SCHEME OF EXAMINATION FOR B.Sc. Botany (Hons.) SEMESTER SYSTEM
w.e.f. Session 2010-11

S.No.	Paper Code	Nomenclature	Core(C)/ Subsidiary(S)	Marks	periods /week#	Exam. Duration
Semester I						
1.	101	Introduction to biology	c	45+5	4	3 hrs
1.	102	Algae and Microbiology	C	45+5	4	3 hrs.
2	103	Mycology and Phytopathology	C	45+5	4	3 hrs.
3	104	Chemistry I	S	45+5	3	3 hrs.
4	105	Zoology 1	S	45+5	3	3 hrs.
5	106	English *	S	45+5	3	3 hrs.
6	107	Practical (101 – 103)		50+50+50	12	3+3+3 hrs.
7	108	Practical (104-105)		50+50	6	3+3 hrs.
Semester II						
1	201	Diversity of Bryophytes and Pteridophytes	C	45+5	4	3 hrs.
2	202	Diversity of Gymnosperms	C	45+5	4	3 hrs.
3	203	Plant Development and Anatomy	C	45+5	4	3 hrs.
4	204	Chemistry II	S	45+5	3	3 hrs.
5	205	Zoology 11	S	45+5	3	3 hrs.
6	206	English*	S	45+5	3	3 hrs
6	207	Practical (201-203)		50+50+50	12	3+3+3 hrs.
7	208	Practical (204-205)		50+50	6	3+3hrs.
Semester III						
1	301	Cell Biology I	C	45+5	4	3 hrs.
2	302	Molecular Biology I	C	45+5	4	3 hrs.
3	303	Plant Resource Utilization	C	45+5	4	3 hrs.
4	304	Chemistry III	S	45+5	3	3 hrs.
5	305	Zoology III	S	45+5	3	3 hrs.
6	306	Practical (301-303)		50+50+50	12	6+6+3hrs.
7	307	Practical (304, 305)		50+50	6	3+3 hrs.
Semester IV						
1	401	Cell Biology II	C	45+5	4	3 hrs.
2	402	Molecular Biology II	C	45+5	4	3 hrs.
3	403	Ecology I	C	45+5	4	3 hrs.
4	404	Chemistry IV	S	45+5	3	3 hrs.
5	405	Computational Skills	S	45+5	3	3 hrs.
6	406	Practical (401-403)		50+50+50	12	6+6+3hrs.
7	407	Practical (404&405)		50+50	6	3+3 hrs.
Semester V						
1	501	Plant Systematics and evolution	C	45+5	4	3 hrs.
2	502	Plant Physiology	C	45+5	4	3 hrs.
3	503	Biostatistics	C	45+5	4	3 hrs.
4	504	Genetics and Genomics I	C	45+5	4	3 hrs.
5	505	Ecology II	C	45+5	4	3 hrs.
6	506	Practical (501-503)		50+50+50	12	3+6+3hrs.
7	507	Practical (504, 505)		50+50	6	6+3 hrs.
Semester VI						
1	601	Plant Metabolism and Biochemistry	C	45+5	4	3 hrs.
2	602	Reproductive Biology of Angiosperms	C	45+5	4	3 hrs.
3	603	Plant Biotechnology	C	45+5	4	3 hrs.
4	604	Genetics and Genomics II	C	45+5	4	3 hrs.
5	605	Tools and Technique	C	45+5	4	3 hrs.
6	606	Practical (601-603)		50+50+50	12	6+3+6 hrs.
7	607	Practical (604-605)		50+50	6	6+3 hrs.
Grand Total Semester I – VI(Core subjects)				2200		

Note: - There will be an internal assessment, in each theory paper, inclusive of 10% of total marks i.e. 45+5

#1 period= 45minutes

* The syllabus of B.Sc 1st and 2nd yr Pass Course is applicable for this session only i.e 2010-11

SYLLABUS FOR B.Sc. BOTANY (Hons.)

Semester I

PAPER 1 –BOT 101

INTRODUCTION TO BIOLOGY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1: Biological systems, evolution and biodiversity

a. Introduction to concepts of biology Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of
Science; Biology and everyday life

b. Evolutionary history of biological diversity Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution;Phylogeny and the tree of life, classifying the diversity of life, Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

Unit 2: Darwinian view of life and origin of species Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation, Genetic approach to Biology Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

Unit 3: Chemical context of living systems

Chemistry of life, the constituents of matter; Structure of an atom; the energy level of electron; the formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

Water and life , water molecule is polar; Properties of water; Ionization of water

Unit 4:

Carbon and life Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds, Structure and function of biomolecules , most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

PRACTICALS

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes

4. Separation of A) amino acids B) chloroplast pigments by paper chromatography.
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To separate and quantify sugars by thin layer chromatography.
9. To raise the culture of *E. coli* and estimate the culture density by turbidity method. Draw a growth curve from the available data.
10. Isolation of genomic DNA from *E.coli*.

SUGGESTED BOOKS

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

PAPER 1 –BOT 102
ALGAE AND MICROBIOLOGY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; and methods of reproduction, classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in ecosystem; aquaculture, industry, biotechnology, agriculture.

Unit II

Cyanophyta

Ecology and distribution; thallus organization; cell structure; chromatic adaptation; physiology; reproduction; economic importance; role in biotechnology; morphology and life cycle of *Nostoc*

Chlorophyta

General characteristics; range of thallus organization; pigment systems; methods of reproduction; evolutionary significance of *Prochloron;* morphology and life cycles of *Chlamydomonas, Volvox, Oedogonium, Coleochaete*

Charophyta

General characteristics; morphology and life cycle of *Chara;* fossils, evolutionary significance

Xanthophyta

General, characteristics; range of thallus organization; methods of reproduction; morphology and life cycle of *Vaucheria*

Phaeophyta

General characteristics; range of thallus structure; methods of reproduction; morphology and life cycles of *Ectocarpus* and *Fucus.*

Rhodophyta

General characteristics; range of thallus organization; methods of reproduction; morphology and life cycles of *Polysiphonia*

Unit III

Introduction to microbial world, microbial nutrition, growth and metabolism.

Virus : Discovery, physiochemical and biological characteristics;Classification; replication, lytic and lysogenic cycle ; special types: DNA virus (coliphage T-2), RNA virus (TMV). Economic importance; Symptoms, Transmission and management of diseases caused by viruses on plants.

Bacteria- general characteristics, comparison of Archaebacteria and Eubacteria , Wall-less forms (L
forms, Mycoplasma and sphaeroplasts), cell structure, nutrition; reproduction: vegetative, asexual,
sexual (conjugation, transformation , transduction), Economic importance**.**

Unit IV

Microbial culturing technique, culture media, and microbial growth, microbes used in agriculture,
mycorrhizae, environmental management and industry, Indian Institutes and their research activities
in microbiology

CORE PRACTICALS

1. Study of the vegetative and reproductive structures in *Nostoc, Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara, Vaucheria,* Bacillariophyta, *Ectocarpus, Fucus, Polysiphonia,*
Procholoron through, EM, temporary preparations and permanent slides.
2. EMs/models of viruses and virus infected plants.
3. Types of bacteria from temporary/permanent slides/EM. Study of bacterial infected plants and Root nodules. Gram staining.

SUGGESTED READINGS

1. Bold, H.C. & Wayne, M.J. 1996 (2nd Ed.) Introduction to Algae.
2. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press.
3. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.
4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-west Press Pvt ltd., Delhi.
5. Pelczar, M.J. (2001) Microbiology, 5th Edition, Tata Mc Graw-Hill Co, New Delhi.
6. Presscott, L. Harley, J. and Klein, D. (2005) Microbiology, 6th Edition, Mc Graw-Hill Co. New Delhi.

PAPER 2 BOT 103
MYCOLOGY AND PHYTOPATHOLOGY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Definition; Why study fungi? General characteristics; Ecology and Distribution; Thallus organization; EM of haustorium and septum; Wall composition; Nutrition; Growth; Reproduction and spores; Heterokaryosis and parasexuality; Sexual compatibility; Life cycle patterns. Role of fungi in biotechnology, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit 2:

Myxomycota

Introduction, Occurrence; Importance (*Physrum* as an experimental tool); General characteristics; Thallus organization; Reproduction. **Oomycota** General characteristics; Ecology; Significance; Thallus organization; Reproduction; Classification; Generalized life cycle of the class with special emphasis on the reproductive structures of *Phytophthora, Albugo*. **Zygomycota** General characteristics; Ecology; Significance; Thallus organization; Reproduction; with special reference to *Rhizopus.* **Ascomycota** General characteristics; Ecology; Significance; Thallus organization; Reproduction; Classification with special reference to Yeasts (S*accharomyces),Eurotium (Aspergillus), Penicillium,* General account of Powdery mildews*, Neurospora, Peziza.* **Basidiomycota** General characteristics; Ecology; Significance; Thallus organization; Reproduction; Classification with special reference to Wheat Rusts (*Puccinia),* Loose & Covered Smuts.

Unit III

Mushrooms (*Agaricus)*; Mushroom cultivation**. Deuteromycota** General characteristics; Ecology, Significance; Thallus organization; Reproduction; Classification with special reference to *Alternaria,* and *Colletotrichum.* **Lichens**; Occurrence,General Characteristics; Growth forms and range of thallus organization; Nature of association of algal and fungal partners; Reproduction; Ecological significance; Applied importance.

