Scheme of Examination and Syllabus

For M.Sc. (BOTANY)

Semester I to IV (2022-2024)

RAFFLES UNIVERSITY

SCHOOL OF BASIC AND APPLIED SCIENCES (SOBAS)

RAFFLES UNIVERSITY

Japanese Zone, National Highway-48, Neemrana-301705,

District: Alwar, RAJASTHAN, INDIA

www.rafflesuniversity.edu.in

SCHOOL OF BASIC AND APPLIED SCINCES
Department of Botany
(Syllabus and Scheme of Studies w. e. f. 2022-23)
M. Sc. I Year (I Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Algae & Fungi
Paper Code: BOT-101 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Criteria for algal classification (pigments, reserve food, flagella etc.) and their taxonomic importance.

Comparative account of important systems of classification and recent trends.

Thallus organization in algae and evolutionary trends.

Economic importance of algae as food, feed, uses in industries etc and algal biofertilizers.

Unit-II

Biodiversity of algae in different habitats (terrestrial, freshwater and marine).

Ecological diversity of algae in unusual habitats (thermal, psychrophilic, subaerial, symbiotic etc.).

Dynamics and consequences of algal blooms and red tides (Freshwater and Marine). Algae as major components of phytoplankton.

Morphological features and life cycle patterns of major divisions with suitable examples (Cyanophyta, Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta, and Rhodophyta with special reference to *Spirulina*, *Gonyaulax*, *Laminaria*, *Gelidium* and *Batrachospermum*).

Unit- III

General characters of fungi: Thallus organization, nutrition and reproduction.

Classification of fungi by Ainsworth & Bisby (1983), Alexopoulus et. Al (1996).- phylogeny of fungi- characters used in classification.

General account of Myxomycota, Mastigomycota, Zygomycota, Ascomycota, Basidiomycota and Mitosporic fungi (with special reference to *Rhizopus*, *Neurospora*, *Polyporus*, *Drechslera* and *Colletotrichum*). Different kinds of spores and their dispersal.

Concept of Homothallism, Heterothallism, alternation of generations and parasexuality.

Unit – IV

Economic importance of fungi in nutrient cycling, decomposition, humus formation, decay and deterioration of wood & timber.

Causal organisms, symptoms and management of: late and early blight of potato, downy mildew of grapes, green ear disease of Bajra (Sorghum), apple scab, karnal bunt of wheat, rust of wheat, tikka disease of ground nut

Lichens: structure, reproduction and economic importance.

Suggested Readings:

1. Ahluwalia, A.S. (Ed.). *Phycology: Principles, Processes and Applications.* Daya Publishing House, New Delhi. 2003.
2. Carr, N.G. & Whitton, B.A. (1982): The biology of Cyanobacteria Blackwell Scientific Publ., Oxford, U.K.
3. Dubey, R.C. (2014): Advanced Biotechnology, S Chand & Company Pvt. Ltd., New Delhi.
4. Fatma, T. (2005): Cyanobacterial and Algal Metabolism and Environmental Biotechnology, Narosa Publishers.
5. Fay, P & C van Baalen (1987): The cyanobacteria, Elsevier Science Publishers, B.V. Amsterdam, Netherlands.
6. Gupta, R.K. & Pandey, V.D. (2007): Advances in Applied Phycology, Daya Publishing House, Daryaganj, New Delhi.
7. Hoek, C. Van Den, Mann, D.G. & Jahns, H.M. (1995): Algae: An Introduction to Phycology, Cambridge University Press, U.K.
8. Kaushik, B.D. (1987): Laboratory methods for Blue-green Algae, Associated Publishing Co., New Delhi.
9. Morris, I. (1980): The Physiological Ecology of Phytoplankton (studies in Ecology, Vol.7), Blackwell Scientific Publ., USA.
10. Prescott, L.M., Harley, J.P. & Klein, D.A. (1996): Microbiology, 3rd edition, Wm. C. Brown Publishers, USA.
11. Singh, B.D. (1998): Biotechnology, Kalyani Publishers, New Delhi.
12. Singh, R.P. (1990): Introductory Biotechnology, Central Book Depot, Allahabad, India.
13. Sze, P. (1993): A. Biology of the Algae, Wm. C. Brown Publishers, U.K.
14. Venkataraman, G.S. ((1969): The Cultivation of Algae, IARI, New Delhi.
15. Alexopoulos, C.J. Mins, C.W. & Blackwell, M. 1995: Introductory Mycology, John Willy and Sons. Inc.
16. Bilgrami, K.S. & Dubey H.C. (1986): A text book of Modern Plant Pathology, Vikas,

Publ Ltd., N.Delhi.

17. Bilgrami, K.SA. & Verma R.N. (1981): Physiology of fungi, Vikas Publ. Ltd., New Delhi.

18. Biswas, S.P. & Biswas, A. 1984: An Introduction to Viruses, Vani Education Books, New Delhi.

19. Butler, E.J. & Jones, S.G. (1978): Plant Pathology, Periodical Expert Book Agency, New Delhi.

20. Clifton, A. 1958: Introduction to the Bacteria. McGraw Hill Books Co. New York.

21. Mehrotra, R.S. & Aneja, K.R. 1990: An introduction of Mycology, New Age International Press, N. Delhi.

22. Moore-landeckar, E.J. (1972): Fundamentals of the fungi, Prentice Hall, Eaglewood, U.K.

23. Mundukar, B.B. (1967): Fungi & Plant Diseases, Mac million Co. Ltd., USA.

24. Webster, J. 1985: Introduction of Fungi. Cambridge University, Press.

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Department of Botany
(Syllabus and Scheme of Studies w. e. f. 2022-23)
M. Sc. I Year (I Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Bryophytes, Pteridophytes & Paleobotany
Paper Code: BOT-102 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

General characteristics features of Bryophytes. Classification of Bryophytes upto classes. General account of structure and development of gametophyte, sporophyte of Marchantiales, Sphagnales, Funariales, Polytrichales, Jungermanniales and Anthcerotales (with special reference to *Plagiochasma, Notothylus, Sphagnum, Physcomitrella* and *Polytrichum*).

Unit -II

Regulation of protonemal differentiation and bud formation.
Biology of reproduction- *In Vitro* regulation of gametangia formation:
effect of physical and chemical factors, Cytology of Bryophytes, Apogamy and Apospory.
Ecological importance of bryophytes: Bryophytes as indicators of pollution and minerals; role of Bryophytes in succession.

Unit-III

General characteristics of Pteridophytes and their classification
Comparative morphology, classification, reproduction and life history of *Lycopodium, Isoetes, Ophioglossum* and *Azolla*.
Origin and evolution of stele, heterospory and seed habit. Economic and Ecological significance of Pteridophyte in succession.

Unit- IV

Paleobotany: History of paleobotany, formation and types of fossils, techniques of study of fossils, Geological time scale. Brief account of Pteridospermales and Cycadeoidales. Paleobotany and the evolution of vascular plants.

