जननायक चंद्रशेखर विश्वविद्यालय, बलिया
Jananayak Chandrashekhar University, Ballia

New

(w.e.f. 2022-2023)

SEMESTER SYLLABUS STRUCTURE
M.Sc. (BOTANY) PROGRAMME
(NEP-2020)

External Experts
Prof. A.K. Mishra, BHU
and
Prof. Y.K. Sharma, LU
Has been provided their
consent about the
acceptance of Syllabuses
through email.
Nisha
26.05.2022
(Head & Convener)
Botany

Ranvir Singh
26-05-22

26.05.22

Nisha Raghuvanshi.
26.05.2022

Jananayak ChandrashekharVishwavidyalaya, Ballia
M. Sc. Botany Syllabus
(w.e.f. 2022-23)
Programme Name: M.Sc. (Botany) Programme Code: PGBOT 100

The programme of M.Sc. Botany is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. The programme focuses on the all-round development of the students to face the competitive world. This is also designed to equip students with subject domain knowledge and technical skills pertaining to plants in a holistic manner. It aims to train the students in all the areas of plant sciences with a unique combination of core and elective papers.

The Objectives of the programme are as follows:

1. To imbibe love and curiosity towards nature through the living plants.
2. To acquaint the students about the methods used in the maintenance of different natural resources.
3. To make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
4. To make the students exposed to the diverse life forms.
5. To make them skilled in practical work, experiments, laboratory equipments and to interpret correctly on biological materials and data.
6. To encourage the students to do research in related disciplines.
7. To develop the ability of the students to transform the society through their education.

Programme Specific Outcome

Students gain knowledge to identify and analyze scientific problems and environmental issues using oral and written communication skills.

1. Students will be able to describe the evolution, anatomy, morphology, systematic, genetics, physiology and ecology of plants.
2. Students will know about the ecological and evolutionary features of the flora and fauna in the environment.
3. Students can find new scientific information's and compare it with existing information.
4. Students develop the skills to identify different types of plants.
5. Students develop the skills to do laboratory work from different equipments.
6. Students develop the skills related to scientific research in the area of Botany.
7. Students are ready to transform the society and can explain the importance of different plants to human beings.

Programme Structure: The programme structure of post-graduation in **Botany** is as follows:

- The post-graduation programme in Botany of this University will comprise of four semesters.
- Every semester will have 5 (4 Theory and 1 Practical) papers of 4 credits each.
- In **First or Second semester**, the student will have to opt for a **minor elective paper** of **4/5** credits from a faculty other than his Main Faculty.
- In every semester, the student has to do a **research project** of **4** credits (thus, a total of **16** credits in 4 semesters) under the supervision of a **supervisor** as nominated by the **head of the department**.
- There may be a co-supervisor also from any industry, company, technical or research institute.
- These projects may be inter-disciplinary or multi-disciplinary and may be in the form of research project/industrial training/internship/survey work etc.
- The reports of the projects carried out in 1st and 2nd semesters will be jointly compiled and submitted in the form of one **PROJECT REPORT/DISSERTATION** at the end of first year. It will be evaluated out of **100** marks (**8** credits) at the end of the first year jointly by the supervisor and the external examiner appointed by the University.
- Similarly, the reports of the projects carried out in 3rd and 4th semesters will also be jointly compiled and submitted in the form of another **PROJECT REPORT/DISSERTATION** at the end of the second year. It will also be evaluated out of **100** marks (**8** credits) at the end of the second year jointly by the supervisor and the external examiner appointed by the University.
- If a student publishes a research paper out of his research project in a UGC-CARE listed journal, he may be given up to 25 additional marks, provided the maximum marks of the project will remain 100. The marks of the research projects will be converted into grades that will be incorporated in the final calculation of CGPA. The final result of M.Sc. (Botany) programme will be declared on the basis of CGPA.
- The courses to be taught in these semesters are given below:

M.Sc. (BOTANY) PREVIOUS YEAR

FIRST SEMESTER

S.N.	PAPER	COURSE CODE	COURSE NAME	MARKS	CREDIT	HOURS
1	PAPER I	PGBOT 101	PLANT VIROLOGY & BACTERIOLOGY	100	4	60
2	PAPER II	PGBOT 102	MYCOLOGY	100	4	60
3	PAPER III	PGBOT 103	PHYCOLOGY AND LICHENS	100	4	60
4	PAPER IV	PGBOT 104	BRYOLOGY	100	4	60
5	PAPER V PRACTICAL	PGBOTP 105	BASED ON PAPER BOT 101 to 104	**100**	4	120
6	**Project 1**		**(To be evaluated at the end of 2nd Sem.)**	–	4	120
			TOTAL	**500**	24	480

SECOND SEMESTER

S.N.	PAPER	COURSE CODE	COURSE NAME	MARKS	CREDIT	HOURS
1	PAPER I	PGBOT 201	PTERIDOLOGY	100	4	60
2	PAPER II	PGBOT 202	GYMNOSPERMS AND PALAEOBOTANY	100	4	60
3	PAPER III	PGBOT 203	ANGIOSPERMS: TAXONOMY, MORPHOLOGY AND ECONOMIC BOTANY	100	4	60
4	PAPER IV	PGBOT 204	ECOLOGY, BIODIVERSITY AND PLANT-SOIL RELATIONSHIP	100	4	60
5	PAPER V PRACTICAL	PGBOTP 205	BASED ON PAPER BOT 201 to 204	**100**	4	120
6	**Project 2**		**(Project1+Project 2 in the form of Dissertation)**	**100**	4	120
			TOTAL	**600**	24	480
7	**One Minor Elective Paper**		**Subject from other faculty In First or Second Semester**	**100**	4/5	60

M.Sc. (BOTANY) FINAL YEAR

THIRD SEMESTER

S.N.	PAPER	COURSE CODE	COURSE NAME	MARKS	CREDIT	HOURS
1	PAPER I	PGBOT 301	PLANT PHYSIOLOGY	100	4	60
2	PAPER II	PGBOT 302	GENETICS AND CYTOGENETICS	100	4	60
3	PAPER III	PGBOT 303	PLANT BREEDING AND BIOSTATISTICS	100	4	60
4	PAPER IV	PGBOT 304	CELL BIOLOGY AND BIOCHEMISTRY	100	4	60
5	PAPER V PRACTICAL	PGBOTP 305	BASED ON PAPER BOT 301 to 304	**100**	4	120
6	Project 3		**(To be evaluated at the end of 2nd Sem.)**	--	4	120
			TOTAL	500	24	480

FOURTH SEMESTER -Papers I, II and III are compulsory. The student has to opt for only one Special paper from 405 A, 405 B and 405 C for their fourth papers. In the V paper (Practical), 405-General is compulsory for all, but for Special paper, the student will opt only for 405 A or 405 B or 405 C according to their optional Special paper IV selected.

S.N.	PAPER	COURSE CODE	COURSE NAME	MARKS	CREDIT	HOURS
1	PAPER I	PGBOT 401	ANATOMY, EMBRYOLOGY AND MORPHOGENESIS	100	4	60
2	PAPER II	PGBOT 402	TISSUE CULTURE AND BIOTECHNOLOGY	100	4	60
3	PAPER III	PGBOT 403	MOLECULAR BIOLOGY AND BIOLOGICAL TECHNIQUES	100	4	60
4	PAPER IV IV-A IV-B IV-C	PGBOT 404 PGBOT 404A PGBOT 404B PGBOT 404C	SPECIAL PAPERS (ANY ONE OF THESE) ENVIRONMENTAL BOTANY ADVANCED PLANT PHYSIOLOGY PLANT PATHOLOGY	100	4	60
5	PRACTICALS General Special-Optional	 PGBOTP 405 PGBOTP 405 A or 405 B- or 405 C	 BASED ON PAPER 401 to 403 BASED ON PAPER 404 A or B or C	 50 50	 2 2	 60 60
6	Project 4	Project 4	**Project1+Project 2 in the form of Dissertation)**	100	4	120
			TOTAL	600	24	480
			GrandTotal	**2300**	**100/101**	**1980**

Overall Marks Distribution Table

Semester	Marks of All Papers	Marks of 1 Minor Elective Paper *	Marks of Project**	Total Marks
First	500			
Second	500	100	100	
Third	500			
Fourth	500		100	
Total	2000	100	200	2300

*** The student will opt for <u>One Minor Elective Paper</u> from other Faculty in Semester First or Second (Credit 4/5).**

**** The student will do <u>One Research Project</u> in each Semester of 4 Credit each. The Reports of Project 1 & 2 will be combined in the form of a Dissertation and will be evaluated in Semester Second. The Reports of Project 3 & 4 will be combined in the form of a Dissertation and will be evaluated in Semester Fourth.**

Note: There will be 9 questions in each paper and candidate has to attempt only 5 questions. **Q.1** will carry short answers and will be **compulsory** based on units I - IV. **Two** questions will be set from **each unit**, out of which one question has to be attempted. Candidate must obtain minimum pass marks in Theory and Practical/ Dissertation Examinations separately.

M.Sc. (Botany) Practicals
Marks Distribution
(w.e.f. 2022- 2023)

M.Sc Ist Semester	**100 Marks/ 4 Credit**
Paper I	15
Paper II	15
Paper III	15
Paper IV	15
Class Record and collections	10
Spot (5) 5×2	10
Viva	10
Seminar	10
M.Sc IInd Semester	**100 Marks/ 4 Credit**
Paper I	10
Paper II	10
Paper III	15
Paper IV	15
Class Record	10
Herbarium collections	10
Spot (5) 5×2	10
Viva	10
Seminar	10
M.Sc IIIrd Semester	**100 Marks/ 4 Credit**
Paper I	15
Paper II	15
Paper III	15
Paper IV	15
Class Record and collections	10
Spot (5) 5×2	10
Viva	10
Seminar	10
M.Sc IVth Semester	**100 Marks/ 4 Credit**
Practical (BOTP 405 General+BOTP 405A/B Special)	**100 (50+50) / 4 Credit**

M.Sc (Botany) Previous Year: Semester-I

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PGBOT 101 – PLANT VIROLOGY & BACTERIOLOGY MM: 100

Objectives:

- To Study the diseases or disorders caused by viruses and bacteria
- To study the microbes, this helps us to understand our world and our place within it.
- To understand the complexity of nature and society, this in turn provides different health, environmental, social, cultural, industrial and economic benefits.

