

Scheme of Examination and Syllabus

Affiliated Colleges

(2018-19 w.e.f. Sem-III and 2019-20 w.e.f. Sem-I)

B. Sc. General (Medical Group) Botany

***BASED ON
CHOICE BASED CREDIT SYSTEM***



***Department of Bio and Nanotechnology
Guru Jambheshwar University of Science & Technology
Hisar***

Course Curriculum of B. Sc. General (Medical Group) Botany

Semester I

| Paper Code | Course | Nomenclature | Credits | Hr/week | Marks | | |
|-------------------|--|--|----------|----------|-----------|-----------|------------|
| | | | | | Ext. | Int. | Total |
| CXL-101L | Language Skill Compulsory Course-I | English-I | 2 | 2 | 80 | 20 | 100 |
| CYL-111L | Awareness Program Compulsory Course-I | Environmental Studies | 2 | 2 | 80 | 20 | 100 |
| BOT-101 L | Core course - Botany Paper I | Biodiversity of Microbes, Algae and Fungi | 2 | 2 | 80 | 20 | 100 |
| BOT- 102 L | Core course - Botany Paper II | Biodiversity of Archegoniate | 2 | 2 | 80 | 20 | 100 |
| ZOO-101 L | Core Course-I (Zoology) | Animal Biodiversity I | 2 | 2 | 80 | 20 | 100 |
| ZOO-102 L | Core Course-II (Zoology) | Animal Biodiversity II | 2 | 2 | 80 | 20 | 100 |
| CCL-104 L | Core Course-I (Chemistry) | Inorganic Chemistry-I (Atomic Structure & Bonding) | 2 | 2 | 80 | 20 | 100 |
| CCL-105 L | Core Course-II (Chemistry) | Organic Chemistry-I (General Organic Chemistry & Aliphatic Hydrocarbons) | 2 | 2 | 80 | 20 | 100 |
| BOT- 103P | Practical -I (Botany) | Laboratory Practical- Paper III (Biodiversity of Microbes, Algae, Fungi and Archegoniate) | 3 | 6 | 50 | - | 50 |
| Zoo 103 P | Practical -I (Zoology) | Laboratory Practical of Animal Biodiversity I & II | 2 | 4 | 50 | - | 50 |
| CCP-109 P | Practical-I (Chemistry) | Chemistry Lab-I | 2 | 4 | 50 | - | 50 |

Semester II

| Paper Code | Course | Nomenclature | Credits | Hr/week | Marks | | |
|-------------------|-------------------------------------|--|----------|----------|-----------|-----------|------------|
| | | | | | Ext. | Int. | Total |
| CXL-201L | Language Skill Compulsory Course-II | English-II | 2 | 2 | 80 | 20 | 100 |
| BOT-201 L | Core course-Botany Paper IV | Plant Ecology | 2 | 2 | 80 | 20 | 100 |
| BOT- 202 L | Core Course- Botany Paper V | Plant Taxonomy | 2 | 2 | 80 | 20 | 100 |
| ZOO-201 L | Core Course-IV (Zoology) | Comparative Anatomy and Developmental Biology of Vertebrates I | 2 | 2 | 80 | 20 | 100 |
| ZOO-202 L | Core Course-V (Zoology) | Comparative Anatomy and Developmental Biology of Vertebrates I | 2 | 2 | 80 | 20 | 100 |
| CCL-204 L | Core Course-III (Chemistry) | Physical Chemistry-I (Chemical Energetics and Equilibria) | 2 | 2 | 80 | 20 | 100 |
| CCL-205 L | Core Course-IV (Chemistry) | Organic Chemistry-II (Functional Group Organic Chemistry) | 2 | 2 | 80 | 20 | 100 |
| BOT 203 P | Practical-II Botany | Laboratory Practicals - Paper VI (Plant Ecology and Taxonomy) | 3 | 6 | 50 | - | 50 |
| Zoo 203 P | Core Course-VI (Zoology Practical) | Laboratory Practicals of Comparative Anatomy and Developmental Biology of Vertebrates I & II | 2 | 4 | 50 | - | 50 |
| CCP-209 P | Practical-II (Chemistry) | Chemistry Lab-II | 2 | 4 | 50 | - | 50 |

Semester III

| Paper Code | Course | Nomenclature | Credits | Hr/week | Marks | | |
|---|--|---|----------|----------|-----------|-----------|------------|
| | | | | | Ext. | Int. | Total |
| CXL-301L | Language Skills Compulsory Course-I | Hindi-I | 2 | 2 | 80 | 20 | 100 |
| BOT- 301 L | Core course - Botany Paper VII | Plant Anatomy | 2 | 2 | 80 | 20 | 100 |
| BOT -302 L | Core course - Botany Paper VIII | Plant Embryology | 2 | 2 | 80 | 20 | 100 |
| ZOO-301 L | Core Course-VII (Zoology) | Physiology and Biochemistry I | 2 | 2 | 80 | 20 | 100 |
| ZOO-302 L | Core Course-VIII (Zoology) | Physiology and Biochemistry II | 2 | 2 | 80 | 20 | 100 |
| CCL-304 L | Core Course-I (Chemistry) | Physical Chemistry-II (Solutions, Phase equilibrium, Conductance and Electrochemistry) | 2 | 2 | 80 | 20 | 100 |
| CCL-305 L | Core Course-II (Chemistry) | Organic Chemistry-III (Functional Group Organic Chemistry-II) | 2 | 2 | 80 | 20 | 100 |
| BOT 303P | Practical-III (Botany) | Laboratory Practical- Paper IX (Plant Anatomy and Embryology) | 3 | 6 | 50 | - | 50 |
| Zoo 303 P | Core Course-IX (Zoology Practical) | Laboratory Practicals of Physiology and Biochemistry I & II | 2 | 4 | 50 | - | 50 |
| CCP-309 P | Practical-III (Chemistry) | Chemistry Lab-III | 2 | 4 | 50 | - | 50 |
| BOT 304 L/ BOT 305 L/ BOT 306L/ BOT 307L | Skill Enhancement Course -1 | Any one of the following: I. Ethnobotany (BOT 304 L) II. Biofertilizers (BOT 305 L) III. Mushroom Culture Technology (BOT 306 L) IV. Plant Diversity and Human Welfare (BOT 307 L) | 2 | 2 | 80 | 20 | 100 |