Suggested Readings:

1. Parihar, N.S. 1965. An Introduction to Embryophyta Vol. I. Bryophyta, Central Book Depot, Allahabad, India.
2. Schofield, W.B. 1985. Introduction to Bryology, Macmillan, New York.
3. Chopra, R.N. and Kumra, P.K. 1988. Biology of Bryophytes. Wiley Eastern Ltd., New Delhi.
4. Chopra, R.N. & Bhatla, S.C. 1990. Bryophyte Development: Physiology and Biochemistry. CRC Press, Boca Raton, USA.
5. Rashid, A. 1998. An Introduction to Bryophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
6. Watson, E.V. 1967. The Structure and Life of Bryophytes. B.I. Publications, New Delhi.
7. Glime, J.M and Saxena D. 1991. Uses of Bryophytes. Today and Tomorrow's Printers and Publishers, New Delhi.
8. Richardson, D.H.S. 1981. The Biology of Mosses. Blackwell Scientific Publications, Oxford, London.
9. Parihar, N.S. 1977. The Biology and Morphology of Pteridophytes. Central Book Depot. Allahabad.
10. Rashid, A. 1976. An Introduction to Pteridophyta (Diversity and Differentiation). Vikas Publishing House Pvt. Ltd., New Delhi.
11. Sporne, K.R. 1985 (reprint) The Morphology of Pteridophytes. B.I. Publications Pvt. Ltd., Delhi.

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M. Sc. I Year (I Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Cytogenetics and Plant breeding
Paper Code: BOT-103 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Chromatin structure and organization:

Chromosome structure and DNA packaging; euchromatin and heterochromatin.

Organization of plastid and mitochondrial genomes.

Special Chromosomes: Structure, occurrence and behaviour of polytene, lampbrush and sex chromosomes.

Karyotype: Karyotype analysis and its evolution; FISH, GISH and flow cytometry.

Unit-II

Cell cycle: Cell cycle phases, checkpoints and regulation.

Chromosome banding techniques and their applications.

Linkage and crossing over: Molecular mechanism of crossing over and role of different enzymes; linkage groups.

Chromosome mapping- Two point and three-point test crosses.

Unit-III

Sex determination: Chromosomal and gene determining sex in plants, animals, *Drosophila* and humans; Gene dosage compensation.

Structural alterations in chromosomes- Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes.

Variation in chromosome number: Haploids, aneuploids and euploids- origin, production, effects and uses; polyploidy and crop improvement.

Unit-IV

Principles of plant breeding: Principles and objectives;

methods of breeding self- and cross-pollinated crops, heterosis and hybrid vigour; utility of hybrids in genetics and plant breeding.

Asexual breeding systems: Methods of breeding of vegetatively propagated crops; non-conventional methods; gene variability.

Male sterility: Concept; classification; genetic control; inheritance pattern and breeding utility.

Suggested Readings:

1. Alberts B, Johnson A, Lewis J. Raff M, Roberts K and Walter P (2008) Molecular Biology of the Cell (5th Ed.). Garland Publishing Inc., New York.

2. Gustafron JP (2002) Genomes, Kluwer Academic Plenum Publishers, New York, USA.

3. Karp G (1999) Cell and Molecular Biology, John Wiley and Sons, USA.

4. Krebs JE, Goldstein ES and Kalpatrick ST (2010) Lewin's Essential Genes (2nd Ed.), Jones and Barlett Publishers.

5. Lewin B (2010) Gene X, Jones and Barlett Publishers.

6. Lodish H, Berk A, Kaiser, CA, Krieger M, Scott MP Bretscher A Ploegh H and Matsudaira P (2008) Molecular Cell Biology (6th Ed), W.H. Freeman and Company, New York, USA.

7. Pierce BA (2012) Genetics- A Conceptual Approach (4th Ed.), W.H. Freeman and Company, New York, USA.

8. Poehlman JM and Sleper DA (1995) Breeding Field Crops, AVI. Publ., U.S.A.

9. Russell PJ (2006) Genetics (5th Ed.), Addison Wesley Longman, California, USA.

10. Snustad P and Simmons MJ (2011) Principles of Genetics. (6th Ed.), John Wiley, New York.

11. Weaver RF (2005) Molecular Biology, McGraw Hill International Edition.

12. Watson, JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene (6th Ed.), CSHLP, New York.

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M. Sc. I Year (I Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Ecology
Paper Code: BOT-104 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

The Environment: Physical environment, biotic environment, biotic and abiotic interactions; Tolerance range and limiting factors, ecotypes

Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population ecology: Concept, characteristics, population growth and regulation, species interactions—mutualism, competition, allelopathy, predation, parasitism, Life-history strategies and r-and K selection, concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations

Unit-II

Community structure and organization; Nature of communities, community structure and its attributes; species diversity, Edges and ecotones, vegetation characteristics (analytical and synthetic characters, methods of analysis.

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Unit-III

Ecosystem organization: structure and functions; primary production (global pattern and controlling factors); energy dynamics—trophic levels, energy flow pathways and ecological efficiencies. Global biogeochemical cycles of C, N, P, & S, ecosystem stability (resistance and resilience).

Unit-IV

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India, speciation and extinction, endemism.

Global atmosphere changes: Environmental pollution, global environmental change and its consequences (CO2 fertilization, global warming sea level rise and UV radiation).

Suggested Readings:

1. Botkin, D.B. and E.A. Keller (2004). Environment Science: Earth as a Living Planet, John Wiley & Sons Inc., New York.
2. Miller (Jr.) and G. Tyler (1994): Living in the Environment. Wadsworth Publishing Company, Belmont, California.
3. Odum, E.P. (1983), Basic Ecology, Sanders, Philadelphia.
4. Peter H. Raven, P.H. and Berg, L. R. Berg. 2005. Environment, 5th Edition. John Wiley & Sons Inc., New York.
5. Ramakrishnan, P.S. 2000. Ecology and Sustainable Development. National Book Trust, India
6. Robert Ricklefs (2001). The Ecology of Nature. Fifth Edition. W.H. Freeman and Company.
7. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
8. Smith, R.L. (1996), Ecology and Field Biology, Harper Collins, New York.
9. Steffen, W., A. Sanderson, P. D. Tyson, J. Jager, P. M. Matson, B. Moore, III, F. Oldfield, K. Richardson, H. J. Schnellnhuber, B. L. Turner, II, and R. J. Wasson. 2004. Global change and the Earth system: a Planet under Pressure. Springer-Verlag, New York, New York, USA Reference books.
10. Townsend, C.R., Begon, M. And Harper, J.L. 2003. Essentials of Ecology. Second Edition. Blackwell Publishing, Oxford.

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M. Sc. I Year (II Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Microbiology and Biostatistics
Paper Code: BOT-201 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Structure & replication of viruses and bacteriophage; transmission & control of viruses; Isolation & purification of Plant Viruses. Diseases caused by Viruses**:** TMV, Tristeza of citrus Cyanobacteria: Salient features and Biological Importance.

Unit-II

Growth, culture and maintenance of microorganisms

Microbial growth and measurement, environmental factors influencing growth.

Control of micro-organisms: Physical methods (High temperature, dry hot or hot air sterilization, moist air sterilization, low temperature, filtration, lyophilization, Radiation), Chemical methods (Disinfectants and antiseptics).

Unit-III

Microbial interaction: Functions of symbiotic relationships, types of symbiosis, commensalism, synergism, mutualism- (Lichens, Bacterial endosymbionts of protozoa, Nitrogen fixing symbiosis, mycorrhizae), parasitism.

Environmental Microbiology: Microbiology of fresh, marine and extreme environment, Biofilms, Bioremediation of polluted environment, Bioleaching.

Unit-IV

Biostatistics: Brief description and tabulation of data and its graphical representation. Measures of central tendency and dispersion.

Mean, mode, median, range standard deviation, variance idea of two types of errors and level of significance, tests of significance (F & t test); chi-square test. Simple Linear Regression and Correlation.