Unit IV

Introduction: Definition; Importance; Terms and Concepts; Classification; Causes; Symptoms; Host-Pathogen relationships Geographical distribution of diseases; etiology; symptomology; disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.

CORE PRACTICALS

1. Study of Phaneroplasmodium from actual specimens and/or photograph. Study of *Physarum* sporangia.
2. Study of symptoms of plants infected with *Albugo*; asexual and sexual structures of through sections/tease mounts and permanent slides.
3. *Rhizopus:* Students to culture Black bread mould in the laboratory to study asexual stage from temporary mounts. Sexual stages of mould to be studied from permanent slides.
4. *Aspergillus* and *Penicillium* : *as*exual stages from tease mounts.
5. *Neurospora*: Asexual and sexual stage from culture/permanent slides/ photographs.
6. *Peziza*: Habit; sectioning through ascocarp, and permanent slides.
7. *Puccinia*: Herbarium specimens of Wheat Rusts- (Black, Brown and Yellow) and infected barberry leaves; section/tease mounts of spores on wheat, and permanent slides of both the hosts.
8. Mushrooms: Specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus,* study of basidiocarp from permanent slides; Photograph of fairy ring, edible and poisonous fungi (two each), bioluminesecent mushroom to be shown.
9. Specimens/photographs and tease mounts of *Alternaria,* and *Colletotrichum.*

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10. Applied mycology: Photographs of Mycorrhizae, fungi used in medicine (*Cylindriocarpon, Tolyposporium, Ganoderma, Cephalosporium* – **any one**), fungi used as biological control agents (fungi used in control of seedling, soil borne, post harvest diseases and in control of nematodes, insects & weeds – **any one**), photographs / mounts of spores of fungi causing human infections along with pictures of patients suffering from such infections (*Aspergillus, Candida, Cryptococcus, Histoplasma, Microsporum, Trichophyton* – **any one**).
11. Study of growth forms of lichens (crustose, foliose, fruticose) **on different substrata**. Study of thallus and reproductive structures (soredia, apothecium) through permanent slides
12. White rust of Crucifers, Early & Late blight of potato, Herbarium/museum specimens of the diseased plants.

Students should submit six specimens of fungal growth at the time of examination.

SUGGESTED READINGS

1. Agrios, G.N. (1997) Plant Pathology, 4th Edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996) Introductory Mycology, 4th Edition, John Wiley and Sons (Asia) Singapore.
3. Singh, R.S. (1998) Plant Diseases. 7th Edition, Oxford & IBH, New Delhi.
4. Webster, J. and Weber, R. (2007) Introduction to Fungi. 3rd Edition, Cambridge University Press, Cambridge.
5. Wickens, G.E. (2004) Economic Botany: Principles and Practices, Springer. Klwer Publishers, Dordrecht, The Netherlands

PAPER 3 -BOT 104
CHEMISTRY-1

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Examiner will set three questions from each section. The candidate will be required to attempt five questions in all, selecting not more than two questions from each section. All questions carry equal marks.

THEORY

Section-A

Atomic Structure
Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge, Slater's rules.

Covalent Bond
Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7 SO_4^{2-}, ClO_4^-)Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, CIF_3, ICI_2^- and H_2O. MO theory of heteronuclear (CO and NO) diatomic molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Section-B

Gaseous States
Maxwell's distribution of velocities and energies (derivation excluded) Calculation of root mean square velocity, average velocity and most probable velocity. Collision diameter, collision number, collision frequency and mean free path. Deviation of Real gases from ideal behaviour. Derivation of Vander Waal's Equation of State, its application in the calculation of Boyle's temperature (compression factor) Explanation of behaviour of real gases using Vander Waal's equation.

Critical Phenomenon: Critical temperature, Critical pressure, critical volume and their determination. PV isotherms of real gases, continuity of states, the isotherms of Vander Waal's equation, relationship between critical constants and Vander Waal"s constants. Critical compressibility factor. The Law of corresponding states. Lequifaction of gases.

Liquid States
Properties of liquids – surface tension, viscosity and their determination.

Solid State
Liquid crystals: Difference between solids, liquids and liquid crystals,types of liquid crystals. Applications of liquid crystals.

Section-C

Structure and Bonding
Localized and delocalized chemical bond, resonance effect and its applications,

Stereochemistry of Organic Compounds
Concept of isomerism. Types of isomerism.

Optical isomerism — elements of symmetry, molecular chirality, enantiomers, , optical activity, , chiral and achiral molecules with two stereogenic centres, diastereomers,
Relative and absolute configuration, sequence rules, R & S systems of nomenclature.
Geometric isomerism — determination of configuration of geometric isomers. E & Z system of nomenclature,

Mechanism of Organic Reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions.
Reactive intermediates — carbocations, carbanions, free radicals,

Alkanes and Cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, methods of formation (with special reference to Wurtz reaction, Kolbe reaction).
Cycloalkanes — nomenclature, synthesis of cycloalkanes , dehalogenation of α,ω-dihalides.

PRACTICALS

Section-A (Inorganic)

Volumetric Analysis

1. **Redox titrations**: Determination of Fe^{2+}, $C_2O_4^{2-}$ (using $KMnO_4$, $K_2Cr_2O_7$)
2. **Iodometic titrations:** Determination of Cu^{2+} (using standard hypo solution).

Section-B (Physical)

1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetatecatalyzed by hydrogen ions at room temperature.
2. To determine the specific refractivity of a given liquid

Organic

1. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
   (i) Iodoform from ethanol (or acetone)

2. To study the process of) sublimation of camphor and phthalic acid

Distribution of marks

1.	Section I	12 marks
2.	Section II	12 marks
3.	Section III	12 marks
4.	Viva-voce	10 marks
5.	Lab Record	04 marks

Paper 4 BOT- 105

Zoology 1

BIODIVERSITY-I: NON-CHORDATA

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

: General account of Non-Chordates

UNIT 1

Protozoa General Characters and Reproduction in Protozoa.
Metazoa Origin of metazoan,
Porifera General characters and Structural organization of *Sycon.*
Cnidaria General Characters and Polymorphism in Cnidarians

UNIT I1

Platyhelminthes General Characters and *Fasciola:* Structure and life history
Aschelminthes General characters and Life history of *Ascaris* and its parasitic adaptations.

UNIT I1I

Annelida General Characters and Adaptive radiations in Polychaeta.
Arthropoda General Characters and Larval forms of crustacea; metamorphosis in Insecta

UNIT IV

Mollusca General characters and Torsion and detorsion
Echinodermata General characters and Water-vascular system and larval forms

PRACTICALS

Protozoa**:**

1. Examination of *Amoeba* , *Euglena, Paramecium, Ceratium, Noctiluca, and Vorticella.*

Porifera:

2. Study of *Sycon* (including T.S. and L.S.). *Euplectella;*
3. Temporary mounts of spicules, gemmules and spongin fibres.

Cnidaria:

4. Study of *Obelia, Sertularia, Millepora, Aurelia, and Metridium* (including T.S. and L.S).

Platyhelminthes:

5. Study of *Fasciola, Taenia,, Echinococcus;* life history and sections of *Fasciola* and *Taenia*

Aschelminthes:

6. Study of male and female *Ascaris* (including sections).

Annelida:

7. **Demonstrations through CD/charts etc:** digestive and nervous systems of earthworm.

8. **Temporary mounts:** Ovary, pharyngeal and septal nephridia of earthworm.
9. **Slides:** T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm.
10. **Specimens:** *Aphrodite, Heteronereis, Chaetopterus, Pheretima, Tubifex, Hirudinaria.*

Arthropoda:

11. **Demonstrations through CD/charts etc:** digestive and nervous systems of cockroach.
12. **Specimens/slides:** *Limulus* , spider, crustacean larvae, *Daphnia, Balanus, Sacculina, Cancer* , Eupagurus, *Scolopendra, Julus* , termite, louse, wasp, honeybee, silkmoth and *Peripatus.*

Mollusca:

13. **Demonstrations through CD/charts etc:** digestive system of *Pila* ; Temporary mounts- radula and gill of *Pila* .
15. **Specimens:** *Chiton, Dentalium, Unio, Ostrea, Teredo, Loligo, Sepia, Octopus* and *Nautilus.*

Echinodermata:

16. **Slides:** T. S. arm of *Pentaceros,* Echinoderm larvae.
17. **Specimens:** *Pentaceros, Ophiura, Echinus. Cucumaria, and Antedon.*

SUGGESTED BOOKS

1. Barnes, R.D. Invertebrate Zoology (1982) VI Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
3. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
4. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
5. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

PAPER 5 BOT 106
ENGLISH

SYLLABUS FOR B.Sc. BOTANY (Hons.)

Semester II

PAPER 1 BOT 201

Diversity of Bryophytes and Pteridophytes

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Characteristic features and life cycle patterns of Bryophytes. Classification; Habit and Habitat; Adaptations to land habit. Evolution of sporophyte. Ecological and Economic importance of Bryophytes.

Unit 2

Comparative account of Morphology and Anatomy of *Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria;* Reproduction and evolutionary trends in *Riccia, Marchantia* ,
Anthoceros and *Funaria* (developmental stages not included).

Unit 3

Characteristic features and life cycle patterns of Pteridophytes. **Evolutionary concepts in Pteridophytes:** Telome theory; Stelar evolution; Heterospory and seed habit Apogamy and Apospory. Ecological and Economic importance of Pteridophytes.

Unit 4

Comparative account of Morphology and Anatomy of *Rhynia, Psilotum, Selaginella, Equisetum, Pteris, Marsilea*; Reproduction and evolutionary trends in *Selaginella*; *Equisetum*; and *Pteris* (developmental details not included).