Semester IV

| Paper Code | Course | Nomenclature | Credits | Hr/week | Marks | | |
|---|---|---|----------|----------|-----------|-----------|------------|
| | | | | | Ext. | Int. | Total |
| CXL-401L | Language Skills Compulsory Course-II | Hindi-II | 2 | 2 | 80 | 20 | 100 |
| ZOO-404 L/ ZOO-405 L/ ZOO-406 L/ ZOO-407 L | Skill Enhancement Course-I (Zoology) | Any one of the following: I. Apiculture II. Aquarium Fish Keeping III. Medical Diagnostics IV. Sericulture | 2 | 2 | 80 | 20 | 100 |
| BOT-401 L | Core course-Botany Paper X | Plant Physiology | 2 | 2 | 80 | 20 | 100 |
| BOT -402 L | Core Course- Botany Paper XI | Plant Metabolism | 2 | 2 | 80 | 20 | 100 |
| ZOO-401 L | Core Course-X (Zoology) | Genetics and Evolutionary Biology I | 2 | 2 | 80 | 20 | 100 |
| ZOO-402 L | Core Course-XI (Zoology) | Genetics and Evolutionary Biology II | 2 | 2 | 80 | 20 | 100 |
| CCL-404 L | Core Course-III (Chemistry) | Inorganic Chemistry-II (Transition Metal and Coordination Chemistry) | 2 | 2 | 80 | 20 | 100 |
| CCL-405 L | Core Course-IV (Chemistry) | Physical Chemistry-III (States of Matter and Chemical Kinetics) | 2 | 2 | 80 | 20 | 100 |
| BOT 403 P | Practical-IV Botany | Laboratory Practicals - Paper XII (Plant Physiology and Metabolism) | 3 | 6 | 50 | - | 50 |
| Zoo 403 P | Core Course-XII (Zoology Practical) | Laboratory Practicals of Genetics and Evolutionary Biology I & II | 2 | 4 | 50 | - | 50 |
| CCP-409 P | Practical-IV (Chemistry) | Chemistry Lab-IV | 2 | 4 | 50 | - | 50 |

Semester V

| Paper Code | Course | Nomenclature | Credits | Hr/week | Marks | | |
|-----------------------------------|--|---|----------|----------|-----------|-----------|------------|
| | | | | | Ext. | Int. | Total |
| CCS-505L | Skill Enhancement Course-I (Chemistry) | Any one of the following: Pesticide Chemistry or Green Methods in Chemistry | 2 | 2 | 80 | 20 | 100 |
| BOT 501L/504L** | Discipline Specific Elective - Botany Paper I | Cell Biology (BOT501L)/ Analytical Techniques in Plant Sciences-I (BOT504L) | 2 | 2 | 80 | 20 | 100 |
| BOT 502L/505L** | Discipline Specific Elective - Botany Paper II | Molecular Biology (BOT502L)/ Analytical Techniques in Plant Sciences-II (BOT505L) | 2 | 2 | 80 | 20 | 100 |
| ZOO- 501 L Or ZOO- 504 L | Discipline Specific Elective Course-I (Zoology) | Applied Zoology I Or Aquatic Biology I | 2 | 2 | 80 | 20 | 100 |
| ZOO- 502 L Or ZOO- 505 L | Discipline Specific Elective Course-II (Zoology) | Applied Zoology II Or Aquatic Biology II | 2 | 2 | 80 | 20 | 100 |
| CCL-503 (i) or CCL-503 (ii) | Discipline Specific Course-I (Chemistry) | Polymer Chemistry-I or Chemistry of Main Group Elements, Theories of Acids and bases-I | 2 | 2 | 80 | 20 | 100 |
| CCL-504 (i) or CCL-504 (ii) | Discipline Specific Course-II (Chemistry) | Polymer Chemistry-II or Chemistry of Main Group Elements-II | 2 | 2 | 80 | 20 | 100 |
| BOT 503P/506P** | Discipline Specific Elective Practical - III Botany | Laboratory Practical-Paper -III Cell biology and Molecular Biology (503 P)/ Analytical Techniques in Plant Sciences (506P) | 3 | 6 | 50 | - | 50 |
| Zoo 503 P Or Zoo 506 P | Discipline Specific Course-III (Zoology Practical) | Laboratory Practicals of Applied Zoology I & II or Aquatic Biology I & II | 2 | 4 | 50 | - | 50 |
| CCP-509 (i) or CCP-509 (ii) | Practical-V (Chemistry) | Chemistry Lab-V(i) or Chemistry Lab-V(ii) | 2 | 4 | 50 | - | 50 |