Suggested Readings:

1. Gupta R & Mukherji K G (2001). Microbial technology, APH Publ. co., New Delhi.
2. Pelezar, MJ, Chaing, ECS & Krieg, NR (1993). Microbiology, Tata McGrawHill Publ. New Delhi.
3. Prescott, LM., Harley, JP & Klein, DA (1996). Microbiology Wm. C. Brown Publ. USA.
4. Ronald, M Atlas (1995). Principles of microbiology. Mosby-Year Book, Inc. St. Louis, Missouri, USA.
5. Singh R.P. (1990): Introductory Biotechnology, Central Book Depot, Allahabad, India.
6. Sumbali, G. 2005: The Fungi, Narosa Publ. House, New Delhi.
7. Statistics for Biologists (1974) Campbell R.C. Cambridge University Press, Cambridge.
8. Statistics in Biology, Vol. 1 (1967) Bliss, C.I.K, McGraw Hill, New York.

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M. Sc. I Year (II Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Natural Resources and Biodiversity
Paper Code: BOT-202 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Resources: Types, Renewable and non-renewable resources; resources degradation and conservation.

Land resources: Land degradation and desertification; management of waste lands in India.

Water resources: Pools of water and Hydrological cycles, surface water and ground water; water-use and management. Environmental pollution of air, water and soil-types, sources and effects.

Unit-II

Forest resources: Forests and their importance, non-timber forest produce, forest resources of India and forest management.

Types of energy resources, renewable sources of energy-wine energy, wave energy, Energy from biomass, bioconversion technologies, energy plantation and petrocrops.

Ecosystem restoration and Environment impact assessment- Brief account.

Unit- III

Principals of resources conservation and conservation strategies. Biological diversity: importance, concept and levels biodiversity, threats to biodiversity-habitat loss and fragmentation, exotic species, pollution, species extinctions; IUCN categories of threat. Distribution and global patterns of biodiversity. Terrestrial and marine hotspots of biodiversity; Hotspots of biodiversity in India.

Unit- IV

***In situ* conservation of biodiversity:** Protected area in India wildlife sanctuaries, national parks, biosphere reserves. Conservation of biodiversity of wetlands, mangroves and coral reefs.

***Ex situ* biodiversity conservation:** principles and practices, field gene banks, seed banks and cryopreservation.

Sustainable development: concept, principles and strategies; sustainability indicators.

Suggested Readings:

1. Ball, J.B. 2001. Global forest resources: history and dynamics. In: *Forest Handbook Volume* 1, Evans, J. (ed.) Blackwell Science, Oxford.
2. Chape, S., Fish, L. Fox, P. and Spalding, M. 2003. United Nations list of protected areas. UCN/UNEP/World Conservation Monitoring Centre, Gland, Switzerland/Cambridge.
3. Gopal, B. (ed.) 1987. Ecology and Management of Aquatic Vegetation of the Indian Subcontinent. W. Junk by. The Hague.
4. Heywood, V. (Ed.) (1995) Global Biodiversity Assessment. United Nations Environment Programme, Cambridge University Press, Cambridge.
5. Huston, M.A. 1994. *Biological Diversity*: The Coexistence of Species on Changing Landscapes. Cambridge University Press, Cambridge.
6. Owen, O.S., Chiras, D.D. and Reganold, J.P. 1998. Natural Resource Conservation: Management for Sustainable Future. Seventh Edition. Prentice Hall. Upper Sadle River, New Jersey.
7. Raven, P.H. and Berg, L.R. 2005. Environment, 5th Edition, John Wiley & Sons Inc., New York.
8. Singh, J.S. and Singh, S.P. 1992. *Forests of Himalaya, Structure, Functioning and Impact of Man.* Gyanodaya Prakashan, Nainital, India.
9. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.

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M. Sc. I Year (II Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Gymnosperms & Ethnobotany
Paper Code: BOT-203 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Classification of gymnosperms and their distribution in India.

Brief account of the following families:

Lyginopteridaceae, Medullosaceae, Glossopteridaceae, Caytoniaceae.

Unit – II

General account of the following orders:

Cycadeoidales (Cycadeoidea), Pentoxylales, Cordiatales

Comparative account of Structure and reproduction in the following orders:

Cycadales (*Zamia*), Ginkgoales (Ginkgo).

Unit- III

Coniferales (*Pinus* and *Taxus*), Welwitschiales (*Welwitschia*), Gnetales (*Gnetum*).

Economic importance of gymnosperms, Role of Gymnosperms in Biodiversity.

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

Unit-IV

Ethnobotany: History and importance of ethnobotany, ethnomedicobotany, ethnozoology, ethnoveterinary, ethnomusicology and ethnoagriculture. Wild edible plants used as emergency food by tribals in India, methods and techniques in ethnobotanical study and research.

Traditional plants: Cereals, pulses, vegetables, spices and mushrooms, wild edible fruits and seeds. Plants in folk songs and proverbs. Sacred grooves, Impact of modernization.

Suggested Readings:

1. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms, New Age International Pvt. Ltd., New Delhi.
2. Sporne, K.R. 1965. The Morphology of Gymnosperms. B.I. Publications Pvt. Ltd., New Delhi.
3. Bierhorst, D. W. 1971. Morphology of Vascular Plants. Macmillan. New York.
4. Cotton, C.M. 1996. Ethnobotany- Principles and Appliations, Centruy School Book by service Film setting Ltd.
5. Dahlgren. R.H., Clifford, T and P.F Yeo 1985.The families of the monocotyledons; structure, Evolution and Taxonomy. SpingeVerag, NY.
6. Gary J, Martin, 2004. Ethnobotany- A Methods Manual, Chapman and Hall. U.K.
7. Jain S.K. 1981. Glimpses of Indian Ethnobotany. Oxford and IBH, New Delhi.
8. Jain S.K. 1987. A manual of ethnobotany. Scientific publisher Jodhpur.
9. Jain S.K. and Mundgal, 1999. Handbook of ethnobotany, London.
10. Pursrglove, J.W. 1972. Tropical Crops-Monocotyledons and Dicotyledons of ethnobotany, ethnomedicine, ethnoecology, ethnic communities.
11. Rao, P.C. 2006. Medicinal plants: Ethanobotanical Approach, Agribios, India.
12. Trivedi, P.C. 2006. Medicinal plants: Ethanobotanical Approach, Agribios, India.
13. Yoganarasimhan, S.N. Medicinal Plants of India-Vol-I- Karnataka, Interline Publishing Pvt. Ltd.

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M. Sc. I Year (II Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Molecular Genetics
Paper Code: BOT-204 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

UNIT-I

Eukaryotic genome: Different forms of DNA, C- value paradox, unique and repetitive DNA, gene families, hybridization kinetics and split genes. **Transposable elements:** Mechanisms of transposition; transposons in bacteria, maize, *Drosophila* and yeast.

DNA Replication: Semi-conservative, bidirectional, replication origins, replication machinery.

UNIT-II

Mutations: types, isolation of mutants, molecular basis of mutations.

DNA damage and repair: Causes of DNA damage; Photoreactivation, excision, mismatch, post replication and error prone repair systems.

Fine structure of gene: *cis-trans* test, rII locus, fine structure analysis of eukaryotes. Bacterial genetics: conjugation, transduction and transformation.

