its

significance in the origin of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. 5.3 Heterospory and seed habit.

## **Gymnosperms**

1. General characters and Classification (Sporne, 1975) upto class with characters and examples.
2. Distribution, vegetative and reproductive morphologies of sporophytes, wood anatomy, structures of ovules, development of gametophytes and embryogeny of - *Cycas*, *Pinus* and *Gnetum*.
3. Fossil Gymnosperms: - 3.1 General characters of Pteridospermales, Cordaitales and Bennettitales; 3.2 Structural features of *Lyginopteris oldhamia* and *Cordaites*; 3.3 Reconstruction of *Williamsonia Sewardiana*.
4. Economic importance of Gymnosperms with reference to wood, resin, essential oil, fatty acid & drugs

## **Palaeobotany**

1. Fossils: - 1.1 Definition, Types and Mode of Preservation (Schoff 1975); 1.2 Conditions for fossilization; 1.3 Palaeopalynology - a brief idea about its application.
2. Geological time scale and major events of plant life through geological ages.
3. Indian Gondwana system with major mega-fossil assemblages.



## **Bibliography**

### **Bryophytes**

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3. Vashishta, B.R. .... Bryophyta [S. Chand & Co.]
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5. Chopra, R.N. & Kumar, P.K. .... Biology of Bryophyte [Wiley Eastern]
6. Puri, P. .... Bryophyte [Atmaram & Sons]

### **Pteridophytes**

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2. Vashishta, P.C. .... Pteridophyta [S. Chand & Co.]
3. Gifford, E.M. & Foster, A.S. .... Morphology and Evolution of Vascular Plants [Freeman & Co.]
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5. Ganguly, H.C. & Kar, A.K. \_ College Botany Vol. II [New Central Book Agency]

## **Gymnosperms**

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## **Palaeobotany**

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2. Andrews, Jr. H.N. ..... Studies in Paleobotany [John Wiley & Sons Inc.]
3. Stewart, W.N. & Rothwell, G.W....Paleobotany and evolution of plants [Cambridge  
University Press]
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5. Taylor, T.N. ..... Paleobotany-An introduction to fossil plant biology [McGraw Hill]
6. Meyen, S.V. ..... Fundamentals of Palaeobotany [Chapman & Hall]

**Paper - III Practical 50 Marks [5 hr.]**  
**(Code - 121103)**

1. Algae (work out) ..... 10 Marks
  2. Fungi (work out) ..... 10 Marks
  3. Microbiology (work out) ..... 6 Marks
  4. Plant Pathology (work out) ..... 6 Marks
  5. Identification..... [3 specimens x 3 marks each.]..... 9 Marks  
[Not more than one from Algae/Fungi/Lichen/Plant Pathology]
  6. Laboratory Note Books [No Slide]..... 4 Marks
  7. *Viva Voce* ..... [5 Qs. x 1 mark]..... 5 Marks
- [Laboratory Note Book (no slide submission) of each section, signed by the respective teachers with date, must be submitted at the time of examination]

**Algae**

1. [Work out] Staining (no permanent slide preparation), Free Hand Drawing and drawing under Drawing - Prism with Magnification of the following genera with reproductive structures - *Nostoc*, *Oedogonium* & *Vaucheria*.
2. Study from permanent slides of the following genera - *Gloeotrichia*, *Chara*, *Coleochaete*, Pennate diatom, *Laminaria* & *Polysiphonia*.

**Fungi & Lichen**

1. [Work out] Staining (no permanent slide preparation), Drawing and Microscopic Measurement of the following genera with reproductive structures - *Rhizopus* (asexual) & *Ascobolus*.
2. Study from permanent slides of the following - Zygosporangium of *Rhizopus*, Conidiophores & Conidia of *Penicillium*, conidia of *Fusarium* and trama, hymenium, subhymenium, basidia & basidiospores of *Agaricus* in the V. L. S. of gills.
3. Morphological study of foliose & fruticose Lichens, *Polyporus* and *Cyathus*.

**Microbiology**

1. [Work out] Preparation of NA, sterilization and sub-culturing
2. [Work out] Simple staining (Ziel's Carbol Fuchsin stain) from curd sample and Gram Staining from culture.

**Plant Pathology**

1. [Work out] Preparation of PDA and Czapek-Dox Agar (CDA), sterilization and sub-culturing.
2. [Work out] Isolation of pathogen from diseased leaf.
3. [Work out] Inoculation of fruit
4. Identification: - Pathological specimens (diseased plant) of Bacterial blight of rice and late blight of potato; Slides showing uredial, telial, pycnidial & aecial stages of *Puccinia graminis* (any variety).