CORE PRACTICALS

Study of habit, Vegetative thallus organization and structure, reproductive structures of the following taxa: *Riccia, Marchantia, Pellia*, Porella*, Anthoceros, Sphagnum*, Funaria, Psilotum,*
*Selaginella, Equisetum, Marsilea, Pteris, Cycas, Ephedra, Gnetum** and through specimens, temporary mounts and permanent slides (Fresh material whichever available).
*Only through permanent slides

SUGGESTED READINGS

1. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
2. Raven, P.H., Johnson, G.B., Losos, J.B. and Singer, S.R. (2005) Biology. Tata MC Graw Hill.
3. Richardson, D.H.S. (1981) The Biology of Mosses. John Wiley and Sons, New York.
4. Sambamurty (2008) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
5. Shaw, A.J. and Goffinet, B. (2000) Bryophyte Biology. Cambridge University Press.
6. Vander-Poorteri (2009) Introduction to Bryophytes. COP.
7. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
8. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

Paper 2 BOT-202
Diversity of Gymnosperms

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

General account of fossils, techniques used to study fossil. Evolution of gymnosperms.
Classification and distribution of Gymnosperms in India. Contribution of Prof. Birbal Sahni.

Unit 2

Characteristic features and life cycle patterns of Gymnosperms. Patterns of variation in morphology of gymnosperms,. Ecological and Economic importance of Gymnosperms.

Unit 3

Morphology and anatomy of *Cycas, Pinus, Ephedra, Gnetum.*
Reproduction in *Cycas, Pinus, Ephedra, Gnetum,* (developmental stages
and EM studies not included).

Unit 4

Modern methods of propagation of gymnosperms: somatic embryogenesis, haploids and protoplast culture.

CORE PRACTICALS

Study of habit, structure and reproductive structures of `
temporary mounts and permanent slides (Fresh material whichever available).
*Only through permanent slides

SUGGESTED READINGS

1. Bhatnager, S.P. and Moitra, A. (1996) Gymnospersm. New Age International (P) Ltd. Publishers, New Delhi.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Raven, P.H., Johnson, G.B., Losos, J.B. and Singer, S.R. (2005) Biology. Tata MC Graw Hill.
4. Richardson, D.H.S. (1981) The Biology of Mosses. John Wiley and Sons, New York.
5. Sambamurty (2008) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
6. Bhatnagar SP and Mohitra A 1996 Gymnosperms. New Age Publishers, New Delhi

Paper 3 BOT - 203
PLANT DEVELOPMENT AND ANATOMY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Plant Sporophyte: A bipolar structure; Onset of polarity; Cytodifferentiation and organogenesis during embryonic development; physiological and genetic aspects. **Introduction and scope of Plant Anatomy:** Applications in systematics, forensics and pharmacognosy. **Tissues and Cell Walls:** Classification and structure of tissues; cytodifferentiation of tracheary elements and sieve elements; pits and plasmodesmata; wall ingrowths and transfer cells; adcrustation and incrustation; ergastic substances.

Unit 2

Leaf: Development of leaf, histology of C3 and C4 leaves; stomatal complex and diversity of stomata, scale leaves. **Stem:** Organization of shoot apex (apical cell theory, histogen theory, tunica corpus theory, plastochrone); shoot chimeras; types of vascular bundles; primary phloem and primary xylem; terminal, lateral and adventitious buds; primary thickening meristem. **Root:** Organization of root apex (apical cell theory, histogen theory, korper-kappe theory); quiescent centre; root cap; primary root tissue: rhizodermis, cortex, endodermis, exodermis, metacutinization,
lateral root apices; secondary growth in roots.

Unit 3

Vascular Cambium

Structure and function; concept of cambial zone; cambial derivatives; seasonal activity of cambium
and unusual cambial activity. **Secondary Growth:** Axially and radially oriented xylary and phloic elements, cyclic aspects, juvenile adult and reaction
woods; sap wood and heart wood; Phloem as a dynamic tissue. **Periderm**
Development and composition of periderm, rhytidome and lenticels.

Unit 4

Adaptive and Protective Systems

Epidermal tissue system (cuticle, epicuticular waxes, trichomes); Anatomical adaptations in stems,
leaves and roots of xerophytes, hydrophytes and halophytes. **Secretory and Excretory System**
Hydathodes, salt glands, nectaries; cavities, lithocysts and laticifers.

CORE PRACTICALS

1. Familiarization with techniques: double staining, maceration, peel mount, clearing.
2. Study of anatomical details through permanent slides/temporary stain mounts/macerations/ Museum specimens with the help of suitable examples.

3. Apical meristem of root and shoot, vascular cambium and intercalary meristem.
4. Distribution and types of parenchyma, collenchyma and sclerenchyma.
5. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres; xylem parenchyma.
6. Wood: ring porous; diffuse porous; tyloses; heart-and sapwood.
7. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
8. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
9. Root: monocot, dicot, origin of lateral roots; secondary growth; anomalous root structure.
10. Stem: monocot, dicot - primary and secondary growth; periderm; lenticel; abnormal secondary
growth in dicots and monocots;
11. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy); venation patterns.
12. Adaptive Anatomy: xerophytes, hydrophytes, parasites and epiphytes.
13. Secretory tissues: ducts and cavities, lithocytes and laticifers.

SUGGESTED READINGS

1. Dickinson, W.C. (2000) Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974) Plant Anatomy. Pergmon Press, USA and UK.
3. Mauseth, J.D. (1988) Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Esau, K. (1977) Anatomy of Seed Plants. Wiley Publishers.
5. Taiz, L. & Zeiger, E. (2006) Plant Physiology. (4th Ed.) Sinauer Associates, Inc. Sunderland, M.A.

PAPER 4
BOT 204
CHEMISTRY-2

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Examiner will set three questions from each section. The candidate will be required to attempt five questions in all, selecting not more than two questions from each section. All questions carry equal marks.

Section-A

Periodic Properties

Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, trends in periodic table (in s & p block elements).

s-Block Elements

Comparative study of the elements including, diagonal relationships and salient features of hydrides (methods of preparation excluded).

p-Block Elements

Emphasis on comparative study of properties of p-block elements (including diagonal relationship and excluding methods of preparation).

Boron family (13th gp):-

Diborane – properties and structure (as an example of electron – deficient compound and multicentre bonding), Borazene – chemical properties and structure.

Carbon Family (14th group)

Allotropy of carbon, Catenation, pה– dה bonding (an idea), carbides, fluorocarbons– general methods of preparations, properties and uses.

Nitrogen Family (15th group)

Oxides – structures of oxides of N,P. oxyacids – structure and relative acid strengths of oxyacids of Nitrogen and phosphorus. .

Oxygen Family (16th group)

Oxyacids of sulphur – structures and acidic strength

Halogen Family (17th group)

Basic properties of halogen, hydro and oxyacids of chlorine – structure and comparison of acid strength.

Section-B

Kinetics

Rate of reaction, rate equation, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order of a reaction, integrated rate expression for zero order, first order, Half life period of a reaction. Methods of determination of order of reaction, effect of temperature on the rate of reaction – Arrhenius equation.

Electrochemistry

Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance,equivalent conductance and relation among them, their vartion with concentration.

Arrhenius theory of ionization, Ostwald's Dilution Law. Debye- Huckel – Onsager's equation for strong electrolytes (elementary treatment only), Kohlarausch's Law, calculation of molar ionic conductance and effect of viscosity temperature & pressure on it. Application of Kohlarausch's Law in calculation of conductance of weak electrolytes at infinite dilution. Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids determination of solubility product of sparingly soluble salts, conductometric titrations. Definition of pH and pK_a, Buffer solution, Buffer action, (elementary idea only).

Section-C

Alkenes

Nomenclature of alkenes, , mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides,. The Saytzeff rule, Chemical reactions of alkenes — mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule,

.**Arenes and Aromaticity**

Nomenclature of benzene derivatives:. Aromatic nucleus and side chain.

Aromaticity: the Huckel rule, aromatic ions, aromatic, anti - aromatic and non - aromatic compounds.

Dienes and Alkynes

Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes.,. Chemical reactions — 1,2 and 1,4 additions (Electrophilic & free radical mechanism), Diels-Alder reaction, Nomenclature, structure and bonding in alkynes., acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions,

Alkyl and Aryl Halides

Nomenclature and classes of alkyl halides, Mechanisms and stereochemistry of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions of aryl halides.

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides.

PRACTICALS

Inorganic

Volumetric analysis

Complexometric titrations: Determination of Mg^{2+}, Zn^{2+} by EDTA.

Paper Chromatography

Qualitative Analysis of the any one of the following Inorganic cations and anions by paper chromatography (Pb^{2+} , Cu^{2+} , Ca^{2+} , Ni^{2+} , Cl^- , Br^- , I^- and PO_4^{3-} and NO_3^-).

Physical

a. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.

2. To determine the surface tension of a given liquid by drop number method.

3. To determine the viscosity of a given liquid**.**

Organic

1. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point

(j) *m*-Dinitrobenzne from nitrobenzene (use 1:2 conc. HNO_3-H_2SO_4 mixture if fuming HNO_3 is not available)

ii) p-Bromoacetanilide from acetanilide.

iii) Dibenzalacetone from acetone and benzaldehyde

iv) Aspirin from salicylic acid.