UNIT- III

Transcription: Initiation, elongation and termination in prokaryotes and eukaryotes, RNA polymerases. RNA Processing: Processing of mRNA, rRNA and tRNA. Genetic code: Deciphering the genetic code, characteristics. Translation: Initiation, elongation and termination in prokaryotes and eukaryotes.

UNIT-IV

Regulation of gene expression in prokaryotes: Operon concept, lac operon regulation by positive and negative mechanism, trp operon, regulation by negative and attenuation.

Regulation of gene expression in eukaryotes: Transcriptional level – Regulatory sequences, nucleosome positioning, chromatin remodelling, histone modifications. Post-transcriptional level – RNA splicing, RNA stability.

Suggested Readings:

1. Alberts B, Johnson A, Lewis J. Raff M, Roberts K and Walter P (2008) Molecular Biology of the Cell (5th Ed.). Garland Publishing Inc., New York.
2. Brown TA (1999) Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
3. Burns GW and Bottino PJ (1989) The Science of Genetics, Macmillan Publishing Co. New York.
4. Clark D (2005) Molecular abiology, Understanding the Genetic Revolution. Elsevier Inc. C. California.
5. Gustafron JP (2002) Genomes. Kluwer Academic Plenum Publishers, New York, USA.
6. Hartl DL (1999) Genetics Principles and analysis. (4th Ed.) Jones and Bartle, Boston.
7. Henry RJ (1997) Practical Applications of Plant Molecular Biology, Chapman & Hall, London, UK.
8. Klug WS and Cunning MR (1996) Essentials of Genetics. Prentice Hall London.
9. Krebs JE, Goldstein ES and Kalpatrick ST (2010) Lewin's Essential Genes (2nd Ed.), Jones and Barlett Publishers.
10. Lewin B (2005) Genes VIII. Oxford University Press, New York.
11. Lodish H, Berk A, Kaiser, CA, Krieger M, Scott MP Bretscher A Ploegh H and Matsudaira P (2008) Molecular Cell Biology (6th Ed), W.H. Freeman and Company, New York, USA.
12. Pierce BA (2012) Genetics- A Conceptual Approach (4th Ed.), W.H. Freeman and Company, New York, USA.
13. Russell PJ (2006) Genetics (6th Ed.), Addison Wesley Longman, California, USA.
14. Snustad P and Simmons MJ (2011), Principles of Genetics. (6th Ed.), John Wiley, New York.
15. Swanson CP, Mertz T and Young WJ (1981) Cytogenetics- The Chromosome in Division, Inheritance and Evolution (2nd Ed.), Englewood Cliffs, Prentice Hall, New Jersey.
16. Weaver RF and Hedrick PW (1997). Genetics (3rd Ed.) WMC Brown, Chicago.
17. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene (6th Ed.), CSHLP, New York.

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M. Sc. I Year (II Semester)

Examination Time: 3 Hrs **Maximum Marks: 50 (10+50)**
Paper Title: *Plants for Human Welfare
Paper Code: BOT-206 **Schedule per week Lectures: 2**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Plants and Civilization: Origin of agriculture; Idea about centre of origin of common crop plants. Brief introduction of **Minor Cereals, Major cereals Pseudo cereals and pulses.**

Spices and condiments (Saffron, Clove, Cardamom, Ginger, Turmeric, Cinnamon, Capsicums, Asafoetida, Coriander, Fennel, Fenugreek**)**

Unit –II

Medicinal plants: Importance of medicinal plants – role in human health care.

Traditional knowledge and utility of some common medicinal plants-*Sarpgandha, Isabgol, Vasaka, Neem, Bhiringraj, Amla, Harrad, Bahera, Arjun, Punarnava, Brahmi, Kasondi, Ghritkumari, Quinine* and *Eucalyptus.*

Unit –III

Nutritive and medicinal value of some fruits and vegetables (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate, Moringa, Cabbage)

Beverages (Coffee, Tea, Chocolate, Cola)**.**

Common ornamental plants and food adulterants.

Unit-IV

Common timber yielding plants and minor forest products; General account of Fibers, dyes, tannins, gums and resins. Insecticides from plants Pyrethrum and Rotenone.

Suggested Readings:

1. Kochar, S.L. 1981. Economic Botany in the Tropics. Macmillan India Ltd., Delhi.
2. Hill, A.F. 1952. Economic Botany (2nd Ed.) McGraw Hill, New York.
3. Cobley, L.S. and Steele, W.M. 1976. An Introduction to the Botany of Tropical Crops (2nd Ed.) Longmans, London.
4. Simmonds, N.W. 1976. Evolution of Crop Plants Longman, London, New York.
5. SambaMurthy, AVS and Subrahmanyam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd.,Delhi
6. Schery, R.W. 1972. Plants for Man. Prentice Hall. Englewood Cliffs, N.J. USA
7. Simpson B. B. M. C. Ogorzaly 2001. Economic botany: plants of our world, 3rd ed. McGraw-Hill, New York, New York, USA.

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M. Sc. II Year (III Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Plant Physiology and Plant Biochemistry
Paper Code: BOT-301 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Water: Passive and active absorption of water.

Plant water relations: Concept and components of water potential, soil water relationship, transpiration and factors governing transpiration, antitranspirants.

Unit-II

Mineral Nutrition: Role and mode of action of micro and macro-nutrients.

Photosynthesis: Photo-oxidation of water, cyclic and non-cyclic photophosphorylation, photorespiration and its significance. The sequence of reactions in photosynthesis, the path of carbon assimilation (C3 and C4 cycles, CAM pathway).

Unit-III

Respiration: Glycolysis, Krebs cycle, electron transport chain and ATP synthesis, pentose phosphate pathway, glyoxylate cycle.

Nitrogen Metabolism: Biochemistry of nitrogen fixation, nitrogenase, nitrogen fixation in legumes, nitrate assimilation, ammonium assimilation, biosynthesis of amino acids.

Unit-IV

Lipid Metabolism: Fatty acid biosynthesis, Alpha and beta oxidation and conservation into carbohydrates.

Enzymes: Structure, properties and functions of enzymes, factors affecting rates of enzymatic reactions, isozymes, allosteric enzymes.

Suggested Readings:

1. Bonner, J. And Varner, J.E. (1976). Plant Biochemistry, IIIrd Edition, Academic Press, New York and London.
2. Buchanan, B.B., Gruissem, W. And Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.

3. Davies, Peter J. (1995). Plant Hormones: Physiology, Biochemistry and Molecular Biology. 2nd Edition. Kluwer Academic Publishers, The Netherlands.

4. Garrett, R.H. and Grisham, C.M. (1999). Biochemistry. Second edition. Saunders College Publishing, Philadelphia.

5. Hopkins, W.G. (1995) Introduction to Plant Physiology, John Wiley and Sons.

6. Krishnamoorthy, H.N. (1993). Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.

7. Kumar, H.D. and Singh, H.N. (1993). Plant Metabolism. Second edition, Affiliated East-West Press Pvt Ltd. New Delhi.

8. Lehninger, A.L. (1978). Biochemistry. Kalyani Publishers, Ludhiana, India (Indian edition).

9. Lehninger, A.L, Nelson, D.L. and Co MM 1993 Principles of Biochemistry Second edition, CBS Publishers.

10. Moore, Thomas. C. (1989). Biochemistry and Physiology of Plant Hormones. Second edition (Reprint 1994), Narosa Publishing House, New Delhi.

11. Noggle, G.R. and Fritz, G.J. (1983). Introductory Plant Physiology, Prentice-Hall of India Pvt. Ltd., New Delhi, Second edition Seventh reprint, 1993.

