

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI



**Examination Scheme
&
Syllabi
For
M.Sc. Botany
(SEMESTER- I to IV)
(2019-2021)**

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

Scheme of Examination for M.Sc. Botany

Semester-I

Credits = 32

Marks = 650

Paper Code	Subjects	Type of Course	Contact Hours Per Week			Credits			Examination Scheme			Total
			Theory	Practical	Total	Theory	Practical	Total	Theory	Internal Assessment	Practical	
BOT 101	Cell Biology	C.C.	04	--	04	04	--	04	80	20		100
BOT 102	Virology, Bacteriology and Mycology	C.C.	04	--	04	04	--	04	80	20		100
BOT 103	Biostatistics	C.C.	04	--	04	04	--	04	80	20		100
BOT 104	Cryptogamic Botany	C.C.	04	--	04	04	--	04	80	20		100
Discipline Centric Elective Course (Any one)												
BOT 105	Tools & Techniques	D.C.E.C.	04	--	04	04	--	04	80	20		100
BOT 106	Soil Science, Energy & Environment	D.C.E.C.	04		04	04		04	80	20		100
Lab Courses												
BOT 107	Lab Course-I (Based on BOT101-103)	C.C.	-	04×03	12	-	02×03	06		-	50	50
BOT 108	Lab Course-II (Based on BOT104 ,105/106)	C.C.	-	04×02	08	-	02×02	04		-	50	50
BOT 109	Seminar	C.C.	-			-	-	01		-	-	25
BOT 110	Self Study Paper	C.C.	-	-		-	-	01		-	-	25
Total			20	20	40	20	10	32	400	100	100	650

C.C = Core Course

D.C.E.C = Discipline Centric Elective Course

Scheme of Examination for M.Sc. Botany
Credits = 34

Semester-II

Marks = 700

Paper Code	Subjects	Type of Course	Contact Hours Per Week			Credits			Examination Scheme			Total
			Theory	Practical	Total	Theory	Practical	Total	Theory	Internal Assessment	Practical	
BOT 201	Molecular Biology	C.C.	04		04	04		04	80	20		100
BOT 202	Plant Anatomy and Diversity of Gymnosperms	C.C.	04	--	04	04	--	04	80	20		100
BOT 203	Taxonomy and Systematic of Angiosperms	C.C.	04		04	04		04	80	20		100
Discipline Centric Elective Course (Any two)												
BOT 204	Plant Breeding and Cytogenetics	D.C.E.C	04		04	04		04	80	20		100
BOT 205	Bioinformatics	D.C.E.C	04		04	04		04	80	20		100
BOT 206	Plant Pathology	D.C.E.C	04		04	04		04	80	20		100
Foundation Elective Course												
BOT 207	Communication Skills and Personality Development	F.E.C.	02		02	02		02	40	10		50
Lab Courses												
BOT 208	Lab course-I Based on BOT 201-203	C.C.	-	04×03	12	-	02×03	06		-	50	50
BOT 209	Lab course-II Based on BOT 204,205,206 (any two)	C.C.	-	04×02	08	-	02×02	04		-	50	50
BOT 210	Seminar	C.C.	-	-	-	-	-	01		-	-	25
BOT 211	Self Study Paper	C.C.	-	-	-	-	-	01		-	-	25
Total			22	20	42	22	10	34	440	110	100	700

C.C = Core Course

D.C.E.C = Discipline Centric Elective Course

F.C. = Foundation Elective Course

Scheme of Examination for M.Sc. Botany**Semester-III****Credits = 35****Marks = 750**

Sr. No.	Paper Code	Subjects	Type of Course	Contact Hours Per Week			Credit			Examination Scheme			Total
				Theory	Practical/ Seminar	Total	Theory	Practical/ Seminar	Total	Exam	Internal Assessment	Practical/ Seminar	
1	BOT 301	Plant Genetics	C.C.	04		04	04		04	80	20		100
2	BOT 302	Plant Biochemistry	C.C.	04		04	04		04	80	20		100
3	BOT 303	Plant Biotechnology & Genetic Engineering	C.C.	04		04	04		04	80	20		100
4	BOT 304	Plant Physiology	C.C.	04		04	04		04	80	20		100
Discipline Centric Elective Course (Any one)													
5	BOT 305	Plant Development	D.C.E.C.	04		04	04		04	80	20		100
6	BOT 306	Genomics & Proteomics	D.C.E.C.	04		04	04		04	80	20		100
7	BOT 307	Genetics of Medicinal Plants	D.C.E.C.	04		04	04		04	80	20		100
Lab Courses													
8	BOT 308	Lab course-I Based on BOT 301-303	C.C.	-	04×03	12	-	02×03	06		-	50	50
9	BOT 309	Lab course-II Based on BOT 304,305/306/307	C.C.	-	04×02	08	-	02×02	04		-	50	50
10	BOT 310	Seminar	C.C.	-	-	-	-	-	01		-	-	25
11	BOT 311	Self Study Paper	C.C.	-	-	-	-	-	01		-	-	25
Open Elective Course /MOOCs Courses (Swayam)													
(Open elective course to be chosen from the pool of open elective courses provided by the University, Excluding the open elective course offered by the Department of Botany)													
12	BOT 312	Plant Resource Utilization	O.E.C.	03		03	03		03	80	20		100
Total				23	20	43	23	10	35	480	120	100	750

C.C= Core Course D.C.E.C = Discipline Centric Elective Course O.E.C. = Open Elective Course

Scheme of Examination for M.Sc. Botany**Semester-IV****Credits = 32****Marks = 650**

Sr. No.	Paper Code	Subjects	Type of Course	Contact Hours Per Week			Credit			Examination Scheme			Total
				Theory	Practical /Seminar	Total	Theory	Practical /Seminar	Total	Exam	Internal Assessment	Practical /Seminar	
1	BOT 401	Biodiversity & Conservation	C.C.	04		04	04		04	80	20		100
2	BOT 402	Evolutionary Biology & Economic Botany	C.C.	04		04	04		04	80	20		100
3	BOT 403	Plant Ecology	C.C.	04		04	04		04	80	20		100
4	BOT 404	IPR & Biosafety	C.C.	04		04	04		04	80	20		100
Discipline Centric Elective Course (Any one)													
5	BOT 405	Plant Tissue Culture	D.C.E.C.	04		04	04		04	80	20		100
	BOT 406	Recombinant DNA Technology	D.C.E.C.	04		04	04		04	80	20		100
Lab Course													
6	BOT 407	Lab course-I Based on BOT401-403	C.C.	-	04×03	12	-	02×03	06		-	50	50
7	BOT 408	Lab course-II Based on BOT404,405/406	C.C.	-	04×02	08	-	02×02	04		-	50	50
8	BOT 409	Seminar	C.C.	-	-	-	-	-	01		-	-	25
9	BOT 410	Self Study Paper	C.C.	-	-	-	-	-	01		-	-	25
Total				20	20	40	20	10	32	400	100	100	650

C.C= Core Course**D.C.E.C = Discipline Centric Elective Course****Duration: 02 Years****Total Credits = 133****Total Marks = 2750**

INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

M.Sc. - Botany

General Instructions

1. Seminar/ Journal Club

Max.Marks-25

Every candidate will have to deliver a seminar of 30 minutes duration on a topic (not from the syllabus) which will be chosen by him / her in consultation with the teacher of the department. The seminar will be delivered before the students and teachers of the department. A three member committee (one coordinator and two teachers of the department of different branches) duly approved by the departmental council will be constituted to evaluate the seminar. The following factors will be taken into consideration while evaluating the candidate. Distribution of marks will be as follows:

- | | |
|--------------------------------|----------|
| 1. Presentation | 10 marks |
| 2. Depth of the subject matter | 10 marks |
| 3. Answers to the questions | 05 marks |

2. Self Study Paper

Max.Marks-25

Objective: This course intends to create habits of reading books and to develop writing skills in a manner of creativity and originality. The students are to emphasis his/her own ideas/words which he/she has learnt from different books, journals and newspapers and deliberate the same by adopting different ways of communication techniques and adopting time scheduling techniques in their respective fields. This course aims:

- To motivate the students for innovative, research and analytical work
- To inculcate the habit of self study and comprehension
- To infuse the sense of historical back ground of the problems
- To assess intensity of originality and creativity of the students

Students are guided to select topic of their own interest in the given area in consultation with their teachers/Incharge/Resource Person.

Instructions for Students

1. Choose the topic of your interest in the given areas and if necessary, seek the help of your teacher.
2. Select a suitable title for your paper.
3. You are expected to be creative and original in your approach.

4. Submit your paper in two typed copies of A4 size 5-6 pages (both sides in 1.5 line spaces in Times New Roman Font size 12).
5. Organize your paper in three broad steps:
 - (a) Introductions
 - (b) Main Body
 - (c) Conclusion
6. Use headings and sub-headings
7. Use graphics wherever necessary
8. Give a list of books/references cited/used
9. The external examiner will evaluate the self-study paper in two ways i.e. Evaluation 15 Marks and Viva-Voce 10 marks.

Distribution of Marks

- | | | |
|--|-------|---------------------|
| 1. The evaluation is divided into different segment as under : | | 15 Marks |
| (i) Selection of Topic | - | 3 Marks |
| (ii) Logical Organization of subject matter | - | 5 Marks |
| (iii) Conclusions | - | 5 Marks |
| (iv) References | - | 2 Marks |
|
2. Viva-Voce: |
- |
10 Marks |

The external examiner will hold Viva-Voce based on contents of the student's Self Study Paper focusing upon the description by the Candidate.

**M.Sc. Botany
Semester-I**

**BOT-101
Cell Biology**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Biomembranes: Molecular composition and arrangement, functional consequences, membrane transportation; diffusion, active transport and pumps, uniports, symports and antiports, Donnan equilibrium; ion movements and cell function: Maintenance of cellular pH; Receptor mediated endocytosis,

The Extra Cellular Matrix Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata Ca^{++} dependent and Ca^{++} independent Homophilic cell-cell adhesion

Unit-II

Cytoskeleton and cell movement: Structure and organization of actin filaments, Actin, myosin and cellular movements, Structure and dynamic organizations of microtubules, Intermediate filaments, Cilia and flagella, Cell matrix adhesion, Integrins, Collagen, Non-collagen components, Protein sorting and transport, Protein uptake into the ER, Membrane proteins and Golgi sorting, Mechanism of vesicular transport, Lysosomes, Molecular mechanism of secretory pathway

Unit-III

Cell cycle: The eukaryotic cell cycle, Regulators of cell cycle progression, The events of M phase, Meiosis and fertilization, Genome organization, Chromosomal organization of genes and noncoding DNA, Mobile DNA, Pathways of intracellular signal transduction, Signaling networks

Unit-IV

Cell death and cell renewal: Apoptosis, Stem cells and the maintenance of adult tissues, Embryonic stem cells and therapeutic cloning, Biology of Cancer, Oncogenes, Tumor suppressor genes, Molecular approaches to cancer treatment, Biology of Ageing

Suggested laboratory Exercises:

1. Preparation of mitotic and meiotic chromosomes.
2. Calculation of morphometric data and preparations of idiogram.
3. Determination of chiasma frequency and terminalization coefficient.
4. Preparation of polytene chromosomes and mapping.
5. Study of permanent slides of different types of cancer and their stages

Suggested Readings:

1. Molecular Cell, Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.

M.Sc. Botany
Semester-I

BOT- 102
Virology, Bacteriology and Mycology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Unit-I

Viruses: Characteristics and ultrastructure of virions; chemical nature, replication, transmission and economic importance of viruses.