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## **PART - II : 200 Marks**

### **Paper - IV Theoretical 100 Marks**

**(Code - 121104)**

- 1. Morphology & Palynology .....20 Marks [15 Periods]**
- 2. Taxonomy of Angiosperms .....50 Marks [45 Periods]**
- 3. Ecology & Plant geography .....30 Marks [25 Periods]**

#### **Morphology & Palynology**

1. Inflorescence: - 1.1 Types with examples; 1.2 Concept of advance and primitive types.
2. Flower: - 2.1 Types with examples; 2.2 Aestivation; 2.3 Floral parts – various types of Cohesion and Adhesion with examples; 2.4 Carpel – Types, advance and primitive types and Placentations.
3. Fruit: - Types with examples.
4. Palynology: - 4.1 Spore & Pollen; 4.2 Pollen wall – chemical nature, stratification & ornamentation; 4.3 NPC classification; 4.4 Basic concepts of Aeropalynology & Melissopalynology.

#### **Taxonomy of Angiosperms**

1. Introduction: - 1.1 Components and Objectives of Plant Systematics; 1.2 Alpha and Omega Taxonomy; 1.3 Data source in plant taxonomy – anatomy, cytology, Phytochemistry, Palynology etc. 1.4 Phases and Functions of taxonomy; 1.5 Phenetics – Definition, Character-state, Phenogram and OTU; 1.6 Cladistics – Definition, Cladogram, concept of monophyletic, polyphyletic & paraphyletic groups; 1.7 Plesiomorphy & Apomorphy; 1.8 Principles of Parsimony.
2. Nomenclature: - 2.1 Elementary knowledge of ICBN [Vienna code 2005 (updated 2006-07)] – Principles, Valid names [Binomial, Authors' Citation, Legitimate & Correct names, Homonym, Basionym, Autonym, Synonyms], Typification, Principle of Priority, Effective and Valid Publication, Retention and Rejection of names.
3. Herbaria & Botanical Gardens: - 3.1 Their Roles/Functions; 3.2 Important Indian Botanical Gardens & CNH-India;
4. Identification: - 4.1 Use of Floras, Monographs, Manuals and Dichotomous Keys.
5. Systems of Classification: - 5.1 Broad outline of the system [upto series/cohorts] of Bentham & Hooker (1863) with merits and demerits; 5.2 Cronquist's system (1988) [upto sub-class with characters & showing affinities] - with merits and demerits.
6. Diagnostic features, systematic positions (as in B&H, and Cronquist's system) and economically important plants (parts used & uses) of the following families:-

6.1 Dicotyledonous families – Magnoliaceae, Malvaceae, Leguminosae (subfamilies), Euphorbiaceae, Solanaceae, Verbenaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Apiaceae, Rosaceae, Cucurbitaceae, Rubiaceae & Asteraceae.

6.2 Monocotyledonous families – Alismataceae, Arecaceae, Poaceae, Liliaceae, Zingiberaceae & Orchidaceae.

## Ecology & Plant Geography

1. Plant and Environment: - 1.1 Niche (multidimensional, fundamental & realized niche); 1.2 Ecotype (Ecotone, Ecads & Ecoclines); 1.3 Microclimate.

2. Population Ecology: - 2.1 Unitary and Modular organisms, Ramets & Genets (clone); 2.2 Age pyramid; 2.3 Population growth (density dependent & independent); 2.4 Carrying capacity; 2.5 Simple population growth models (difference & logistic equations).

3. Community Ecology: - 3.1 Plant succession (primary & secondary) and Seral stages (with reference to Hydrosere); 3.2 Autogenic and Allogenic succession; 3.3 , , - diversity & diversity index (Simpson index)

4. Conservation: - 4.1 Biodiversity hot spots in India; 4.2 *in situ* & *ex situ* - conservation, seed bank and Cryopreservation.

5. Plant Geography: - 5.1 Phytogeographical regions in India (Chatterjee 1960); 5.2 Dominant flora of Eastern Himalayas, and Sunderban; 5.3 Endemism - types & factors; 5.4 Geographical Information System (GIS) - a brief idea.

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2. Nair, P.K.K. .... Pollen Morphology of Angiosperms [Scholar Publication]

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Publishers]
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  3. Sukla, R.S. & Chandal, P.S. .... Plant Ecology [S. Chand & Co.]
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  6. Dhaliwal, G.S., Sangha, G.S and Ralhan, P.K .....Fundamentals of Environmental  
Sciences [Kalyani Pub.]
  7. Asthana, D.K and Asthana M. .... Environmental Problems and Solutions  
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  8. Cox, C.B & Moore, P.D ..... Biogeography –An Ecological and Evolutionary  
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  9. Mani, M.S. .... Biogeography of India [Springer-Verlag]
  10. Mitra, D., Guha, J. & Chowdhury, S.K..... Studies in Botany Vol. II  
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## Paper - V Theoretical 50 Marks (Code - 121105)