12. Salisbury, F.B. and Ross, C.W. (1992). Plant Physiology. Fourth edition, Wadsworth Publishing Co. Belmont, California, USA.

13. Singhal, G.S. Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee (editors) (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.

14. Srivastava, L.M. (2006). Plant Growth and Development: Hormones and Environment. Academic Press. Published by Elsevier India Pvt. Ltd., New Delhi.

15. Taiz, L and Zeiger, E. (1998). Plant Physiology. Second edition. Sinauer Associates, Inc., Publishers, Massachusetts, USA

16. Trehan, K. (1990). Biochemistry. Second edition, Wiley-Eastern Ltd., New Delhi.

17. Trivedi, P.C. (2006). Plant Molecular Physiology: Current Scenario and Future Projections. Aavishkar Publishers, Distributors, Jaipur.

18. Weil, J.H. (1990). General Biochemistry. Sixth edition. Wiley-Eastern, New Age International Publishers, New Delhi.

19. Wilkins, M.B. (1987). Advanced Plant Physiology, ELBS, Longman, England. Zubay, Geoffrey. (1989). Biochemistry. Mc.Millan Publishing Co. New York.

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M. Sc. II Year (III Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Plant Taxonomy and Economic Botany
Paper Code: BOT-302 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

The Species concept, Taxonomic hierarchy, Species, Genus and Family

Taxonomic evidence: Morphology, anatomy, palynology.

Taxonomic Tools: Herbarium and Floras.

Botanical Gardens and herbaria in India; Botanical Survey of India its organization and role.

Unit-II

Salient Features of the International Code of Nomenclature (ICN).

Systems of angiosperm classifications of Bentham and Hooker, Engler and Prantl, Hutchinson, Cronquist, Takhtajan, Dahlgren and Thorne,

Relative merits and demerits of these systems.

Unit-III

Origin of agriculture: World centers of primary diversity of domesticated plants.

Origin, botany, cultivation and uses of cereals (wheat, rice), Sugarcane, Potato

Oil yielding plants (groundnut, mustard, sunflower)

Unit-IV

Botany, origin, uses of important fibres (Cotton, Jute),

General account of important spices (Ginger, Turmeric, Cinnamon, Clove, Cardamom, Chilies, Pepper, Fennel, Coriander, Cumin, Asafoetida, Nutmeg, Mace, and Saffron),

General account of important medicinal plants (Aconite, Cinchona, Belladonna, Digitalis, Glycyrrhiza, Rauwolfia, Papaver, Vasaka, Aloe and Ginseng). A brief account of major Indian **Medicinal plants** (Amla, Neem, Arjun, Harad, Bahera, Isabgol, Ashwagandha, Bhringraj and Senna). General account of important timber, dye, gums and tannin yielding plants.

Suggested Readings:

1. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row Publishers Inc.
2. Lawrence, G.H.M. 1951. Taxonomy of vascular plants. The Macmillan C., New York.
3. Davis, P.H. and Heywood, V.H. 1965. Principles of Angiosperm Taxonomy. D Van Nostrand Co., New York.
4. Sivarajan, V.V. 1984. Introduction to Principles of Plant Taxonomy. Oxford IBH Pub. Co., New Delhi.
5. Kochar, S.L. 1981. Economic Botany in the Tropics. Macmillan India Ltd., Delhi.
6. Hill, A.F. 1952. Economic Botany (2^{nd} Ed.) McGraw Hill, New York.
7. Cobley, L.S. and Steele, W.M. 1976. An Introduction to the Botany of Tropical Crops (2^{nd} Ed.) Longmans, London.
8. Simmonds, N.W. 1976. Evolution of Crop Plants Longman, London, New York.
9. Samba Murthy, AVS and Subrahmanyam, N.S. 1989. A Text Book of Economic Botany. Wiley Eastern Ltd., Delhi
10. Judd, W.S.; Campbell. C.S., Kellogg, E.A. and Stevens, P.F. 1999. Plant Systematics A Phylogenetic Approach. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts, U.S.A.
11. Schery, R.W. 1972. Plants for Man. Prentice Hall. Englewood Cliffs, N.J. USA
12. Simpson B. B. M. C. Ogorzaly 2001. Economic botany: plants of our world, 3^{rd} ed. McGraw-Hill, New York, New York, USA.
13. Hancock. J. F. 2004. Plant evolution and the origin of crop species. 2^{nd} edition. CABI Publishing, Cambridge, MA USA.
14. Radford, A. E., W. C. Dickison, J. R. Massey, C. R. Bell. 1976. Vascular Plant Systematics Harper and Row, New York.

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M. Sc. II Year (III Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Plant Biotechnology and Genetic Engineering
Paper Code: BOT-303 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Techniques used in DNA Technology: Gel Electrophoresis, PAGE, Southern and Western blotting, Dot blots, Chemical synthesis of genes, DNA chip technology.

Isolation & Sequencing of genes: Maxam & Gilbert's method, Sanger's method and next-generation sequencing technologies,

Brief account of proteomics and genomics.

Unit-II

DNA cloning methods, using vectors (Plasmids, phages, cosmids, phagemids, transposons, artificial chromosomes, BAC, YAC, MAC), cloning in bacteria and eukaryotes, genomic and C-DNA Libraries.

Gene amplification by PCR: different types, DNA finger printing, molecular probes: General features and applications.

Unit-III

Gene transfer methods in plants: plasmid mediated, electroporation, cation precipitation, liposomes, microinjection and particles gun technology, expression of transgenes.

Transgenic plants: production of transgenic plants with respect to insect resistance, herbicide resistance, resistance against biotic and abiotic factors, transgenics for male sterility and edible vaccines

Unit-IV

Yeast and algal biomass as source of single cell protein, oils and vitamins, microbial fermentation technology in food industry.

Plant and microbial biopesticides, bioremediation and phytoremediation.

Suggested readings

1. Bajaj, Y.P.S. 2000. Biotechnology in Agriculture and Forestry-46-Transgenic Trees, Springer Pub., New York, USA
2. Brown, T.A. 1999 Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore
3. Dawson, M.T. Powell, R, and L. Gannon, F.1996. Gene Technology, BIOS Sci. Pub. Ltd., Oxford, UK.
4. Erlich, H.A.(Ed.) 1989, PCR Technology – Principles and applications for DNA Amplification, Stockton Press, New York, USA.
5. Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology, W.H. Freeman & Company, New York, USA.
6. Glover, D.M. and Hames, B.D.(Eds.) 1995. DNA Clonning 1 – A Practical Approach, OIRL Press, Oxford, UK.
7. Gupta, P.K. 1996. Elements of Biotechnology, Rastogi & Co., Pub., New Pub., Meerut, India.
8. Hammond, J., McGarvey, P. And Yusibov, V. (Eds.) 1999. Plant Biotechnology – New Products and Applications, Springer Pub., New York, USA.
9. Henry, R.J. 1998. Practical Applications of Plant Molecular Biology, Chapman & Hall, London, UK
10. Keller, G.H. and Manak, M.M. 1993. DNA Probes, Mac Millan Pub. Ltd. UK.
11. Lea, P. And Leegood, R.C. 1999. Plant Biotechnology and Molecular Biology (2nd Ed.) John Wiley & Sons, Ltd., England.
12. Lewin, B. 2005. Genes VIII,Osford University Press, Oxford, UK
13. Lindsey, K. And Jones, M.G.K. 1990. Plant Biotechnology in Agriculture, Prentice Hall Int. Pub., London, UK
14. Malaacinski, G.M. and Freifilder, D. 1998. Essentials of Molecular Biology 3rd Ed.), Jones & Bartlett Pub., London, UK
15. Miesfield, R.L. 1999. Applied Molecular Genetics, Wiely Liss, New York, USA.
16. Nicklin,J., Graeme-Cook, K.Paget, T. And Killington, R. 1999. Instant Notes in Mircobiology, VIVA Books Pvt. Ltd., New Delhi, India
17. Purohit, S.S., Kothari, P.R. and Mathur, S.K. 1993. Basic and Agricultural Biotechnology, Agro Botanical Pub. Bikaner, India.
18. Rehm, H.I. and Reed, S.G. (Eds.) 1995. Fundamentals of Genetic Engineering, Pallicut, London, UK.
19. Scragg, A. 1999. Environmental Biotechnology, Pearson Education Ltd., England, UK