Phytoplasma: General characteristics and role in causing plant diseases.

Unit-II

Archaeobacteria and eubacteria: General account; ultrastructure, nutrition and reproduction; economic importance.

Cyanobacteria: Salient features and biological importance.

Unit-III

Mycology: General characters of fungi, their significance to human, Organization of thallus, cell wall composition, nutrition (saprophytic, biotrophic, symbiotic), reproduction, kinds of spores. Fungal classification: Ainsworth, 1973; Alexopoulos *et. al.*, 1996; general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.

Unit-IV

Heterokaryosis, heterothallism, parasexuality, sex hormones, mycorrhizae and predaceous fungi; Lichens: structure, reproduction and economic importance.

Importance of fungi in different microbiological and Biotechnological processes; role of fungi in industry (Alcohol), medicine (Antibiotics and steroids) and food (edible mushrooms).

Suggested Laboratory Exercises:

1. Morphological study of some Cyanobacteria, Bacteria and Fungi.
2. Preparation of media for Fungus and Bacteria culture.
3. Preparation of different stains of bacteria.
4. To demonstrate Gram's staining of bacteria.

5. Identification of fungal cultures: Rhizopus, Mucor, Aspergillus, Penicillium, Emericella, Chaetomium, Drechslera, Curvularia, Fusarium, Phoma, Colletotrichum, Graphium.
6. Study of permanent slides of Bacteria and Fungi
7. Collection and submission of locally available Cryptogamic plant species.

Suggested readings:

1. Aneja, K. R. and Mehrotra, R. S., 2015, An Introduction of Mycology, 2nd Edition, New Age International Press, New Delhi.
2. Aneja, K. R. and Mehrotra, R. S., 2011, Fungal Diversity and Biotechnology, 1st Edition, New Age International Press, New Delhi.
3. Sumbali, G., 2005, The Fungi, Narosa Publication, New Delhi.
4. Webster, J., 1985. Introduction of Fungi, Cambridge University, Press.
5. Pelczar, M. J. 2001, Microbiology, 5th Edition, Tata McGraw-Hill Co. New Delhi.
6. Prescott, L., Harley, J. and Klein, D., 2005. Microbiology, 6th Edition, Tata McGraw-Hill Co., New Delhi.
7. Bilgrami, K. S. and Dubey, H. C., 1986. A Textbook of Modern Plant Pathology, Vikas Publication Ltd., New Delhi.
8. Alexopoulos, C. J., Mims, C. W. and Blackwell, M., 1996, Introductory Mycology, 4th Edition, John Wiley and Sons (Asia), Singapore.
9. Pelczar, M. J., Chaing, E. C. S. and Krieg, N. R., 1993, Microbiology, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
10. Agrios, G. N., 1997, Plant Pathology, Academic Press, London.

**M.Sc. Botany
Semester-I**

**BOT- 103
Biostatistics**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Permutations and combinations, Functions, Limits and Continuity, Exponential and Logarithmic functions, Differential Calculus : Rules of differentiation, Higher derivatives, Maxima and minima, Integration, Integration by parts, Definite integrals, Properties of definite integrals, Elementary ideas of differential Equations.

Unit-II

Types of data, Collection and Graphical representation of data, Measures of central tendency: Mean, Median, Mode, Quartile, Percentile. Measures of Dispersion: Range, Variance, Standard deviation, Coefficient of Variation, Correlation and Regression.

Unit-III

Probability and its applications: Laws of Addition and Multiplication, Compound Probability, Bayes theorem. Probability distributions: Binomial, Poisson and Normal distributions and their applications.

Testing of hypothesis: Parameter and Statistic, Sampling distribution and Standard error, Null and Alternative hypotheses, Simple and composite hypotheses, Two types of errors, Level of significance and Power of the test, One tailed and two tailed tests.

Unit-IV

Tests of significance: t and Z tests for mean and proportion for one and two samples, Chi square test of goodness of fit and independence. F test, Analysis of variance for one way and two way classification, Elementary ideas of Designs of Experiments.

Suggested Laboratory Exercises:

Descriptive statistics: Systemic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion (using calculators).

Correlations (Product Moment and Spearman's Rank Correlation) and Linear Regression

Tests of significance (Mean, Standard Deviation, proportion, Correlation Coefficient)

Chi Square Test of Goodness of fit, test of independence of attributes, Analysis of Variance (One way and Two way).

Suggested readings:

1. Daniel, Wayne W. (2007) Biostatistics: A Foundation for Analysis in Health Sciences 10th Edition, Wiley Series.
2. Pagano, Marcello and Gauvreau, Kimberlee (2000) Principles of Biostatistics, 2nd Edition, CRC Press
3. Chap T. Le, Introductory Biostatistics (2017), Wiley India Pvt Ltd.
4. P.N. Arora and P. K. Malhan, Biostatistics, Himalaya Publishing House
5. B. K. Mahajan, Methods in Biostatistics: For Medical Students and Research Workers, JPB

M.Sc. Botany
Semester-I

BOT- 104
Cryptogamic Botany

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Phycology: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; cell ultrastructure; reproduction (vegetative, asexual and sexual). Classification of algae; criteria for classification; pigments, reserve food and flagella.

Unit-II

Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

Algal blooms; algal biofertilizers; economic importance of algae as food, feed, in medicine and industry.

Unit-III

Bryophyta: Morphology, structure, reproduction and life history; distribution; economic and ecological importance.

Classification of bryophytes; general account of Marchantiales, Jungermanniales, Anthocerales, Sphagnales, Funariales and Polytrichales

Unit-IV

Pteridophyta: General characteristics, morphology, anatomy, reproduction and classification of Pteridophytes.

Introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida. General account of fossil pteridophyta; Evolution of stele and stelar system; heterospory and origin of seed habit.

Suggested Laboratory Exercises

1. Taxonomy/ morphological study of representative members of algae, bryophytes and pteridophytes.
Algae: *Volvox*, *Hydrodictyon*, *Cladophora*, *Coleochaete*, *Oedogonium*, *Zygnema*, *Spirogyra*, *Chara*, *Vaucheria*, *Pinularia*, *Ectocarpus*, *Fucus*, *Sargassum*, *Polysiphonia*, *Batrachospermum*, *Oscillatoria*, *Nostoc*, *Scytonema*, *Euglena*, *Peridinium*.
Bryophytes: *Marchantia*, *Anthoceros*, *Funaria*, *Polytrichum*, *Pellia*, *Porella*, *Sphagnum*.
Pteridophytes: *Lycopodium*, *Selaginella*, *Psilotum*, *Equisetum*, *Adiantum*, *Marsilea*, *Azolla*, *Pteris*, *Ophioglossum*, *Dryopteris*, *Nephrolepis*.
2. To study permanent slides of Algae, Bryophytes and Pteridophytes (both vegetative and reproductive phases)
3. Collection and submission of locally available cryptogamic plant species.

Suggested readings:

1. Lee, R. E., 2008. Phycology, 4th Edition, Cambridge University Press, USA.
2. Parihar, N. S., 1966. Bryophyta- An Introduction to Embryophyta, Vol.I., Central Book Depot, Allahabad, India.
3. Parihar, N. S., 1977. The Biology and Morphology of Pteridophytes, Central Book Depot, Allahabad, India.
4. Rashid, A., 1998. An Introduction to Bryophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
5. Kumar, H. D., 1999. Introductory Phycology. Allied East-West Press Ltd., New Delhi.
6. Verma, V., 2015. Phycology and Microbiology, Ane Books Pvt. Ltd., New Delhi.
7. Bilgrami, K. S. and Saha, L. C., 2007. A Textbook of Algae, CBS Publishers & Distributors, New Delhi.
8. Vashishta, B. R., Sinha, A. K. and Singh, V. P., 2012. Algae, S. Chand Publishing, New Delhi.
9. Kumar, A., Vashishta, B. R. and Sinha, A. K., 2012. Bryophyta, S. Chand Publishing, New Delhi.
10. Kumar, A., Vashishta, B. R. and Sinha, A. K., 2012. Pteridophyta, S. Chand Publishing, New Delhi.
11. Puri, P., 1980. Bryophytes. Atma Ram & Sons, New Delhi.
12. Sporne, K. R., 1991, The Morphology of Pteridophytes, B.I. Publ. Pvt. Ltd.

**M.Sc. Botany
Semester-I**

**BOT- 105
Tools and Techniques**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT-I

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanning and transmission electron microscopes.

Centrifuge technique: Principle, types of centrifuge, density gradient centrifuge in isolation of cell, cell organelles and biomolecules.

UNIT-II

Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC) and FPLC. Application of chromatographic technique in biology.

Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).

UNIT-III

Spectroscopy: Fluorescence, UV, visible, Infrared, Atomic absorption spectroscopy, NMR and ESR spectroscopy; Mass spectrometry (LC-MS, GC-MS), X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography. Application of different spectroscopic technique in biology.

UNIT-IV

Nature and types of radiation, preparation of labelling biological sample, detection and measurement of radiation, GM counter, Scintillation counter. Flow cytometry. Safety measurement in handling radioisotopes, ELISA, RIA and non-radiolabelling.

Suggested Laboratory Exercises:

1. Demonstration of working of different types of microscopes.
2. Demonstration of Chromatography i.e. TLC, HPLC, GC.
3. To demonstrate the separation of proteins with the help of electrophoresis.
4. To study various molecular biology techniques i.e. PCR.
5. To demonstrate the use of spectrophotometer.
6. Purification of protein by column chromatography.
7. Visit of various laboratories in the university, preparation and submission of report.

Suggested reading:

1. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
2. Cooper, T.G. 1977. Tools in Biochemistry. John Wiley, New York, USA.
3. Dryer, R. L. and Lata, G. F. 1989. Experimental Biochemistry. Oxford University Press, New York.
4. Hames, B.D.(Ed.).1998. Gel Electrophoresis of Proteins: A Practical Approach, 8th edition. PAS, Oxford University Press, Oxford, UK.
5. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.
6. Wilson, K. and Walker, J. 1994. Practical Biochemistry: Principles and Techniques, 4th edition. Cambridge University Press, Cambridge, UK.

**M.Sc. Botany
Semester-I**

**BOT- 106
Soil Science, Energy and Environment**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

UNIT-I

Soil Genesis: Weathering processes and soil formation; Soil profile development, chemical mineralogical composition of soil; Soil classification.

Different forms of water in soil, hygroscopic, capillary and gravitational; Movement of soil water under saturated and unsaturated conditions; Soil temperature, Absorption and loss of heat, Thermal conductivity through a soil profile.