****Students can opt any one of the following combinations (Theory as well as Practicals):**

- 1. Cell Biology (BOT501L) + Molecular Biology (BOT 502L)**
- 2. Analytical Techniques in Plant Sciences I (BOT504L)+Analytical Techniques in Plant Sciences II (BOT 505 L)**

Semester VI

| Paper Code | Course | Nomenclature | Credits | Hr/week | Marks | | |
|--------------------------------------|--|--|----------|----------|-----------|-----------|------------|
| | | | | | Ext. | Int. | Total |
| BIT-603 L/604L /605L | Skill Enhancement Course - Biotechnology Paper I | Molecular Diagnostic (BIT 603 L) / Basics in Forensic (BIT 604 L) Science/ Bioinformatics BIT (605 L) | 3 | 3 | 80 | 20 | 100 |
| BOT 601L/604L | Discipline Specific Elective - Botany Paper IV | Economic Botany (BOT601L)/ Genetics (BOT604L) | 2 | 2 | 80 | 20 | 100 |
| BOT 602L/605 L | Discipline Specific Elective - Botany Paper V | Biotechnology(BOT602L)/ Plant Breeding (BOT605L) | 2 | 2 | 80 | 20 | 100 |
| ZOO- 601 L or ZOO- 604 L | Discipline Specific Elective Course-IV (Zoology) | Reproductive Biology I or Insect, Vector and Diseases I | 2 | 2 | 80 | 20 | 100 |
| ZOO- 602 L Or ZOO- 605 L | Discipline Specific Elective Course-V (Zoology) | Reproductive Biology I Or Insect, Vector and Diseases I | 2 | 2 | 80 | 20 | 100 |
| CCL-603 (i) or CCL-603 (ii) | Discipline Specific Course-III (Chemistry) | Organometallics and Bioorganic Chemistry or Quantum Chemistry | 2 | 2 | 80 | 20 | 100 |
| CCL-604 (i) or CCL-604 (ii) | Discipline Specific Course-IV (Chemistry) | Polynuclear Hydrocarbon and UV-IR Spectroscopy or Spectroscopy and Photochemistry | 2 | 2 | 80 | 20 | 100 |
| BOT603P or 606P | Discipline Specific Elective - Practical-VI | Laboratory Practical - Paper VI (Economic Botany and Biotechnology (BOT603P)/ Genetics and Plant Breeding (606P)(BOT606P) | 3 | 6 | 50 | - | 50 |
| Zoo 603 P or Zoo 606 P | Discipline Specific Elective Course-VI (Zoology Practical) | Laboratory Practicals of Reproductive Biology I & II or Insect, Vector and Diseases I & II | 2 | 4 | 50 | - | 50 |
| CCP-609 (i) or CCP-609 (ii) | Practical-V (Chemistry) | Chemistry Lab-VI(i) or Chemistry Lab-VI(ii) | 2 | 4 | 50 | - | 50 |

****Students can opt any one of the following combinations (Theory as well as Practicals):**

- 1. Economic Botany (BOT 601L) + Biotechnology (BOT602L)**
- 2. Genetics (BOT 604L) + Plant Breeding (BOT605L)**

Note:

- 1. The subject combinations under B. Sc. General (Medical Group) are Botany, Zoology and Chemistry.**
- 2. Definition of Credit:
1 credit =1 Hr. Lecture (L) per week
1 credit= 2 Hrs. Practical (P) per week
2 Hrs. = 3 periods of approx. 40 minutes**
- 3. Each theory paper will be of 100 marks. The distribution of marks for external and internal assessment will be of 80 and 20 respectively. The distribution of internal assessment marks of 20 is based on the marks obtained by the student in one minor test of 12 marks to be conducted preferably in the month of November for Odd Semester and in the month of March for Even Semester. A student is required to pass the individual paper with 35% marks including internal assessment. The student also needs to pass the external examination individually with 35% marks. There will be maximum 4 marks for attendance (1 mark for attendance of 71-75%, 2 marks for attendance of 76-80%, 3 marks for attendance of 81-85% and 4 marks for attendance above 85%). The remaining 4 marks are for extracurricular activities including assignments.**
- 4. Practical examinations to be held annually with even semesters. The marks of odd semester practical may be reflected in the DMC of even semester with code and nomenclature, to be shown separately for each semester.**
- 5. The Batches of 20 or more can be opted for various courses as per requirement for all practical purposes by the college/institution. Each practical will be of 50 marks. The evaluation of practical may be distributed as 20% marks for lab record, 50% marks for performance during the examination and 30% marks for Viva Voce examination.**

Semester I

Botany Paper I Biodiversity of Microbes, Algae and Fungi (BOT 101 L)

(Credits: 2+0)

Time: 3 Hours

Max. Marks: 80

Internal Assessment: 20

Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Viruses

Viruses – Discovery, general characteristics, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV), Economic Importance of Viruses. **(6 Lectures)**

Unit 2: Bacteria

Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance of bacteria. **(8 Lectures)**

Unit 3: Algae

General characteristics; Range of thallus organization and reproduction; Classification of algae upto classes (Lee, 1980); Morphology and life-cycles of the following: *Nostoc*, *Volvox*, *Oedogonium*, *Ectocarpus* and *Polysiphonia*; Economic importance of algae. **(8 Lectures)**

Unit 4: Fungi

Introduction- General characteristics, economic importance, reproduction and classification upto Classes (Ainsworth, 1966); Morphology and life cycles of *Rhizopus*, *Penicillium*, *Puccinia*, *Agaricus*, and *Colletotrichum*. Causal organism, symptoms and control of following plant diseases; Rust of wheat, white rust of crucifers, late blight of potato, and red rot of sugarcane. Lichens: General account and significance. **(8 Lectures)**