Distribution of marks

1.	Section I	12 marks
2.	Section II	12 marks
3.	Section III	12 marks
4.	Viva-voce	10 marks
5.	Lab Record	04 marks

PAPER 5 BOT 205

Zoology 11

BIODIVERSITY-II: CHORDATA

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

General account of Chordates:

UNIT I

1. Chordates Introduction and origin.

2. Protochordates General features and Phylogeny of Hemichordates, Urochordates and Cephalochordates. Retrogressive metamorphosis.

UNIT II

3. Agnatha General features of living Agnatha

4. Pisces Osmoregulation, Migration and Parental care.

UNIT III

5. Amphibia Origin and evolution of terrestrial ectotherms, Parental care.

6. Reptiles Origin,Poisonous and non- poisonous snakes in India, Biting mechanism in snakes, Affinities of *Sphenodon.*

UNIT IV

7. Aves Origin, Flight adaptations, Mechanism of flight and Migration.

8. Mammals Origin of Mammals. Origin and evolution of human

PRACTICALS

1. Protochordata:

Study of Balanoglossus *, Herdmania, Branchiostoma*

Balanoglossus sections through Probosis, Collar, branchiogenital & hepatic region.

Amphioxus - oral hood, Whole Mount sections through pharyngeal, intestinal & caudal regions . **2. Fishes:**

Study of *Petromyzon, Scoliodon, Sphyrna, Pristis, Trygon, Torpedo, Chimaera, Notopterus, Labeo, Catla, Cirrihina, Heteropneustes, Mystus, Exocoetus.*

Demonstrations through CD/charts etc: Cranial nerves of *Scoliodon.*

Temporary unstained preparation of Placoid, Cycloid and Ctenoid scales.

3. Amphibia:

Study of *Necturus, Salamander, Bufo, Hyla, Rhacophorus.*

4. Reptiles:

Study of *Chelone, Testuda, Kachuga, Hemidactytus, Varanus, Uromastix, Chameoleon, Draco, Hydrophis, Bungarus, Viper, Krait* , Coral snakes, Crocodiles.

5. Aves: Study of dozen Birds of local place/district/Zoo/National park

6. Mammals:

Study of *Sorex/Hedgehog*, Bat (Insectivorous & frugivorous).

SUGGESTED BOOKS

1. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000).Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.
4. Hall B.K. and Hallgrimsson B. (2008).Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers

PAPER 5 BOT 206

English

SYLLABUS FOR B.Sc. BOTANY (Hons.)
Semester III

PAPER 1-BOT 301
CELL BIOLOGY-I

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Overview of prokaryotic and eukaryotic cells, cell size and shape, Phages, Viriods, Mycoplasma and *Escherichia coli*. **Microscopy: Pri**nciples of Light microscopy; Phase contrast microscopy; Confocal microscopy; Electron microscopy (EM)- scanning EM and scanning transmission EM (STEM); Fluorescence microscopy;

Unit II

Flow cytometry- flurochromes, fluorescent probe and working principle;
Spectrophotometry; Mass spectrometry; X-ray diffraction analysis.
Separation-Sub-cellular fractionation- differential and density gradient centrifugation;
Chromatography- paper, thin-layer, gel-filtration, ion-exchange, affinity and High-Performance Liquid Chromatography (HPLC).

Unit 3.

Composition of Cells: Molecules of cell, cell membranes and cell Proteins.
The Nucleus : Nuclear Envelope- structure of nuclear pore complex, nuclear lamina, Transport across Nuclear Envelope, Chromatin: molecular organization, Nucleolus and rRNA Processing.
Protein Sorting and Transport The Endoplasmic reticulum, The Golgi Apparatus, Mechanism of Vesicular Transport,
Lysosomes.

Unit 4

Mitochondria, Chloroplasts and Peroxisomes Structural organization, Function, Marker enzymes,Mitochondrial biogenesis, Protein import in mitochondria, Semiautonomous nature of mitochondria and chloroplast, chloroplast DNA, Peroxisomes'assembly **Cytoskelton and Cell Movement** Structure and organization of actin filaments; actin, myosin and cell movement; intermediate filaments; microtubules.

PRACTICALS

1. Separation of nucleic acid bases by paper chromatography.
2. Microscopy- Theoretical knowledge of Light and Electron microscope.
3. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting.
4. Study of structure of cell organelles through electron micrographs.

Permanent slide preparation:

5. Cytochemical staining of DNA-Feulgen.
6. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP).
7. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS).
8. Cytochemical staining of Total proteins- Bromophenol blue.
9. Cytochemical staining of Histones -Fast Green.

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

PAPER 2 BOT- 302
MOLECULAR BIOLOGY-1

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Nucleic Acids convey Genetic Information: DNA as the carrier of genetic information, Key experiments establishing-The Central Dogma, DNA Double helix, Genetic code, Direction of Protein Synthesis. **The Structures of DNA and RNA / Genetic Material**

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, DNA topology - linking number, topoisomerases; RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

Unit 2

Genome Structure, Chromatin and the Nucleosome: Organization of genome in Prokaryotes, Viruses, Eukaryotes. Genome Sequence and Chromosome Diversity, Chromosome Duplication and Segregation, The Nucleosome Chromatin structure- Euchromatin, Heterochromatin-Constitutive and Facultative heterochromatin. Regulation of Chromatin Structure and Nucleosome Assembly. Special chromosomes: polytene and lampbrush chromosomes.

Unit 3 The Replication of DNA (Prokaryotes and Eukaryotes)

Chemistry of DNA synthesis, general principles - bidirectional replication, Semi- conservative, Semi discontinuous,RNA priming, Various models of DNA replication including rolling circle, D-loop (mitochondrial), Θ (theta) mode of replication, replication of linear ds-DNA, replicating the 5'end of linear chromosome. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins

Unit 4

The Mutability and Repair of DNA Replication Errors, DNA Damage and their repair. DNA denaturation and renaturation, cot curves, molecular mechanism of recombination, Genomics.

PRACTICALS

1. Preparation of Polytene chromosome from *Chironomous* larva/*Drosophila* larva
2. Demonstration of mammalian sex chromatin.
3. Preparations of temporary mount and study the different stages of Mitosis (Onion root tip).
4. Perform Southern Blot Hybridization (Restrict DNA for Southern Blot electrophoresis, perform electrophoresis of restricted DNA, perform southern transfer, hybridization and detection of gene of interest)
5. Demonstration of Northern Blotting.
6. Demonstration of Western Blotting.
7. Perform DNA amplification by PCR.
8. Study of semiconservative replication of DNA through micrographs/schematic representations.

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub

Paper 3 BOT - 303

Plant Resource Utilization

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Origin of Cultivated Plants

Concept of centres of origin, their importance with reference to Vavilov's work; examples of major
plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversty.

Unit 2

Cereals

Wheat and Rice, Role of dwarf varieties in green revolution; brief account of millets and Pseudocereals. **Legumes:** General account, importance to man and ecosystem; chief pulses grown in India. **Fruits :**Mango, Citrus, Papaya. **Sugars and starches:** Ratooning and nobilization of sugarcane, products and by products of sugarcane industry; Potato (Tuber anatomy and propagation methods) and comparative account with cassava.

Unit 3

Spices

Listing of important spices, their family and part used; with special reference to fennel, saffron, clove, turmeric and all spices; common adulterants of spices. **Beverages:** Tea, coffee and cocoa, their processing and some common adulterants. **Oils and Fats:** General description with details of groundnut, coconut, linseed and *Brassica* spp and their use
related health implications. **Essential Oils:** General account and comparison with fatty oils. **Natural Rubber** Para Rubber, tapping and processing, Various substitutes of Para Rubber.

Unit 4

Drug Yielding Plants

Therapeutic and habit forming drugs with special reference to *Cinchona*, *Digitalis*, *Rauvolfia*, *Papaver* and *Cannabis.* **Masticatories and Fumitories** Tobacco and Health hazards. **Timber plants**

General account with special reference to teak and pine. **Fibres** Classification based on the origin of fibres, Tetraploid cotton and Jute.

CORE PRACTICALS

Study of the following through habit sketches temporary preparations permanent slides photographs
specimens products microchemical tests etc. to bring out the economic importance: **Cereals**: Wheat, Rice, Millets and Pseudo cereals; **Legumes**: Soyabean, groundnut and gram, **Fruits**:

mango, citrus and papaya; **Sugars and starches**: sugarcane, potato, cassava; **Spices**: black pepper,
coriander, fennel; **Beverages**: tea, coffee, cocoa; **Oils and Fats**: Coconut, mustard and linseed **Essential-oil yielding plants**: Rosa, *Cymbopogon, Vetiveria, Santalum* and *Eucalyptus*; **Fiberyielding**
plants: *Gossypium, Corchorus,* jute; **Woods**: *Tectona, Pinus,* **Rubber***: Hevea brasiliensis*; **Drug yielding plants:** *Cinchona, Digitalis, Rauvolfia, Papaver, Cannabis*; **Fumitory**
plants: Tobacco

Each student should submit a theoretical project on any one of the topic pertaining to the course content. Some of the suggested topics for this purpose are: Biofuels; Biocides; Newer drug plants;
Germplasm conservation; IPR, MTA; Heterosis; Selection methods of breeding; Conventional and
non conventional plant breeding methods, GM crops, Quarantine Practices in a botanical conservation.

In the Practicals, students should also be shown a few standing crops under field conditions wherever possible and to made aware of constraints faced by the farming community for increasing
crop productivity. This could be integrated with the project reports that students have to submit. Students should also be made to understand India's productivity status for various economically important plants in relation to that of other countries and their economic ramifications.