UNIT-II

Classification of climate - Koppen's classification and Thornthwaite's scheme; climatic types and zones.

Climate of India: Physiography, spatial and temporal patterns of climatic parameters temperature, rainfall and its variability in India with special reference to NE India, general circulation, jet stream, The Indian monsoons, ElNino, cyclone.

UNIT-III

Energy: Energy resources and their exploitation, Conventional and non-conventional energy sources. Renewable sources of energy- hydroelectric power, solar, tidal, wind, geothermal energy, biomass and biofuels.

Environmental impacts of conventional and renewable energy. Sun as source of energy, nature of solar radiation, Earth's temperature and atmosphere, Photovoltaics and Solar collectors. Energy use pattern in India and the world.

UNIT-IV

Biological monitoring, bioindicators and control of environmental pollution, xenobiotics. Biocomposting:– Microbial process involvement, vermin composting. Biomining: Extraction of Cu, Au, etc from Ore by microbes . Bioremediation- In situ and Ex-situ bioremediation, Bioremediation of toxic metals, Concept of Phytoremediation, International and National efforts for environment protection..Environmental (protection) Act-1986.

Suggested laboratory Exercises:

1. Study of EC and pH of the soil.
2. Study of soil profile.
3. Determination of organic matter from soil.
4. Some ecological instruments used in air and water pollution studies.
5. Estimation of the following in water: Total hardness, Calcium, Organic matter, BOD

Suggested readings:

1. J.M. Fowler, Energy and the Environment, McGraw Hill, 1984 3.
2. R. A. Ristinen and J. J. Kraushaar Energy and the Environment, John Wiley and Sons, 1998
3. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, 2000
4. G.D. Rai, Non-Conventional Sources of Energy, Khanna Publishers, 1997
5. 3. N. H. Ravindranath, K. UshaRao, B. Natarajan and P. Monga Renewable Energy and Environment - A Policy Analysis for India, Tata-McGraw Hill, 2000
6. 4. N. Nakicenovic (edtr) Global Energy Perspectives, Cambridge University Press, 1998
7. Agarwal S. K. (1992) : Fundamentals of Ecology.
8. Bradbury I. K. (1990) :The Biosphere.
9. Das S. M. (1989) :Handbook of Limnology and water pollution with practical Methodology.
10. D. D. Basu Introduction to the Constitution of India, Wadhwa and Company Law Publisher, 2003
11. S.K. Choudhury, Environmental Legislation in India, Oxford IBH, 1996
12. V. H. Heywood and R. T. Watson Global Biodiversity Assessment, Cambridge University Press, 1995
13. V.K. Prabhakar International Laws on BioDiversity, Annal, 2001
14. R.K. Trivedi Handbook of Environmental Laws, Acts, Guidelines, Compliance and Standards, Vol I & II, B.S. Publications, Hyderabad, 2004

**M.Sc. Botany
Semester-II**

**BOT- 201
Molecular Biology**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

DNA Replication: Mechanism of DNA replication in Prokaryotic and eukaryotic cells. Enzymes and accessory proteins involved in DNA replication and DNA repair. Transcription: Prokaryotic & Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Transcriptional and post-transcriptional gene silencing, Modifications in RNA: 5'- Cap formation, Transcription termination, 3'-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA & its stability.

Unit -II

Translation: Prokaryotic and eukaryotic translation, Regulation of translation, co- and post translational modifications of proteins. Protein Localization: Synthesis of secretory and membrane protein & their import into nucleus, mitochondria, and peroxisomes, Receptor mediated endocytosis, Oncogenes and Tumor Suppressor Genes: Viral and cellular oncogenes, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins

Unit -III

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer head & their designing strategies, hairpin and other ribozymes. Applications of Antisense and ribozyme technologies. Homologous Recombination: Holliday junction, gene targeting, gene disruption, and Cre/Lox recombination, RecA and other recombinases Molecular Mapping of Genome: Genetic and physical maps & their applications.

Unit -IV

Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, Molecular markers & their applications viz., forensic, disease prognosis, genetic counseling, Pedigree, animal trafficking and poaching; Germplasm maintenance, taxonomy and bio-diversity Genome Sequencing: Genome sizes, organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencing genome, Packaging, transfection and recovery of clones, Application of Sequencing, sequence information for identification of defective genes

Suggested laboratory Exercises:

1. Isolation of Genomic DNA.
2. Isolation of RNA.
3. Quantitative analysis of DNA.
4. Restriction digestion of DNA.
5. Ligation of DNA fragments.
6. Molecular weight analysis using agarose gel electrophoresis.
7. Isolation of plasmid DNA.
8. Western blotting.
9. Southern blotting.
10. Preparation of competent cell.

Suggested Readings:

1. Molecular Biology of the Gene, J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. The Benjamin/Cummings Pub. Co., Inc., California.
2. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Books, Inc., USA. 3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York.
3. Gene VI, Benjamin Lewin, Oxford University Press, U.K.
4. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.), VCH Publishers, Inc., New York.
5. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
6. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York. 8. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford

**M.Sc. Botany
Semester-II**

BOT- 202

Plant Anatomy and Diversity of Gymnosperms

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Plant tissue system: tissue types and functions. Meristems, their classification, functions, organization of root and shoot apices. Structure of xylem and phloem. Anatomy of dicot and monocot stem, root, leaves and wood. Transition from root to stem. Primary and secondary growth, anomalous structure and abnormal secondary growth in stems. Application of anatomy in systematics, archaeology and climate change studies.

Unit-II

Introduction to gymnosperms: general characters, life cycle, diversity and origin and classification of gymnosperms, Evolution of gymnosperms. Distribution of gymnosperms in India, Economic and ecological importance of gymnosperms.

Unit-III

Paleobotany: fossils, types of rocks, types of fossils and fossilization. Techniques for study of fossils, Notable paleobotanists of India. General account of few fossil gymnosperm families (Lyginopteridaceae, Medullosaceae, Glossopteridaceae and Caytoniaceae) and orders (Cycadeoidales, Pentoxylales and Cordaitales).

Unit-IV

Comparative account of the morphology, anatomy and reproduction in the following orders: Cycadales (Cycas), Ginkgoales (Ginkgo) Coniferales (Pinus), Ephedrales (Ephedra) Welwitschiales and Gnetales.

Suggested Laboratory Exercises:

1. Study of various meristems and plant tissues from permanent and temporary slides.
2. Identification of plant organs on the basis of anatomy
3. Study of anatomy of root, stem and leaves by double staining method
4. Comparative study of anatomy of vegetative and reproductive parts of Cycas, Pinus, Ginkgo, Cedrus , Aurocaria , Cryptomeria, Ephedra, Gnetum and Taxus.
5. To study permanent slide of various Gymnosperms

Suggested readings:

1. Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi.
2. Chamberlain, C.J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.
3. Sporne, K.R. 1986. Morphology of Gymnosperms. Hutchinson University Press.
4. Vashishta, P.C. 1999. Gymnosperms, S. Chand & Company Ltd. New Delhi.
5. David F. Cutler et. al. 2007. Plant Anatomy: An Applied Approach, Wiley-Blackwell.
6. William C. Dickison 2000. Integrative Plant Anatomy, Academic Press.
7. Sharma, O.P. and S. Dixit. Gymnosperms. Pragti Prakashan, Meerut. 344 pp. 2002.
8. Rothwell, G.W. The Role of Comparative Morphology and Anatomy in interpreting the Systematics of Fossil Gymnosperms. Bot. Rev. 51 : 318-327. 1985.

**M.Sc. Botany
Semester-II**

BOT- 203

Taxonomy and Systematic of Angiosperms

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Principles of Plant Classification with emphasis on modern tools of taxonomy: Taxonomy as a synthetic discipline, Modern tools of Taxonomy(Cytotaxonomy, Chemotaxonomy ,Numerical Taxonomy, , Serology.)

Taxonomic literature:- General Indexes, Floras, Manuals, Important periodicals with emphasis on Indian floristic.

Important Botanical Gardens and Herbaria.

Botanical Survey of India – its organization and role.

Botanical Nomenclature and International Code of Botanical Nomenclature.

Unit-II

Systems of classification –Bentham & Hooker, Hutchinson ,Cronquist ,Takhtajan , Dahlgren and Thorne.

Phylogeny of Angiosperms: Origin, Evolution and inter-relationship of dicots and monocots.

General evolutionary trends in angiosperms: Habits and Habitats, Leaf structure, Inflorescence and Flowers.

Unit-III

Salient features of following families:

DICOTYLEDONS: Ranunculaceae, Magnoliaceae, Fumariaceae, Cruciferae, Papaveraceae, Capparidaceae, Caryophyllaceae, Malvaceae, Sterculiaceae, Rutaceae, Meliaceae, Rhamnaceae, Anacardiaceae, Leguminosae, Rosaceae, Combretaceae, Myrtaceae, Solanaceae, Lythraceae ,Cucurbitaceae, Cactaceae, Umbelliferae, Compositae, Primulaceae, Oleaceae, Asclepiaceae, Apocynaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae, Acanthaceae, Labiatae Verbenaceae, Amaranthaceae, Polygoniaceae, Nyctaginaceae, Euphorbiaceae, and Cannabinaceae.

Unit-IV

MONOCOTYLEDONS: Orchidaceae, Cannaceae, Amaryllidaceae, Liliaceae, Palmae, Araceae, Cyperaceae and Graminae.

The Species Concept & Taxonomic hierarchies: Species, Genus, Family and other Categories.

Concepts of phytogeography: Endemism, Hotspots and hottest hotspots ; Plant Explorations; Invasions and Introductions. Evolution of Stamen and Carpel.

Suggested laboratory Exercises :

1. Study of morphology, primitive and advanced characters of cultivated and wild representatives of various families. Study of basic structure of flower, variations , floral parts in details, floral symmetry, insertion of floral parts etc.
2. Location of key characters and use of keys to derive families.
3. Field study of angiosperm in different types of habitats and preparation of plant herbarium.
4. Training in using floras for identification of specimens describes in fields or class.

Suggested readings:

1. Benson, L.D. 1962. Plant Taxonomy: Methods and Principles. Ronald Press, New York.
2. Collet, H. 1971. Flora Simalensis. Thacker and Spink , Calcutta and Simla.
3. Cronquist, A. 1968. The evolution and classification of flowering plants. Houghton Mifflin , Boston.
4. Cronquist, A. 1981. An integrated system of classification of flowering plants. Columbia University Press, Columbia.
5. Davis, P.H. and V.H. Heywood. 1973. Principles of Angiosperm Taxonomy. Van Nostrand Reinhold, New York.
6. Eames, A.J. 1961. Morphology of Angiosperms. McGraw – Hill Inc., New York.
7. Gupta, R.K. 1981. Systematic Botany. Atma Ram and Sons, New Delhi.
8. Hutchinson, J. 1950. The families of flowering plants. Vol. I, II. Clarendon Press, Oxford.
9. Lawrence, H.M. 1951. Taxonomy of Vascular plants. MacMillan, New York.
10. Naik, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill, New Delhi.
11. Pandey, S.N. and S.P. Misra. 2008. Taxonomy of Angiosperms. Ane Books, India.
12. Shivana, K.R. and N.S .Rangaswamy. 1992. Pollen Biology : A Laboratory Manual. Springer-Verlag, Berlin.
13. Shivana, K.R. and B.M. Johri. 1985. The Angiosperm Pollen : Structure and Function. Wiley Eastern Ltd.. New Delhi.
14. Singh, G. Plant Systematic: 1999. Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
15. Sharma, O.P. 2002. Plant Taxonomy. Tata McGraw Hill Publishing Co. Pvt. Ltd., New Delhi.
16. Sneath, P.H.A and R.R. Sokal. 1973. Numerical Taxonomy. W.H. Freeman, San Francisco.
17. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics . The MacMillan Co., New York.