1. Anatomy & Embryology .....25 Marks [25 Periods]  
2. Biochemistry .....25 Marks [25 Periods]

### Anatomy & Embryology

1. Cell Wall & Stele: - 1.1 Ultrastructure, chemical composition and functions of Cell wall and middle lamella; 1.2 Ontogeny of Trachea and Sieve tube; 1.3 Types & Evolution of Stellar forms; 1.4 Concept of Floral Anatomy.
2. Stomata: - 2.1 Types of Stomata (Metcalf and Chalk, Stebbins and Khush).
3. Cambium: - 3.1 Distribution & structure; 3.2 Secondary growth.
4. Specialized Growth & Tissue organization: - 4.1 Mechanical Tissues and their distribution; 4.2 Anomalous secondary growth – in the stems of *Bignonia*, *Boerhaavia*, *Tecoma* and *Dracaena*, -and in the root of *Tinospora*; 4.3 Parastichy, Plastochrone & Leaf – trace.
5. Development: - 5.1 Organization of Shoot Apex and Root Apex (Tunica-Corpus & Körper-Kappe); 5.2 Floral Meristem and Ontogeny of Floral Parts (Primary concept).
6. Embryology: - 6.1 Sporogenesis & Gametogenesis – 6.1.1 Microsporogenesis & Microgametogenesis; 6.1.2 Megasporogenesis & Megagametogenesis (monosporic – 8 nucleate type); 6.2 Fertilization; 6.3 Development of Embryo in *Capsella bursa-pastoris* (Brassicaceae); 6.4 Development of Endosperms.

### Biochemistry

1. Fundamentals: - 1.1 Covalent, non - covalent & hydrogen bonds, van der Waals interactions; 1.2 Structure & properties of water; 1.3 pH and buffer, Henderson - Hasselbalch equation; 1.4 Isoelectric point.
2. Biomolecules: - 2.1 Nucleic acids - nucleosides, nucleotides, oligo- & poly - nucleotides, different forms of DNA and RNA, nucleic acids derivatives; 2.2 Proteins - structure and classification of amino acids; Primary, Secondary, Tertiary & Quaternary structures of proteins; 2.3 Carbohydrates - structures of mono- , di-, oligo-& poly- saccharides; stereoisomers, enantiomers, epimers and anomers; sugar derivatives; 2.4 Lipids - structures of triglycerides, phospholipids and glycolipids; saturated and unsaturated fatty acids.
3. Bioenergetics and oxidation-reduction reaction: - 3.1. Laws of thermodynamics, 3.2 Open and closed system; 3.3 Exergonic and endergonic reactions; 3.4 Standard free energy ( $G^{\circ}$ ) change and actual free energy ( $G$ ) change; 3.5 Relation between  $G^{\circ}$  and  $K$  eq; 3.6 Coupling of biochemical reaction (with example) and its significance;

3.7 Energy rich bond with reference to ATP; 3.8 Electromotive force, half-reaction and conjugate redox pair; 3.9 Standard reduction potential ( $E^{\circ}$ )

4. Enzymology: - 4.1 Definition, mechanism of action (lock and key, and induced fit hypothesis) and classification (only major groups - according to IUBMB); 4.2 Basics - Co-factor, coenzyme, prosthetic group, apoenzyme, holoenzyme, active site, activation energy, rate equation, rate constant and first order reaction; 4.3 Allosteric regulation with example; 4.4 Enzyme kinetics - steady state, velocity, and equilibrium, Michaelis-Menten equation and Lineweaver-Burk plot, and enzyme inhibition.

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### **Anatomy**

1. Esau, K. .... Plant Anatomy [Wiley Eastern]
2. Fahn, A. .... Plant Anatomy [Pergamon press]
3. Mauseth, J.D. .... Plant Anatomy [Benjamin Cummings Publications]
4. Foster, A.S. .... Practical Plant Anatomy [D. Van Nestland Co.]
5. Ganguly, H.C. & Kar, A.K. .... College Botany Vol. I [New Central Book Agency]

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### **Embryology**

1. Maheswari, P. .... An Introduction to the Embryology of Angiosperms [Tata McGraw Hill]
2. Bhojwani, S.S. & Bhatnagar, S.D. .... The Embryology of Angiosperms [Vikas Publishing House]

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### **Biochemistry**

1. Voet, D. & Voet, J.G. .... Biochemistry [John Wiley]
  2. Conn, E.E., Stumpf, P.K., Bruening, G. & Doi, R.H. .... Outlines of Biochemistry [John Wiley & Sons]
  3. Lehninger, A.L., Nelson, D.L. & Cox, M.M. .... Principles of Biochemistry [CBS]
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  5. Goodwin, T.W. & Mercer, E.I. .... Introduction to Plant Biochemistry [Oxford: Pergamon]
  6. Lea, P.J. & Leegwood, R.C. .... Plant Biochemistry and Molecular Biology [John Wiley]
  7. Berg, J.M., Tymoczko, J.L. & Stryer, L. .... Biochemistry [Freeman Publ.]
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**Paper - VI Practical 50 Marks [5 hr.]**  
(Code - 121106)