SUGGESTED READINGS

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
2. Plant Pathology. 3rd Ed. 2017. R.S. Mehrotra and Ashok Aggarwal. McGraw Hill Education India Pvt Ltd. New Delhi.
3. Fundamentals of Plant Pathology .2013. R.S. Mehrotra and Ashok Aggarwal. McGraw Hill Education India Pvt Ltd. New Delhi.
4. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
7. Thakur, A.K. and Bassi, S.K. (2008). Diversity of Microbes and Cryptogams. S. Chand & Co., Delhi.
8. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
9. Willey, J.M., Sherwood, L., Woolverton, C.J, Prescott, L.M. and Willey, J.M. (2011). Prescott's Microbiology. New York, McGraw-Hill.

Semester I

Botany Paper II
Biodiversity of Archegoniate
(BOT 102 L)

(Credits: 2 + 0)

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1:Archegoniate

Unifying features of archegoniate, Transition to land habit, Alternation of generations, General account of Paleobotany; Types of fossils and process of fossilization. Study of fossil plants: *Rhynia* and *Lyginopteris* **(6 Lectures)**

Unit 2: Bryophytes

General characteristics, Range of habitat and thallus organization. Classification up to classes (Smith), morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria*. (Developmental details not to be included). Ecology and Economic importance of Bryophytes **(8 Lectures)**

Unit 3: Pteridophytes

General characteristics, Classification up to Classes (Smith), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit. Economic importance of Pteridophytes **(8 Lectures)**

Unit 4: Gymnosperms

General characteristics, Classification up to Classes (Pilger and Melchior, 1954), morphology, anatomy and reproduction of *Cycas*, and *Pinus*. (Developmental details not to be included). Ecological and Economic importance of Gymnosperms. **(8 Lectures)**

Suggested Readings

1. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
2. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
3. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
4. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India

Semester I

(Credits: 0+3)

Biodiversity of Microbes, Algae, Fungi and Archegoniate
Laboratory Practical Paper-III
BOT 103 P

Time: 3 Hours

Total Marks: 50

Note:

1. Practicals of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and/ or specimens, if any

List of Practical

1. Electron Micrographs/Models of viruses – T-Phage and TMV, Photograph/ Line drawing of Lytic and Lysogenic Cycle. Types of bacteria from permanent slides/photographs.
2. Study of vegetative and reproductive structures of *Nostoc*, *Volvox*, *Oedogonium*, *Ectocarpus* and *Polysiphonia* through temporary preparations and permanent slides.
3. Gram Staining and serial dilution technique of bacteria.
4. ***Rhizopus*, *Penicillium*, *Puccinia*, *Agaricus* and *Colletotrichum***: Asexual and sexual stage (temporary mounts / permanent slides).
5. Study of plant disease specimens as per theory syllabus.
6. **Lichens**: Study of growth forms of lichens (crustose, foliose and fruticose).
7. ***Marchantia***- morphology of thallus, W.M. rhizoids and scales, V.S. thallus with gemma cup, W.M.gemmae, V.S. of antheridiophore and archegoniophore, L.S. sporophyte (temporary/permanent slides).
8. ***Anthoceros***- morphology of thallus, W.M. rhizoids, V.S. thallus, VS Antheridia and Archegonia, L.S. sporophyte (temporary/permanent slides).
9. ***Funaria***- morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores, slides showing antheridial and archegonial heads, L.S. capsule (temporary /permanent slides).
10. ***Selaginella***- morphology, W.M. leaf with ligule, T.S. stem, W.M. strobilus, W.M. microsporophyll and megasporophyll, L.S. strobilus (temporary/ permanent slide).
11. ***Equisetum***- morphology, T.S. internode, L.S. strobilus, T.S. strobilus, W.M.sporangiophore, W.M. spores (wet and dry)(temporary slides); T.S rhizome (permanent slide).
12. ***Pteris***- morphology, T.S. rachis, V.S. sporophyll, W.M. sporangium, W.M. spores, T.S. rhizome, W.M. prothallus with sex organs and young sporophyte (temporary/ permanent slide).
13. ***Cycas***- morphology (coralloid roots, bulbil, leaf), T.S. coralloid root, T.S. rachis, V.S. leaflet, V.S.microsporophyll, W.M. spores, L.S. ovule, T.S. root (temporary/ permanent slide). LS Seed.
14. ***Pinus***- morphology (long and dwarf shoots, W.M. dwarf shoot, male and female), W.M. dwarf shoot, T.S. needle, T.S. stem, L.S./T.S. male cone, W.M. microsporophyll, W.M. microspores (temporary slides), L.S. female cone (temporary/ permanent slide). LS Seed.

Semester II

Botany Paper IV (Credits: 2+0)

Plant Ecology

(BOT 201 L)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Introduction to Ecology and Ecological factors

Introduction to Ecology: Basic concepts, types and Scope of Ecology. Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Effect of light and temperature on plants. Morphological and anatomical adaptation of hydrophytes and xerophytes.

(8 Lectures)

Unit 2: Ecosystem

Structure; energy flow trophic levels; Food chains and food webs, Ecological pyramids; Biogeochemical cycles; Hydrological, Carbon, Nitrogen and Phosphorous

(8 Lectures)

Unit 3: Plant Communities and Phytogeography

Qualitative and quantitative characters; Ecotone and edge effect; Succession; Process and types (Hydrosere and Xerosere). Phytogeographical regions of India, Endemism.