18. Sporne, K.R. 1986. The Morphology of Angiosperms. B.I. Publication, Bombay, Calcutta, Delhi.
19. Stace ,C.A. 1984. Plant Taxonomy and Biosystematics. Contemporary Biology Series, Edward Arnold, London.
20. Subramaniam, N.S. 2007. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd., Delhi.
21. Takhtajan, A.E. 1969. Flowering plants: Origin and dispersal. Oliver and Boyd Ltd., Edinburg.

**M.Sc. Botany
Semester-II**

**BOT- 204
Plant Breeding and Cytogenetics**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Allelism and Linkage: Multiple Allele, Pseudo-alleles, Complementation tests, Pleiotropy, Genomic imprinting, Penetrance and Expressivity, Phenocopy, Linkage and Crossing over, Sex Linkage, Sex limited and Sex influenced characters.

Genetic Recombination and Gene Mapping methods : Recombination, Molecular Mechanism of Recombination, Role of RecA and RecBCDenzymes, Site-specific recombination, Linkage maps, Tetrad analysis - Centromere mapping in linear tetrads and analysis of unordered tetrads.

Unit-II

Extrachromosomal Inheritance: The Genetics of Plastids, mitochondria and chloroplasts.

Microbial Genetics: Mapping the bacteriophage genome; phage phenotypes; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria

Multigene families: Multigene families and their evolution.

Unit-III

Quantitative Genetics: Polygenic inheritance, Heritability and its measurements, QTL mapping.

Molecular Cytogenetics: FISH, GISH, FIBER-FISH, Flow Cytogenetics, Flow karyotyping, Applications of molecular cytogenetics.

Population Genetics : Gene pool, Gene frequency, Hardy- Weinberg Law , Concepts and rate of change in gene frequency through mutation, natural selection and migration ; random genetic drift.

Unit-IV

Asexual Breeding Systems: Methods of breeding of vegetatively propagated crops; Non-conventional methods; polyploidy; gene variability.

Male Sterility: Concept, Types, Genetic control and Breeding utility.

Suggested Laboratory Exercises:

1. Study of problems on Mendelian Genetics, Gene interactions, Multiple allele and multiple gene inheritance.
2. To test the genetics Hypothesis by Chi-square Test and study goodness of fit.
3. Preparation of Linkage Maps in Diploids using three points test cross method.
4. Tetrad analysis and Centromere mapping in ordered and unordered tetrads.
5. Pedigree analysis.
6. Problem relating to population genetics.
7. Study of B chromosome in Maize/ Drimia.
8. Induction of polyploidy using Colchicine.
9. Study different stages of mitosis in root tips of Allium species.
10. Study meiotic behaviour of chromosomes in Anthers of Allium sp. or Rhoeo

Suggested readings:

1. Atherly, A.G., J.R. Girton & J.F. McDonald. 1999. The Science of Genetics 5th Edition Saunders College Publishing Fort Worth, U.S.A.
2. Brooker, R.J. 2014. Genetics. Mc Graw –Hill education.
3. Brown, T.A. 2011. Genetics : A Molecular Approach. 4th Ed. Taylor & Francis.
4. Griffiths, A.J.F., W.M. Gelbart & J.H. Lewontin. 2002, Modern Genetic Analysis. 2nd Ed W.H. Freeman & Company, U.S.A.
5. Gupta, P.K. 2014. Genetics. 4th Edition ,Rastogi Publication, Meerut.
6. Hartl, D.L. & E.W. Jones. 1998. Genetics: Principles and Analysis. 4th Ed. Jones and Bartlett Publishers, Massachussets, U.S.A.
7. Lewin, B. 2007, Gene XI. Pearson Prentice Hall, USA.
8. Primrose, S.B., R.M. Twyman and R.W. 2006. Old Principles of Gene Manipulation & Genomics 7th Edition.. Blackwell Publ.
9. Russell, P.J. Genetics. 1998. 5th Ed. Addison Wesley Longman, California, U.S.A.
10. Sinnott, E.W., L.C. Dunn & T. Dobzhansky 1973. Principles of Genetics. 5th Ed. Tata McGraw Hill Book Co., New Delhi.
11. Snustad, D.P. & M.J. Simmons. 2015. Principles of Genetics. 7th ed. John Wiley & Sons Inc., U.S.A.
12. Stickberger, M.W. 2008. Genetics, 3rd Ed., MacMillan, New York.
13. Weaver, R.F. & P.W. Hedrick .1997. Genetics. 3rd Ed. William C. Brown Publishers, U.S.A.

**M.Sc. Botany
Semester-II**

**BOT- 205
Bioinformatics**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Computers: An overview of computers, microcomputers, VDUs and printer; What is programming? Algorithms; Languages and packages: Introduction to MS Office, MS Access, introduction to SQL (structured query language) Handling arrays, procedures. Colour, sound and graphics; Use of standard packages.

Unit-II

Introduction to PERL: Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O, Input from file named in command line, Regular expression, Pattern matching, Pattern modifiers.
Applications of PERL in Bioinformatics: Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Generating random numbers, simulating DNA mutation, generating random DNA, Analyzing DNA

Unit-III

Biological Sequence Databases: Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GenBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences. Preliminary ideas of query and analysis of sequence information.

Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch&SmithWaterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method. Theory of scoring matrices and their use for sequence comparison.

Unit-IV

Database Search Algorithms: Methods for searching sequence databases like FASTA and BLAST algorithms. Statistical analysis and evaluation of BLAST results. Pattern Recognition

Methods in Sequence Analysis: Concept of a sequence pattern, regular expression based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrices and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAST. Markov chains and Markov models and their use in gene finding. Concept of HMMs, the Forward backward and the Viterbi algorithm. The Baum Welch algorithm for training a HMM. Use of profile HMM for protein family classification.

Suggested Laboratory Exercises:

1. Retrieve Nucleotide sequences from NCBI serve.
2. Retrieve Protein sequences from PDB.
3. Analysis of sequences Similarity using BLAST/pBLAST/nrBLAST
4. To predict protein secondary structures by using iPred.
5. Perform phylogenetic analysis using PHYLIP.
6. Perform multiple sequence alignment by using ClustalW.
7. Primer design
8. Computational modeling of genomic, transcriptomic and proteomic

Suggested readings:

1. JinXiong. 2006. Essential Bioinformatics. Cambridge publisher
2. ZhumurGhosh and BibekanandMallick. 2008. Bioinformatics: Principles and Applications. Oxford University Press publisher
3. OrpitaBosu and SimminderKaurThukral. 2007. Bioinformatics. Oxford University Press publisher
4. M.Lesk. 2002. Introduction to Bioinformatics. Oxford University Press publisher
5. Dan E. Krane, Michael L. Raymer, Michael L. Raymer, Elaine NicponMarieb. 2002. Fundamental Concepts of Bioinformatics Benjamin/Cummings
6. P. Rastogi and N. Mendiritta. 2013. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th Revised edition.
7. Mount and David W .2004. Bioinformatics: sequence and genome analysis. Cshl Press, 2nd edition
8. Harisha S. 2007. Fundamentals of Bioinformatics. I K International Publishing House Pvt. Ltd .
9. Dan E. Krane. 2003. Fundamentals concepts of bioinformatics. Dorling Kindersley (RS); First edition .
10. David Edwards and Jason Stajich. 2009. Bioinformatics: Tools and Applications. Published by Springer.

M.Sc. Botany
Semester-II

BOT- 206
Plant Pathology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Fundamentals of plant pathology: History of plant pathology; Various levels of parasitism; Classification of plant diseases.

Pathogenesis: Penetration and entry of plant pathogens; development inside host tissue.

Unit-II

Agents of plant diseases: General characteristics and symptoms caused by- agents of infectious diseases (fungi, bacteria, mycoplasma, virus and nematodes), how pathogens attack plants: chemical weapons of pathogens (enzymes and toxins)

Unit-III

Plant Diseases: Causal organisms, symptoms and management of –

- a. Downy mildew of grapes
- b. Karnal bunt of wheat
- c. Smut of Bajra
- d. Late and early blight of potato
- e. Yellow vein mosaic of Bhindi
- f. Tikka diseases of groundnut
- g. Bacterial blight of paddy
- h. Black, yellow and brown rust of wheat
- i. Sandal spike.

Unit-IV

Defense Mechanisms in plants: Structural and biochemical defense mechanisms; Management of plant pathogens; cultural, chemical and biological methods.

Suggested Laboratory Exercises:

1. Study of plant diseases mentioned in Theory syllabus.
2. Isolation and spore culture of selected pathogens.
3. Collection and submission of plant diseases samples.

Suggested readings:

1. Agrios, G.N. *Plant Pathology*. 5th Ed. Elsevier Academic Press, San Diego. 2005.
2. Alexopoulos, C.J., C.W. Mims and M. Blackwell. *Introductory Mycology*. 4th Ed. John Wiley & Sons, New York. 2007.
3. Bilgrami, K.S. and H.C. Dube. *A Textbook of Modern Plant Pathology*. Vikas Publishing House, New Delhi. 1990.
4. Bilgrami, K.S. and R.N. Verma. *Physiology of Fungi*. 2nd Ed. Vikas Publ House, New Delhi. 1994.
5. Bos, L. *Introduction to Plant Virology*. Longman, New York.. 1978.
6. Burnett, J.H. *Fundamentals of Mycology*. 2nd Ed. Edward Arnold, London. 1976.
7. Gibbs, A.J. and B.D. Harrison. *Plant Virology: The Principles*. John Wiley and Sons, NY. 1979.
8. Mehrotra, R.S. and A. Aggarwal. *Plant Pathology*. 2nd Ed. Tata McGraw Hill Co. Ltd., New Delhi. 2003.

M.Sc. Botany

Semester-II

BOT- 207

Communication Skills and Personality Development

Maximum Marks: 50

Theory Examination: 40

Internal Assessment: 10

Time: 3 hrs

Note: The examiner shall set nine questions in all covering the whole syllabus. Question No.1 will be compulsory and consist of 04 small questions of two marks each, covering the whole syllabus. The remaining 8 questions will be set from the syllabus on two questions from each unit basis; out of which the students will attempt four questions selecting one from each unit. All questions carry 08 marks each.