<u>Topics</u>	<u>Marks</u>
1. Angiosperms (work out).....	10
2. Anatomy (work out- double staining).....	10
3. Plant recognition (Angiosperm) [genus 1+species 1+family 1].....	3
4. Identification ..... [4 specimens x 3 marks each].....	12
[From Bryophyta/ Pteridophyta/ Gymnosperms/ Palaeobotany/ Anatomy: - Not more than two from any group]	
5. Laboratory Note Books & Slides .....	4
6. Field records .....	4
7. Herbarium .....	3
8. <i>Viva Voce</i> .....[4 Qs. x 1 mark each] .....	4
{2 Local Excursions, a visit to the BSI/CAL and One Excursion to a Different Phyto-Geographical Region - are all compulsory}	
[Field records, Laboratory Note Book of each section, Herbarium sheets <u>[only angiospermic weeds- at least 20 sheets]</u> , signed by the respective Teachers with date, and Slides, must be submitted at the time of examination]	

### Angiosperms

- [Work out] Identification of the Genus, with drawings, description, floral diagram, floral formula and identifying characters, of the wild plant specimens from the following families - **Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Verbenaceae, Scrophulariaceae, Acanthaceae, Lamiaceae and Rubiaceae.**
- Plant recognition** - Names & Families of the specimens from the angiospermic families included in the theoretical syllabus.

### Anatomy

- [Work out] Microscopic studies on - Types of Stomata, Sclereids, Raphides, Cystolith, Aleurone grains, Laticiferous ducts and oil glands.
- [Work out] Staining, Preparation of permanent slides and study of Anomalous secondary structures - in the stems of ***Bignonia, Boerhaavia & Dracaena***, and in the root of ***Tinospora***.

### Bryophytes

- External Morphology (macroscopic - from preserved specimens) of the gametophyte plant body and Internal Morphological (microscopic - from permanent slides) study of the features given in parentheses, in the genera as - ***Riccia*** (V.T.S. of Thallus showing Antheridia/ Archegonia/ Sporophyte), ***Marchantia*** (L.S. of gemma cup/ Antheridiophore/ Archegoniophore), ***Anthoceros*** (L.S. of sporophyte) and ***Funaria*** (L.S. of capsule)

## **Pteridophytes**

1. External Morphology (macroscopic - from preserved specimens) of the sporophyte plant body and Internal Morphological (microscopic - from permanent slides) study of the features found in the conditions / preparations given in parentheses, in the genera as - *Psilotum* (T.S. of synangium), *Lycopodium* (L.S. of strobilus), *Selaginella* (L.S. of strobilus), *Equisetum* (L.S. / T.S. of strobilus), *Ophioglossum* (L.S. of spike), *Dryopteris* (V.T.S. of fertile pinnule through sori) and *Marsilea* (H.L.S. / V.L.S. of sporocarp).

## **Gymnosperms**

1. Morphological and Anatomical study (from preserved specimens and permanent slides) of different parts of certain genera as stated in the following - *Cycas* (Megasporophyll, Microsporophyll & L.S. of Ovule), *Pinus* (Male Cone, Female Cone and their L.S. views) and *Gnetum* (Male and Female Cones, and L.S. of male cone and Ovule).

## **Palaeobotany**

1. Morphological study of *Ptilophyllum* and *Glossopteris* leaf fossils.

2. Study from slides - T.S. views of the stems of *Rhynia*, *Lepidodendron*, *Calamites*, *Lyginopteris* and *Cordaites*.

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## **PART - III : 400 Marks**

### **Paper - VII Theoretical 100 Marks (Code - 121107)**

- 1. Plant Physiology ..... 60 Marks [50 Periods]**
- 2. Pharmacognosy.....20 Marks [15 Periods]**
- 3. Plant Biotechnology.....20 Marks [15 Periods]**

#### **Plant physiology**

1. Plant water relations: - 1.1 Water transport - short distance transport by diffusion (Fick's law) & long distance transport by mass flow; 1.2 Components of water potential - osmotic potential (Van't Hoff equation), pressure potential, relation between cell water potential with its components and relative cell volume (Hoffler diagram), cell water potential and its components; 1.3 Absorption by roots - apoplastic, symplastic & transmembrane pathways; 1.4 Ascent of sap - tensile strength of water & cohesion - tension theory, role of air-water interface in the development of transpiration pull, Cavitation.

2. Transpiration: - 2.1 Stomata - micellation of guard cell; 2.2 Role of CO<sub>2</sub>, K<sup>+</sup> - ion, sucrose, blue light & abscisic acid in stomatal movement; 2.3 Antitranspirant.