(8 Lectures)

Unit 4: Pollution and Environmental Laws

Definition, Types, Sources, Control of Air, Water and Soil Pollution. A basic knowledge of Environment Protection Act, 1986.

(6 Lectures)

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Odum, E.P. 1983: Basic Ecology, Saunders, Philadelphia.
3. Mackenzie, A. et al. 1999: Instant Notes in Ecology, Viva Books Pvt. Ltd., New Delhi.
4. Sharma, P.D., 2010 Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.

Semester II

Botany Paper V (Credit: 2+0) Plant Taxonomy (BOT 202 L)

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Plant Taxonomy

Identification, Classification, Nomenclature. Ranks, categories and taxonomic groups. Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. Types of classification- artificial, natural and phylogenetic. Bentham and Hooker system of classification (upto series), Angiosperm Phylogeny Group (APG)- general introduction (8 Lectures)

Unit 2 Herbarium, Botanical Gardens and Taxonomic Literature

Herbarium: general introduction and importance. Botanical gardens of the world (Royal Botanic Garden, Kew) and India (Acharya Jagdish Chandra Bose Indian Botanical Garden, Kolkata), Introduction to Botanical Survey of India (BSI Dehradun); Documentation: Introduction to Floras, monograph and journals, Keys: single access and multi-access (8 Lectures)

Unit 3. Modern trends in Taxonomy

Taxonomic evidences from cytology, phytochemistry and molecular data. Biometrics: Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences). (6 Lectures)

Unit 4: Study of Plant Families

Salient features, vegetative, floral characters and economic importance of the following families: *Ranunculaceae*, *Brassicaceae*; *Leguminosae*, *Asteraceae*; *Solanaceae*; *Lamiaceae*, *Liliaceae*, *Poaceae* (8 Lectures)

Suggested Readings

1. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
 2. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
- A. V. S. S. Sambamurthy (2005) Taxonomy of Angiosperms. I K International Publishing House Pvt. Ltd

Plant Ecology and Taxonomy
Laboratory Practical Paper-VI
 BOT 203 P

Time: 3 Hours

Total Marks: 50

Note:

1. Practicals of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and/ or specimens, if any

List of Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/ hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates and organic matter by rapid field test.
3. Study of morphological adaptations of hydrophytes and xerophytes (four each).
4. Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanchae*, *Striga*), Epiphytes, Insectivorous plants
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
7. Visit and Preparation of Report on polluting Industry/ polluting site and different Ecosystems.
8. Study of floral characters of the following families (Description, V.S. flower, section of ovary, floral diagrams, floral formulae and systematic position according to Bentham & Hooker's system of classification): **Ranunculaceae**- *Ranunculus/ Delphinium*; **Brassicaceae**- *Brassica/ Alyssum / Iberis*; **Leguminosae**- *Pisum, Acacia, Cassia*, **Asteraceae** -*Sonchus/ Helianthus/ Ageratum/ Eclipta/ Tridax*; **Solanaceae** -*Solanum nigrum/ Datura/Petunia*; **Lamiaceae**-*Salvia/ Ocimum*; **Liliaceae** -*Asphodelus/ Lilium/ Allium*, **Poaceae**- *Wheat*. Any other available plant species belonging to these families can also be studied.

Semester III

Botany Paper VII Plant Anatomy (BOT 301 L)

(Credits: 2+0)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Meristematic and permanent tissues (8 Lectures)

Root and shoot apical meristems; Simple and complex tissues. Theories of shoot apex.

Unit 2: Organs (6 Lectures)

Structure of dicot and monocot root stem and leaf, Stomata and its types, epidermal hairs, Trichomes

Unit 3: Secondary Growth (8 Lectures)

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). Anamolous secondary growth in Boehrvia and Dracaena.

Unit 4: Adaptive and protective systems (8 Lectures)

Epidermis, cuticle, Anatomical aspects of adaptations in xerophytes, hydrophytes, halophytes.

Suggested Readings

1. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/ Cummings Publisher, USA.
2. Pandey B.P (2012) Plant Anatomy. S. Chand Publisher
3. Katherine Esau (2006) Anatomy of Seed Plants, 2ed Paperback – 2006 Wiley Publisher
4. William C. Dickison (2015) Integrative Plant Anatomy.. Academic Press
5. Fahn A. (1990) Plant Anatomy. Pergamon Press
6. Bryan G. Bowes (1999) A Colour Atlas of Plant Structure. Manson Publishing

Semester III

Botany Paper VIII Plant Embryology (BOT 302 L)

(Credits: 2+0)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Structural organization of flower (8 Lectures)

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. Placentation-Types.

Unit 2: Pollination and fertilization (8 Lectures)

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 3: Embryo and endosperm (8 Lectures)

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship.

Unit 4: Apomixis and polyembryony (6 Lectures)

Definition, types and practical applications.