UNIT – 1		Credit	Hours
1a	i. History of virology. ii. Nature, morphology and genome organization of plant viruses. iii. Nomenclature and classification of plant viruses.	1	15
1b	i. Morphological, anatomical, and biochemical changes in virus-infected plants. ii. Transmission of plant viruses and their relationship with vectors. iii. Methods to control plant-virus diseases.		
UNIT – 2		Credit	Hours
2a	i. Replication of plant viruses. ii. Structure and replication of Viroids, virusoids and prions . iii. Structure and replication of bacteriophages: lytic and lysogenic cycles.	1	15
2b	Technique in plant virology: i. Detection: Indicator plants, serological methods, molecular methods. ii. Purification: culture and extraction. iii. Electron microscopy.		
UNIT – 3		Credit	Hours
3a	i. History of bacteriology. ii. Classification of bacteria based on Bergey's Manual of Systematic Bacteriology (2nd Edition): Archaea, Proteobacteria, Firmicutes, Other gram negative bacteria, and actinobacteria. iii. Structure and reproduction of bacteria.	1	15
3b	i. Bacterial genetics: genome structure (chromosomal and extra-chromosomal) and recombination. ii. A general account of Phytoplasma, iii. Economic importance of bacteria.		
UNIT – 4		Credit	Hours
4a	i. Bacterial nutrition: types and their metabolism. ii. Role of bacteria in nutrient cycling in nature. iii. Bacterial staining: requirements, types and methods.	1	15
4b	i. Sterilization: physical and chemical methods; antibiotics and their mode of action. ii. Bacterial culture: requirements, types and methods; isolation; culture media; growth curves. iii. Fermentation in bacteria; bioreactor.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completions of this course students will be able to learn about viruses and bacteria are most famous for their ability to cause disease, as well as microorganisms which are also vital to agriculture, industry and ecology. They will understand that life on Earth would not survive without microorganisms.

REFERENCE BOOKS

1. Baveja, C.P. (2017). Text Book of Microbiology. Arya Publications, New Delhi.
2. Mahapatra, P.K. (2008). Textbook of Environmental Microbiology. IK International Publishing House Pvt. Ltd., New Delhi.
3. Maheshwari, D.K. & Dubey, R.C. (2013). A Text Book of Microbiology. S. Chand & Co. New Delhi.
4. Mandahar, C.L. (1978). Introduction to Plant Viruses. S. Chand & Co. Ltd.,Delhi.
5. Pelczar, M.L., Chan, E.C.S., and Krieg, N.R. (2009), Microbiology, Tata McGraw-Hill, New Delhi.
6. Prescott, L.M., Harley, J.P. and Klein, D.A. (2010). Microbiology. McGraw-Hill, New York.
7. Sastry, A.S. & Bhat, K.S. (2018). Essentials of Practical Microbiology. Jaypee Brothers Medical Publishers, New Delhi.
8. Sharma, P.D. (2016). Microbiology. Rastogi Publishers, Meerut,U.P.
9. Singh, R.P. (2017). Microbiology. Kalyani Publishers, New Delhi.
10. Tortora, G.J., Funke, B.R. & Case, C.L. (2016). Microbiology, An Introduction. Pearson Education India, New Delhi.

Programme Name and Code: M. Sc. (Botany)
Course code and Name: PGBOT 102 – MYCOLOGY **MM:100**

Objectives:

- To discuss the importance of fungi in various ecological roles.
- To demonstrate an understanding of how fungi impact human affairs.
- To discuss the characteristics of the major classes and orders within the fungal kingdom.
- To identify the major families and certain species of mushrooms and other macro-fungi.
- To demonstrate a working knowledge of how fungi grow and reproduce, and where and how they can be isolated.

UNIT – 1		Credit	Hours
1a	i. History of mycology. ii. Thallus organization, cell ultrastructure; cell wall composition; nutrition for growth and reproduction. iii. Mode of Reproduction; sex hormones in fungi.	1	15
1b	i. History of classification of fungi. ii. Classification of fungi based on Alexopoulus and Mims (1979). iii. Status of fungi.		
UNIT – 2		Credit	Hours
2a	i. Fossil fungi. ii. Heterokaryosis; parasexuality; heterothallism. iii. Fungi as Biocontrol agents and its mechanism.	1	15
2b	i. Fungal ecology. ii. Isolation and culture of fungi iii. Economic importance of fungi		
UNIT – 3		Credit	Hours
3a	Characteristic features, phylogeny, and interrelationships of principal orders of the classes of fungi.	1	15
3b	Study of genera: **Myxomycetes**– *Stemonitis*; **Chytridiomycetes**– *Synchytrium*; **Oomycetes** – *Saprolegnia, Phytophthora*; **Zygomycetes** – *Pilobolus*		
UNIT – 4		Credit	Hours
4a	Study of genera: Ascomycetes – *Taphrina, Saccharomyces, Penicillium*	1	15
4b	Study of genera: Basidiomycets– *Puccinia, Melampsora, Ustilago*; Deuteromycetes– *Fusarium, Alternaria*		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completions of this course students will be able to learn about the world of fungi. They will understand the economic and pathological nature of fungi. They will be able to work in any pathological lab and use the knowledge.

REFERENCE BOOKS

1. Alexopoulus, C.J. and Mims, C.W. (1979). Introductory Mycology, 3rd Edition, John Wiley & Sons, Inc., New York.
2. Alexopoulus, C.J., Mims, C.W. & Blackwell, M. (1996). Introductory Mycology, 4th Edition, John Wiley & Sons, Inc., New York.
3. Aneja, K.R. & Mehrotra, R.S.(2015). An Introduction to Mycology. New Age International Pvt Ltd, New Delhi.
4. Hait, G. (2016). A Textbook of Mycology. New Central Book Agency, New Delhi.
5. Mehrotra, R.S. & Aneja, R.S. (1998). An Introduction to Mycology. New Age Intermediate Press, New Delhi.
6. Mishra, S.R. (2010). Textbook of Mycology. Discovery Publishing House Pvt Ltd, New Delhi.
7. Singh, R.P. (2010). Fungi, Central Book Depot, Allahabad.
8. Vashistha, B.R., Sinha, A.K. & Kumar, A. (2016). Fungi, S. Chand & Co. Ltd., Delhi.
9. Webster, J. & Weber, R.(2007). Introduction to Fungi, 3rd Edition, Cambridge University Press, London.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PGBOT 103 – PHYCOLOGY AND LICHENS **MM:100**

Objectives:

- To explain why green and red algae are included in the plant kingdom while other algal groups are not.
- To list the habitats of green algae
- To describe the essential features of the lichen symbiosis
- To describe the economic importance of algae and lichens

UNIT – 1		Credit	Hours
1a	i. History of phycology ii. Thallus organization, cell ultrastructure; cell wall composition; nutrition; growth iii. Reproduction; spores; life cycles in algae;	1	15
1b	i. Classification of algae: history and present status ii. Evolutionary trends in algae iii. Fossil algae		
UNIT – 2		Credit	Hours
2a	i. Algal ecology ii. Isolation and culture of algae iii. Economic importance of algae	1	15
2b	Characteristic features, phylogeny, and interrelationships of principal orders of the classes of algae (Fritsch, 1945).		
UNIT – 3		Credit	Hours
3a	Study of genera: Chlorophyceae – *Eudorina, Chlorella, Ulva, Cladophora, Fritschiella, Bulbochaete, Zygnema, Caulerpa, Nitella.*	1	15
3b	Study of genera: i. Xanthophyceae – *Botrydium;* ii. Bacillariophyceae – *Navicula* iii. Phaeophyceae – *Dictyota, Laminaria, Fucus;* iv. Cyanophyceae – *Gloeotrichia, Stigonema;* v. Rhodophyceae – *Gelidium, Gracilaria*		
UNIT – 4		Credit	Hours
4a	i. History of Lichenology ii. Classification and distribution iii. Structure and reproduction of lichens	1	15
4b	i Ecology, physiology and chemistry of lichens ii. Isolation of symbionts and synthesis of thallus iii. Economic importance of lichens		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, vist to nearby water bodies for collection of material, etc

LEARNING OUTCOMES:

After completions of this course students will gain adequate knowledge on comparative account of various algal divisions. Study and impart knowledge about the occurrence, distribution, structure and life history of lower plants such as algae and lichens. They will learn the phylogeny and evolutionary concepts in lower group of organisms. They will be able to use the knowledge of this course for industrial production of many substances like agar-agar (used in ice creams and one of the components of culture media).

REFERENCE BOOKS

1. Ahmadjian, V.& Hale, M.E.(1973). The Lichens. Academic Press, London.
2. Fritsch, F.E. (1935). The Structure and Reproduction of Algae, Vol. I, Cambridge University Press, Cambridge, UK
3. Kumar, H.D. (1988). Introductory Phycology. Affiliated East-West Press Ltd. New Delhi.
4. Muthukumar, S. & Tarar, J.L. (2006). Lichen Flora of Central India. Dattsons, Nagpur
5. Round, F.E. (1986). The Biology of Algae. Cambridge University Press, Cambridge.
6. Smith, A.L. (1921). Lichens. Cambridge University, Cambridge
7. Smith, G.M.(1974). Cryptogamic Botany. Vol. I (Algae and Fungi). TMH publishing Company Ltd., New Delhi.
8. South, G.R. & Whittick, A. (1987). Introduction to Phycology. Blackwell Scientific Publication. London.
9. Upreti, D.K., Divakar, P.K., Shukla,V. & Bajpai, R. (2015).Recent Advances in Lichenology-Modern Method and Approaches in Biomonitoring and Bioprospection,Vol.1,Springer Nature, India.
10. Upreti, D.K. & Nayaka, S.(2004).A Field Guide to the Common Lichens of Corbett Tiger Reserve. Bishen Singh Mahendra Pal Singh,D.Dun.
11. Vashistha, B.R., Sinha, A.K. & Kumar, A.(2016). Algae, S.Chand & Co. Ltd., Delhi.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PGBOT 104 – BRYOLOGY **MM:100**

Objectives:

- To Identify the main characteristics of bryophytes.
- To discuss the distinguishing traits of liverworts, hornworts, and mosses.
- To know about development of land adaptations in the bryophytes.
- Describe the events in the bryophyte lifecycle.