3. Membrane Transport: - 3.1 Transport proteins - channels and carriers; 3.2 Primary active transport (electrogenic pump) and secondary active transport (symport & antiport).

4. Phloem Transport: - 4.1 Source & Sink; 4.2 Phloem loading & unloading, and composition of phloem sap; 4.3 Mass flow hypothesis.

5. Photosynthesis: - 5.1 Pigments - Structure of chlorophyll a & b, importance of carotenoids, and nature of phycobilins and anthocyanins; 5.2 Photobiology - Absorption and Action spectra, Red drop & Emerson effect, Photosystems & Photochemical reaction centers, Water splitting, and Cyclic and non-cyclic Photophosphorylation; 5.3 Calvin cycle and Photorespiration (mechanism & significance); 5.4 C<sub>4</sub> cycle (an out line), and efficiency of C<sub>3</sub> & C<sub>4</sub> plants; 5.5 CAM and its ecological significance.

6. Respiration: - 6.1 Glycolysis & its significance, and synthesis of acetyl Co-A; 6.2 Krebs cycle and its significance; 6.3 Oxidative pentose phosphate pathway and its significance; 6.4 Electron Transport System and Mechanism of Oxidative Phosphorylation; 6.5 P/e ratio; 6.6 Stoichiometry of glucose oxidation.

7. Nitrogen metabolism: - 7.1 Nitrogen fixing organisms and process of nodule formation; 7.2 Biochemistry of N<sub>2</sub> - fixation; 7.3 Amino acid biosynthesis (by GS-GOGAT, Transamination and direct amination); 7.4 Nitrification, nitrate assimilation and denitrification; 7.5 A general idea about *nif* and *nod* genes.

8. Growth regulators: - 8.1 Source, chemical nature, structure and role of - auxins, gibberellins, cytokinins, ethylene and abscisic acid; 8.2 Biosynthesis of IAA; 8.3 Signal Transduction pathway; 8.4 G-proteins, Ca<sup>2+</sup>-ion & Calmodulin: 8.5 Mode of action of GA<sub>3</sub>.

9. Photomorphogenesis: - 9.1 Definition with example; 9.2 Photoreceptors, chemical composition of phytochrome, photostationary state and active form of phytochrome and photoreversibility.

10. Photoperiodism: - 10.1 Classification of plants, on the basis of 'Critical day length', with examples; 10.2 Importance of dark period in flowering and phytochrome control of flowering; 10.3 Photoperiodic stimulus and translocation of floral hormone; 10.4 Florigen concept; 10.5 Vernalization.

11. Dormancy: - 11.1 Concept of bud & seed dormancy; 11.2 Factors causing seed dormancy and method of breaking seed dormancy.

## **Pharmacognosy**

1. General account: 1.1 Pharmacognosy and its importance in modern medicine; 1.2 Crude drugs; 1.3 Pharmacological and chemical classification of drugs; 1.4 Drug evaluations - (Definitions with examples of the following) - organoleptic, microscopic, chemical & physical; 1.5 Bioassay of drug - Definition and examples.

2. Secondary metabolites of plants: - 2.1 Definitions of, and difference in between, Primary and Secondary Metabolites; 2.2 Secondary metabolites and plant protection; 2.3 Utilization of major types of metabolites as drug - phenolics & quinones, terpenoids, flavonoids and alkaloids.

3. Active constituents: - Source plants, parts used, chemical nature & uses of the following - 3.1 Glycosidic anthraquinone (Barbaloin); 3.2 Tannic acid derivative (Catechin); 3.3 Resins (Gingerol, Curcuminoids); 3.4 Steroids (Diosgenin, Digitoxin); 3.5 Alkaloids (Emetine, Caffeine, Quinine, Strychnine, Reserpine, Vinblastine).

## **Plant Biotechnology**

1. Plant Tissue Culture: - 1.1 Cellular Totipotency; 1.2 Tissue culture media; 1.3 Methods of sterilization; 1.4 Methods and applications of Callus and Cell Suspension culture; 1.5 A brief idea about Organogenesis and Somatic Embryogenesis; 1.6 Factors affecting organ induction; 1.7 Artificial seeds.

2. Other Culture Techniques: - 2.1 Methods and applications of Embryo culture; 2.2 Techniques of Pollen and Haploid culture and their applications; 2.3 Protoplast isolation and culture; 2.4 Protoplast fusion (somatic hybridization) and its importance.

3. Micropropagation: - 3.1 Definition and applications.

4. Recombinant DNA Technology:- 4.1 Restriction Endonucleases (Definition and examples), 4.2 Cloning Vector (pBR322), 4.3 Genomic and cDNA library.