Unit I

Writing Skills

Letter Writing, Resume Writing, CV Writing, Difference between bio-data, Resume and CV, cover letter, Preparation of Report, Paragraph writing

Unit II

Interview Skills

Job Interview: Importance and Factors Involving Job Interview; Characteristics of Job Interview; Job Interview Process; Job Interview Techniques- Manners and etiquettes to be maintained during an interview; Sample Questions Commonly asked During Interview, Dress Code, Mock-Interview, How to be Successful in an Interview.

Unit III

Oral Presentation

Delivering a Presentation, Tools that enhance the effect of the presentation, conducting presentations in a smooth and self-assured manner. Group presentation, Group discussions, Group projects. Group Discussion, Differences between group discussion and debate, Narrating a story/an incident.

Unit IV

Technology-based Communication

Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Suggested readings

1. Sethi, J & et al. A Practice Course in English Pronunciation, Prentice Hall of India, New Delhi.
2. Sen, Leena. Communication Skills, Prentice Hall of India, New Delhi.
3. Prasad, P. Communication Skills, S.K. Kataria & Sons.
4. Bansal, R.K. and J.B. Harrison. Spoken English, Orient Language.
5. Roach Peter. English Phonetics and Phonology.
6. A.S. Hornby's. Oxford Advanced Learners Dictionary of Current English, 7th Edition.
7. T. Balasubramaniam: Phonetics & Spoken English.

**M.Sc. Botany
Semester-III**

**BOT- 301
Plant Genetics**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

UNIT-I

Cytology: Molecular organisation of chromatin, centromere and telomere; Euchromatin and heterochromatin.

Karyotype analysis; Chromosome banding technique; Flow cytometry and Confocal microscopy in karyotype analysis; Specialized types of chromosomes: Polytene, Lampbrush, B- chromosomes and sex chromosomes; Molecular basis of chromosome pairing.

UNIT-II

Structural and numerical alterations in chromosomes: origin, breeding behaviour of deficiency, duplication, inversion and translocation in chromosome; Robertsonian and B-A translocations.

Meiotic behaviour and use of trisomics, monosomics and nullisomics in chromosome ;Polyploids- origin and production of auto and allopolyploids; Meiosis in autotetraploid; Genome analysis in Tobacco and Wheat.

UNIT-III

Chromosome Manipulation: Alien gene transfer; transfer of whole genome in triticum, *Arachis* and *Brassica*; Transfer of individual chromosome and chromosome segments; Methods of detecting alien chromatin; Production , characterisation and utility of alien and substitutional lines.

Genetic fine structure: Cis-trans test; Dosage compensation and mechanism of sex determination in plants.

UNIT-IV

Genetics of plant pathogens: Genetic variability and molecular mechanism of variability among bacteria, virus and fungi; Molecular basis of host parasite interaction; Physiological specialization and production of new races, inheritance of resistance and virulence.

Mutations: Mutagens and their molecular mechanisms of occurrence; Site directed mutagenesis; DNA methylation; Role of mutation in crop improvement.

Suggested Laboratory Exercises:

1. Isolation of total RNA.
2. Isolation and partial purification of proteins.
3. Karyotype analysis in any two plant species.
4. Genetic problem on gene mapping in higher plants.

Suggested readings:

1. Russel P.J., 1998. Genetics (5th ed.). The Benjamin/Cummings Publishing Co., Inc. USA.
2. Snustad, D.P. and Simmons, M.J., 2000. Principles of Genetics (2nd ed.) John Wiley and Sons, Inc. USA.
3. Strickberger, M.W., 2008. Genetics, Phi Learning.
4. Atherly, A.G., Girton, J.R. and McDonald, J.F., 1999. The Science of Genetics. Saunders College Publishing, Frot Worth, U.S.A.
5. Hartk, D.L. and Jones, E.W., 1998. Genetics: Principles and Analysis (4th ed.). Jones and Bartlett Publishers, Massachusetts, U.S.A.
6. Lodish, H., Berk, A., Zipursky, S.L., Matudaria, P., Baltimoe, D. and Darnell, J. 2000. Molecular, Cell Biology, W.H. Freeman and Co., New York, USA.
7. Miesfeld, R. 1999. Applied molecular genetics. John Wiley and Sons, Inc. USA.
8. Ringo, J., 2004. Fundamental Genetics. Cambridge University Press.
9. Brooker, R., 2008. Genetics: Analysis and Principles. McGraw-Hill Science.
10. Hartwell, L., 2010. Genetics: From Genes to Genomes. McGraw-Hill Science.
11. Elrod, S., 2010. Schaum's outline of Genetics (5th ed.). McGraw-Hill Science.
12. Lewin, B., Elliot, S. G., Krebs J. E. and Kilpatrick, S.T., 2009. Lewins Gene X. Jones and Bartlett Publishers.

**M.Sc. Botany
Semester-III**

**BOT- 302
Plant Biochemistry**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

UNIT-I

Principles of Biochemistry: Structure of atom, molecules, forces stabilizing macromolecules, weak bonds and covalent bonds, buffers and pKa values.

Bioenergetics: Principles of thermodynamics, free energy, chemical and redox potential, structure and function of ATP, Exergonic and endergonic reaction, Entropy and energy.

UNIT-II

Fundamentals of enzymology: General aspects, nature of enzyme catalysis, enzyme kinetics, enzyme regulation and inhibition, isozymes, Allosteric enzyme and cofactors.

Amino acids and Proteins: Structure types, properties and Metabolism of Amino acids; Primary, Secondary, Tertiary and Quaternary structure of proteins; Domains, motif and folds; Stability of protein structure; Classification of proteins based on composition, solubility function; Reverse turns and Ramachandran plot.

UNIT-III

Carbohydrates: Structure and classification. Metabolism of carbohydrates (polysaccharide, glycoprotein and peptidoglycan); Stereoisomerism, transformation of carbohydrates, synthesis and degradation of sucrose, starch and cellulose

Lipids: Composition, structure and classification, Biosynthesis and oxidation of structural and storage lipids.

UNIT-IV

Nitrogen fixation and N & S metabolism: Overview of biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation. Sulfate uptake, transport and assimilation.

Vitamins: structure and function of Thiamine, Riboflavin, Nicotinic Acid, Pantothenic Acid, Pyridoxine, Biotin, Folic Acid, Vitamin B12, Ascorbic Acid, Vitamin A, D, E and K.

Suggested Laboratory Exercises:

1. Detection of reducing, non reducing and total sugars: Molisch test, Fehling's test, Benedict's test, Bradford's test, Saliwnoffs test and Iodine test.
2. Quantitative estimation of total carbohydrates by anthrone reagent. Preparation of potato starch, its microscopic structure and solubility test.
3. Qualitative tests of protein like Biuret test, Xanthoproteic test, Ninhydrin test.
4. Quantitative estimation of amino acid by using Spectrophotometer.
5. Comparison of various detection methods on sensitivity basis,

Suggested readings:

1. Conn, E.E., P.K Stumpf., G.Bruening and R.H.DoI. Outlines of Biochemistry. 5th Ed. Wiley, India. 712 pp. 2006.
2. Deb, A.C. Fundamental of Biochemistry. 9th ed. New Central Book Agency Pvt. Ltd., Kolkutta. 664 pp. 2008.
3. Dey, P.M. and J.B. Harborne. Plant Biochemistry. Academic Press, London. 554 pp. 1997.
4. Hames, D. and Cooper, N. Biochemistry. Garland Science Publishers, U.S.A. 2008.
5. Jain, J.L., N. Jain and S. Jain. Fundamentals of Biochemistry. S. Chand & Co. Ltd., New Delhi. 1264 pp. 2007.
6. Lehninger, A. Principles of Biochemistry. Worth Publishers. 1011 pp. 1982.
7. Malik, C.P. and M.B. Singh. Plant Enzymology and Histoenzymology. Kalyani Publishers. 1980.
8. Mathews, K. Vanhold and Ahren. Biochemistry. Pearson Edu. Pvt. Ltd., New Delhi. 2003.
9. Nelson, D.L. & M.M. Cox. Lehninger's Principles of Biochemistry. 5th Ed. W.H.Freeman & Co., USA. 1100 pp. 2008.
10. Palmer, T. Enzymes Biochemistry, Biotechnology, Clinical Chemistry. Affiliated East – West Press Pvt. Ltd. 2004.
11. Plummer, D.T. An Introduction to Practical Biochemistry. 2nd Ed. T.M.H. Publishing Co., New Delhi. 352pp. 1979.
12. Prince, N.C and L. Stevens. Fundamentals of Enzymology. Oxford University Press, Oxford. 1984.
13. Stumpf, P.K. and E.E. Conn. The Biochemistry of Plants – A Comprehensive Treatise. Academic Press, London. 1981.
14. Voet, D. and J.G. Voet. Biochemistry. 3rd Ed. John Wiley & Sons_Inc. 1264 pp. 2008.

**M.Sc. Botany
Semester-III**

**BOT- 303
Plant Biotechnology & Genetic Engineering**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT-I

History, Scope and basic concepts of biotechnology and tools.
Plant tissue culture: Laboratory Organization; Media preparation and sterilization techniques; Concept of cellular differentiation and totipotency; Types of cultures, protoplast culture and somatic hybridization; Anther and pollen culture.

UNIT-II

Techniques used in DNA technology: Gel electrophoresis, PAGE, southern and western blotting; DNA chip technology; Brief account of proteomic and genomics; Isolation of genes.
Sequencing of genes: Maxam and Gilberts method, Sanger's method, automatic sequencers and pyrosequencing; Next generation sequencing; Synthesis of gene (chemical and gene synthesizing machine).

UNIT-III

Tools of Genetic engineering : Enzymes, Cloning vectors (Plasmids, Bacteriophages, Cosmids, Phagemids, Shuttle vectors, transposons vectors, artificial chromosomes as vector and eukaryotic vectors); Construction of genomic library and cDNA library; Polymerase Chain Reaction (PCR) Principles, technique and modifications; DNA fingerprinting, molecular probe: labeling and application.

UNIT-IV

Gene transfer methods in plants: Plasmid mediated, electroporation, cation precipitation, liposomes, microinjection and particle gun technology; *Agrobacterium* mediated gene transfer, Molecular genetics of TDNA transfer from *Agrobacterium* to plants; Production of transgenic plant with respect to herbicide resistance, resistance against biotic (insect, fungal and viral) and abiotic (salinity, drought, chill) factor. Transgenic crops: current concepts . Nutritional quality improvement - Golden rice and other development.

Suggested Laboratory Exercises:

1. Isolation and culture of bacteria.
2. Spectrophotometer demonstration of DNA/RNA.
3. Study of PCR.
4. Study of bacterial growth pattern.
5. Study of Agrobacterium mediated transformation.
6. Composition and preparation of various culture media: Knop medium and Murashige and Skoog's media.