SUGGESTED READINGS

1. Kochhar, S.L. (2009) Economic Botany in Tropic. Macmillan and Co. New Delhi.
2. Wickens, G.E. (2004) Economic Botany: Principles and Practices, Springer. Klwer Publishers, Dordrecht, The Netherlands.
3. Chrispeels, M.J. and Sadava, D. (1977). Plants, Food and People. San Francisco: W. H. Freeman & Co.
4. Swaminathan, Ms and Kochhar, S.L. (1989). Plants and Society. Macmillan Publishers Ltd.
5. Harlan, J.R. (1992). Crops and Man. 2nd ed. Madison W D: American Society of Agronomy.
6. Chrispeels, M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones & Bartlett Publishers.
7. Slater, A., Scott, N.W. & Fowler, M.R. (2008) Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

Paper 4 BOT 304
Chemistry 3

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Examiner will set three questions from each section. The candidate will be required to attempt five questions in all, selecting not more than two questions from each section. All questions carry equal marks.

Section-A

Chemistry of d-Block Elements

Definition of transition elements, position in the periodic table, General characteristics & properties of d-block elements, Comparison of properties of 3d elements with 4d & 5d elements with reference only to ionic radii, oxidation state, magnetic and spectral properties.

Coordination Compounds

Werner's coordination theory, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Metal-ligand Bonding in Transition Metal Complexes

Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral and tetrahedral complexes, factors affecting the crystal-field parameters.

Section-B

Thermodynamics

Definition of thermodynamic terms: system,surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

Zeroth Law of thermodynamics, First law of thermodynamics: statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Calculation of w.q. dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process, Kirchoffs equation.

Second law of thermodynamics, need for the law, different statements of the law, Carnot's cycles and its efficiency, Carnot's theorm, Thermodynamics scale of temperature. Concept of entropy – entropy as a state function, entropy as a function of P, V & T.

Section-C

Alcohols

Monohydric alcohols — nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature.

Dihydric alcohols — nomenclature, methods of formation, chemical reactions of vicinal glycols,.

.Phenols

Nomenclature, structure and bonding. Preparation of phenols, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Mechanisms of Fries rearrangement, Claisen rearrangement, and Schotten and Baumann reactions.

Epoxides

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides,

Ultraviolet (UV) absorption spectroscopy

Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

Carboxylic Acids & Acid Derivatives

Nomenclature of Carboxylic acids, structure and bonding, , acidity of carboxylic acids, effects of substituents on acid strength. Hell-Volhard-Zelinsky reaction. Mechanism of decarboxylation.

. Relative stability of acyl derivatives. interconversion of acid derivatives by nucleophilic acyl substitution.

Mechanisms of esterification and hydrolysis (acidic and basic).

PRACTICAL

SECTION – I (Inorganic)

Preparations: Preparation of Cuprous chloride, prussion blue from iron fillings, tetraammine cupric sulphate, chrome alum, potassium trioxalatochromate (III).

Section-B (Physical)

1. To determine the solubility of benzoic acid at various temperatures and to determine the ▲H of the dissolution process
2. To determine the enthalpy of neutralization of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride

4 .To study the distribution of iodine between water and CCl_4.

Distribution of marks

1.	Section I	13 marks
2.	Section II	23 marks
3.	Viva-voce	10 marks
4.	Lab Record	04 marks

PAPER 4 BOT 305

Zoology III

ANIMAL PHYSIOLOGY AND FUNCTIONAL HISTOLOGY

(With reference to human)

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

UNIT I

1. Digestive system

Structure and types of mode of digestive system and its glands; Process of digestion, assimilation and various disorders.

2. Respiratory system

Structure and functions of respiratory system; Control and coordination of respiration.

UNIT II

3. General organization: Neuron resting membrane potential and its basis; Origin of action potential and **Nervous System**

its propagation in myelinated and unmyelinated nerve fibers; Synaptic transmission and types of synapses, Neuro-muscular junction; Physiology of hearing and vision.

UNIT III

4. Muscle

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit.

5. Reproductive System

Histology of male and female reproductive systems, Puberty, physiology of male and female reproduction; Methods of contraception (depicted through flow chart); Disorders of reproductive system.

UNIT IV

6. Endocrine System

Histology and functions of endocrine glands; Nature of hormones; Mode of action of hormones; Hypothalamus- principal nuclei involved in control of endocrine system, control of anterior pituitary hormones by hypothalamic releasing hormones (neuroendocrine mechanisms).

PRACTICALS

1. Recording of simple muscle twitch with electrical stimulation.
2. Demonstration of the knee jerk reflex.
3. Preparation of temporary mounts: Squamous epithelium, Ciliated epithelium, Striated muscle fibres and nerve cells.
4. Examination of sections of Mammalian skin, Cartilage, Bone, Pancreas, Testis, Ovary, Pituitary, Adrenal, Thyroid, Parathyroid.
5. Preparation of permanent slide of any five mammalian tissues- Microtomy.

SUGGESTED BOOKS

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt

Asia PTE Ltd. / W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional Correlations. XII Edition. Lippincott W. & Wilkins.
4. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders

SYLLABUS FOR B.Sc. BOTANY (Hons.)
Semester IV

PAPER 1- BOT 401
CELL BIOLOGY-II

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1. The Plasma Membrane Structure; Transport of small molecules, Endocytosis **Cell Wall, the Extracellular Matrix and Cell Interactions** Bacterial and Eukaryotic Cell Wall; the extracellular matrix and cell matrix interactions; cell-cell interactions.

Unit 2. Cell Signaling (Ch 15 Cooper *et al*.)

Signaling molecules and their receptor; functions of cell surface receptors; Intracellular signal transduction pathway; signaling networks. **The Cell Cycle ;**Eukaryotic Cell Cycle, Regulation of Cell cycle progression, Events of Mitotic Phase,Meiosis and Fertilization.

Unit 3. Cell Death and Cell Renewal

Programmed Cell Death, Stem Cells and Maintenance of adult tissues, Embryonic Stem Cells and Therapeutic cloning.

Unit 4. Cancer Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, Cancer Treatment- molecular approach.

PRACTICALS

1. To demonstrate the presence of mitochondria in striated muscle cells/ cheek epithelial cell using vital stain Janus Green B.
2. Study of polyploidy in Onion root tip by colchicine treatment.
3. Preparations of temporary mount of Grasshopper testis / onion flower bud anthers and study the different stages of Meiosis.
4. Study of mitosis and meiosis from permanent slides.
5. Identification and study of cancer cells- Slides/Photomicrographs.

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SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

PAPER 2 BOT - 402
MOLECULAR BIOLOGY-II

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1. Mechanism of Transcription

RNA Polymerase and the transcription unit

Transcription in Prokaryotes Transcription in Eukaryotes **RNA Modifications**:Split genes, concept of introns and exons, removal of Introns, spliceosome machinery, splicing pathways, alternative splicing, exon shuffling, RNA editing, and mRNA transport.

Unit 2. Translation (Prokaryotes and Eukaryotes

Assembly line of polypeptide synthesis - ribosome structure and assembly, various steps in protein

synthesis. Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides. Fidelity of translation. Inhibitors of protein synthesis.

Regulation of translation Translation-dependent regulation of mRNA and Protein Stability.

Unit3. Transcription Regulation in Prokaryotes (Ch 16 Watson)

Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons **Regulatory RNAs :**Riboswitches, RNA interference, miRNA, siRNA, Regulatory RNA and X-inactivation

Unit 4. Transcription Regulation in Eukaryotes (Ch 17 Watson)

Conserved mechanism of regulation, Eukaryotic activators, Signal integration, combinatorial control, transcriptional repressors, signal transduction and control of transcriptional regulator, Gene

Silencing

PRACTICALS

1. Preparation of culture medium (LB) for *E.coli (both solid and liquid)* and raise culture of *E.coli*.
2. Demonstration of antibiotic resistance. (Culture of *E.coli* containing plasmid (pUC 18/19) in LB medium with/without antibiotic pressure and interpretation of results).
3. Isolation and quantitative estimation of salmon sperm / calf thymus DNA using colorimeter (Diphenylamine reagent) or spectrophotometer (A260 measurement).
4. To perform Ames test in *Salmonella / E.coli* to study mutagenicity.

SUGGESTED BOOKS

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson

PAPER 3 BOT - 403
ECOLOGY I

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1: Introduction to the Biosphere

Inter-relationships between the living world and the environment, the components and dynamism,
homeostasis.

Unit 2: Soil

Importance, origin, formation, composition; physical, chemical and biological components; soil profile; role of climate in soil development. **Water:** Importance; states of water in the environment; atmospheric moisture; precipitation types; water in soil, water table, water bodies: aquifers, water shed

Unit 3: The Atmosphere

Composition and stratification; radiation flux; role of electromagnetic radiations, UV, visible spectrum; variations in temperature; wind as a factor. **The Living World:**Biotic component of environment; types of biotic interactions. **Fire:**As an ecological factor.

Unit 4 Levels of Organisation

Individual, population, community; concepts of autecology, synecology; concept of biological diversity; habitat and ecological niche. **Population Ecology :**Distribution and characteristics of population; population dynamics; Ecological Speciation.