5. Genetic Engineering: - 5.1 Brief idea about gene transfer methods with special reference to Ti Plasmid; 5.2 Transgenic plants and their importance.

## **Bibliography**

### **Plant Physiology**

1. Taiz, L & Zeiger, E. .... Plant Physiology [Sinauser Associates Inc. Publishers]
  2. Wilkins, M.B. .... Advanced Plant Physiology [ELBS, Longman]
  3. Hopkins, W.G. & Hüner, M.P. ....Introduction to Plant Physiology  
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  4. Salisbury, F.B. & Ross, C.W. ....Plant Physiology [Wordsworth Publ. Co.]
  5. Mukherji, S. & Ghosh, A. .... Plant physiology [New central Book Agency]
  6. Pandey, S.N & Sinha, B.K. .... Plant Physiology [Vikas Publ. House]
  7. Verma, S.K ....A Text book of Plant Physiology & Biochemistry [S. Chand & Co.]
  8. Sinha, R.K. .... Modern Plant Physiology [Narosa Publishing House]
  9. Hall, D.O & Rao, K.K. .... Photosynthesis [Cambridge Publishing House]
  10. Singhal, G.S. ....Concepts Photobiology, Photosynthesis & photomorphogenesis  
[Narosa Publishing House]
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1. Wallis, T.E. .... Text Book of Pharmacognosy [CBS Publishers....]
  2. Evans, W.C..... (G.E. Trease & W.C. Evans') Pharmacognosy [Saunders]
  3. Melentyeva, G. & Antonova, L. ....Pharmaceutical Chemistry [MIR Publishers]
  4. Beckett, A.H. .... Practical Pharmaceutical Chemistry [CBS Publishers.....]
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1. Razdan, M.K. .... An Introduction to Plant Tissue Culture [Oxford & IBH]
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[Elsevier]
  3. Dixon, R.A. & Gonzales. M.K. .... Plant Cell Culture: A Practical Approach  
[Oxford Univ. Press]
  4. Dubey, R.C. .... Biotechnology [S. Chand & Co.]
  5. Balasubramanian, D. et al ..... Concepts in Biotechnology [Universities Press]
  6. Channarayappa ..... Molecular Biotechnology: Principles and Practices  
[Universities Press]
  7. Gamborg, O.L. & Philips, G.C. .... Plant Cell, Tissue and Organ Culture -  
Fundamental Method [Narosa Publications]
-

**Paper - VIII Theoretical 100 Marks**  
**(Code - 121108)**

- 1. Cell Biology ..... 25 Marks [20 Periods]**
- 2. Genetics & Molecular Biology .....55 Marks [45 Periods]**
- 3. Plant Breeding & Biometry .....20 Marks [15 Periods]**

**Cell Biology**

- 1. Microscopy: - 1.1 Brief knowledge about microscopy (light, Phase contrast, TEM, SEM, Immunofluorescence and confocal) 1.2 Resolving power.
- 2. Origin and Evolution of cells: - 2.1 Ribozyme and RNA world; 2.2 The first cell; 2.3 Origin of Eukaryotic cell; 2.4 Organellar DNA (cp- & mt- DNA).
- 3. Cell Membrane: - 3.1 Ultrastructure and function; 3.2 Endomembrane system and Cytoskeleton; 3.3 Cellular Organelles - Mitochondria, Plastid and Golgi apparatus.
- 4. Nucleus and Chromosome: - 4.1 Ultrastructure of Nuclear pore complex; 4.2 Nucleolus ultrastructure and ribosome biogenesis; 4.3 Eukaryotic chromosome - chromatin organization and DNA packaging, euchromatin and heterochromatin; 4.4 Karyotype concept and its parameters; 4.5 Brief knowledge of chromosome banding (C, G, & Q) and its application.
- 5. Cell Cycle & its Regulation: - 5.1 Meiotic cell division and its significance; 5.2 structure & Functions of Centromere, Kinetochores & Spindle apparatus; 5.3 Structural organization & function of Telomere; 5.4 Dynamics of chromosome movement in anaphase; 5.5 Mechanism of cell cycle control in yeast (role of MPF); 5.6 Apoptosis (Preliminary idea).

**Genetics & Molecular Biology**

- 1. Inheritance: - 1.1 Mendelian basis of inheritance and Gene Interaction; 1.2 Epistasis; 1.3 Cytoplasmic inheritance; 1.4 Sex determination; 1.5 Sex linked inheritance.
- 2. Linkage, Crossing over and Gene mapping: - 2.1 Complete and incomplete linkage & linkage group; 2.2 Molecular mechanism of crossing over (Holliday Model) and Detection of crossing over (McClintock's experiment); 2.3 Gene mapping (Three point test cross); 2.4 Molecular mapping- FISH and GISH (brief idea),
- 3. Ploidy: - 3.1 concept and examples; 3.2 Aneuploidy and Polyploidy - types, examples, meiotic behavior and importance.
- 4. Chromosomal aberration: - 4.1 Definition and Factors responsible; 4.2 Types, meiotic behavior and significance of Deletion, Duplication, Translocation and Inversion.