Suggested Readings

1. P. Maheshwari (1950) An Introduction to the Embryology of Angiosperms Mc Graw Hill
2. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
3. B.M. Johri Editor (1984) Embryology of Angiosperms Springer Verlag

Plant Anatomy and Embryology
Laboratory Practical Paper-IX
BOT 303 P

Time: 3 Hours

Total Marks: 50

Note:

1. Practicals of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and/ or specimens, if any

List of Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Skill Enhancement Courses

Ethno botany
(BOT 304 L)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Ethnobotany

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

(6 Lectures)

Unit 2: Methodology of Ethnobotanical studies

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

(6 Lectures)

Unit 3: Role of ethnobotany in modern Medicine

Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

(10 Lectures)

Unit 4: Ethnobotany and legal aspects

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

(8 Lectures)

SUGGESTED READINGS

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- 3) F A Lone, M. Khan, G M Khan (1993) Palaeoethonobotany plants and Ancient Man in Kashmir. Taylor and Francis.
- 4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
- 6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
- 7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah. 8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996

Semester III

(Credits: 2+0)

Skill Enhancement Course Biofertilizers (BOT 305 L)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. *Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. **(6 Lectures)**

Unit 2: *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication. Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation. **(10 Lectures)**

Unit 3: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants. **(8 Lectures)**

Unit 4: Organic farming – Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. **(6 Lectures)**

Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand& Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John JothiPrakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. SubhaRao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming AktaPrakashan, Nadiad

Skill Enhancement Course
Mushroom Culture Technology
(BOT 306 L)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India –*Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*. **(5 Lectures)**

Unit 2: Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

(12 Lectures)

Unit 3: Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

(8 Lectures)

Unit 4: Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

(5 Lectures)

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Semester III

(Credits: 2+0)

**Skill Enhancement Course
Plant Diversity and Human Welfare
(BOT 307 L)**

Time: 3 Hours

**Max. Marks: 80
Internal Assessment: 20
Total Marks: 100**

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, uses of plants, Uses of microbes. **(8 Lectures)**

Unit 2: Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, **Management of Plant Biodiversity:** Organizations associated with biodiversity Management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication. **(8 Lectures)**

Unit 3: Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. **(8 Lectures)**

Unit 4: Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. **(6 Lectures)**

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. SP Singh and JS Singh (2017) Ecology Environmental Science and Conservation.
3. Atiya Khanum Irfan Ali Khan (2004) Ethnomedicine And Human Welfare.

**Botany Paper X
Plant Physiology
(BOT 401 L)**

**Max. Marks: 80
Internal Assessment: 20
Total Marks: 100**

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Plant-water relations

Importance of water, Osmosis, Imbibition, Plasmolysis, Water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

(8 Lectures)

Unit 2: Mineral nutrition

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

(8 Lectures)

Unit 3: Translocation

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading, Factors affecting translocation.

(6 Lectures)

Unit 4: Plant growth regulators and Photoperiodism

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA and ethylene. Photoperiodism (SDP, LDP, Day Neutral Plants); Phytochrome (Discovery & Structure); Vernalization.

(8 Lectures)

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Jain V.K. (2017) Fundamentals of Plant Physiology S Chand Publisher
4. Taiz L., Zeiger E., Moller, Ian Max, Murphy, A. (2018) Fundamental of Plant Physiology. Sinauer Associates.
5. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

**Botany Paper XI
Plant Metabolism
(BOT 402 L)**

Time: 3 Hours

**Max. Marks: 80
Internal Assessment: 20
Total Marks: 100**

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Photosynthesis

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C₃, C₄ and CAM pathways of carbon fixation; Cranzanatomy, Factors affecting rate of photosynthesis, Photorespiration.

(8 Lectures)

Unit 2 Respiration

Glycolysis, Anaerobic respiration, TCA cycle; Electron Transport Chain Oxidative phosphorylation, Glyoxylate Cycle, Oxidative Pentose Phosphate Pathway.

(8 Lectures)

Unit 3: Enzymes

Structure and properties; Enzyme vs Chemical catalyst, Nomenclature and Classification, Mechanism of enzyme action and enzyme inhibition.

(8 Lectures)

Unit 4: Nitrogen and Lipid Metabolism

Biological nitrogen fixation; Nitrate and ammonia assimilation, Structure and functions of Fatty acids lipids, Fatty acids biosynthesis and degradation

(6 Lectures)

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Nelson D.L. and Cox M M (2017) Principles of Biochemistry. W.H. Freeman.
5. Jain V K (2015) Fundamental of Plant Physiology S Chand Publishing

Plant Physiology and Metabolism

Laboratory Practical Paper-XII

List of Practical

BOT 403 P

Time: 3 Hours

Total Marks: 50

Note:

1. Practicals of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs,

List of Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of imbibition by Plaster of Paris cone method.
3. To study the effect of environmental factors (light and wind) on transpiration by excised twig.
4. To determine the phenomenon of phototropism, geotropism and hydrotropism.
5. Determination of activity of salivary amylase and study the effect of pH and temperature on it.
6. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
7. Demonstration of Hill reaction.
8. To study the phenomenon of aerobic and anaerobic respiration.
9. To compare the rate of transpiration by four leaf method/cobalt chloride method.
10. Determination of the activity of catalase and study the effect of pH and enzyme concentration.
11. To study the effect of light intensity and bicarbonate concentration on O₂ evolution in photosynthesis.
12. Comparison of the rate of respiration in plant.
13. Separation of amino acids by paper chromatography.
14. To demonstrate the phenomenon of ascent of sap by Eosin method.
15. Separation of photosynthetic pigments by paper chromatography
16. Qualitative tests for proteins, carbohydrate and fats.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Discipline Specific Elective Botany Paper-I
Cell Biology
(BOT 501 L)

Time: 3 Hours

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Cell as a unit of Life

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. Cell Cycle: Overview of Cell cycle, Mitosis and Meiosis; Molecular controls

(8 Lectures)

Unit 2: Cell Organelles-I

Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles.