20. Shantharam, S. And Montogomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Pub. Pvt. Ltd., New Delhi, India.

21. Sheehan, D. (Ed.) 1997. Bioremediation Protocols, Humana Press, Totowa, USA

22. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2^{nd} Ed.) John Wiley & Sons. Inc., New York, USA

23. Trehan, K. 1990. Biotechnology, New Age Int. Pvt. Ltrd. New Delhi India.

24. Twyman, R.M. 1999. Advanced Molecular Biology, VIVA Books Pvt. Ltd., New Delhi.

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M. Sc. II Year (III Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Biophysical and Biochemical Techniques
Paper Code: BOT-304 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Microscopic techniques: Introduction; Light microscope; Phase contrast microscope; Fluorescent microscope; Electron microscope (EM) – SEM, TEM and STEHM; Scanning probe microscopes; Different fixation and staining techniques.

Centrifugation: Principles of sedimentation; Types, care and safety aspects of centrifuges; Differential centrifugation; Density gradient centrifugation and their applications.

Unit-II

Chromatographic techniques: Theory of chromatography; Types of chromatography- Paper chromatography, Thin layer chromatography, Adsorption chromatography, Partition chromatography, Affinity chromatography, Ion exchange chromatography, HPLC and Size-exclusion chromatography.

Spectrophotometry: Colorimetry; UV and Visible spectrophotometry.

Unit-III

Electrophoresis: Principle; Agarose gel electrophoresis; Polyacrylamide gel electrophoresis; 2-Dimensional gel electrophoresis; Capillary electrophoresis; Microchip electrophoresis and Isoelectric focusing.

Mass spectrometry: Introduction; Theory; Mass spectrometer; Ionization of molecules; Mass analysers- MALDI; Detectors and Applications.

Unit-IV

Immunotechniques: Antibody generation; Detection of molecules using ELISA, RIA, Immunoprecipitation and Immunofluorescence microscopy; Detection of molecules in living cells.

Radioisotope techniques: Radioactive isotopes; Nature of radioactivity; Detection and measurement of different types of radioisotopes normally used in biology; Incorporation of radioisotopes in biological tissues and cells; Molecular imaging of radioactive material; Disposable of radioactive wastes and safety guidelines.

Suggested Readings:

1. Plummer DT (1990) An Introduction to Practical Biochemistry, Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi.
2. Prescott L and Harley J Klein D (2005) Microbiology (6^{th} Ed) Mc Graw-Hill.
3. Ranade R and Deshmukh S (2013) Handbook of Techniques in Biotechnology, Studium Press (India) Pvt. Ltd. New Delhi.
4. Sawhney SK and *Singh R (2000)* Introductory *Practical Biochemistry (Ed.),* Narosa Publishing House Pvt. Ltd., New Delhi.
5. Wilson K and Walker J (2010) Principles and Techniques of Biochemistry and Molecular Biology (7^{th} Ed.), Cambridge University Press, New Delhi.

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M. Sc. II Year (III Semester)

Examination Time: 3 Hrs **Maximum Marks: 50 (10+40)**
Paper Title: *Biodiversity and its conservation
Paper Code: BOT-306 **Schedule per week Lectures: 2**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Biodiversity: importance, levels of biodiversity- species, genetic and ecosystem diversity, threats to biodiversity- habitat loss and fragmentation, exotic species, pollution, overexploitation, IUCN categories of threat.

Unit-II

Terrestrial and marine hotspots of biodiversity; hotspots of biodiversity in India.

Approaches for biodiversity conservation: tropical forests, wetlands and aquatic ecosystems.

Unit-III

Principles and importance of conservation biology; In- situ conservation of biodiversity- Sanctuaries, national parks, biosphere reserves.

Ex-situ conservation of biodiversity: Principles and practices, field gene banks, seed banks and cryopreservation.

Unit-IV

Distribution and global patterns of biodiversity. Biodiversity and ecosystem services.

Major approaches to Management, Indian case studies on conservation/management strategy (biosphere reserves).

Suggested Readings:

1. Chape, S., Fish, L., Fox, P. and Spalding, M. 2003. United Nations list of protected areas. IUCN/UNEP/World Conservation Monitoring Centre, Gland, Switzerland/Cambridge
2. Gopal, B. (ed.) 1987. Ecology and Management of Aquatic Vegetation of the Indian Subcontinent. W. Junk bv. The Hague.
3. Heywood, V.(Ed.) (1995). Global Biodiversity Assessment. United Nations Environment Programme, Cambridge University Press, Cambridge, U.K.
4. Hunter (Jr.) M.L. (1996); Fundamentals of Conservation Biology, Blackwell Science. Meffe G.K. and C. Ronals Corroll (1994) Principles of Conservation Biology, Sinaur Associates, Inc., Sunderland. Massachusetts.
5. Peter H. Raven, P.H. and Berg, L. R. Berg. 2005. Environment, 5th Edition. John Wiley & Sons Inc., New York.
6. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
7. Soule, M.E. (ed.) (1986): Conservation Biology. The Science of Scarcity and Diversity. Sinaur Associates, Inc., Sunderland, Massachusetts.

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M. Sc. II Year (IV Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Physiology of Plant Growth and Development
Paper Code: BOT-401 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Plant Growth: Growth concepts, Growth curves, Growth analysis.

Germination and Dormancy of seeds; factors affecting dormancy and its regulation by plant growth regulators and environmental factors.

Stress Physiology: Response of plants to abiotic stresses: abiotic stress affecting plant productivity. Basic principles of crop improvement programme under stress.

Unit-II

Plant Growth Regulators: Discovery, biosynthetic pathways, transport, influence on plant growth and mechanism of action of: Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid.

Senescence and Abscission: Physiological and biochemical changes associated with senescence and abscission.

Unit-III

Seed Physiology: Seed viability and seed dormancy, Metabolism of germinating seeds.

Environmental and hormonal control of seed dormancy and germination.

Fruits: Climacteric and non-climacteric fruits, fruit ripening.

Post-harvest storage of fruits – quality maintenance, physiological and biochemical studies under different kinds of storage conditions.

Unit-IV

Sensory Photobiology:

Phytochromes:mechanism of phytochrome action, photomorphogenesis and cryptochromes.

Tropism: Phototropism, nature of receptors, role of hormones, Geotropism and nastism.

The Flowering Process:

Photoperiodism and its significance, importance of dark periods, role of vernalization.
Nature and events during flowering, florigen concept, chemical control of flowering.