5. Mutation: - 5.1 Definition and Types (Spontaneous, Induced, Point, Transition, Transversion and Frame-Shift); 5.2 Mutagens; 5.3 Mode of action of alkylating agents.

6. DNA Replication & Protein Synthesis: - 6.1 Semiconservative replication (Meselson & Stahl experiment); 6.2 Central dogma; 6.3. Transcription and Translation.

7. Structural organization and sequence complexity of gene: - 7.1 One Gene- one Polypeptide concept; 7.2 Split gene, Homoeotic gene (*Arabidopsis* - MADS box) and overlapping gene; 7.3 Repetitive DNA & Transposon (Ac-Ds element).

8. Gene Regulation: - 8.1 Concept of Lac operon; 8.2 Positive and negative controls; 8.3 Regulation of gene expression in eukaryotes.

9. Genetic Code: - 9.1 Properties and Decipherance of code.

10. Bioinformatics: - 10.1 Preliminary knowledge about bioinformatics; 10.2 Genetic data base; 10.3 Brief idea of Genomics and Proteomics.

## **Plant Breeding and Biometry**

1. Introduction: - 1.1 Aim and Objective of plant breeding.

2. Methods of plant breeding:- 2.1 Methods of Hybridisation - Mass selection, Pureline selection; Bulk method and Pedigree method, Male sterility and its use; 2.3 Back cross and Test cross; 2.4 Heterosis; 2.5 Maintenance of germplasm.

3. Biometry: - 3.1 Terms& Definitions- Sample and Populations, random sampling, Quantitative & Qualitative variables and frequency distribution; 3.2 Central tendency (Arithmetic Mean, Mode, & Median); 3.3 Measurement of Dispersion- standard deviation and standard error of mean; 3.4 Analysis of correlation coefficient; 3.5 Test of significance- Null hypothesis and test for Goodness of Fit; 3.6 Probability (addition and multiplication rules); 3.7 Measurement of gene frequency (Hardy-Weinberg equilibrium).

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### **Cell Biology**

1. De Robertis, E.D.P. & De Robertis, E.M.M. ....Cell and molecular Biology [Waverly Pvt. Ltd. for Lea & Fabiger]
2. Powar, C.B. .... Cell Biology [Himalaya Publishing House]
3. Cooper, G.M. .... The Cell - A Molecular Approach [ASM Press]
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6. Karp, G.....Cell and Molecular Biology: Concepts and Experiments [John Wiley & Sons. Inc]

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## Genetics & Molecular Biology

1. Watson, J.D. et al. Molecular Biology of the Gene [Benjamin/Cumming Publ. Co.]
2. Gardner, E.J., Simmons, M.J. & Snustad, D.P...Principles of Genetics [John Wiley]
3. Gupta, P.K. .... Genetics [Rastogi Publications]

5. Lewin, B. ....	Genes (any one: - VI or VII or VIII or IX) [Oxford University Press]
6. Weaver, R.F. & Hedrick, .....P.W	Genetics [WCB Publications]
7. Stent, G.S. & Calendar, . ...R	Molecular Genetics-An Introductory Narrative [CBS]
8. Freifelder, D. ....	Molecular Biology [Narosa Publishing House]
9. Russell, P.J. ....	iGenetics [Benjamin / Cumming Publ. Co.]
10. Klug, W.S. & Cummings, .....M.R	Concept of Genetics [Prentice Hall]

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### **Plant Breeding & Biometry**

1. Chawdhuri, H.K. ....	Elementary Principles of Plant Breeding [Oxford & IBH]
2. Allard, R.W. ....	Principles of Plant Breeding [John Wiley]
3. Poehlman, J.M. & .....Barthakur, D	Plant Breeding [Oxford & IBH]
4. Singh, B.D. ....	Plant Breeding: Principles and Methods [Kalyani Publishers]
5. Bailey, N.T.J. ....	Statistical Method in Biology [Cambridge University Press]
6. Sokal, R.R. & Rohlf, . ....F.J	Introduction to Biostatistics [W H Freeman]

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**Paper - IX Practical 100 Marks [6 hr.]**  
**(Code - 121109)**

1. Plant Physiology (Major & Minor) ..... 30 Marks
  2. Biochemistry (Qualitative & Quantitative)..... 35 Marks
  3. Pharmacognosy (Two Experiments) ..... 15 Marks
  4. Laboratory Note Books ..... 10 Marks
  5. *Viva Voce* ..... 10 Marks
- [Laboratory Note Book of each section, signed by the respective Teachers with date, must be submitted at the time of examination]

**Plant Physiology**

**Major [20 marks]**

1. Determination of stomatal frequency and rate of transpiration per stomata per hour.
2. Rate of photosynthesis under varying  $\text{HCO}_3^-$  concentration (using bicarbonate) in an aquatic plant to find out the optimum and toxic concentration.
3. Measurement of oxygen uptake by respiring tissue (per gram / hr.)- By germinating seeds.
4. Determination of R.Q. of germinating seeds.
5. Measurement of osmotic pressure of storage tissue by weighing method.
6. Measurement of osmotic pressure in the leaf cells of *Rhoeo discolor* by plasmolytic method.