(8 Lectures)

Unit 3: Cell Organelles-II

Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis. Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

(8 Lectures)

Unit 4: Cell Membrane and Cell Wall

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

(6 Lectures)

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Hofmann Andreas and Clokie Samuel ed. (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
5. Ian F.M. Van Impe, Peter A Vanrolleghem and Dirk M Iscrentant (2013) Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, Kluwer Academic Publishers

Discipline Specific Elective Botany Paper-II
Molecular Biology
(BOT 502 L)

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Genetic material and DNA Replication

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semidiscontinuous RNA priming, replication of linear dsDNA, replicating the 5' end of linear chromosome including replication enzymes. **(8 Lectures)**

Unit 2: Transcription

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases **(6 Lectures)**

Unit 3: Translation and gene expression

Genetic code and its characteristics, prokaryotic and eukaryotic translation: ribosome structure and assembly, charging of tRNA, aminoacyl-tRNA synthetase, mechanism of initiation, elongation and termination of polypeptides, Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system). **(8 Lectures)**

Unit 4: Techniques in Molecular Biology

Introduction to electrophoresis, agarose gel electrophoresis, acrylamide gel electrophoresis, Immuno-electrophoresis, PCR and its variants, application of PCR, Principles of microscopy; Light and Phase contrast microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM). **(8 Lectures)**

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th 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. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Lewin's (2017) Genes XII. Jones and Bartlett Publishers.

Cell biology and Molecular Biology
Laboratory Practical Paper-III
(BOT 503 P)

Time: 3 Hours**Total Marks: 50**

Note:

1. Practical of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and/ or specimens, if any

List of Practical

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
7. Study of mitosis and meiosis (temporary mounts and permanent slides).
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene&lampbrush) either by slides or photographs.
13. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Semester V

(Credits: 2+0)

**Discipline Specific Elective Botany Paper -I
Analytical Techniques in Plant Sciences-I
(BOT 504 L)**

Time: 3 Hours

**Max. Marks: 80
Internal Assessment: 20
Total Marks: 100**

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Imaging and related techniques

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy, Chromosome banding, FISH, chromosome painting. **(8 Lectures)**

Unit 2: Electron Microscopy

Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching. **(6 Lectures)**

Unit 3: Cell fractionation

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl₂ gradient, analytical centrifugation, ultracentrifugation, marker enzymes. **(8 Lectures)**

Unit 4: Radioisotopes and Spectrophotometry

Radioisotopes and its biological application, radioactive decay, auto-radiography, pulse chase experiment. Spectrophotometry: Principle and its application in biological research.

(8 Lectures)

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Egerton R F (2016) Physical Principles of Electron Microscopy: An Introduction to TEM, SEM and AEM. Springer.
5. Hofmann Andreas and Clokie Samuel eds. (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
6. Sawhney SK and Randhir Singh (1999) Introductory Practical Biochemistry. Narosa Publishing House.

Discipline Specific Elective Botany Paper-II
Analytical Techniques in Plant Sciences-II
(BOT 505 L)

Max. Marks: 80**Internal Assessment: 20****Total Marks: 100****Time: 3 Hours**

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Chromatography

Principle; Paper chromatography; Thin Layer Chromatography, Column chromatography, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography. **(8 Lectures)**

Unit 2: Characterization of proteins and nucleic acids Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE. **(8 Lectures)**

Unit 3: Biostatistics-I

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; **(8 Lectures)**

Unit 4: Biostatistics-II

Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit. **(6 Lectures)**

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Egerton R F (2016) Physical Principles of Electron Microscopy: An Introduction to TEM, SEM and AEM. Springer.
5. Hofmann Andreas and Clokie Samuel eds. (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
6. Sawhney SK and Randhir Singh (1999) Introductory Practical Biochemistry. Narosa Publishing House.
7. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

Semester V

(Credits: 0+3)

Analytical Techniques in Plant Sciences

Laboratory Practical Paper-III

(BOT 506 P)

Time: 3 Hours

Total Marks: 50

Note:

1. Practical of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs,

List of Practical

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH)
11. Study DNA packaging by micrographs.

Semester VI

(Credits: 2+0)

**Discipline Specific Elective Botany Paper-IV
Economic Botany
(BOT 601 L)**

Time: 3 Hours

**Max. Marks: 80
Internal Assessment: 20
Total Marks: 100**

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Origin of Cultivated Plants

Concept of centres of origin, their importance with reference to Vavilov's work, Cereals: Wheat and Rice-Origin, morphology, uses

(8 Lectures)

Unit 2: Legumes and Spices

General account with special reference to Gram, pea, arhar and soybean; Spices: General account with special reference to clove, ginger, turmeric and black pepper (Botanical name, family, part used, morphology and uses)

(8 Lectures)

Unit 3: Beverages and Oils

Tea, coffee and cocoa (morphology, processing, and uses); Oils and Fats: General description with special reference to groundnut, mustard, coconut

(8 Lectures)

Unit 4: Fibre Yielding Plants

General description with special reference to Cotton, Jute and Coir (Botanical name, family, part used, morphology and uses)

(6 Lectures)

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Pandey, B.P. (1999) Economic Botany. S. Chand & Company
3. Robert W. Schery (1972) Plants for Man. Prentice Hall

Semester VI

(Credits: 2+0)

Discipline Specific Elective Botany Paper-V
Biotechnology
(BOT 602 L)

Max. Marks: 80

Internal Assessment: 20

Total Marks: 100

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Plant cell and tissue culture

Plant tissue culture, Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

(8 Lectures)

Unit 2: Recombinant DNA Techniques

Restriction endonucleases, DNA restriction digestion and ligation, Plasmid and Cloning vectors, PCR and its application, Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting;

(8 Lectures)

Unit:3 Molecular Markers

Molecular DNA markers i.e. RAPD, RFLP, AFLP, ISSR, SNPs; DNA sequencing, Hybridoma technology and monoclonal antibodies.