Suggested Readings:

1. Audus, L.J. (1972). Plant Growth Substances. Vol. I Chemistry and Physiology. Leonard Hill, London.
2. Bonner, J. And Varner, J.E. (1976). Plant Biochemistry, IIIrd Edition, Academic Press, New York and London.
3. Buchanan, B.B., Gruissem, W. And Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
4. Davies, Peter J. (1995). Plant Hormones: Physiology, Biochemistry and Molecular Biology. 2nd Edition. Kluwer Academic Publishers, The Netherlands.
5. Dey, P.M. and Harborne, J.B. (1997), First Indian Edition, Plant Biochemistry. Academic Press, Harcourt Asia Pvt.Ltd.
6. Garrett, R.H. and Grisham, C.M. (1999). Biochemistry. Second edition. Saunders College Publishing, Philadelphia.
7. Hopkins, W.G. 1995 Introduction to Plant Physiology, John Wiley and Sons.
8. Krishnamoorthy, H.N. (1993). Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.
9. Kumar, H.D. and Singh, H.N. (1993). Plant Metabolism. Second edition, Affiliated East-West Press Pvt Ltd. New Delhi.
10. Lehninger, A.L. (1978). Biochemistry. Kalyani Publishers, Ludhiana, India
11. Lehninger, A.L, Nelson, D.L. and Co MM 1993. Principles of Biochemistry Second edition, CBS Publishers.
12. Moore, Thomas. C. (1989). Biochemistry and Physiology of Plant Hormones. Second edition (Reprint 1994), Narosa Publishing House, New Delhi..
13. Noggle, G.R. and Fritz, G.J. (1983). Introductory Plant Physiology, Prentice-Hall of India Pvt. Ltd., New Delhi, Second edition Seventh reprint, 1993.
14. Salisbury, F.B. and Ross, C.W. (1992). Plant Physiology. Fourth edition, Wadsworth Publishing Co. Belmont, California, USA.
15. Singhal, G.S. Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee (editors) (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
16. Srivastava, L.M. (2006). Plant Growth and Development: Hormones and Environment. Academic Press. Published by Elsevier India Pvt. Ltd., New Delhi.

17. Taiz, L and Zeiger, E. (1998). Plant Physiology. Second edition. Sinauer Associates, Inc., Publishers, Massachusetts, USA

18. Trehan, K. (1990). Biochemistry. Second edition, Wiley-Eastern Ltd., New Delhi.

19. Trivedi, P.C. (2005). Applied Botany. Aavishkar Publishers, Distributors, Jaipur.

20. Trivedi, P.C. (2006). Plant Molecular Physiology: Current Scenario and Future Projections. Aavishkar Publishers, Distributors, Jaipur.

21. Weil, J.H. (1990). General Biochemistry. Sixth edition. Wiley-Eastern, New Age International Publishers, New Delhi.

22. Wilkins, M.B. (1987). Advanced Plant Physiology, ELBS, Longman, England.

23. Zubay, Geoffrey. (1989). Biochemistry. Mc.Millan Publishing Co. New York.

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M. Sc. II Year (IV Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Biology of Reproduction and Anatomy
Paper Code: BOT-402 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit I

History of plant embryology;

Male gametophyte: structure of anther, microsporogenesis, role of tapetum, Pollen development, male sterility; Pollen germination, pollen tube growth and guidance; pollen allergy

Unit II

Female gametophyte: ovule development, megasporogenesis; Organization of the embryo sac, structure of the embryo sac cells. Pollination, Pollination mechanisms and vectors,

Unit III

Pollen pistil interaction and fertilization; structure of pistils; pollen-stigma interaction, sporophytic and gametophytic incompatibility, double fertilization

Endosperm development, polyembryony; apomixis

Experimental Embryology: in vitro fertilization Anther, Pollen and embryo culture,

Unit IV

Anatomy in relation to taxonomy.

Anomalous secondary Structure: Anomalous secondary growth, anomalous position of cambium, abnormal behaviour of normal cambium, accessory cambium formation and its activity, extrastelar cambium, Interxylary and intraxylary phloe, presence of medullary bundles, cortical bundles, presence of exclusive phloem and xylem bundles, secondary growth in monocots.

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House, New Delhi.
2. Shivanna, K.R. and Johri, B.M. 1985. The Angiopsrem Pollen: Structure and Function. Wiley Eastern Ltd., New Delhi.
3. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge Univ. Press, Cambridge.
4. Johri, B.M. (ed.) Embryology of Angiosperms. Springer-Verlag, Heidelberg, Berlin,
5. Esau, K. 1965. Plant Anatomy. John Wiley & Sons New York.
6. Fahn, A. 1967. Plant Anatomy. Pergamon Press, London, New York.
7. Eames, A.J. and MacDaniels, L.H. 1947. An Introduction to the Plant Anatomy (2nd Ed.), McGraw Book Comp., New York.
8. Eames, A. J. 1961. Morphology of Angiosperms. McGraw Hill Book Company, New York

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M. Sc. II Year (IV Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Plant Tissue Culture
Paper Code: BOT-403 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit I

History of Plant Tissue Culture, Basic concept, principles and scope of plant cell and tissue culture, concepts of cellular differentiation; Totipotency; basic techniques of plant tissue culture; callus formation, organogenesis and embryogenesis.

Protoplast isolation, fusion and culture, somatic hybridization, hybrid selection and regeneration. Cybrids and their application.

Unit-II

In vitro haploid production and its significance, Anther/Pollen culture and ovary culture; Embryo and ovule culture Production of triploids through endosperm culture.

Micropropagation: meristem culture and virus-free plants; Cryopreservation of plant cell and tissue cultures and establishment of gene banks.

Unit-III

Somaclonal variations and isolation of useful mutants; mechanisms and applications in genotype improvement. Role of plant cell cultures in Bioreactor types and application in cell culture and secondary metabolite production.

Unit-IV

Somatic embryogenesis, production of synthetic seeds, importance, limitation and their utilization. Application of tissue culture in forestry and agriculture; status of tissue and cell culture technology in India edible vaccines, and their prospects.

Suggested Readings

1. Ammirato, P.V., D.A. Evans, N.D. Sharp and Y.P.S. Bajaj (1990). Hand Book of Plant Cell Culture, Vols. 1-5. McGraw Hill Publishing Company, New York.
2. Bhojwani, S.S. and Razadan, M.K. 1996. Plant Tissue Culture: Theory and Practice (A revised Edition), Elsevier Science Pub., New York, USA
3. Collins, H.A. and Edwards, S. 1998, Plant Cell Culture, Bios Scientific Pub., Oxford, U.K.
4. Kartha, K.K. 1985. Cryopreservation of Plant Cells and Organs, CRC Press, Boca Raton, Florida, U.S.A.
5. Razadan, M.K. 1993. An introduction to Plant Culture. Oxford & IBH Pub., Co., New Delhi, India.

RAFFLES UNIVERSITY

SCHOOL OF BASIC AND APPLIED SCINCES
Department of Botany
(Syllabus and Scheme of Studies w. e. f. 2022-23)
M. Sc. II Year (IV Semester)

Examination Time: 3 Hrs **Maximum Marks: 100 (20+80)**
Paper Title: Genomics
Paper Code: BOT-404 **Schedule per week Lectures: 4**

Note: Examiner will set nine questions and the students will be required to attempt five questions in all, Question number one is compulsory containing ten short answer types' questions covering the entire syllabus and will be of 2 marks. Further examiner will be set two questions from each unit and the students will be required to attempt one question from each unit which will be of 15 marks each.