**Minor [10 Marks]**

1. Determination of stomatal frequency.
2. Relationship between evaporation and transpiration.
3. Extraction and detection of anthocyanins pigments from plants.
4. Separation of plastidial pigments by usual solvent system method.
5. Comparison of imbibitions of water by starchy, proteinaceous and fatty seeds.

**Plant biochemistry**

**A. Qualitative [15 Marks]**

1. Detection of organic acids - citric, oxalic, malic & tartaric from laboratory samples.
2. Detection of protein from plant samples.
3. Detection of nature of carbohydrate- glucose, fructose and starch from laboratory samples.
4. Detection of Ca, Mg, Fe and S from plant ash samples.

**B. Quantitative [20 Marks]**

1. Estimation of amino-nitrogen in an amino acid by formol titration method.
2. Estimation of glucose by Benedict's quantitative reagent.
3. Estimation of titrable acidity from lemon.
4. Estimation of catalase activity in plant samples.
5. Estimation of urease activity in plant samples.
6. Colorimetric estimation of protein using Folin-Ciocalteu phenol reagent.

## Pharmacognosy

### Major [10 marks]

1. **Chemical tests** for - (a) **Tannin** (from *Camellia sinensis* & *Terminalia chibula* - any two confirmatory tests), and (b) **Alkaloids** (**Caffeine** and **Quinine** from any drug - single test - by I<sub>2</sub> Soln. in KI added to the sample in acidic medium).

### Minor [5 Marks]

1. **Microscopic study** of powder (of parts used in drug) - *Zingiber officinale* and *Holarrhena antidysenterica*.

2. **Histo-chemical tests** of - (a) Curcumin (*Curcuma longa*), (b) Starch in non-lignified vessel (*Zingiber officinale*) and Alkaloids (in the stem of *Catharanthus roseus* and bark of *Holarrhena antidysenterica*)

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**Paper - X Practical 100 Marks [6 hr.]**  
**(Code - 121110)**

1. Study of Mitotic Chromosomes ..... 25 Marks
  2. Study of Meiotic Chromosomes ..... 15 Marks
  3. Study of Mitotic Index ..... 10 Marks
  4. Biometry ..... 15 Marks
  5. Identification..... [5 specimens x 3 marks each]..... 15 Marks  
(Specimens / Slides: - as prescribed in the syllabus)
  6. Laboratory Note Books & Slides ..... 10 Marks
  7. Viva Voce ..... 10 Marks
- [Laboratory Note Book of each section, signed by the respective Teachers with date, and Slides, must be submitted at the time of examination]

### **Study of Chromosomes & Mitotic Index**

1. Chromosome Preparation: - 1.1 Pretreatment, Fixation, Staining, Squash and Smear preparation; 1.2 Preparation of permanent slides.
2. Study of Mitotic Index: - 2.1 Determination of index and frequency of different mitotic stages (to be calculated from dividing cells) in normal pre-fixed growing root tips of *Allium cepa*.
3. Study of Mitotic Chromosomes: - 3.1 Metaphase chromosome preparation, free hand drawing and drawing under drawing prism (under oil-immersion lens); 3.2 Determination of 2n number and comment on chromosome morphology of *Allium cepa*, *Nigella sativa*, and *Lens culinaris*.
4. Study of Meiotic Chromosomes: - 4.1 Smear preparation of meiotic plates, identification and free hand drawing of different meiotic stages of *Allium cepa* flower bud.
5. Identification from permanent slides: - 5.1 Meiotic cells - normal stages, abnormal stages - laggards, anaphase bridge and ring chromosome (*Rhoeo discolor*); 5.2 Mitotic cells - Abnormal stages: early separation, late separation, multipolarity, sticky bridge, fragmentation and pollen mitosis.
6. Isolation of plant genomic DNA (from Rice or Mustard seedling).

### **BIOMETRY**

1. Determination of goodness of fit in normal and modified mono and dihybrid ratios (3:1, 9:7, 13:3, 1:1:1:1, 15:1, 9:3:3:1) by Chi-square analysis and comment on the nature of inheritance.
2. Univariate analysis of statistical data: Statistical tables, mean mode, median, standard deviation, and standard error (using seedling population/leaflet size).