UNIT – 1		Credit	Hours
1a	i. History of Bryology ii. Classification of bryophytes: history and present status iii. Geographical distribution of bryophytes with special reference to India	1	15
1b	i. Range of gametophytic structure in bryophytes ii. Range of sporophytic structure in bryophytes iii. Reproductive biology of bryophytes		
UNIT – 2		Credit	Hours
2a	i. Fossil bryophytes ii. Origin and evolution of principal classes of bryophytes iii. Evolution of sporophyte in bryophytes	1	15
2b	i. Economic importance of bryophytes ii. Ecology and physiology of bryophytes iii. Axenic culture of bryophytes		
UNIT – 3		Credit	Hours
3a	i. Characteristic features of principal orders of the class Hepaticopsida. ii. Study of genera: *Calobryum*, *Porella*, *Plagiochasma*	1	15
3b	i. Characteristic features of principal orders of the class Anthocerotopsida. ii. Study of genera: *Anthoceros*, *Notothylas*		
UNIT – 4		Credit	Hours
4a	i. Characteristic features of principal orders of the class Bryopsida. ii. Peristome structure and its significance in the classification of mosses	1	15
4b	Study of genera: *Sphagnum*, *Andraea*, *Polytrichum*, *Takakia*		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES

After completion of this course the students will develop understanding about the diversity, identification, classification and economic importance of these lower plants.

REFERENCE BOOKS

1. Malhotra, M. & Pathak, C. (2012). A Text Book of Bryophyta. Wisdom Press, New Delhi.
2. Rashid, A. (2015). An Introduction to Bryophyta. Vikas Publishing House Pvt. Ltd., New Delhi.
3. Richardson, D.H.S. (1981). The Biology of Mosses. Blackwell Scientific Publishing, Oxford.
4. Sharma, O.P. (2016). Bryophyta. McGraw Hill Education (India) Private Limited. New Delhi
5. Smith, G.M. (1955). Cryptogamic Botany, Vol. II (Bryophytes and Pteridophytes), TMH Publishing Company Ltd., New Delhi.
6. Vashistha, B.R., Sinha, A.K. & Kumar, A. (2016). Bryophyta, S.Chand & Co. Ltd., Delhi.

Programme Name and Code: M. Sc. (Botany) **100 Marks/ 4 Credit**
Course code and Name: PGBOTP 105 – Practical

Paper I- Plant Virology and Bacteriology **1 Credit**

1. Preparation of Nutrient media and sterilization technique
2. Gram's staining of bacteria
3. Inoculation techniques for growth of bacterial population
4. Isolation of microorganisms from different natural sources- soil, water and sewage
5. Bacteriological examination of water, milk and milk product
6. Symptomatology of virus

Paper II- Mycology **1 Credit**

1. Study of following genera of fungi- (On the availability of material)

Synchitrium, Saprolegnia, Phytophthora, Pythium, Taphrina, Penicillium, Phyllactinia, Puccinia, Melampsora, Ustilago, Colletotrichum, Alternaria, Cercospora,

2. Isolation and culture of fungi
3. Herbarium (Plant/ plant parts with fungal diseases)

Paper III- Phycology and Lichen. **1 Credit**

1. Study of following genera

Eudorina, Chlorella, Ulva, Cladophora, Fritschiella, Bulbochaete, Zygnema, Caulerpa, Nitella, Gloeotrichia, Stigonema, Botrydium, Navicula, Ectocarpus, Dictyota, Laminaria, Batrachospermum, Gelidium, Polysiphonia, Gracilaria

2. External morphology and preparation of slides of Lichens

Paper IV- Bryology **1 Credit**

1. Study and Identification of following genera with suitable preparation

Plagiochasma, Porella, Anthoceros, Notothylas, Sphagnum, Polytrichum

M.Sc (Botany) Previous Year: Semester-II

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PG**BOT 201 – PTERIDOLOGY** **MM: 100**

Objectives:

- Understand the morphological diversity of Pteridophytes.
- Understand the economic importance of the Pteridophytes.
- Know the evolution of Pteridophytes.

UNIT – 1		Credit	Hours
1a	i. General characters of Pteridophytes ii. Classification of Pteridophytes. iii. Ecology and distribution of Pteridophytes.	1	15
1b	i. Origin and evolution of Pteridophytes. ii. Telome theory and evolution of stellar system. iii Heterospory, seed habit, Apogamy and Apospory. iv. Physiology of germination of spores and development of fern prothallus.		
UNIT – 2		Credit	Hours
2a	Classification, distribution, morphology, life history and phylogeny of Psilophyta with special reference to genera- *Rhynia, Psilotum*	1	15
2b	Classification, distribution, morphology, life history and phylogeny of Lycophyta with special reference to genera: *Lycopodium, Selaginella, Isoetes*		
UNIT – 3		Credit	Hours
3a	Classification, distribution, morphology, life history and phylogeny of Sphenophyta with special reference to genera- *Sphenophyllum, Equisetum, Calamites*	1	15
3b	Classification, distribution, morphology, life history and phylogeny of Filicophyta with special reference to genera- *Ophioglossum, Osmunda*		
UNIT – 4		Credit	Hours
4a	Classification, distribution, morphology, life history and phylogeny of Filicophyta with special reference to genera- *Pteris, Adiantum, Cyathea*	1	15
4b	*Marsilea, Azolla*		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completion of this course, the students will be able to describe the general characters and classification of Pteridophytes. They will able to examine the distribution, morphology, anatomy, reproduction and life cycle of types mentioned in the syllabus. They will know about economically important Pteridophytes.

Book References

1. Smith, G.M. (1955). Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes). TMH publishing Company Ltd., New Delhi.
2. Sporne, K.K. (1991). The Morphology of Pteridophytes. B.I. publishing Pvt. Ltd., Bombay
3. Parihar, N.S. (1993). An Introduction to Embryophyta: Vol II-Pteridophyta. Central book Depot. Allahabad
4. Parihar, N.S. (1996). Biology and Morphology of Pteridophytes. Central book Depot. Allahabad
5. Rashid, A. (2015). An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd., New Delhi.
6. Vashistha, B.R., Sinha, A.K. & Kumar, A.(2016). Pteridophyta, S.Chand & Co.Ltd., Delhi.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PG**BOT 202 – GYMNOSPERMS AND PALAEOBOTANY MM: 100**

Objectives:

- To discuss the type of seeds produced by gymnosperms, as well as other characteristics of gymnosperms
- To know which period saw the first appearance of gymnosperms and explain when they were the dominant plant life on earth.
- To list the groups of modern-day gymnosperms and provide examples of each.

UNIT – 1		Credit	Hours
1a	i. General characteristics of Gymnosperms. ii. Classification of Gymnosperms. iii. Distribution of Gymnosperms with special reference to India.	1	15
1b	i. Origin and evolutionary tendencies in Gymnosperm. ii. Cytology of Gymnosperms iii. Economic importance of Gymnosperms		
UNIT – 2		Credit	Hours
2a	Study of morphology, structure, life history, interrelationship and phylogeny of class Cycadopsida with special reference to the following extinct and extant genera: *Glossopteris, Zamia.*	1	15
2b	*Williamsonia, Cycadeoidea* (Bennittites), *Pentoxylon.*		
UNIT – 3		Credit	Hours
3a	Study of morphology, structure, life history, interrelationship and phylogeny of class Coniferopsida with special reference to the following extinct and extant genera: *Cordaites, Ginkgo.*	1	15
3b	*Araucaria, Thuja, Taxus.*		
UNIT – 4		Credit	Hours
4a	Study of morphology, structure, life history, interrelationship and phylogeny of class Gnetopsida with special reference to the following extant genera: *Ephedra, Gnetum, Welwitschia*	1	15
4b	Palaeobotany i. Types of Fossils, their methods of preservation and methods of study. ii. Applied Palaeobotany: Carbon dating, palaeobotany of coal and petroleum, palynology. iii. Study of Indian Fossil Flora: Gondwana Flora, The Rajmahal Flora, Deccan Intertrappean Flora.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, the students will be able to describe the general characters and classification of Gymnosperms. They will able to examine the distribution, morphology, anatomy, reproduction and life cycle of types mentioned in the syllabus. They will know about economically important Gymnosperms. They will understand the significance of Paleobotany and its applications.

REFERENCE BOOKS

1. Beck, C.B. (2006). Origin and Evolution of Gymnosperm. Columbia University Press.
2. Bhatnagar, S.P. & Moitra, A. (2013). Gymnosperms. New Age International Publishers, New Delhi.
3. Chamberlain, C.J. (1998). Gymnosperms Structure & Evolution. CBS Publisher & Distributors, New Delhi.
4. Coulter, J.M. & Chamberlain, C.J. (1978). Morphology of Gymnosperm. Central book Depot. Allahabad.
5. Govil, C.M. (2014). Gymnosperms: Extinct and Extant. Krishna Prakashan Media (P) Ltd. Delhi.
6. Stewart, W.N. & Rathwell, G.W. (1993). Palaeobotany and Evolution of Plants. Cambridge University Press, London
7. Vashistha, B.R., Sinha, A.K. & Kumar, A.(2016). Gymnosperms. S.Chand & Co.Ltd., Delhi.

Programme Name and Code: **M. Sc. (Botany)**

Course code and Name: PG**BOT 203 – ANGIOSPERMS: TAXONOMY, MORPHOLOGY AND ECONOMIC BOTANY** **MM: 100**

Objectives:

- To provide a convenient method of identification of plants.
- To provide classification which is based on natural affinities of organisms as far as possible.
- To provide an inventory of plant taxa by means of flora.
- To detect evolution at work, discovering its process of interpreting into results.

UNIT – 1		Credit	Hours
1a	**Taxonomy** i. History of plant taxonomy. ii. Systems of Classification: History, outlines, basis, merits and demerits of following classifications- Bentham and Hooker, Hutchinson, Takhtajan, Cornquist iii. ICBN -History, Principles and Application.	1	15
1b	i. Field and herbarium techniques. ii. Herbaria and Botanical Gardens of India and World, Organisation and activities of BSI. iii. Taxonomy as a synthetic discipline, Modern trends of taxonomy: Morphology, Cytology, Nucleic Acid Hybridization, Chemotaxonomy, numerical taxonomy and serotaxonomy.		
UNIT – 2		Credit	Hours
2a	General knowledge of the distinguishing features of the following **Dicot** families with special reference to best flora: **Polypetalae-** Ranunculaceae, Capparaceae, Caryophyllaceae, Tiliaceae, Rutaceae, Rosaceae, Fabaceae, Mimosaceae, Caesalpiniaceae, Moraceae, Myrtaceae, Cucurbitaceae, Apiaceae.	1	15
2b	**Gamopetalae-** Rubiaceae, Asteraceae, Asclepiadaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Lamiaceae **Monochlamydeae** Amaranathaceae, Polygonaceae, Euphorbiaceae,.		
UNIT – 3		Credit	Hours
3a	General knowledge of the distinguishing features of the following **Monocot** families with special reference to best flora: Orchidaceae, Liliaceae, Zingiberacea, Commelinaceae, Arecaceae, Cyperaceae, Poaceae.	1	15
3b	**Morphology** i. Phylogeny and interrelationship of Angiosperm. ii. Morphology of flower with special reference to the morphology of carpel and inferior ovary.		
UNIT – 4		Credit	Hours
4a	**Economic Botany** i. Scope of economic botany, study of economically important plants and plant products. ii. Forest Products: a) Wood, Timber and Lumber. b) Resins, gum, tanning, material and cork. c) Rubber and other latex products. iii. Textile plants and products: A general account.	1	15
4b	i. Fumitories and masticatories: A general account. ii. Narcotics and Insecticide as plant products. iii. Important medicinal plants and products		

INTERAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course, the students will be able to develop understanding of plant morphology, terminologies and identifying morphological peculiarities. They will be able to understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches. **They will be able to** recognize members of the major angiosperm families by identifying their diagnostic features and economic importance. They will be able to evaluate the economically important selected angiosperms.