PRACTICALS

1. Study of following microclimatic variables in different habitats: soil and air temperature, wind velocity, relative humidity, rainfall and light intensity.
2. Permeability (percolation; total capacity as well as rate of movement) of different soil samples.
3. Saturation capacity and field capacity of different soil samples and rapid test for texture of soils.
4. Density and porosity and rate of infiltration of water in undisturbed soils.
5. Soil organic matter in different soil samples by titration method.

SUGGESTED READINGS

1. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi
2. Wilkinson, D.M. (2007). Fundamental Processes in Ecology. An Earth System Approach. Oxford.
3. Daubenmier, R.F. (1970). Plants and Environment: A text book of Plant Autoecology, Wiley Eastern Private Limited

4. Daubenmier, R.F. (1970), Plant Communities, Wiley Eastern Private Limited
5. Odum, E. (2008) Ecology. Oxford and IBH Publisher.
6. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.

Paper 4 BOT – 404
Chemistry IV

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Examiner will set three questions from each section. The candidate will be required to attempt five questions in all, selecting not more than two questions from each section. All questions carry equal marks.

Section-A

Non-aqueous Solvents

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2

Acids and Bases, HSAB Concept

Arrhenius, Bronsted – Lowry, the Lux – Flood, Solvent system and Lewis concepts of acids & bases, relative strength of acids & bases, Concept of Hard and Soft Acids & Bases.

Chemistry of f – block elements

Lanthanides

Occurrence, Electronic structure, oxidation states and ionic radii and lanthanide contraction and complex formation of lanthanide compounds.

Actinides

General features and chemistry of actinides, Comparison of properties of Lanthanides and Actinides and with transition elements. Elementary idea about the transuranic elements.

Section-B

Thermodynamics

Third law of thermodynamics: Nernst heat theorem, Thermodynamic functions G,H,E,A & S. Criteria for thermodynamic equilibrium and spontaneity of a process in terms of thermodynamic functions.

Chemical Equilibrium

Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium. Clapeyron equation and clausius – clapeyrou equation its applications.

Electrochemistry

Electrolytic and Galvanic cells – reversible & Irreversible cells, conventional representation of electrochemical cells. EMF of cell and its measurement, Weston standard cell, activity and activity coefficients.

Calculation of thermodynamic quantities of cell reaction (▲G, ▲H & K).

, Nernst equation, prediction of single electrode potentialand EMF of cell. Reference electrodes; standard hydrogen electrode & calomel electrode standard electrode potential, sign convention, electrochemical series and its applications.

Section-C

Infrared (IR) absorption spectroscopy

Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups.

Amines

Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. . Gabriel-phthalimide reaction, Hofmann bromamide reaction.

electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid.

Diazonium Salts

Mechanism of diazotisation, structure of benzene diazonium chloride, Replacement of diazo group by H, OH, F, Cl, Br, I, NO_2 and CN groups.

Aldehydes and Ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, advantage of oxidation of alcohols with chromium trioxide (Sarett reagent) pyridinium chlorochromate (PCC) and pyridinium dichromate.,. Comparison of reactivities of aldehydes and ketones. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin and aldol, condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction.

PRACTICAL

Section-A

1**. Gravimetric Analysis**

Quantitative estimations of, Cu^{2+} as copper thiocyanate and Ni^{2+} as Ni – dimethylglyoxime.

2**. Colorimetry:**

To verify Beer - Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given $KMnO_4/K_2Cr_2O_7$ solution.

Section- B (Organic)

Systematic identification (detection of extra elements, functional groups, determination of melting point or boiling point and preparation of at least one pure solid derivative) of the following simple mono and bifunctional organic compounds: Naphthalene, anthracene, acenaphthene, benzyl chloride, *p*-dichlorobenzene, *m*-dinitrobenzene, *p*-nitrotoluene, resorcinol , hydroquinone, α-naphthol, β-naphthol, benzophenone, ethyl methyl ketone, benzaldehyde, vanillin, oxalic acid, succinic acid, benzoic acid, salicyclic acid, aspirin, phthalic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline hydrochloride, p-toluidine, phenyl salicylate (salol), glucose, fructose, sucrose, *o-, m-, p*-nitroanilines, thiourea.

Distribution of marks

1.	Section I	13 marks
2.	Section II	23 marks
3.	Viva-voce	10 marks
4.	Lab Record	04 marks

Paper 5 BOT- 405
COMPUTATIONAL SKILLS

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I

Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers; Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices; User Interface with the Operating System, System Tools

Unit II

Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and
subtraction of binary numbers, BCD, ASCII, Unicode;

Unit III

Types of networks, router, switch, server-client architecture. **Multimedia:** Introduction, Characteristics, Elements, Applications.

Unit IV

Problem Solving: Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet. **General Awareness:** IT Act, System Security (virus/firewall etc.), I-Tax, Reservations, Banking.

PRACTICALS

1. Defined projects will be done by the students and evaluated by the instructor.
2. Document Preparation
3. Presentation Software
4. Familiarizing with the Operating System, Control Panel, Networking Configuration, Firewall setting
5. Spreadsheet Handing, Working with worksheets, Creating a spreadsheet, entering and formatting information, basic functions and formulas, creating charts, tables and graphs.

SUGGESTED BOOKS

[1] V Rajaraman, **Fundamentals of Computers,** Fourth Edition, PHI.
[2] Anita Goel, **Fundamentals of Computers;** Forthcoming title in Pearson-Education

Note: Use of Open Office/Star Office is recommended, as they are freely downloadable.
Reference manual for Open Office available at: http://www.openffice.org and
Reference manual for Star Office available at: http://www.sun.com/software/staroffice/

SYLLABUS FOR B.Sc. BOTANY (Hons.)

SEMESTER V

PAPER 1 BOT - 501
PLANT SYSTEMATICS AND EVOLUTION

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

What is systematics; Identification, Classification and Nomenclature of plants; Field inventory,Herbarium preparation and management; important herbaria and botanical gardens of the world and India, Documentation: Flora, Monographs, Journals, Online Journals and Keys; Evidences from morphology, palyonology, cytotaxonomy, chemotaxonomy, serology, and molecular systematics.

Unit 2:

Taxonomic hierarchy: Concept of taxa; categories and hierarchy; species concept (taxonomic, biological, evolutionary), Principles and rules of nomenclature; ranks and names; type method, author citation, valid publication; rejection of names, principle of priority and its limitation; names of hybrids and cultivars.

Unit 3:

Systems of classification: Classification by Bentham and Hooker, Engler and Prantl & Takhtajan; brief reference of Angiosperm Phylogeny Group (APG) Classification, role of Computers in systematics; Characters and attributes; OTUs, character weighing and coding; cluster analysis, phenograms, cladistics.

Unit 4:

Terms and concepts (homology, analogy, parallelism, convergence, monophyly, polyphyly, clades);origin & evolution of angiosperms; co-evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

CORE PRACTICALS

1. Study of vegetative and floral characters of the following families: Brassicaceae, Malvaceae, Cucurbitaceae, Fabaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Lamiaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae and Poaceae (families most likely to be available during July—November).
2. Study of only characteristic morphological features of the following families: Capparaceae, Asclepiadaceae, Acanthaceae, and Cannaceae.
3. Identification of selected taxa using taxonomic keys.
4. Familiarity with local flora and herbarium techniques.
5. Use of computers/internet for data collection, identification**.**

SUGGESTED READINGS

1. Angiosperm Phylogeny Group (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.
2. Crawford, D.J. (2003). Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
3. Cronquist, A. (1981). An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
4. Hollingsworth, P.M., Bateman, R.M. and Gornall, R.J. (1999). Molecular Systematics of Plant Evolution Taylor and Francis, London.
5. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. and Donoghue, M.J. (2008). Plant Systematics- A Phylogenetic Approach. Sinaner Associates Inc, Massachusetts, USA.
6. Simpson, M.C. (2006). Plant Systematics. Elsevier, Amsterdam.
7. Stussy, T.F. 1990. Plant Taxonomy, Columbia University Press, USA.39

PAPER 2 BOT - 502
PLANT PHYSIOLOGY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1:

Pathway of water movement; concepts of symplast and apoplast; ascent of sap; transpiration; energy exchange during transpiration; role of stomata; relationship with photosynthesis; antitranspirants; guttation; exchange of gases.

Characterization of stress response to water and high and low temperature response to saline soils; mechanism of response, essential and non-essential elements; criteria for essentiality; macro and micronutrients; roles of essential elements; mineral deficiency symptoms; ion antagonism and toxicity.

Unit 2:

Transport of ions across cell membranes, passive absorption, electrochemical gradient, Donnan's equilibrium, facilitated diffusion, accumulation against concentration gradient, active absorption, role of ATP, carrier systems, role of cell membrane, proton pump and ion flux, Structure-function relationship for the Translocation of photoassimilates from source to sink cells.

Unit 3:

Flowering; physiological definition; role of light; photoperiodism – discovery; variation in response; long day; short day and day neutral plants; inductive and non- inductive cycles; role of dark period; role of quality and intensity of light; vernalization; mechanism; bolting in long day plants; role of growth regulators; nutrient status; nature of the flowering stimulus; diffusibility of photoperiodic and vernalization stimuli; florigen concept.

Unit 4

Structure, biosynthesis, analysis, transport, physiological effects and mechanism of action. Of growth regulators, Physiological and biochemical changes of fruit ripening, phyto**chrome:** Discovery; chemical nature; mode of action; role of low energy response (LER) and high irradiance response (HIR); red (R) and far red (FR) light on photomorphogenesis.