Suggested readings:

1. Bajaj, Y.P.S. Biotechnology in Agriculture and Forestry Plant Protoplasts and Genetic Engineering I., Springer Verlag, Berlin. 1989.
2. Balasubramaniam, D., K.Dharmalingam, C.F.A. Bryce, J.Green and K.Kunthala. Concepts in Biotechnology. University Press (India) Ltd., Hyderabad. 1996.
3. Bhojwani, S.S. & M.K. Razdan. Plant Tissue Culture – Theory and Practices.5 th Ed. Elsevier Science Pub. Co. Inc., New York.776pp. 2005.
4. Butcher, D.N. & D.S. Ingram. Plant Tissue Culture, Edward Arnold Ltd., U.K. 1976.
5. Evans, D.A., W.R. Sharp, P.V. Ammirato& Y. Yamada(Ed.). Handbook of Plant Cell Culture. Vol. I Coolier MacMillan Publishing Co.USA. 970pp. 1983.
6. Gupta, P.K.. Biotechnology and Genomics. Rastogi Publication Meerut.796 pp. 2004
7. Ignacimuthu, S.J. Basic Biotechnology. Tata McGraw Hill Pub. Co. Ltd., New Delhi.284 pp. 1995.
8. Kumar, H.D. A Text of Biotechnology. E.W.P., New Delhi.639 pp. 1998.
9. Murary, David R. (Ed.). Advanced Methods in Plant Breeding and Biotechnology. Redwood Press Ltd., Melksham.384pp. 1991.
10. Ratledge, C. and B. Kristiansen.. Basic Biotechnology. Cambridge University Press, Cambridge. 568 pp. 2001
11. Razdan, M.K. An Introduction to Plant Tissue Culture. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.397 pp. 2001.
12. Reinert, J. and M.M Yeoman. Plant Cell and Tissue Culture-A Laboratory Manual, Springer Verlag, Berlin. 83pp. 1982.
13. Singh, B.D. Biotechnology. Kalyani Publishers, New Delhi.574 pp. 2004.
14. Singh, B.D. Biotechnology: Expanding Horizon. Kalyani Publishers, New Delhi.860 pp. 2007.
15. Smith, R.H. Plant Tissue Culture, Technique and Experiments.2 nd Ed. Academic Press, New York.231pp. 2000.

**M.Sc. Botany
Semester-III**

**BOT- 304
Plant Physiology**

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

UNIT-I

Water relations of plants: Mechanisms of absorption of water (active and passive transport); Apoplast and symplast concept; Modern thermodynamics concepts of physical state of water in plant cells and tissues, movements of water in the soil-plant-atmosphere continuum.

Stomatal physiology: Mechanism of stomatal movement and transpiration, antitranspirants; Beneficial nutrient elements, their functions and deficiency symptoms; Toxic effects of minerals; Comparison of xylem and phloem transport, molecular mechanism of phloem loading and unloading.

UNIT-II

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, Ca^{+2} - calmodulin cascade; Regulation of signaling pathways. Specific signaling mechanisms: Two component system in plants.

Photoperiodism, Phytochrome, Endogenous rhythmus and Tropism.

UNIT-III

Photosynthesis: Chloroplast as an energy transducing organelle; Composition and characterization of Light harvesting systems; Electron flow through cyclic, non-cyclic and pseudo-cyclic photophosphorylations; Pathways of CO_2 fixation; (C3, C4 and CAM) and regulation of photorespiration.

Respiration: Glycolysis, Oxidative pentose phosphate pathway, Krebs' cycle and its significance, Electron transport system, gluconeogenesis, factors affecting respiration.

UNIT-1V

Phytohormone: Biosynthesis, physiological role and mode of action.

Plant Growth Regulators- auxins, gibberellins, cytokinins, abscisic acid; Structure and function of ABA, ethylene, ascorbic acid, brassinosteooids, polyamines (putrescine, spermidine, spermine and cadavarin, nitric oxide & strigolactone), jasmonic acid and salicylic acid.

Stress physiology: Mechanism of plant response to abiotic stress(water, low and high temperature and salt stress) and biotic stress(pathogen and insects); Secondary plant metabolites: role of terpenes, phenols and nitrogenous compounds, allelopathy.

Suggested Laboratory Exercises:

1. Demonstration of stomatal activity from suitable plant material.
2. Spectroscopic Determination of chlorophyll a, chlorophyll b, and total chlorophyll, carotenoids and anthocyanins under varied environmental conditions.
3. Determination of chlorophyll a and chlorophyll b ratio in C3 and C4 plants.
4. Seed germination as affected by environmental factors.
5. Bioassays of auxin ,gibberlin.

Suggested readings:

1. Brett, C.T. and Waldron, K.K. 1996. Physiology and Biochemistry of Plant Cell Walls, Chapman and Hall London.
2. Daphne. J. Osborne, Micheal. B. Jackson. 1989. Cell separation in plants physiology, Biochemistry and Molecular Biology. Springer – Verlag. Berlin.
3. David T. Dennis and David H. Trurpin (Eds.) 1993. Plant Physiology, Biochemistry and Molecular Biology. Longmann Scientific and Technical, Singapore.
4. Devlin and Witham, 1997. Plant Physiology. CBS Publishers and Distributors, New Delhi.
5. Fitter, A.H. and Hay R.K.M. 1987. Environmental physiology of plants. Academic Press.
6. Hall, D.O. and Rao, K.K. 1999. Photosynthesis. Cambridge University Press.
7. Hatch, M.D. et. al., 1971. Photosynthesis and Photorespiration.
8. Hess, D. 1975. Plant physiology. Narosa Publishing House, New Delhi
9. Jain, J.L. 2000 Fundamentals of Biochemistry. S. Chand & Co. New Delhi.

10. Lincoln Taiz and Eduardo Zeiger, 2010. Plant Physiology. The Benjamin/Cummings publishing Company, Inc.
11. Noggle and Fritz, 1999. Introductory Plant physiology. Prentice hall, London.
12. Salisbury, F.B. and Ross. C. 2000, Plant physiology. John Wiley & Sons, New Delhi.
13. Strafford, G.A. 1979 Essentials of Plant Physiology. Heinemann Publishing Co. New York.
14. Wilkins, M.B. (Ed) 1984. Advanced Plant Physiology, Pitman Publishing Co. New York.
15. William G. Hopkins, 1999. Introduction to Plant Physiology. John Wiley & Sons. Inc. New York

M.Sc. Botany
Semester-III

BOT- 305
Plant Development

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Unique features of plant development, Cell determination, Differentiation, Germline development, Specialization, Cell lineage, Predictability of cell fate, Positional information in plant development, Cell layer and Chimeras, Information transmission between cell layers by *Knotted* and *Floricaula* gene.

Unit -II

Embryogenesis: Early event in embryo, Genetics of embryo development, Gene interaction during embryo development, Pattern mutants (Apical-basal axis mutants- Short integuments mutants, Gnom1 emb30 mutants, Segment deletion mutants-Monopteros mutants, Gurke mutants and Radial axis mutants-Knoll mutants). Summary about pattern formation in embryogenesis.

Unit -III

SAM organization, Developmental changes in zonation of SAM, Molecular biology of SAM by mutants. Organization of Root Apical Meristem and promeristem, Genetics of root and root hair development; Role of positional information in root; Genetics of vascular tissue differentiation, Genetics of leaf development in dicots & monocots, Genetic control over trichome development.

Unit -IV

Molecular genetics of anther and pollen development, Genetics of ABC model of flower development. Function and regulation of homeotic gene expression, Cadastal functions of homeotic genes, Molecular functions of MADS box genes, Genetics of floral meristem and floral organ identity genes, Control of whorl formation in flower; Developmental stages of the endosperm maturation and desiccation, Genetic control over seed germination and dormancy (*VPI* gene in Maize, *ABI-3*, *LEC1* and *FUS3* gene in *Arabidopsis*).

Suggested Laboratory Exercises:

1. Study of Cytohistological zonation in the shoot apical meristem in sectioned double-stained permanent slides.
2. Examination of L.S. of root apical meristem from a permanent slide preparation.
3. Study of phyllotaxy in different plants.
4. Study of V.T.S. of leaves of dicots and monocots plants.
5. Study of epidermal peels of leaves of dicots & monocots to study the development and final structure of stomata and prepare stomatal index.
6. Study of T.S. of stem of various plants having primary and secondary anomalous structure.

Suggested readings:

1. Howell, S.H. 1998. Plant Growth and Development. A Molecular approach. Academic Press, San Diego.
2. Mauseth, J.D. 1988. Plant Anatomy. Benjamin Cummings. California.
3. Lyndon, R.F. 1990. Plant Development. The Cellular Basis. Unwin Hyman, London.
4. Waisel, Y., Eshel, A. and Kafkaki, V. (eds) 1996. Plant Development (2nd edition), Cambridge University Press, Cambridge.
5. Dekker, M. 2013. Plant Roots: the Hidden Half (4th edition), CRC press, New York.
6. Taiz et al., 2015. Plant Physiology and Development, 5th edition.

M.Sc. Botany
Semester-III

BOT- 306
Genomics and Proteomics

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Genome sequencing strategies and programs, genomic libraries, physical mapping of genomes, methods for sequence alignment and gene annotation, analyze differential expression of genes- ESTs, SAGE, microarrays and their applications; Knockout and Knock down mutant.

Unit-II

Comparative genomics of model plants and related crop sp., Recombination based cloning techniques- Gateway cloning, RNAi and gene silencing, genome imprinting, RNAs and their biogenesis, role of small RNAs in gene silencing and heterochromatin formation.

Unit-III

Proteomics: Introduction to proteome & proteomics and its relevance in the post genomic era, Proteomics as a tool for plant genetics, breeding & diversity studies. Comparative account of translation in prokaryotes and eukaryotes, analysis of post translational modifications and protein-protein interactions.

Unit-IV

Analysis of proteins by different biochemical and biophysical procedures like- CD, NMR, UV/Visible and fluorescent spectroscopy, 1-D and 2-D gel electrophoresis for proteome analysis, Mass spectrometry, DIGE and column chromatography, future directions and scope of functional proteomics; Future direction in proteomics and scope of functional proteomics.

Suggested laboratory Exercises:

1. Isolate genomic DNA.
2. PCR amplification and analysis by Agarose gel electrophoresis.
3. Restriction digestion and mapping.
4. Gateway cloning
5. Vector and insert ligation and PCR amplified product.
6. Preparation of competent cells and transformation of *E. coli*
7. Site-directed mutagenesis
8. 2D electrophoresis
9. RNA extraction and preparation of cDNA.
10. Southern hybridization of genomic DNA

Suggested readings:

1. Buchanan B, Gruissem G, and Jones R (2000) Biochemistry and Molecular Biology of Plants, American Society of Plants Physiologists, USA.
2. Hammes GD (2005) Spectroscopy for the Biological Science; Wiley Interscience, USA.
3. Harlow and Lane D (Eds.) (1988) Antibodies-A Laboratory Manual; Cold Spring Harbor Laboratory, USA.
4. Liber DC (2006) Introduction to Proteomics: Tools for New Biology; Humana Press, NJ.
5. Sambrook J and Russel DW (2001). Molecular Cloning-A Laboratory Manual, Vols 1-3, Cold Spring Harbor Laboratory, USA.
6. Primrose SB and Twyman RN (2007) Principles of gene manipulation and Genomics, Blackwell.
7. Campbell AM and Heyer L (2004) Discovery Genomics, Proteomics and Bioinformatics. Pearson Education.
8. Brown TA (2007) Genome III, Garland Science Publ.