REFERENCE BOOKS

1. Das, S.M. (2013). A Text Book of Plant Taxonomy: theory & Objectives. Wisdom Press, New Delhi.
2. Davis, P.H. (2011). Principles of Angiosperm Taxonomy. Scientific Publishers, Jodhpur.
3. Eames, A.J. (1961). Morphology of Angiosperms. McGraw Hill Book Company, New York
4. Kochhar,S.L.(2019). Economic Botany in the Tropics.Laxmi Publications,New Delhi
5. Kumar,S.(2011).Economic Botany.Campus Books International,New Delhi
6. Lawrence, G.H.M. (1951). Taxonomy of Vascular Plants. Macmillan, New York
7.Sammbamurty,A.V.S.S.&Subrahmanyam,N.S.(2008).A Textbook of Modern Economic Botany,CBS Publishers & Distributors Pvt.Ltd.,N. Delhi
8. Sambamurty, A.V.S.S. (2014). Taxonomy of Angiosperms. I.K.International Publishing House Pvt. Ltd., New Delhi.
9. Saxena,N.B.& Saxena,S.(2014).Plant Taxonomy.Pragati Prakashan,Meerut.
10. Sharma,A.K.& Sharma,R.(2015).Taxonomy of Angiosperms and utilization of Plants.Pragati Prakashan,Meerut.
11. Subramanyam, N.S. (1995). Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. New Delhi.
12. Subramanyam, N.S.(1996). Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd. New Delhi.
13. Stace, C.A. (1989). Plant Taxonomy and Biosystematics. Edward Arnold Press, UK
14. Verma, B.K. (2011). Introduction to Taxonomy of Angiosperms. PHI Learning Private Limited, N.Delhi.
15. Verma,V.(2013).Text Book of Economic Botany.Ane Booksa Pvt Ltd,New Delhi.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PG**BOT 204 – ECOLOGY, BIODIVERSITY AND PLANT-SOIL RELATIONSHIP**

MM:100

Objectives:

- This paper aims to understand the nature of environmental influences individual organisms, population and communities.
- To know about the conservation of bio- diversity, sustainable use of its components and fair sharing of the benefits of the utilization of genetic resources.
- To develop the understanding about the physico-chemical properties of soil and agronomic management as well as to understand the transport of energy, water, solutes and gases through soil structures.

UNIT – 1		Credit	Hours
1a	i. Plant Ecology and its scope. ii. Autecological studies, gene ecology with emphasis on Indian work iii. Plant communities: characteristics and its classification.	1	15
1b	i. Life-forms. ii. Plant community dynamics and development: succession and climax. iii. Population ecology. v. Ecological niche.		
UNIT – 2		Credit	Hours
2a	i. Study of different types of ecosystem. Ii Ecological energetic. iii. Biogeochemical cycles in ecosystem with special reference to Carbon and Nitrogen	1	15
2b	i. Production ecology, measurement of primary productivity. ii. Ecological adaptation of plants in different ecosystems. iii. Environmental pollution and its consequences		
UNIT – 3		Credit	Hours
3a	**Biodiversity and its conservation**: i. Introduction to Biodiversity. ii. Levels of Biodiversity: Genetic species community and Ecosystem. iii. Mega diversity Zones and Hot spots.	1	15
3b	i. Threats to Biodiversity: Causes of Biodiversity loss species extension. ii. Red Data Book. IUCN threat categories. iii. Strategies for Biodiversity conservation: ***in-situ*** and ***ex-situ*** conservation.		
UNIT – 4		Credit	Hours
4a	**Plant-soil relationship** i. Soil: its origin, formation and development. ii. Soil profile. iii. Soil properties in relation to plant growth.	1	15
4b	i. Soil types of India with special reference to U.P. ii. Soil erosion: its causes and effects on environment. iii. Methods of soil conservation		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Upon completion of this course students will be able to identify soil types and will be able to know ways to conserve the soil, as well as to reduce soil erosion. They will be able to understand functional traits on population, community and landscape level interactions between plants and the biotic and abiotic environment. They will understand diversity and distribution, restoration of plant communities and conservation of plants.

REFERENCE BOOKS

1. Ambasht,R.S.& Ambasht,N.K.(2008).A Text Book of Plant Ecology.CBS Publishers,Ltd.N.Delhi.
2. Chapman, J.L. & Reiss, M.J. (2003). Ecology: Principles and Applications. Cambridge University Press,
3. Kumaresan,V.& Arumugam,N.(2016).Plant Ecology and Phytogeography.Saras Publications,kanyakumari.
4. Kapur,P.& Govil,S.R.(2004).Experimental Plant Ecology.CBS Publishers Pvt Ltd.,New Delhi.
5. Odum,E.(1971). Fundamentals of Ecology. Saunders,Philaelphia
6. Odum, E., Barrick, M. & Barrett, G.W. (2005). Fundamentals of Ecology. Cengage Publishers (India Edition).
7. Sharma,P.D.(2017).Ecology and Environment. Rastogi Publications, Meerut
8. Siddhartha,K.(2013). Ecology and Environment. Kisalaya Publoications, New Delhi.

Programme Name and Code: M. Sc. (Botany) 100 Marks/ 4 Credit

Course code and Name: PGBOTP 205 – Practical

Paper I- Pteridology **1 Credit**

1. Monographic study of the sporophyte body of the following

Lycopodium, Selaginella, Sphenophyllum, Equisetum Calamites, Ophioglossum, Osmunda , Pteris, Adiantum, Cyathea, Marsilea, Azolla

Paper II- Gymnosperms and Palaeobotany **1 Credit**

1. A study of representative types

Zamia, Ginkgo, Araucaria, Thuja, Taxus, Ephedra, Gnetum

2. Study of fossils and fossils slides

Paper III- Angiosperms: Taxonomy, Morphology and Economic Botany 1 Credit

1. Description of local plant in semi technical language

2. Identification of Angiospermic plants of known family up to the level of genus and species with the help of flora

Note: - Compulsory excursion- Students have to collect and submit at least 100 plants properly pressed, mounted and arranged according to Bentham and Hooker's classification on Herbarium sheets.

3. Study of all economically important plants and their products included in syllabus

Paper IV- Ecology and Plant soil Relationship **1 Credit**

1. Autecology observations on selected plant species
2. Study of the vegetation by

i. Transect method ii. Quadrate method iii. Point method

3. Study of the environmental factors

i. Climatic factors and their measurement

ii. Edaphic factors, mineral composition of soil, pH, soil profile, moisture content, nitrate, calcium, carbonate

iii. Water Analysis

4. Measurement of Biomass

M.Sc. (Botany) Final Year: Semester-III

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PG**BOT 301 – PLANT PHYSIOLOGY** **MM: 100**

Objectives:

- The field of plant physiology includes the study of all the internal activities of plants, those chemical and physical processes associated with life as they occur in plants.
- This course helps to analyse processes in plants, namely, as photosynthesis, mineral nutrition, respiration, transportation, and ultimately plant development and growth which are traits displayed by living entities.

UNIT – 1		Credit	Hours
1a	**Plant Water Relations:** i. Cell osmotic quantities: Osmosis, osmotic potential, water potential. ii. Mechanism of water uptake and translocation: water absorption by roots, root pressure and turgor pressure. Phloem loading and unloading. iii. Transpiration and its regulation: Stomatal opening and closing.	1	15
1b	**Photosynthesis:** i. General aspects and historical background. ii. Absorption and Action spectra, organization of photosynthesis apparatus, pigments and light harvesting complexes, photolysis of water, mechanism of electron transport- structure and functions of components of Photosystem I and II, Photophosphorylation. iii. Proton transport and ATP synthesis in chloroplast- ATP synthetase. iv. Carbon assimilation: Calvin cycle, Photorespiration (C 2 Cycle) and C4 cycle and their regulation, CAM pathway. Factors affecting Photosynthesis		
UNIT – 2		Credit	Hours
2a	**Respiration:** i. Aerobic and anaerobic respiration. ii. Glycolysis, Kreb's Cycle and their regulation. Substrate level Phosphorylation. Alternate iii. Glycolytic reaction (Gluconeogenesis), Pentose phosphate Pathway, Glyoxylate cycle. iv. Electron Transport System and ATP synthesis.	1	15
2b	**Lipid Metabolism**: Synthesis of fatty acids and degradation		
UNIT – 3		Credit	Hours
3a	**Mineral Nutrition:** i. Essential and Beneficial elements. ii. Role and deficiency effects of essential nutrient elements.	1	15
3b	**Stress Physiology:** i. Plant responses to abiotic stress. ii. Stress Proteins (HSP, LEA). iii. Water deficit and drought, heat, chilling and freezing, salinity, light and anoxia stress.		
UNIT – 4		Credit	Hours
4a	**Growth regulators:** Auxin, Cytokinin, Gibberellins, Abscisic acid, Ethylene.	1	15
4b	**Flowering:** i. Floral initiation, florigen concept, circadian rhythms, photoperiodism and its regulation. ii. Vernalization, phytochromes and their functions. iii. Abscission, dormancy (bud and seed), seed germination and senescence.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completion of the course students will know importance and scope of plant physiology. They will understand the plants and plant cells in relation to water and about the movement of sap and absorption of water in plant body. They will better understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C3 and C4 pathways and the respiration in higher plants with particular emphasis on aerobic and anaerobic respiration. Understand the plant movements. They will be able to apply this in research of crop physiology.