CORE PRACTICALS

1. Preparation of solutions of various concentrations of a few selected solutes.
2. Determination of osmotic potential of plant cell sap by plasmolytic method.
3. Determine water potential of given tissue by weight method and falling drop method.
4. Study of the effect of various environmental factors on transpiration in an excised twig/leaf.
5. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophyte.
6. Study of the mechanism of stomatal opening and closing
7. Bolting experiment / *Avena* coleoptiles bioassay.

Projects: Students are required to perform at least one long-duration experiment as project (a
suggestive list of experiments will be provided).

SUGGESTED READINGS

1. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
2. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, New York, USA.
3. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.
4. Taiz, L. and Zeiger, E. (2006) Plant Physiology, 4th Edition, Sinauer Associates Inc .MA, USA 41

PAPER 3 BOT- 503

Biostatistics

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1

Measures of central tendency:Mean, median and mode. Measures of dispersion; skewness, kurtosis. . Graphical representation of data.

Unit 2

Discrete and Continuous Random variable, Mathematical Expectation, Mean and Variance of Binomial, Poisson and Normal distribution. Sample mean, Sampling variance and coefficient of variation.

Unit 3

Hypothesis testing using standard normal variate. Curve Fitting. Correlation and Regression. Emphasis on examples from Biological Sciences. Experimental design and sampling theories.

Unit 4

Elementary Probability and basic laws**.** Probabilities theory; t- test, F- test and χ^2- test; Probability distributions and their properties

PRACTICALS

Numerical Problems related all statistical parameters

SUGGESTED READINGS

1. E. Batschelet : *Introduction to Mathematics for Life Scientists,*Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)

2. A. Edmondson and D. Druce : *Advanced Biology Statistics*, Oxford University Press; 1996.

3. W. Danial : Biostatistics : *A foundation for Analysis in Health Sciences*, John Wiley and Sons Inc; 2004.

PAPER 4 BOT - 504
GENETICS AND GENOMICS-I

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

2. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1.

Introduction to Genetics : Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information, Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios), Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis Incomplete and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy,
Environmental effects on phenotypic expression, sex linked inheritance.

Unit 2:

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

Unit 3.

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms, Sex Determination, Environmental factors determining sex determination, Barr bodies, Dosage compensation.

Unit 4.

Extrachromosomal Inheritance **:** Chloroplast mutation/Variegation in Four o' clock plant and *Chlymodomonas,* Mitochondrial mutations in *Neurospora* and yeast, Maternal effects, Infective heredity- Kappa particles in *Paramecium,* Quantitative and multifactor inheritance, Transgressive variations, Heterosis.

PRACTICALS

1. Mendelian laws and gene interaction using *Drosophila* crosses.
2. Chi-square and probability.
3. Study of Linkage, recombination, gene mapping using marker based data from *Drosophila*.
4. Study of Human and *Phlox/ Allium* Karyotype (normal and abnormal).
5. Pedigree analysis of some human inherited traits.
6. Study of Hardy-Weinberg Law using simulations (seeds).

SUGGESTED BOOKS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.

5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.

ADDITIONAL READING:

Both students as well as teachers of genetics can further benefit from knowledge of following topics -

- Epigenetics- http://www.nature.com/nrg/focus/epigenetics/index.html
- Tetrad Analysis in fungi
- Centromere Mapping
- Cytogenetic Mapping

Paper 5 BOT - 505

Ecology II

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1:

Plant Communities

Community characters (analytical and synthetic), ecotone and edge effect; methods of studying vegetation; dynamics of communities; plant succession, processes, types; primary and secondary succession; climax concepts.

Unit 2

Ecosystems

Structure, biotic and the abiotic components; processes within ecosystem; trophic organization, basic source of energy, autotrophy, heterotrophy, parasitism; food chains and webs; ecological pyramids; biomass, standing crop. **Functional aspects of Ecosystem** Energy flow; principles, grazing and detritus food chains, models of energy flow; ecosystemproductivity, measurement ofproductivity; ecological efficiencies and concept of energy subsidy;biogeochemical cycles; dynamics: hydrologic cycle; gaseous cycles, sedimentary cycles.

Unit 3:

Diversity of Ecosystems and Biomas

Aquatic: fresh water (lotic and lentic), marine (pelagic and benthic), estuarine; major terrestrial biomes: tundra, temperate and tropical.

Unit 4:

Phytogeogarphy

Principles of phytogeography; endemism; hotspots; phytogeogarphical divisions of India: vegetation of Delhi.

PRACTICALS

1. Study of following microclimatic variables in different habitats: soil and air temperature, wind velocity, relative humidity, rainfall and light intensity.
2. Permeability (percolation; total capacity as well as rate of movement) of different soil samples.
3. Saturation capacity and field capacity of different soil samples and rapid test for texture of soils.
4. Density and porosity and rate of infiltration of water in undisturbed soils.
5. pH and rapid field tests of soils for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency.
6. Soil organic matter in different soil samples by titration method.
7. Determination of minimal area of quadrat size by species area curve method.
8. Quantitative analysis of herbaceous vegetation for frequency; density and abundance.
9. Determination of dissolved oxygen of water samples from polluted and unpolluted sources
10. Morphological adaptations of hydrophytes and xerophytes.

SUGGESTED READINGS

1. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi
2. Wilkinson, D.M. (2007). Fundamental Processes in Ecology. An Earth System Approach. Oxford.
3. Daubenmier, R.F. (1970). Plants and Environment: A text book of Plant Autoecology, Wiley Eastern Private Limited
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4. Daubenmier, R.F. (1970), Plant Communities, Wiley Eastern Private Limited
5. Odum, E. (2008) Ecology. Oxford and IBH Publisher.
6. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.

SYLLABUS FOR B.Sc. BOTANY (Hons.)
Semester VI

PAPER 1 BOT- 601
PLANT METABOLISM & BIOCHEMISTRY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1:

Enzymes : Historical background, classification, nomenclature and importance of enzymes; role of enzymes as catalysts; physiochemical and biological properties; concept of holoenzymes; coenzyme; apoenzyme and prosthetic groups; mechanism and kinetics of enzyme action; enzyme inhibitors; isoenzymes; allosteric enzymes; industrial aspects of enzymology.

Unit 2:

Carbon Assimilation: Role of chlorophylls and accessory pigments; antennae molecules and active center molecules; evidences for two photosystems; reduction of NADP; photophosphorylation; reduction of CO_2 into glucose; Benson and Calvin cycle; Hatch and Slack pathway; Crassulacean acid metabolism; energetics of CO_2 reduction; factors affecting CO_2 reduction. , **Carbon Oxidation:** Glycolysis, anaerobic conversion of pyruvate into ethanol or lactate, energy balance, reversibility and inhibition of glycolysis, Pasteur effect, oxidative decarboxylation of pyruvate into acetyl CoA, TCA cycle, oxidative phosphorylation, oxidation of RuBP (photorespiration), factors affecting oxidative processes, regulation of TCA cycle, role of glyoxalate cycle.

Unit 3:

Carbohydrate Metabolism: Structure, properties and importance of mono-, di- and polysaccharides; Synthesis of di - (sucrose) and polysaccharides (starch and cellulose).

Nitrogen and Protein Metabolism : Biological nitrogen fixation and nitrogen cycle, Catabolism of amino acids, ammonia assimilation, transamination, deanimation, structure and general properties of amino acids and proteins (protein folding).

Lipid Metabolism: Structure, properties, classification and functional significance of fatty acids, triglycerides and steroids; Synthesis and breakdown, formation of glycerides; oxidation of fatty acids, beta oxidation; energy balance.

Unit 4:

Intermediary Metabolism: Interrelationship of carbohydrates, lipids and protein metabolism.**)**

Regulation of Metabolism : Nature of integrated metabolism, role of acetyl CoA, control at the level of transcription and Translation, control of enzyme action. **Secondary Metabolites and Plant Defense :**Introduction to alkaloids, phenolics, plant terpenes, phytoalexins, sesquiterpenes and sterols.

CORE PRACTICALS

1. Detection of the presence of plant enzymes amylase, catalase, nitrate reductase urease (*in vivo*)] in various sources.
2. To study properties (thermolability, proteinaceous nature and specificity) of any one of the enzymes (catalase/urease).
3. To study the effect of various factors (concentration, temperature, pH, inhibitor) on the activity of catalase enzyme.
4. Demonstration of dye reduction by isolated chloroplasts.
5. Study the effect of different factors on O2 evolution during photosynthesis and demonstrate the Law of limiting factors.
6. Chemical separation of chloroplast pigments and determination of their absorption spectra.
7. To extract anthocyanin pigments and study the effect of pH on their absorption spectra.
8. Study of the rate of aerobic respiration and respiratory quotient in different plant parts/materials.
9. Identification tests for carbohydrates (Fehling's test, Benedicts test) and proteins (Ninhydrin test, Xanthoproteic test).
10. Preparation of standard curve for estimation of proteins and determination of total proteins in plant tissue extracts for example of control and GA3 treated embryo-less wheat grains.
11. Separation and identification of amino acids by thin layer chromatography.