M.Sc. Botany
Semester-III

BOT- 307
Genetics of Medicinal Plants

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

History & philosophics of herbal medicine (Ayurveda, Unani), Importance and need of cultivation of medicinal and aromatic plants; Harvesting, drying, grading and storage of medicinal plants; Organic cultivation of medicinal plants; Good agricultural practices in medicinal plants.

Unit-II

Active constituents and uses of important medicinal and aromatic plants:

Asparagus racemosus, Stevia rebaudiana, Aloe vera, Withania somnifera, Solanum nigrum, Cassia angustifolia, Rosa damascena, Tagetes minuta, Salvadora species, Cassia tora, Cassia occidentalis, Boerhavia diffusa, Achyranthes aspera, Nectanthus arbor-tristis, Balanites aegyptiaca, Tridax procumbens or any other species specific to the region.

Unit-III

Molecular biology of plant natural products: Genes involved in biosynthetic pathways of plants, Families of metabolic genes and their evolution (Gene families & their evolution, cytochrome, P450 genes): Expression of metabolism genes; Molecular biology tools used in natural products research; Application of molecular biology approaches to natural products.

Unit-IV

Separation and purification of phytopharmaceuticals through thin layer chromatography and column chromatographic techniques; Extraction of essential oils and their evaluation for quality parameters; Natural products and plant biodiversity; Plant cell biotechnology for the production of secondary metabolites, Metabolic engineering of plant secondary metabolism; Molecular farming, Transferring genes from plants to rhizosphere microbes and vice-versa.

Suggested laboratory Exercises:

1. Identification and preparation of herbaria of locally available medicinal plants
2. Preparation of aqueous extracts of medicinal plants by using Soxhlet apparatus

Suggested readings:

1. Farooqi, A. A. and Sreeramu, B. S., 2004, Cultivation of Medicinal and Aromatic Crops. Universities Press (India) Private Ltd.
2. Handa, S. S., 1996, Supplement to Cultivation and Utilization of Medicinal Plants, Regional Research Laboratory, CISR.
3. N. Kumar, J. B. M. Md. Abdul Khadar, P. Rangaswami, and I. Irulappan, Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants, 1997, South Asia Books.
4. Cseke L. J., Kirkasyan A., Kaufman P. B., Warber S. L., Duke J. A. and Brielmann H. L., Natural Products from Plants, 2006, Taylor and Francis group, CRC Press.

M.Sc. Botany
Semester-III

BOT- 312
Plant Resource Utilization

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Origin of Agriculture, World Centres of Primary diversity of domesticated plants: The Indo-Burma Centre, Plant Introductions and Secondary Centres. Origin, Distribution, Types, Botany, Cultivation, Harvesting and uses of Wheat and Rice. History, Botany, Breeding, Cultivation and uses of following fruits and vegetables: Mango, Apple, Banana, Potato, Alliums, Cabbage, Spinach and Tomato

Unit-II

General Account of the Spices: Ginger, Turmeric, Cinnamon, Clove, Umbelliferous spices and Peppers. Beverage Plants: Source and general account of Tea and Coffee.

Legumes: Origin, Botany, Cultivation and uses of Pigeon pea, Chick pea, Cluster bean, French bean etc.

Medicinal Plants: Plants as sources of drugs, parts used, composition and uses.

Unit-III

Gums: Important commercial gums and their uses.

Tannins and Dyes: Sources and their uses.

Vegetable Oils and Fats: Distinction between fatty and essential oils. Drying (Soyabean and linseed), nondrying (Groundnut and Mustard oil) and Semi drying (Cotton seed and Sunower oil) oils and their uses.

Fibres: Classification, uses, type of bres - Soft bres, Hard bres, Surface bres, Brush bres and Braiding bres.

Unit-IV

Wood and its Uses: Soft woods and hard woods, wood as fuel, construction material Unexploited plants of potential economic value; plants as a source of renewable energy. Genetic Resources and their conservation.

Suggested readings:

1. Anonymous. National Gene Bank: Indian Heritage on Plant Genetic resources (Booklet). National Bureau of Plant Genetic Resource, New Delhi. 1997.
2. Cobley, L.S. and W.M. Steels. An Introduction to the Botany of Tropical Crop Plants. 3rd Ed. The English Language Book Society and Longman, London. 1979.
3. Bole, P.V. and Y. Vaghani. Field Guide to Common Indian Trees. Oxford University Press, Mumbai. 1991.
4. Chandel, K.P.S., G. Shukla and N. Sharma. Biodiversity in Medicinal and Aromatic Plants in India: Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi. 1996.
5. Conway, G. and V.W. Rattan. The Doubly Green Revolution. Food for all in the 21st Century. Cornell Univ. Press. 1999.
6. Dastur, J.F., Medicinal Plants of India and Pakistan, 3rd Edition, Meyerbooks, 1985.
7. Hill, A.F. Economic Botany. McGraw Hill Book Co. Inc., New York. 1986.
8. Kirtikar, K.R. & D.D. Basu. Indian Medicinal Plants. Vols. I & II. 2nd Ed. Lalit Mohan Basu, Allahabad. 1953.
9. Kochhar, S.L. Economic Botany of the Tropics. 2nd Ed. MacMillan India Ltd., Delhi.
10. Leonard, W.H. & J.H. Martin. Cereal Crops. MacMillan Co., New York, USA. 824 pp. 1963.

M.Sc. Botany
Semester-IV

BOT- 401
Biodiversity & Conservation

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

UNIT-I

Biodiversity: concept; national & global status; endemism, speciation and extinction; levels of biodiversity, hotspots and hottest hotspots; study of Indian biodiversity hot spot, significance of biodiversity; local plant diversity and its socio-economic importance, causes of biodiversity depletion, IUCN categories of threat; Red Data Book.

UNIT-II

Principles of conservation, major approaches to management, Biodiversity Conservation strategies, Protected areas in India -Wildlife sanctuaries; National parks; Biosphere reserves; Wetlands and Ramsar convention, Role of botanical gardens, seed banks, in-vitro repositories and cryobanks in biodiversity conservation.

UNIT-III

Plant explorations; invasions and introductions; National Bureau of Plant Genetic Resources (NBPGR), Convention of Biological Diversity (CBD), National Biodiversity Authority (NBA) , Phytogeography and forest types of India -Ecological and economic importance of forests, social forestry; desertification and wasteland reclamation

UNIT-IV

International Law and Constitutional Frame for Conservation Policies United Nations Framework Convention on Climate Change, Convention on Bio-Diversity-1992,Kyoto Protocol and Emission Trading, Post Kyoto World: Problems and Prospects. Importance of Ethnobotany in Indian context; Indian initiatives in biodiversity conservation.

Suggested laboratory Exercises:-

1. Study of climate / topography/flora-fauna in the perspective of biodiversity conservation.
2. Understanding the concept of sampling: Random sampling, sample size, quadrat, transect and point method for the study of community structure
3. Study the community structure using quadrat method by establishing minimum size and minimum number of quadrates.
4. Study of community structure and assessing frequency of the species as assessed by Raunkiaer (1934). Prepare a frequency diagram and divide the species into classes based on percentage frequency (Raunkiaer, 1934)
5. Study of community structure and assess the density and abundance of the species
6. Study of community structure and assessment of cover and basal area of species present and determine the IVI (Importance Value Index) of the species
7. Understand the concept of community coefficient by comparing the frequency of two communities
8. Assessment of β diversity to measure the degree of turnover in species composition along a gradient or transect
9. Estimating β diversity by employing similarity measures like Jaccard measure and Sorenson measure and species diversity by Simpsons Index.

Suggested readings:

1. Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology (5th Ed.) Brooks/Cengage Learning India Pvt. Ltd., New Delhi.
2. Kormondy, E.J. 2008. Concepts of Ecology. Prentice Hall of India., New Delhi.
3. Subrahmanyam, N.S. and Sambamurty, A.V.S.S. 2008. Ecology (2nd Ed.) Narosa Publishing House, New Delhi
4. Singh, J.S., Singh, S.P. and Gupta, S.R. 2008. Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
5. Stiling, P. 2009. Ecology: Theory and Applications (4th Ed.). PHI Learning Pvt. Ltd. New Delhi.
6. Rana, S.V.S. 2009. Essentials of Ecology and Environmental Sciences (4th Ed.) PHI Learning Pvt. Ltd. New Delhi..
7. A. Rosencranz and S. Divan. 2004, Environmental Law and Policy in India: Cases, Materials and Statutes. Oxford University Press, New Delhi.
8. Sahasranaman, P. B. 2009. Handbook of Environmental Law. Oxford University Press, New Delhi, India.
9. Singh, Chhatrapati. 2000. India's Forest Policy and Forest Laws. Natraj Publishers, Dehradun, India.
10. Biswas, S.K. 1988. Forest Administration in India. Cough Publications, Allahabad, India.
11. Dogra, B. 1983. Forests and People: A Report on the Himalayas. Bharat Dogra, New Delhi.
12. Jain, A. K. Forest Economy of India (A case study of Balaghat District of Madhya Pradesh). Vohra Publishers, Allahabad.
13. Upadhyay, C. B. 2001. Forest Laws: Central and States. Hind Publishing House, Allahabad, India.
14. P. Leelakrishnan. 2004. Environmental Law Case Studies. LexisnexisButterworths, Nagpur, India.
15. Mohan. I. Environment and Habitat. Anmol Publications Pvt. Ltd., India.
16. Dutta, R and B. Yadav. 2005. Supreme Court on Forest Conservation. Universal Publishing House, Delhi.
17. Bandyopadhyaya, J. 2005. India's Environment: Crisis and Responses. Natraj Publisher, Dehradun.
18. Boyle and Birnie. 1995. Basic Documents on International Law and Environment.
19. Trivedy, R. K.; Goel, P.K. and Trisal, C. L. 1998. Practical methods in ecology and environmental science. Enviro Media publishers, Karad Maharashtra .
20. Magurran, A. E. 1988 Ecological Diversity and its Measurement. Princeton University Press, USA.
21. Misra, R. 2013 Ecology Workbook. Scientific publishers, India

**M.Sc. Botany
Semester IV**

BOT- 402

Evolutionary Biology and Economic Botany

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

UNIT-I

Evolutionary Biology: Origin of life (including aspects of prebiotic environment and molecular evolution); Concept of evolution; Theories of organic evolution; Mechanisms of speciation. Hardy weinberg genetic equilibrium, genetic polymorphism and selection; origin and evolution of economically important microbes and plants.

UNIT-II

Origin of agriculture: World centers of primary diversity of domesticated plants; Plant introduction; Secondary centers of origin. Plant as a source of renewable energy; Innovations for meeting world food demands.

UNIT-III

Botany, cultivation and uses of – . Food, forage and fodder crops (cereals, pulses, vegetables and fruits) - Fiber yielding plants Botany, cultivation and uses of - Medicinal plants ,Aromatic plants, Oil yielding plants

UNIT-IV

Important fire-wood, timber-yielding plants and Non-wood forest products (NWFPs) such as- Bamboos, rattans, raw materials for paper-making, gums, tannins, dyes and resins. Plants used as avenue trees for shade, pollution control and aesthetics.