REFERENCE BOOKS

1. Devlin,R.M.& Witham,F.H.(1986).Plant Physiology.CBS Publishers & Distributors,New Delhi.
2. Hopkins,W.G.(1995).Introduction to Plant Physiology.John Wiley & Sons,New York.
3. Malik,C.P.(2014).Plant Physiology.Kalyani Publishers,New Delhi.
4. Mukherji,S. & Ghosh,A.K.(2012)..Plant Physiology.New Central Book Agency(P) Ltd,London
5. Noggle,G.R.&Fritz,G.J.(1986).Introductory Plant Physiology.Prentice-Hall of India Pvt Ltd,New Delhi.
6. Pandey,S.N. & Sinha,B.K.(2016).Plant Physiology,Vikas Publishing House Pvt.Ltd,New Delhi.
7. Ridge,I.(1996).Plant Physiology.CBS Publishers & Distributors,New Delhi
8. Salisbury,P.B. & Ross,C.W.(1992).Plant Physiology.Wadsworth Publishing,California.
9. Verma,S.K.& Verma,M.(2012).Plant Physiology,Biochemistry and Biotechnology.S.Chand & Company, Ltd.,New Delhi.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PGBOT 302 – GENETICS AND CYTOGENETICS **MM: 100**

Objectives:

- To study historical perspective of how genetics has evolved.
- To study about the location of a particular gene on the chromosome.
- To understand genetic inheritance, and led to the development of new experimental methods.
- To know how the traits are passed down in families in different patterns.
- To know the clinical relevance of genetic concepts and to describe the inheritance and expression of human blood groups.

UNIT – 1		Credit	Hours
1a	**Inheritance Genetics:** i. Principles of Mendelian inheritance- Introduction to Pre Mendelian and Post Mendelian genetics, Mendel's Laws, Modification to Mendel's laws. ii. Interaction of genes- Complementary, Epistasis, Inhibitory, Duplicate, Polymeric, Lethal and additive genes.	1	15
1b	i. **Cytoplasmic inheritance**: Cytoplasmic inheritance involving chloroplast (Mirabilis jalapa, Zea mays) and Mitochondria (petite yeasts and cytoplasmic male sterility in higher plants), mitochondrial and chloroplast genomes, interaction between nuclear and cytoplasmic genes (Rubisco and Cytochrome oxidase) ii.**Quantitative Inheritance**: Qualitative and Quantitative traits, Continuous variation, Inheritance of quantitative traits, (corolla length in Nicotiana, cob length in Zea mays), multiple factors hypothesis and heritability.		
UNIT – 2		Credit	Hours
2a	**Population genetics:** i. Gene and genotype frequencies, Hardy-Weinberg law ii.Factors affecting Hardy-Weinberg equilibrium (selection, mutation, migration and genetic drift).	1	15
2b	**Cytogenetics and induced variation:** **Structural changes in chromosomes**: i.Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes. ii.Cytological consequences of crossing over in Inversion and translocation heterozygotes, genetics of structural heterozygotes, complex translocation heterozygotes, Robertsonian translocations.		
UNIT – 3		Credit	Hours
3a	**Numerical alterations in chromosomes**: i. Origin, occurrence and meiosis of haploids, aneuploids and euploids. ii. Origin and production of autopolyploids, chromosome and chromatid separation, allopolyploids. iii.Induction and characterization of trisomics and monosomics. Transmission of trisomics and monosomics.	1	15
3b	**Recombination and Linkage**: i. Concept of Linkage, types and applications . ii. Concept and Types of Recombination, Molecular mechanism of recombination, Site specific recombination, estimation of recombination percentages and map distances. iii. Gene mapping in Fungi using ordered and unordered tetrads of Neurospora. Three point test crosses and estimation of linkage distances in plants. Gene maps and physical maps..		
UNIT – 4		Credit	Hours
4a	i. Sex Determination: Important theories of sex determination, sex determination in plants. ii.Mutation—Spontaneous and induced mutation, physical and chemical mutagens, molecular basis of mutations.	1	15
4b	i. DNA damage and repair mechanism- Types of DNA damage, enzymes involved in repair of DNA, excision repair, recombination repair and mismatch repair systems. ii.IS element, transposable elements in prokaryotes and eukaryotes, mechanism of transposition, retroelement, application of transposons.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Students who successfully complete this course will be able to apply quantitative problem-solving skills to genetics problems and issues. They will be able to demonstrate their ability to reason both inductively and deductively with experimental information and data. Describe the chromosome theory, molecular genetics and quantitative and evolutionary genetics. Select and apply experimental procedures to solve genetic problems.

REFERENCE BOOKS

1. Strickberger, M.W. (2015). Genetics. Pearson Education, India
2. Gardner, E.J. ,Simmons, M.J. & Snustad, D.P. (2006). Principles of Genetics. Wiley
3. Klug, W.S , Cummings, M.R., Spencer, C.A. & Palladino, M.A. (2016). Concepts of Genetics. Pearson Education, India.
4. Singh, B.D. (2009). Genetics. Kalyani Publishers, New Delhi
5. Gupta, P.K. (2009). Genetics. Rastogi Publishers, Meerut.
6. Gupta, P.K. (2007). Cytogenetics. Rastogi Publishers, Meerut.
7. Prasad, G. (2013). Introduction to Cytogenetics. Kalyani Publisher, New Delhi.

8. Roy, D. (2009). Cytogenetics. Narosa Publishing House, New Delhi

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PGBOT 303 – **BREEDING AND BIOSTATISTICS** **MM: 100**

Objectives:

- To raise plants with desired characteristics.
- To increase the crop yield. To develop a disease-resistant crop.
- To develop plants that can tolerate extreme environmental stress.

UNIT – 1		Credit	Hours
1a	**Plant Breeding:** i Plant Genetic resources: Genetic diversity in plants, Penetrance and Expressivity, Pleiotropy, Centres of origin, Importance of genetic diversity in crop improvement and its erosion. ii Collection and evaluation of germplasm. iii.Competition in natural populations, Inter genotype competition, Environmental variation.	1	15
1b	i Heritability-definition and types. Estimates of heritability. ii.Incompatibility and Male sterility: Genetic, physiological and biochemical basis of incompatibility, Utility of self incompatibility, Evolution of incompatibility mechanism; Genetic and Cytoplasmic male sterility		
UNIT – 2		Credit	Hours
2a	i. Hybridization and its role, Principles of combination breeding and its application. ii. Hybrid breeding in self and cross-pollinated crops. Development of hybrids, Use of male sterility in development of hybrids, iii.Testing of combining ability, prediction of performance of hybrids- single cross hybrid, three way cross hybrid, double cross hybrid, Multiple crosses –composite cross breeding.	1	15
2b	i. Back cross method of breeding-theory of transfer of alleles. ii. Heterosis. Theories of heterosis, Environmental heterosis, Inbreeding depression. iii. Methods of direct gene transfer.		
UNIT – 3		Credit	Hours
3a	i. Breeding methods in self fertilizing species –Pedigree method, bulk method, single seed descent, dihaploidy, Genotype assessment, recurrent selection, reciprocal recurrent selection. ii. Breeding methods in cross fertilizing species-Mass selection, family selection, combined selection, inter population selection schemes.	1	15
3b	i. Factors affecting efficiency of breeding methods. ii. Breeding methods of important crop plants e.g. wheat, rice.		
UNIT – 4		Credit	Hours
4a	**Biostatistics:** i. Importance and scope of Biostatistics. ii. Sample and sampling, iii. Collection and representation of date-tabulation, graphical, diagrammatic iv. Measures of Central tendency	1	15
4b	i. Measures of dispersion: Standard deviation, Variance, Deviation ii. Tests of significance: Significance and difference in means, Standard error of mean, Standard error of SD, Students 't' test , Chi-square test. iii. Analysis of variance (ANOVA). iv. Correlation and regression - Meaning, kinds of correlation, coefficient of correlation, methods of studying correlation. Aims of regression analysis. Kinds of regression analysis.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completion of this course students will acquire knowledge on floral biology and selection of proper breeding method. They will be able develop cultivate skill in emasculation and pollination of various crop plants. Gain expertise on hybrid seed production techniques. They will also learn to use the descriptors in various crops for selection of superior genotypes.

REFERENCE BOOKS

1. Allard,R.W.(1999).Principles of Plant Breeding.John Wiley & Sons,New York.
2. Chaudhary,H.K.(2008).Introduction to Plant Breeding.Oxford & IBH,New Delhi.
3. Ram,M.(2014). Plant Breeding Methods, PHI Learning Pvt.Ltd,Delhi.
4. Singh,B.D.(2014). Plant Breeding-Principles and Methods.Kalyani Publishers,New Delhi.
5. Singh,B.D.(2009).A Text Book of Plant Breeding, Kalyani Publishers,New Delhi.
6. Banerjee, P.K.(2007). Introduction to Biostatistics. Rastogi publication, Meerut.
7. Rastogi, V.B. (2015). Biostatistics. Meditech Publishers, New Delhi
8. Ramakrishna, P. (2015). Biostatistics. Saras Publication, Kanyakumari
9. Prasad, S. (2009). Elements of Biostatistics. Rastogi Publication, Meerut
10. Ambrosius,W.T.(2010). Topics in Biostatistics. Humana Press. New Jersey.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: **PGBOT 304 – CELL BIOLOGY AND BIOCHEMISTRY** **MM: 100**

Objectives:

- The main aim to study the cell biology is to understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- The main goal of biochemistry is to understand the structure and behaviour of biomolecules.

UNIT – 1		Credit	Hours
1a	**CELL BIOLOGY:** Cell structure and function: i. Structural organization of cell. ii.Organization of microfilaments, Intermediate filaments and microtubules . iii. Plasmadesmata.	1	15
1b	Cell organelles (Microbodies, Golgi apparatus, Lysosomes, Endoplasmic Reticulum, Vacuole, Ribosomes, Nucleus, Chloroplast, Mitochondria).		
UNIT – 2		Credit	Hours
2a	i.Cell wall, Plasma membrane and their structural models and functions. ii.Active and Passive uptake of ions- facilitated diffusion, primary and secondary active transport, ion carriers, channel proteins and pumps (Na+/K+ and Ca 2+pumps).	1	15
2b	i. Membrane transport proteins- Plasma membrane H+- ATPase, vacuolar H+-ATPase and H+ pyrophosphatases. ii. Cell cycle, It's regulation & Apoptosis: Biochemical and genetic mechanism– Mitosis, spindle formation mechanism, cytokinesis, cell plate formation, Meiosis and its significance, Cell signalling in plants, Programmed Cell Death (PCD).		
UNIT – 3		Credit	Hours
3a	**BIOCHEMISTRY** **Amino acids, Peptides and Proteins**: i. Amino acids: Classification and properties. ii. Chemical and enzymatic hydrolysis of protein to peptides, amino acid sequencing. iii.Secondary structure of proteins, forces responsible for holding of secondary structure. helices, sheets, super secondary structures, Ramachandran Plot, Tertiary structure of protein-folding and domain structure. Quaternary structure. iv.Denaturation, renaturation and degradation of protein. **Lipids:** General characters, classification and properties.	1	15
3b	**Carbohydrates:** i.Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides. ii.Disaccharides and polysaccharides. Structural polysaccharides-Cellulose and chitin. Storage polysaccharides-starch and glycogen. iii.Carbohydrate metabolism: Glycogenesis, gluconeogenesis.		
UNIT – 4		Credit	Hours
4a	**Nucleic Acids:** i. Biosynthesis of nucleotides. ii. Denaturation, renaturation and degradation of nucleic acids.	1	15

Ranjit Singh

4b	**Enzymes:** i. General aspects, nomenclature and classification. ii. Mode of action, Active sites, reversible and irreversible enzyme inhibition. iii. Enzyme kinetics and Michaelis- Menton equation. iv. Factors affecting enzymatic reactions. v. Structure and function of co-enzymes		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After successful completion of the course students will understand how cells work in healthy and diseased states. They will learn how cell biologists working in animal, plant and medical science will be able to develop new vaccines, more effective medicines, plants with improved qualities. The will be able to demonstrate the ability to use discipline specific research techniques. Analyze and interpret data and scientific literature. Synthesize data and draw appropriate inferences.