(6 Lectures)

Unit 4: Diagnostic Techniques

Molecular diagnosis of human disease, Human gene Therapy, automation in diagnostic techniques, rapid diagnostic approach including purification and standardisation of antigen and specific antibodies, ELISA and Immunodetection.

(8 Lectures)

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
4. Singh B D (2015) Biotechnology Expanding Horizons. Kalyani Publishers

Laboratory Practical Paper-VI
Economic Botany and Biotechnology
(BOT 603 P)

Time: 3 Hours**Total Marks: 50**

Note:

1. Practical of both the semesters shall be held annually.
2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.
3. Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and/ or specimens, if any

List of Practicals

1. Study of economically important plants : Wheat, Rice, Gram, Pea, Arhar, Soybean, Black pepper, Ginger, Clove, Turmeric, Tea, Coffee, Cocoa, Cotton, Jute, Coir, Groundnut, Coconut and Mustard
2. To prepare any one of the tissue culture medium.
3. To prepare the slants and Petri plates for plant tissue culture.
4. Study of techniques of sterilization, culturing and sub-culturing of cell, tissues and organs.
5. Demonstration of anther culture, protoplast isolation and culture, embryo culture using suitable models / charts / photographs etc.
6. Brief introduction to the components and working of the instruments
7. (oven, autoclave, incubator, centrifuge, laminar air flow and spectrophotometer)Familiarization with basic equipments in tissue culture
8. To study the structure of DNA using model or Charts
9. Isolation and quantification of genomic DNA from bacteria (E. coli), animals or Plants
10. Analysis of DNA by Agarose Gel Electrophoresis
11. Estimation of DNA by DPA method.
12. Estimation of RNA by orcinol method.
13. Absorption spectra of proteins and nucleic acids
14. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
15. Demonstration of ELISA.
16. To separate nitrogenous bases by paper chromatography.
17. To separate sugars by thin layer chromatography.
18. Isolation of chloroplasts by differential centrifugation.
19. To separate chloroplast pigments by column chromatography.
20. To estimate protein concentration through Lowry's methods.
21. To separate proteins using PAGE.
22. To separate DNA (marker) using AGE.
23. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).

Discipline Specific Elective Botany Paper-IV
Genetics
(BOT 604 L)

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Heredity

Brief life history of Mendel, Terminologies, Laws of Inheritance, Modified Mendelian Ratios: 2:1- lethal Genes; 1:2:1- Co- dominance, incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1: Chi Square, Pedigree Analysis

(8 Lectures)

Unit 2: Cytoplasmic and Chromosomal Inheritance

Cytoplasmic Inheritance: Shell Coiling in Snail, Kappa particles in Paramecium, leaf, variegation in *Mirabilis jalapa*, Male sterility, Multipleallelism, Pleiotropism, Chromosome theory of Inheritance. Sex-determination and Sex-linked Inheritance

(8 Lectures)

Unit 3: Linkage and Crossing over

Linkage: concept & history, complete & incomplete linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps based on two and three factor crosses. Crossing over: concept and significance, cytological proof of crossing over.

(8 Lectures)

Unit 4: Mutations and Chromosomal Aberrations

Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

(6 Lectures)

Suggested Readings

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons 5th Inc., India.
3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to the Genetic Analysis. W. H. Freeman and Co., U.S.A. 10 edition.
5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
6. Verma P S (2010) Genetics. S Chand Publishing.
7. Singh B D (2009) Genetics Kalyani Publishers.

Discipline Specific Elective Botany Paper-V
Plant Breeding
(BOT 605 L)

Max. Marks: 80
Internal Assessment: 20
Total Marks: 100

Time: 3 Hours

Note: Total 9 questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the entire syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question carries equal marks.

Unit 1: Plant Breeding

Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

(6 lectures)

Unit 2: Methods of crop improvement

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self-pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

(8 lectures)

Unit 3: Quantitative inheritance

Concept, mechanism, examples. Monogenic vs polygenic Inheritance. Inbreeding depression and heterosis: History, genetic basis of inbreeding depression and heterosis; Applications.

(8 lectures)

Unit 4: Crop improvement and breeding

Role of mutations, gene mutation, chromosomal mutation and types of mutants; Polyploidy and its role in agriculture; Distant hybridization and role of biotechnology in crop improvement.

(8 lectures)

Suggested Readings

1. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

Semester VI

(Credits: 0+4)

Laboratory Practical Paper-VI
Genetics and Plant Breeding
(BOT 606 P)

Time: 3 Hours

Total Marks: 50

Note:

- 1. Practical of both the semesters shall be held annually.**
- 2. Students should draw Figures or diagrams and write related descriptions/ notes in their practical note books.**
- 3. Report on excursion tours with photographs, collection, preservation and preparation of herbarium sheets and/ or specimens, if any**

List of Practicals

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
2. Chromosome mapping using point test cross data.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging, Cross Pollination (For demonstration only).
8. Induction of polyploidy conditions in plants (For demonstration only).
9. To prepare any one of the tissue culture medium.
10. To prepare the slants and Petri plates for plant tissue culture.
11. Study of techniques of sterilization, culturing and sub-culturing of cell, tissues and organs.
12. Brief introduction to the components and working of the instruments (oven, autoclave, incubator, centrifuge, laminar air flow and spectrophotometer)
Familiarization with basic equipments in tissue culture