Suggested Laboratory Exercises:

The practical course is divided into three units:

- i) Laboratory Work
- ii) Field Survey,
- iii) Scientific visits
- i) Laboratory Work

Food Crops: Wheat, Rice, Maize, Potato, Chickpea(Bengal gram), Sugarcane.

Morphology, anatomy, microchemical tests for stored food materials.

Fodder Crops:Sorghum, Bajra, Berseem, Guar, Oat.

Plant Fibres: Cotton, Jute, Sun hemp, Coir.

Medicinal and Aromatic Plants: Study of live or herbarium specimens or other visual materials to become familiar with following plants:

Papaver somniferum, Atropa belladonna, Catharanthus roseus, Adhatoda zeylanica, Allium sativum, Rauwolfia serpentine, Withania somnifera, Phyllanthus niruri, Andrographis paniculata, Aloe barbadensis, Mentha arvensis, Ricinus communis, Abutilon indicum, Datura sp., Artemisia sp., Pedalium murex, Ocimum sanctum, Vetiveria zizanoides, Cymbopogon maritini.

Gums, Resins, Tannins, Dyes:

Acacia, Terminalia, Tea, Turmeric, Bixa orellana, Indigo, Butea monosperma, Lawsonia inermis.

ii) Field Survey

Prepare a list of important sources of firewood and timber in your locality. Give their local names, scientific names and families to which they belong.

iv) Scientific visits

Students should be taken to any protected area, a recognized botanical garden or museum(such as FRI, BSI, NBRI), to a CSIR laboratory doing research on plants and their utilization and an ICAR research institute or a field station dealing with crops.

Suggested readings:

1. Swaminathan, M.N. & Jain, R.S. Biodiversity: Implications for global security, Macmillan, 1982.
2. CSIR 1986. The Useful Plants in India.
3. Kothari, 1987. Understanding biodiversity, life sustainability and equity, Orient Longman. Sharma, O.P. 1996. Hills Economic Botany.
4. Thakur, R.S. et al., Major Medicinal Plants.
5. Kocchar, S.L. 1998. Economic Botany of Tropics..
6. Richard B. Primack. 1993. Essentials of Conservation Biology.
7. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment.
8. Peter B. Kaufman et al., 1999. Natural Products from Plants.
9. Negi, S.S. 1993. Biodiversity and its Conservation in India.

M.Sc. Botany
Semester-IV

BOT- 403
Plant Ecology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks*

Unit-I

Environment: Physical environment; biotic environment; biotic and abiotic interactions; climate and soil pattern of world.

Habitat ecology: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement and major habitat types of the sub-continent.

Unit-II

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and k selection); age structured populations.

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis; Mechanisms of litter fall decomposition and climatic factors associated with decomposition.

Unit-III

Community ecology: Nature of communities; community structure and attributes; analysis of communities (analytical and synthetic characters); levels of species diversity and its measurement; edges and ecotones.

Ecological succession: Types; mechanisms; changes involved in succession; concept of climax; models of succession, Ecological adaptations.

Unit-IV

Ecosystem ecology: Structure and function; energy flow and biogeochemical cycles; primary production and methods of measurement, global pattern and controlling factors; ecosystem restoration.

Biomes: Distribution, climatic and edaphic, oral and faunal characteristics of major terrestrial biome.

Suggested Laboratory Exercises:

1. To study the physical characteristics (temperature, colour and texture) of soil.
2. To determine water holding capacity of soils collected from different locations.
3. To determine pH and conductivity of soils collected from different locations.
4. Chemical testing of soil for phosphorus, potassium and nitrate.
5. To determine percentage organic carbon and organic matter in the soils of crop land, grassland and forest.
6. To determine the pH and conductivity of water samples collected from different locations.
7. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples.
8. To record the abiotic components i.e. pH, temperature, turbidity and light intensity of water in a pond ecosystem.
9. To determine the minimum size of the quadrat by species-area curve.
10. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
11. Determination of species diversity index and importance value index of local vegetation.
12. To compare protected and unprotected grasslands using community coefficients (similarity index).
13. To study the species composition of an area for analyzing biological spectrum and comparison with Raunkiaers normal biological spectrum.
14. To survey and study the ecological adaptations of locally available hydrophytes and xerophytes.
15. Field visit of any protected area and to discuss causes and impacts of biodiversity loss.

Suggested readings:

1. Sharma, P.D., 2010, Ecology and environment, 8th Edition, Rastogi Pub. Meerut.
2. Odum, E.P., 1983, Basic Ecology, Sanders, Philadelphia.
3. Singh, J. S., Singh, S. P. and Gupta, S. R., 2006, Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi.
4. Smith, R. L., 1996, Ecology & Field Biology, Harper Collins, New York.

M.Sc. Botany
Semester-II

BOT- 404
IPR & Biosafety

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Introduction to Intellectual Property

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP

IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS

Unit-II

Concept of ‘prior art’

Invention in context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation

Basics of Patents

Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application

Unit-III

Patent filing and Infringement

Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US Patenting by research students, lecturers and scientists-University/organizational rules in India and abroad, credit sharing by workers, financial incentives Patent infringement- meaning, scope, litigation, case studies and examples

Unit-IV

Biosafety

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

Important Links

<http://www.w3.org/IPR/>

<http://www.wipo.int/portal/index.html.en>

http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html www.patentoffice.nic.in
www.iprlawindia.org/ - 31k - Cached - Similar page

<http://www.cbd.int/biosafety/background.shtml>

<http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm>

<http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>

Suggested Readings

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804, 9781555811808.
2. Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
5. Intellectual Property Right- Wattal- Oxford Publication House.(1997) ISBN:0195905024.
6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nd ed) ISBN-10 3527304320.
7. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.
8. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
9. B.D. Singh. Biotechnology expanding horizons.
10. H.K.Das. Text book of biotechnology 3rd edition.

M.Sc. Botany
Semester-IV

BOT- 405
Plant Tissue Culture

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit-I

Plant Tissue Culture: General introduction, History and Scope and basic concepts, laboratory Organization; media preparation and sterilization techniques, Nutrition of plant tissues-Growth limiting Factor, Concept of cellular differentiation and totipotency, Types of culture, Embryo and Endosperm culture, Induction and maintenance of Callus and suspension Cultures.

Unit-II

Fundamental aspect of Morphogenesis, Study of differentiation through Organogenesis and Embryo-genesis, Somatic embryogenesis, Zygotic vs. Somatic embryogenesis, micropropagation advances and encapsulation of somatic embryo & shoot tip for artificial seeds and its applications, In-vitro production of haploids, techniques and utility, Haploid for breeding and selection of mutants.

Unit-III

Protoplast isolation, fusion, culture, hybrid selection and regeneration possibilities with special reference to crop plants, Limitations of protoplast research, Somatic hybridization and selection mechanism for hybrids and cybrids, cell line selection through callus/ suspension culture for the production of stress resistant plants, their application in crop improvement.

Unit-IV

Somaclonal & gametoclinal variations, Large scale clonally propagation of plants, Cryopreservation and germplasm storage, embryo/endosperm culture, Applications of plant tissue culture in Forestry, Ornamental Plants, Disease free plants and in the production of secondary metabolites/natural products.

Suggested Laboratory Exercises:

1. Preparation of germination medium
2. Inoculation of seeds on germination medium
3. Determination of fresh and dry weight of in vitro seedling
4. Preparation of culture medium (MS/B5 medium)
5. Culture of explants on MS medium
6. Establishment and maintenance of callus & suspension culture
7. Organogenesis and Somatic embryogenesis using appropriate explants
8. Multiple shoots induction & calli regeneration
9. Raising of haploids by tissue culture
10. Protoplast isolation from various tissues and testing their viability
11. Demonstration of fusion technique

Suggested readings

1. Bhojwani, S. S. and Razdan, 2004. Plant Tissue Culture and Practice, 5th Edition, New Delhi. .
2. Smith, R., 2000 . Plant Tissue Culture: Techniques and Experiments, 2nd Edition, Academic.
3. Chawla, H. S., 2004. Introduction to Plant Biotechnology, 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Singh, B. D., 2007. Biotechnology, Kalyani Publishers, New Delhi.
5. Brown, T. A., 2015. Gene Cloning and DNA Analysis: An Introduction, 7th Edition, Blackwell Publication.

M.Sc. Botany
Semester-IV

BOT- 406
Recombinant DNA Technology

Maximum Marks: 100
Theory Examination: 80
Internal Assessment: 20
Time: 3 hrs

Note: *There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.*

Unit-I

Principles of Genetic Engineering: Historical account, Components Nucleic acids, DNA modifying enzymes, Cloning vectors and Cloning hosts, Gene transfer and cloning methods, Gene Screening and isolation -Strategies, DNA libraries, Probe Selection and gene screening.

Unit-II

PCR and DNA sequencing: PCR Principle, Methodology, Types - RT-PCR, RAPD, AFLP, ISSR, inverse PCR and Real time PCR and their applications, DNA sequencing methods - Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing method, Capillary gel electrophoresis for DNA sequencing.

Unit-III

Molecular markers: Type of molecular markers; Application of molecular markers in discerning polymorphism, germplasm characterisation, Gene tagging; Disease diagnostics; Marker aided selection in crop improvement.

DNA Engineering techniques: Gel electrophoresis of nucleic acids, Methods of labelling of DNA, Blotting of macromolecules and hybridization, Oligonucleotide synthesis, Promoter characterization, DNA fingerprinting, Microarray technology, In-vitro translation.

Unit-IV

Application r-DNA technology: (Production of recombinant protein, Vaccine and pharmaceutical compounds; application in agriculture, Fluorescence in situ hybridization (FISH).

Proteomics: Tools techniques, study of protein- protein interaction, protein analysis for gene identification, post translation modification.

Suggested Laboratory Exercises:

1. Extraction of total nucleic acid DNA from plant tissues.
2. Extraction of total nucleic acid RNA from plant tissues
3. Determination of RNA concentration by orcinol method.
4. Quantitative determination of DNA and RNA by Spectrophotometric method.
5. Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) for protein profiling.
6. Protein quantification by Bradford method.
7. To determine the T_m of given sample DNA.
8. To study PCR (Polymerase Chain Reaction).

Suggested readings:

1. Wilson, K. and Walker, J., 2010, Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, New York.
2. Debnath, M., 2005, Tools & Techniques of Biotechnology, Pointer Publishers.
3. Cooper, T. G., 1977, The Tools of Biochemistry, Wiley-Interscience publication.
4. Chawla, H. S., 2004, Introduction to Plant Biotechnology 2nd Edition, Oxford & IBH Publishing Co. Pvt. Ltd. New. Delhi.
5. Singh, B. D., 2007, Biotechnology, Kalyani Publishers, New Delhi.
6. Morris, M. D., 2016, Molecular Biotechnology, 1st Edition, CBS Publishers and Distributors, New Delhi.