REFERENCE BOOKS

1. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2002). Biochemistry. W.H.Freeman & Co. Ltd.
2. Conn, E.E., Stumpf, P.K., Bruening, G. & Doi, R.H. (2006). Outlines of Biochemistry. Wiley.
3. Day, P.M. & Harborne, J.B. (1997). Plant Biochemistry. Academic Press, UK.
4. Goodwin, T.W. & Mercer, E.I. (2003). Introduction to Plant biochemistry. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
5. Jain, J.L., Jain, S. & Jain, N. (2016). Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi
6. Karp, G. (2013). Cell Biology, Wiley
7. Lehninger, A.L. (2013). Biochemistry. Kalyani publishers, New Delhi.
8. Powar, C.B. (2010). Cell Biology. Himalaya publishing house, Mumbai.
9. Rastogi, S.C. (2005). Cell Biology. New age Publishers, New Delhi.
10. Verma, P.S. & Agarwal, V.K. (2016). Cell biology. S. Chand & Company Ltd., New Delhi
11. Wilson, K. & Walker, J. (2013). Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press, London.

Programme Name and Code: M. Sc. (Botany) 100 Marks/ 4 Credit
Course code and Name: PGBOTP 305 – Practical

Paper I- Plant Physiology **1 Credit**

1. To determine the Osmotic pressure of vacuolar sap of *Rheo discolar* or *Tradescantia* leaves by Plasmolytic method (50% plasmolysis).
2. To determine the diffusion pressure deficit (water potential) of potato tuber tissue by weighing method.
3. To determine the structure, size and frequency of stomata in mesophytic and xerophytic leaves.
4. To determine the rate of transpiration of plant i. Weight ii. Potometer method.
5. To determine the rate of transpiration by Cobalt Chloride paper method and to calculate transpiration index (TI), Transpiration efficiency (TE) of various leaves.
6. To measure the rate of photosynthesis in aquatic plants by Willmotts bubble counting method.
7. To study the effect of-i. CO_2; ii. Light quality and intensity; iii. Injury; iv. Temperature on the rate of photosynthesis in leaves of an aquatic / terrestrial plant.
8. To extract the major plant pigments from leaves by different solubility method.

Paper II- Genetics and Cytogenetics **1 Credit**

1. Chromosomal Technique- Pretreatment, fixation, staining techniques- Acetocarmine- Fuelgen, Banding Technique- G Banding
2. Karyotypic studies- Preparation of mitotic metaphase plates and to draw Camera Lucida drawing of chromosome and study of chromosome morphology, Calculation of arm ratios, chromosome formula and symmetry of karyotype, preparation of idiograms and drawing photograph

3. Study of genetic crosses based on Mendel's Laws, modification to Mendel and Interaction of genes

Paper III- Plant Breeding and Biostatistics 1 Credit

1. Emasculation Techniques
2. Statistic analysis of seed samples and applying suitable statistical test for interpretation as desired
3. Numerical problem and design

Paper IV- Cell Biology and Biochemistry 1 Credit

Cell Biology

1. Preparation of squash for the study of mitosis
2. Preparation of smear for the study of meiosis
3. Permanent Slide Studies of various stages of mitosis and meiosis
4. Model studies for cell organelles

Biochemistry

1. To separate the major plant pigments (i) Paper chromatography and (ii) Thin Layer Chromatography to calculate Rf values of the pigment
2. To determine the Rf values of a given mixture of amino acids using Circular Paper chromatography
3. To measure the activity of enzyme catalase and to study the effect of – (i) Substrate concentration and (ii) pH on enzyme activity
4. 5.. To extract proteins from germinating seeds of moong bean/ black gram and to estimate them by the Biuret test
5. 6.. To extract and test the presence of Reducing sugar by Benedict's test
6. Effect of (a) enzyme concentration (b) substrate concentration on the activity of Urease

M.Sc (Botany) Final Year: Semester-IV

Programme Name and Code: M. Sc. (Botany)

Course code and Name: **PGBOT 401 – ANATOMY, EMBRYOLOGY AND MORPHOGENESIS MM: 100**

Objectives:

- To study the plant tissues and cells in order to learn more about the way these organisms are constructed and how they work.
- To study of micro and mega sporogenesis, gametophyte development, fertilization development of endosperm, embryo and seed coats.
- To make aware that embryological evidence has been used in solving the taxonomical problems at almost all levels.

UNIT – 1		Credit	Hours
1a	**ANATOMY:** i. Shoot development: Organization of shoot apical meristem (SAM), Leaf (Marginal meristem). ii. The cambium, its derivative tissues, differentiation of secondary phloem and xylem. iii. Structure of woods in relation to its weight, strength, durability and taxonomic significance.	1	15
1b	iv. Anomalous secondary growth in roots and stems. v. Cork cambium and its derivatives.		
UNIT – 2		Credit	Hours
2a	i. Abscission layers. ii. Origin of lateral and adventitious roots, root-stem transition. iii. Anatomy in relation to taxonomy.	1	15
2b	**EMBRYOLOGY** i. Structure of microsporangium, microsporogenesis and development of male gametophyte. ii. Structure of ovule, megasporogenesis and development of female gametophyte. iii. Pollen-Pistil interaction. iv. Fertilization and its control.		
UNIT – 3		Credit	Hours
3a	i. Endosperm: Development, types, haustoria, ruminate endosperm, xenia, metaxenia. ii. Embryogenesis in dicot and monocot. iii. Apomixis, causes and significance.	1	15
3b	i. Parthenocarpy. ii.Polyembryony and its induction. iii. Embryology in relation to taxonomy.		
UNIT – 4		Credit	Hours
4a	**MORPHOGENESIS** i. Polarity: Polarity in isolated cells, plasmodia & coenocytes. Expression of polarity in external and internal structure of plants. Role of polarity in developmental pattern. ii. Correlation: Physiological and genetical correlations.	1	15
4b	i. Symmetry: Inorganic and organic symmetries. Radial, bilateral and dorsiventral symmetries in plant body. Development of symmetry. ii. Morphogenesis in *Acetabularia*.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completion of this course students will be able to know the characteristics and classifications of meristems, theories on apical meristems, secondary and anomalous secondary structures of stem and root. They will understand the micro and megasporogenesis; development of male gametophyte, ontogeny of types of embryosac and endosperms. They will be able to apply the knowledge in the field of farning and plant breeding after studying the pollen pistil interactions, double fertilization, classification of embryo development and Polyembryony.

REFERENCE BOOKS

1. Bhojwani, S.S., Bhatnagar, S.P. & Dantu, P.K. (2014). The Embryology of Angiosperm. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Cutter, E.G. (1966). Trends in Plant Morphogensis. Longmans, London.
3. Cutler, D.F., Botha, T. & Stevenson ,D.W. (2008). Plant Anatomy: An Applied Approach. John Wiley & Sons
4. Dwivedi, J.N. & Singh, R.B. (1986). Anatomy of Angiosperms. Central book Depot, Allahabad.
5. Esau, K. (2006). Anatomy of Seed Plants. Wiley
6. Pandey, B.P. (2012). Plant Anatomy. S.Chand & Company Ltd. New Delhi.
7. Roy, P. (2010). Plant Anatomy. New Central book Agency, New Delhi.
8. Sharma, H.P. (2009) Plant Embryology: Classical and Experimental. Narosa Publishing house, New Delhi
9. Sinnott, E.W. (1960). Plant Morphogenesis. McGraw Hill Book Company, London.
10. Wardlaw, C.W. (1968). Morphogenesis in Plants: A Contemporary Study. University of Manchester, Methuln and Company Ltd., London.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PG**BOT 402 – TISSUE CULTURE AND BIOTECHNOLOGY** **MM: 100**

Objectives:

- Modern biotechnology and tissue culture techniques provide breakthrough products and technologies. This course is designed -
- To combat debilitating and rare diseases,
- To reduce our environmental footprint, feed the hungry, use less and cleaner energy, and have safer, cleaner and To know how to enhance more efficient industrial manufacturing processes, production of therapeutic proteins and other drugs through genetic engineering.

UNIT – 1		Credit	Hours
1a	**TISSUE CULTURE:** i. Plant cell and tissue culture techniques: Plant Cell and Tissue culture: Introduction, history, scope, concept of cellular differentiation, totipotency. ii. Culture media and laboratory requirements.	1	15
1b	i. Applications of plant tissue culture ii. Micropropagation-Organogensis and embryogenesis.		
UNIT – 2		Credit	Hours
2a	i. Somaclonal variation---applications and reasons for generation. ii. Somatic hybridization –protoplast culture, regeneration and somatic hybridization, cybrids.	1	15
2b	i. Production and uses of haploids. ii.. Endosperm and nucellus culture		
UNIT – 3		Credit	Hours
3a	**BIOTECHNOLOGY** i. Tools of Genetic Engineering: Enzymes (restriction endonucleases, polymerases, reverse transcriptase, alkaline phosphatase, polynucleotide kinase, Ligases, terminal transferases) and Cloning vectors (plasmid and bacteriophage vectors). ii. DNA cloning, preparation of plasmid DNA, Expression vector, purification and cloned gene product, Restriction and electrophoresis, ligation.	1	15
3b	i. Methods of direct and indirect gene transfer in plants, *Agrobacterium*, Ti and Ri plasmids, application of transgenic plants for pest, disease and herbicide management. ii. Principles and methods of Genetic Engineering, Gene libraries and cDNA libraries, Polymerase chain reaction, DNA fingerprinting.		
UNIT – 4		Credit	Hours
4a	i. DNA Sequencing, Southern blotting, RAPD, RFLP, Restriction mapping. ii. Biotechnology and Human welfare iii. Applications of genetically engineered bacteria in crop production and protection, biodegradation of xenobiotics and toxic wastes, production of chemicals, fuels and medicines.	1	15
4b	i. Biofertilizers. ii. Organic farming. iii. Microbes for improving soil fertility.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After successfully completing this course students will be able to describe biocatalysis, pathway engineering, bioprocess control and downstream processing. They will be able to demonstrate their ability to reason both inductively and deductively with experimental information and data. They will be efficient enough to explain the theory and practice of recombinant DNA technology. They may select and apply experimental procedures to the spectrum of fields making use of biotechnology.