SUGGESTED READINGS

1. Conn, E.E., Stumpf, P.K. and Bruening, G. (2006) Outlines of Biochemistry, 4th Edition, John Wiley and Sons Inc.

2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Elliot (2009) Biochemistry and Molecular Biology. Oxford Publishers.
4. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
5. Taiz, L. and Zeiger, E. (2006) Plant Physiology, 4th Edition Sinauer Associates Inc. Publishers, Massachusetts, USA
6. Dennis, D.T., Layzell, D.B., Lefebre, D.D. and Turpin, D.H. (1997) Plant Metabolism. Addison Wesley Longman.
7. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
8. Kaul RP (2009) Plant Metabolism. Swastik Publishers and Distributors.
9. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

PAPER 2 BOT- 602
REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1:

Introduction: History and scope, **Anther:** Structure, ontogeny; tapetum; structure and functions; micro-sporogenesis; callose deposition and its significance**,** Microgametogenesis, pollen wall development, MGU (male germ unit) structure, NPC system, pollen wall proteins; pollen viability, storage and germination; pollen tube structure.

Unit 2:

Ovule: Structure, ontogeny, types; special structures – endothelium, operculum, obturator, aril, arillode, caruncle, hypostase, epistase: female gametophyte –megasporogenesis and megagametogenesis: organization and ultra structure of mature embryo sac.

Unit 3:

Pollination and Fertilization: Pollination types and significance; adaptations; pollination biology; pollen-pistil Interaction; structure of stigma and style; double fertilization. **Self Incompatibility:** Basic concepts; methods to overcome self incompatibility.

Unit 4:

Endosperm: Types, development and functions; endosperm haustoria. **Embryogenesis:** Classification, development, organization and differentiation of crucifer and Najas embryo; embryo– endosperm relationship; physiological and genetical control. **Polyembryony and Apomixes:** Introduction; classification; causes and applications.

CORE PRACTICALS

1. Photographs of eminent embryologists.
2. Anther: wall and its ontogeny; tapetum; microsporogenesis, stages; psuedomonads, massulae (slides and fresh material).
3. Pollen grains: fresh and acetolysed, ornamentation and aperture; pollen viability: tetrazolium test.
4. Pollen germination: in different media; calculation of percentage germination; male germ unit (MGU): through photographs.
5. Ovule: types; unitegmic, bitegmic; tenuinucellate and crassinucellate; special structuresendothelium,
operculum, obturator, hypostase and epistase; caruncle and aril (permanent slides/ specimens/photographs).
6. Female gametophyte through permanent slides/ photographs: types and ultrastructure of mature embryo sac.
7. Style and stigma through suitable preparations: unpollinated and pollinated stigma and style; wet and dry stigma; hollow and solid styles; tracing and path of pollen tube.
8. Intra-ovarian pollination; test tube pollination/ fertilization: through photographs.
9. Endosperm: dissections of developing seeds for free-nuclear endosperm with haustoria; types

(permanent slides).
10. Embryogenesis: study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; study of suspensor through electron micrographs.

SUGGESTED READINGS

1. Raghavan, V. (2000) Developmental Biology of Flowering plants, Springer, Netherlands.
2. Raghavan, V. (1997) Molecular embryology of flowering plants. Cambridge, University Press.
3. Shivanna, K.R. (2003) Pollen Biology and Biotechnology, Science Publishers.
4. Bhojwani, S.S. and Bhatnagar SP (2004) The Embryology of Angiosperms, Vikas Publishing House
5. Johri, B.M. (1984), Embryology of Angiosperms, Springer-Verlag, Netherlands.

PAPER 3 BOT - 603
PLANT BIOTECHNOLOGY

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1:

Plant Tissue Culture : Historical perspective; composition of media; nutrient and hormone requirement; totipotency; Organization; physic-chemical conditions for propagation of plant cells and tissues; somatic embryogenesis; protoplast isolation culture and fusion; cybrids micropropagation; androgenesis. Tissue Culture Applications

Unit 2:

Tools and Techniques of Genetic Engineering : Restriction Endonucleases (history, types and role); Gel Electrophoresis; PCR; Restriction Mapping; DNA Sequencing (Sanger's method); Southern, Northern and Western blotting; construction of genomic library; DNA Fingerprinting (RAPD, RFLP); FISH.

Unit 3:

Plant Transformation Technology: Obtaining gene of interest by different methods; Gene constructs; Gene transfer – prokaryotic and eukaryotic vectors; *Agrobacterium*-mediated transformation; Direct gene transfer methods– Electroporation, Microinjection, Gene-gun; Selection of transgenic - marker and reporter genes.

Unit 4:

Pest resistant plants (Bt-cotton); herbicide resistance; disease and stress resistant plants; transgenic crops with improved quality traits (Flavr savr tomatoes, Golden rice); Role of transgenics in degradation of pollutants (Superbug) leaching out of minerals; Application of plant biotechnology for production of quality oil, industrial enzymes, edible vaccines and plantibodies.

CORE PRACTICALS

1. Preparation of media MS (1962), Nistch (1969) and White's medium
2. Aseptic culture of different explants, methods of *in vitro* sterilization, inoculation and subculture methods
3. Construction of Restriction Map from the data provided.
4. Study of Genetic engineering Techniques (photographs): FISH , DNA Fingerprinting, DNA Sequencing , Gene gun, Ti plasmid.
5. Calculation of percentage similarity between different cultivars of a species using RAPD profile (by binary method) and study of Dendrogram.

6. Demonstration of Southern, Northern and Western Blotting
7. Study of steps of genetic engineering techniques from photographs (Bt cotton, Golden rice, Flavr savr tomatoes)

SUGGESTED READINGS

1. Slater, A., Scott, N.W. & Fowler, M.R. (2008) Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.
2. Bhojwani, S.S. and Razdan (2004) Plant Tissue Culture and Practice.
3. Chrispeel, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones and Barlett Publishers.
4. Reinert, J. and Bajaj, Y.P.S. (1997) Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
5. Smith, R. (2000) Plant Tissue Culture: Techniques and Experiments, 2nd Edition, Academic
6. Gardner, E.J. Simmonns, M.J. Snustad, D.P. (2008) VIIIed. Principles of Genetics. Wiley India.
7. Russell, P.J. (2009) Genetics – A Molecular Approach. III Edition. Benjamin Co.
8. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. (2005) Biology. Tata MC Graw Hill.
9. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
10. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd Ed)

PAPER 4 BOT - 604

GENETICS AND GENOMICS II

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit 1.

Genetic Analysis and Mapping in Bacteria and Bacteriophages :
Conjugation; Transformation; Transduction, Recombination. **Genome Dynamics-Transposable genetic elements, Eukaryotic Viruses: Prokaryotic** transposable elements- IS elements, Composite transposons, Tn-3 elements; Eukaryotic transposable elements- Ac-Ds system in maize and P elements in *Drosophila*; Uses of transposons; Eukaryotic Viruses.

Unit 2.

Developmental Genetics and Model System : Study of model systems in developmental genetics- *Drosophila melanogaster, Sachharomyces cerevisiae, Caenorhabditis elegans, Arabidopsis thaliana,* and *Xenopus laevis.* Introduction to Bioinformatics, Gene and protein databases; Sequence similarity and alignment; Gene feature identification.Gene Annotation and analysis of transcription and translation; Post translational analysis, Protein interaction..

Unit 3.

Genomics, Bioinformatics and Proteomics : Genomes of bacteria, *Drosophila* and Humans*;* Human genome project; Evolution and Comparative Genomics. **Genomic Analysis- Dissection of Gene Function:** Genetic analysis using mutations, forward genetics, genomics, reverse genetics, RNAi, functional genomics and system biology.

Unit 4.

Population Genetics : Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, Mutation, genetic drift. **Evolutionary Genetics:** Genetic variation and Speciation.

PRACTICALS

1. Genomic DNA isolation from *E.coli* (without plasmid*)*.
2. Restriction enzyme digestion of genomic DNA from *E.coli*.
3. Isolation of plasmid DNA and genomic DNA together from *E.coli*. and restriction enzyme digestion.
4. Restriction enzyme digestion (*EcoR*I) of genomic and plasmid DNA (obtained from Expt.3).
5. Estimation of size of a DNA fragment after electrophoresis using DNA markers.
6. Construction of Restriction digestion maps from data provided.
7. Demonstration of DNA fingerprinting.

SUGGESTED BOOKS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.

4. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis.
8. Ghosh, Z. and Mallick,V. (2008). Bioinformatics-Principles and Applications. Oxford Univ.Press

Paper 5 BOT – 605
Tools and Techniques

Max Marks: 45 + 5 (Internal assessment) **Time allotted: 3 Hours**

Note: Nine questions are to be set in all and the candidates are required to attempt five questions including compulsory question.

1. Question number I is compulsory consisting of 10 parts (1.0 mark each) covering the entire syllabus. Answer to each part should not exceed 20 words.
2. Out of remaining eight questions, two questions are to be set from each unit (I to IV), possibly splitting them in parts. Candidate is required to attempt four questions, selecting one question from each unit.

Unit I:

Instrument 1

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

Unit II:

Instruments, basic principles and usage

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles

Unit III:

Chromatography techniques

Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC

Unit IV:

Electrophoresis and Fermentation Technology

Starch-gel, polyacrylamide gel (native and SDS-PAGE), agrose-gel electrophoresis, immuno electrophoresis, isoelectric focusing, western blotting

Different types of fermenters: principles operating characteristics of fermenters, air lift, continous stirred tank, fluidized and photofermenter, aeration and agitation system, antiform agents, pH, temperature and dissolved oxygen measurements and control, computer and automation

PRACTICALS:

1 Native gel electrophoresis of proteins
2 SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions
3 Preparation of the sub-cellular fractions of rat liver cells
4 Preparation of protoplasts from pea leaves
5 Separation of amino acids by paper chromatography
6 To identify lipids in a given sample by TLC
7 To verify the validity of Beer's law and determine the molar extinction coefficient of NADH