Unit-I

Genome: Completely sequenced prokaryotic (T_4, and λ phages; *E. coli*) and eukaryotic genomes (*Saccharomyces cerevisiae, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana, Oryza sativa, Mus musculus* and *Homo sapiens*); Mitochondrial and Chloroplast genomes.

Mapping of Genome: Genetic mapping- using DNA markers and Linkage analysis; Physical mapping- restriction mapping, Fluorescent *in-situ* hybridization and Sequence Tagged Sites (STSs) mapping.

Unit-II

Genome sequencing: Chain termination and chemical degradation methods; Next generation sequencing (NGS)- Pyrosequencing, SOLiD sequencing, Bridge amplification sequencing, Assembly of a contiguous DNA sequence- shotgun and clone contig methods, Human Genome Project. **Understanding a Genome Sequence**: Gene location using 1.) ORF scanning, Automatic annotation, Homology searches and comparative genomics. 2.) Experimental techniques- northern hybridization, cDNA sequencing and RACE.

Unit-III

Identification of a Gene Function: Using computer analysis; Experimental analysis- gene inactivation and overexpression; Directed mutagenePsis; Reporter genes and Immunocytochemistry. **Analysis of the Transcriptome**: Expressed Sequence Tags (ESTs); Serial analysis of gene expression (SAGE); Differential Display (DD); Representational Difference Analysis (RDA) and DNA Microarrays.

Proteome Analysis: Using 2-D; Protein identification; Protein-DNA and Protein- Protein interactions and Biochips.

Unit-IV

Biological Databases: Introduction; Primary and Specialized Databases; Database Scheme; Database Annotation; Retrieval System; Nucleotide Databases; Protein Databases; Genomic Databases and Resources; Gene Databases and Resources; Transcriptome Databases; Mutation Databases; Mitochondrial Databases and Resources.

Computational Methods for Analysis of Genome Sequence Data: Introduction; Dot-Plot Matrix; Sequence pairwise alignment; Database searching; Multiple alignment; Alignment profiles to recognize distantly related protein or protein modules; Methods for sequence assembly; Linguistic analysis of biosequences; Prediction of RNA secondary structures; Protein sequence analysis; Evolutionary and phylogenetic analysis.

Suggested Readings:

1. Birren B, Green ED, Klapholz S, Myers RM and Roskams J (1997) Genome Analysis, CSHL Press.
2. Brown TA (1999) Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
3. Brown TA (2002) Genomes 2, Wiley-Liss, New York.
4. Brown TA (2007) Genomes 3, Garland Science Publishing New York, London.
5. Chawla HS (2009) Introduction to Plant Biotechnology (3rd Ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Dale JW, Schantz MV and Plant N (2012) From Genes to Genomes (3rd Ed.), John Wiley and Sons, Ltd. UK.
7. Glick B and Pasternak JJ (2003), Molecular Biotechnology (3rd Ed), ASM Press, Washington.
8. Hartl DL and Ruvolo M (2011) Genetics- Analysis of Genes and Genomes (8th Ed.), Jones and Bartlett Publishers, Inc., USA.
9. Hunt SP and Livesey FJ (2000) Functional Genomics, Oxford University Press, New York. London.
10. Saccone C and Pesole G (2003), Handbook of Comparative Genomics, John Wiley and Sons, Inc., Hoboken, New Jersey.
11. Sambamurty AVSS (2007) Molecular Genetics, Narosa Publishing House Pvt. Ltd., New Delhi.
12. Singer M and Berg P (1991) Genes and Genomes: A Changing Perspective; University Science Books, CA, USA.

RAFFLES UNIVERSITY
BOTANY DEPARTMENT

M.Sc. BOTANY Scheme of Examination (CBCS) w.e.f. 2022-23

Semester I

Paper code	Title of paper	Type of paper	Hours /week	Credits	Marks + Internal Assessment	Total	Duration of Exam
BOT-101	Algae & Fungi	Core	4	4	80 + 20	100	3 hrs
BOT-102	Bryophytes, Pteridophytes & Paleobotany	Core	4	4	80 + 20	100	3 hrs
BOT-103	Cytogenetics & plant breeding	Core	4	4	80 + 20	100	3hrs
BOT-104	Ecology	Core	4	4	80 + 20	100	3 hrs
BOT-105	Practical based on 101 + 102	Core	8	4	80 + 20	100	6 hrs
BOT-106	Practical based on 103 + 104	Core	8	4	80 + 20	100	6 hrs
Total				24		600	

Semester II

Paper code	Title of paper	Type of paper	Hours/ week	Credits	Marks + Internal Assessment	Total	Duration of Exam
BOT-201	Microbiology and Biostatistics	Core	4	4	80 + 20	100	3 hrs
BOT-202	Natural Resources & Biodiversity	Core	4	4	80 + 20	100	3 hrs
BOT-203	Gymnosperms & Ethnobotany	Core	4	4	80 + 20	100	3 hrs
BOT-204	Molecular genetics	Core	4	4	80 + 20	100	3 hrs
BOT-205	Seminar	Core	1	1	25	25	1 hr
BOT-206	*Plants for human welfare	Open Elective	2	2	40 + 10	50	3 hrs
BOT-207	Practical based on 201 + 202	Core	8	4	80 + 20	100	6 hrs
BOT-208	Practical based on 203 + 204	Core	8	4	80 + 20	100	6 hrs
Total				27		675	

Semester III

Paper code	Title of paper	Type of paper	Hours/ week	Credits	Marks + Internal Assessment	Total	Duration of Exam
BOT-301	Plant physiology & Plant biochemistry	Core	4	4	80 + 20	100	3 hrs
BOT-302	Plant Taxonomy & Economic botany	Core	4	4	80 + 20	100	3 hrs
BOT-303	Plant Biotechnology & Genetic engineering	Core	4	4	80 + 20	100	3 hrs
BOT-304	Biophysical & biochemical techniques	Elective	4	4	80 + 20	100	3 hrs
BOT-305	Seminar	Core	1	1	25	25	1 hr
BOT-306	*Biodiversity and its conservation	Open Elective	2	2	40 + 10	50	3 hrs
BOT-307	Practical based on 301	Core	6	3	60 + 15	75	6 hrs
BOT-308	Practical based on 302 + 303	Core	6	3	60 + 15	75	6 hrs
BOT-309	Practical based on 304	Core	4	2	40 + 10	50	6 hrs
Total				27		675	

Semester IV

Paper code	Title of paper	Type of paper	Hours/ week	Credits	Marks + Internal Assessment	Total	Duration of Exam
BOT-401	Physiology of Plant growth & development	Core	4	4	80 + 20	100	3 hrs
BOT-402	Biology of Reproduction and Anatomy	Core	4	4	80 + 20	100	3 hrs
BOT-403	Plant Tissue Culture	Core	4	4	80 + 20	100	3 hrs
BOT-404	Genomics	Elective	4	4	80 + 20	100	3 hrs
BOT-405	Practical based on 401	Core	6	3	60 + 15	75	6 hrs
BOT-406	Practical based on 402 + 403	Core	6	3	60 + 15	75	6 hrs
BOT-407	Practical based on 404	Core	4	2	40 + 10	50	6 hrs
BOT-408	**Project Work/Field Training Report	Core	4	4	100	100	
Total				28		700	