REFERENCE BOOKS

1. Bhojwani, S.S. & Razdan, M.K. (1996). Plant tissue Culture: Theory and Practice. Elsevier Science Publisher, New York.
2. Chawla,H.S.(2006).Introduction to Plant Biotechnology.Oxford & IBH Publishing Co.Pvt.Ltd.,N.Delhi.
3. Dube, R.C. (2014). A Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi
4. Govil,C.M.,Aggarwal,A. & Sharma,J.(2017).Plant Biotechnology and Genetic Engineering. PHI Learning Pvt Ltd,Delhi.
5. Gupta, P.K. (2016). Plant Biotechnology. Rastogi Publications, Meerut.
6. Janarthanan,S.& Vincent,S.(2009).Practical Biotechnology.Universities Press,Hyderabad
7. Kumaresan,V.& Arumugam,N.(2016).Fundamentals of Biotechnology.Saras Publication,Kanyakumari
8. Singh, B.D. (2012). Biotechnology. Kalyani Publishers, New Delhi.
9. Slater, a., Scott, N. & Fowler, M. (2010). Plant biotechnology: The Genetic manipulation of Plants. Oxford University Press, oxford.

Programme Name and Code: M. Sc. (Botany)

Course code and Name: **PGBOT 403 – MOLECULAR BIOLOGY AND BIOLOGICAL TECHNIQUES** **MM: 100**

Objectives:

Molecular biology, field of science concerned with studying the chemical structures and processes of biological phenomena that involve the basic units of life, molecules. This course is design-

- To understand the molecular basis of biological activity in and between cells,
- To understand molecular synthesis, modification, mechanisms, and interactions.
- To understand the living world and the ways its many plant and animal species (including humans) function, evolve, and interact.

UNIT – 1		Credit	Hours
1a	**MOLECULAR BIOLOGY:** i. Genome-Basic concept and organization. ii. Chromosome structure, nucleosome, solenoid and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotype analysis, banding patterns.Specialized chromosomes—Polytene chromosomes, lampbrush chromosomes, B chromosomes.	1	15
1b	i. Nuclear DNA content, C-value paradox.Structure and Properties of Nucleic acids: Structure, Chemical, Physical and thermal properties of nucleic acids. ii. Dissociation and reassociation kinetics of DNA, Cot curves, Cot ½ values and its significance, Unique, moderately repetitive and highly repetitive DNA. iii. Cconformation of nucleic acids. (A, B, Z DNA, r-RNA, m- RNA, t-RNA) and DNA sequencing;micro-RNAs & their roles.		
UNIT – 2		Credit	Hours
2a	i. DNA amplification, molecular genetic maps, genome projects. ii. Allele concept, multiple alleles, isoalleles, pseudoalleles. **iii.** Genetic Code	1	15
2b	**i.** Gene Structure: Organization and Structure of prokaryotic and eukaryotic genes; structure and role of promoters, exons, introns, terminators and enhancers. **ii.** DNA Replication: Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus, Origins of replication, priming and DNA polymerases. iii. Transcription: RNA polymerases and their role, Transcription apparatus, Transcription in prokaryotes and eukaryotes, Initiation, elongation and termination, RNA processing, reverse transcription, Ribonucleoproteins		
UNIT – 3		Credit	Hours
3a	i. Regulation of Transcription in prokaryotes and eukaryotes: Operon concept (Lac, Tryptophan, cAMP) positive and negative regulation of prokaryotic genes, eukaryotic transcription factors, transcriptional and translational control. ii. Translation in prokaryotes and eukaryotes.	1	15
3b	**BIOLOGICAL TECHNIQUES** i. Theory of fixation and important fixatives, storage of fixed material. ii. Different types of stains, their preparation and uses: Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram's stains, Acetocarmine. iii. Microtomy: Dehydration, clearing and embedding of material, section cutting, dewaxing.		
UNIT – 4		Credit	Hours
4a	i. Uses of Basic Instruments: pH meter, oven, incubator, autoclave. ii. Microscopy: Compound (Bright and Dark field), Phase contrast, Fluorescence, Ultra violet and Infra Red, Scanning and Transmission Electron Microscopy. iii. Biochemical Methods: Chromatography, Electrophoresis, Centrifugation, X- ray diffraction.	1	15
4b	i Methods of quantitative analysis- Spectrophotometry, MS, NMR, ESR, ORD/CD spectrometers. ii Radioisotopic methods: Geiger Muller & Liquid Scintillation Counters, Autoradiography. iii DNA Chip technology and Microarrays. iv. Biosensors. v. Computational methods: Nucleic acids and protein sequence databases, web based tools for sequence searches & comparison.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Students will be able to explain the living systems at the molecular level, especially DNA and RNA, and will be able to work in the rapidly expanding areas of genomics, cell biology, biotechnology, microbiology, diagnostics, and therapeutics

REFERENCE BOOKS

1. De Robertis,E.D.P. & De Robertis, Jr. E.M.F. (1987). Cell and Molecular biology. Lea and Febiger, U. S.
2. Dwivedi,J.N.& Singh,R.B.(1990).Essentials of Plant Techniques. Scientific Publishers,Jodhpur.
3. Ghatak,K.L.(2011). Techniques and Methods in Biology.PHI Learning Pvt.Ltd.,New Delhi.
4. Gupta, P.K. (2005). Molecular Biology and Genetic engineering. Rastogi Publications, Meerut.
5. Gupta, P.K. (2014). Cell and Molecular Biology. Rastogi Publications, Meerut.
6. Patki,L.R.,Bhalchandra,B.L.& Sapkal,V.M.(1983).An Introduction to Microtechnique.S.Chand & Company Ltd.,New Delhi.
7. Prasad,M.K. & Prasad,M.K.(1984).Outlines of Microtechnique.Emkay Publications,Delhi.
8. Raghava, N.& Raghava, R.P.(2017).Biophysical methods: Tools and Techniques in Biology. Part I-Microscopy. Scholarink.com/ Notion Press Media Pvt. Ltd, Chennai,TN.
9. Rastogi, S.C. (2010). Molecular Biology of the Cell. New Age International publisher, New Delhi.
10. Sheeler, P. & Bianchi, D.E. (2009). Cell and Molecular Biology. Wiley
11. Vidyavathi, N. & Chetan, D.M. (2009). Molecular biology. I.K.International Publishing House Pvt. Ltd., New Delhi.
12. Wilson, K. & Walker, J.(2013). Principles and Techniques of Biochemistry and Molecular biology. Cambridge University Press. London.
13. Yadav, P. R.& Tyagi, R. (2006). Biological Techniques. Discovery Publishing House, New Delhi.

Programme Name and Code: M. Sc. (Botany) –Optional papers with specialization

Course code and Name: **PGBOT 404 A – ENVIRONMENTAL BOTANY** **MM: 100**

Objectives:

- To create the awareness about environmental problems among people.
- To Impart basic knowledge about the environment and its allied problems.
- To develop an attitude of concern for the environment.

UNIT – 1		Credit	Hours
1a	i. Introduction: Relation of man with environment, National and International effects on environmental problems, applied aspects of environmental botany. ii. Ecosystem: Classification, general idea of different ecosystems.	1	15
1b	i. Environment: concept of environment, environmental segments, Biosphere. ii.Biodegradable substances:Classification of pesticides, A brief history of use of synthetic pesticides, ecological effects of pesticide pollution, Bio-accumulation and biomagnifications of pesticide.		
UNIT – 2		Credit	Hours
2a	i. General idea about pollution, Pollutants. ii. Water pollution: Physico-chemical and biological characteristics of polluted and drinking water. iii. Air pollution :Air pollutants, PAN, Ozone, Ozone layer and Ozone hole ,Green house effects ; Consequences of climate change (global warming, Sea lend rise).	1	15
2b	i. Radioactive pollution: General ideas about hazardous impacts of radiations and radioactive fallouts. ii. Noise Pollution: General idea about various levels of noise pollution and human response.		
UNIT – 3		Credit	Hours
3a	i. Environmental management: Control of environmental pollution: ii. Water management of aquatic ecosystem. iii. Purification of water sewage treatment. iv. Air methods for monitoring air pollutants air quality management and air pollution control device, role of plants in air pollution abatement.	1	15
3b	i. Soil conservation: Solid waste and their disposal, waste collection, reclamation and cycling processes. ii. Radioactive waste treatment. iii. Noise abatement.		
UNIT – 4		Credit	Hours
4a	i. Conservation: Forest, Forestation, deforestation and social forestry. ii. Renewable energy sources. iii. Non – conventional energy sources.	1	15
4b	i. Environmental education in India , international summits and treaties related to environment. ii. Control of environmental pollution through law. iii. Phytogeography: Distribution patterns, barriers and Age area hypothesis, vegetation & floristic regions of India.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

Environmental botany facilitate students' understanding of complex environmental issues from a problem-oriented, interdisciplinary perspective. Students understand key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions. Students learn to correlate ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.

REFERENCE BOOKS

1. Ambasht,R.S.& Ambasht,N.K.(2008).A Text Book of Plant Ecology.CBS Publishers,Ltd,N.Delhi.
2. Kapur,P.& Govil,S.R.(2004).Experimental Plant Ecology.CBS Publishers Pvt Ltd.,New Delhi.
3. Chapman, J.L. & Reiss, M.J. (2003). Ecology: Principles and Applications. Cambridge University Press, London
4. Kumaresan,V.& Arumugam,N.(2016).Plant Ecology and Phytogeography.Saras Publications,kanyakumari.
5. Odum,E.(1971). Fundamentals of Ecology. Saunders,Philaelphia
6. Odum, E., Barrick, M. & Barrett, G.W. (2005). Fundamentals of Ecology. Cengage Publishers (India Edition)
7. Sharma,P.D.(2015).Environmental Botany and Plant Pathology.Rastogi Publications,Meerut.
8. Sharma,P.D.(2017).Ecology and Environment. Rastogi Publications, Meerut
9. Siddhartha,K.(2013). Ecology and Environment. Kisalaya Publoications, New Delhi
10. Verma,V.(2011).Plant Ecology.Ane Books Pvt.Ltd.,New Delhi.

OR

Programme Name and Code: M. Sc. (Botany)

Course code and Name: PG**BOT 404 B – Advanced Plant Physiology** **MM: 100**

Objectives:

- This course is designed to enrich students' knowledge of plant physiology with a range of contemporary and emerging aspects of the subject.
- The course is useful to strengthen students' analytical and higher order thinking skills with respect to plant physiological processes and mechanisms.
- To know about the acquisition and storage of energy and the utilization of stored energy during plant metabolic activities.

UNIT – 1		Credit	Hours
1a	**Plant Metabolism** **i. Photosynthesis and chemosynthesis:** a. Quantasomes, biosynthesis of chlorophylls, heme compounds, role and biosynthesis of accessory pigments, photo oxidation. b. Biochemical pathways of conversion of solar energy into chemical energy and its utilization in CO_2 reduction cycle. c. Efficient and inefficient plants, bacterial photosynthesis and its utility in nature.	1	15
1b	i. **Organic acid metabolism**: Succulents, CAM pathway and its significance. ii. Plant Energetics : As controlled by photosynthesis, respiration and photorespiration iii. Respiration: Biological oxidation of carbohydrates and interconversions of the products, terminal oxidation, electron transport, role of cytochromes and other heme compounds.		
UNIT – 2		Credit	Hours
2a	i. **Nitrogen metabolism**: Synthesis and activation of amino acids, transcription and translation of genetic code, the template. Chemical regulation and biosynthesis of proteins and enzymes. Biochemistry of biological nitrogen fixation and its significance. ii. Phosphorus metabolism: Metabolism of phosphorylated compounds and their role.	1	15
2b	i. **Lipid metabolism**: Classification of fat and fatty Acids, biosynthesis and breakdown of fats and lipids, its significance. Unsaturated fatty acids. ii. **Vitamins** : Water and fat-soluble vitamins, biochemical function of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxin, biotin, folic acid, vitamin B12, ascorbic acid, vitamin A and D.		
UNIT – 3		Credit	Hours
3a	**Secondary metabolites** : i. Coumarins and lignins : Structure and synthesis. ii. Tannins : Distribution synthesis and function. iii. Flavonoids and water-soluble pigments: Synthesis and function.	1	15
3b	i. Hallucinogens: Distribution, chemistry and function. ii. Alkaloids : Pyrrole, pyrrolidine, pyridine, polyacetyl isoquinoline, tropane and indole alkaloids- their distribution, synthesis and function. iii. Saponins and sapogenins: Sterols, steroids, steroidal alkaloids-their distribution, synthesis and function.		

UNIT – 4		Credit	Hours
4a	**Growth** i. Plant growth regulators: Natural and synthetic, biochemistry and physiological effects of auxins, gibberellins, cytokinins, brassinosteroids, jasmonic acid; salicylic acid, polyamines, morphactins and cyanogenic compounds. ii. Stress physiology : Plant responses to biotic and abiotic stresses, mechanism of biotic and abiotic stress resistance, plant defence mechanisms against water stress, salinity stress, metal toxicity, freezing and heat stress and oxidative stress.	1	15
4b	i. Photobiology: Photoreceptors, Phytochromes: history, discovery, physiological properties, interaction between hormones and phytochromes, role of different phytochromes in plant development and flowering, mechanism of phytochrome signal transduction. Cryptochromes and phototropins. ii. Photomorphogenesis & Skotomorphogenesis iii. Circadian rhythms in plants: Nature of oscillator, rhythmic outputs, entrainments (inputs) and adaptive significance. iv. Flower Initiation and Floral Expression.		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completion of the course students will gain knowledge of metabolism, physiology and structure of plants together with a better understanding of regulation of growth and development and influence of environment. Students will be able to opt the field as a crop physiologists which works on a whole plant, its growth and problems, nutrient / water uptake, air exchange, photosynthesis / respiration and production and partitioning of different resources affecting growth.

REFERENCE BOOKS

1. Datta,S.C.(2010).Plant Physiology.New Age International Publishers,New Delhi.
2. Dhaka,T.S.(2019).New Pattern Plant Physiology and Plant metabolism. Pragati Prakashan,Meerut.
3. Inam,A.(2012).A Laboratory Manual of Plant Physiology, Biochemistry and Ecology.Agrobios(India),Jodhpur.
4. Jain,V.K.(2016).Fundamentals of Plant Physiology.S.Chand & Co.,Pvt.,Ltd,New Delhi.
5. Kochhar,S.L. & Gujral,S.K.(2012). Comprehensive Practical Plant Physiology.MACMILLAN Publisher India Ltd,Delhi.
6. Krishnamoorthy,H.N.(1993).Physiology of Plant Growth and Development.Atma Ram & Sons,Delhi.
7. Leopold,A.C. & Kriedemann,P.E.(1985).Plant Growth and Development.Tata McGraw-Hill Publishing Co,Ltd.,New Delhi.
8. Oxlade,E.(2010).Plant Physiology.The Structure of Plants Explained.Viva Books,New Delhi.
9. Sinha,R.K.(2015). Modern Plant Physiology.NarosaPublishing House,New Delhi.
10. Stiles,W.(2016).Principles of Plant Physiology.Discovery Publishing House,New Delhi.
11. Tivedi,P.C.(2006). Advances in Plant Physiology.I.K.International Publishing House Pvt. Ltd, New Delhi.
12. Taiz, L. & Zeiger, E. (2006). Plant Physiology. Sinauer Associates Inc., US.
13. Wilkins,M.B.(1984).Advanced Plant Physiology,Longman,London.
14. Wilkins,M.B.(1979).The Physiology of Plant Growth and Development.Tata McGraw-Hill Publishing Co.Ltd.,New Delhi.

OR

Programme Name and Code: M. Sc. (Botany)

Course code and Name: **PGBOT 404 C – Plant Pathology** **MM: 100**

Objectives:

- The course is designed to the study on: the living entities that cause diseases in plants; the non-living entities and the environmental conditions that cause disorders in plants
- To understand the mechanisms by which the disease causing agents produce diseases and the interactions between the disease causing agents and host.

UNIT – 1		Credit	Hours
1a	i. Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. ii. Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development.	1	15
1b	Fungal interactions: i. Role of antibiotics, hyphal interference, ii. Mycoparasitism, iii. Commensalism, Mycorrihizae,		
UNIT – 2		Credit	Hours

2a	Symptoms of diseases i. Fungal plant diseases ii. Bacterial plant diseases iii. Viiral plant diseases.	1	15
2b	i. Causes of plant diseases. ii. Host-parasite relationship, iii. Role of enzymes and toxins in disease development		
UNIT – 3		Credit	Hours
3a	i. Effect of infection on physiology of host. ii. Effect of environment on disease development-epiphytotics, iii. Plant disease forecasting	1	15
3b	i. Disease control by Physical methods, chemical methods, crop rotation, plant quarantines, resistance ii. Integrated pest management mechanism, its advantages, disadvantages and future prospects.		
UNIT – 4		Credit	Hours
4a	i. Principles of biological control of air- borne and soil-borne plant diseases. ii. Fungi as biocontrol agents of air borne and soil borne plant diseases (antibiosis, hyphal interference and mycoparasitism).	1	15
4b	i. A study of symptomology, histopathlogy, and identification of pathogen of various fungal diseases : Fruit and stem rot of Papaya, Red rot of sugarcane, Damping off of seedling of crop plants, Downy mildew of bajra, crucifer and pea, Powdery mildew of barley and cucurbits, Rust of linseed Cover and loose smut of barley, Wilt of Arhar, Leaf spot of crucifer, rice and turmeric, Blast of rice, Late blight of potato, Peach leaf curl, Ergot of bajra, Tikka disease of ground nut. ii. A study of symptomology in bacterial (Citrus canker, Blight of rice, Tundu disease of wheat, Soft rot of carrot/ onion), viral (Mosaic of apple, papaya, tobacco and potato, Leaf curl of tobacco, chilly and tomato, Tungru of paddy, Yellow vein mosaic and Bunchy top of banana)and M.L.O. (Sesame phyllody, Little leaf of brinjal, and Grassy shoot of sugarcane) disease		

INTERNAL ASSESSMENT

Attendance: 5 marks; Assignment / Presentation: 10 marks ; Class test: 10 marks

TRANSACTIONAL STRATEGIES

Lectures, tutorials, demonstrations, field practicals, teaching tools (photographs, models, charts, etc.), OERs, digital libraries, etc

LEARNING OUTCOMES:

After completion of the course students will learn the basic understanding of plant diseases, their causes, effects and controls. Students will integrate plant pathology principles into the understanding of their major discipline(s) through the study of agronomic diseases, horticultural diseases, turf diseases, entomology, applied microbiology, biotechnology and other relevant career fields.

REFERENCE BOOKS

1. Agrios, G.N. (2005). Plant Pathology. 5th Ed. Academic Press, New York.
2. Heitefuss, R. & Williams, P.H. (1976). Physiological Plant Pathology. Springer Verlag, Berlin, New York.
3. Mehrotra, R.S. & Aggarwal, A. (2003). Plant Pathology. 2nd Ed. Oxford & IBH, New Delhi.
4. Singh, R.S. (2002). Introduction to Principles of Plant Pathology. Oxford & IBH, New Delhi.
5. Singh, D.P. & Singh, A. (2007). Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi.
6. Upadhyay, R.K. & Mukherjee, K.G. (1997). Toxins in Plant Disease Development and Evolving Biotechnology. Oxford & IBH, New Delhi.

Programme Name and Code: M. Sc. (Botany) 100 Marks/ 4 Credit

Course code and Name: PGBOTP 405 – Practical

M. Sc. IV SEMESTER PRACTICAL (PGBOTP 405 General) 50 Marks/ 2 Credit

Practical based on Paper I- Code 401: Anatomy, Embryology and Morphogenesis **0.5 Credit**

1. Study of the plants and its parts (root, stem and leaves) by sectioning and staining
2. Prepare of smear for the study of gametophyte
3. Micro- dissection techniques for embryo and embryo sac
4. Elementary techniques for pollen germination
5. Study for various stages in reproduction from permanent slides, pre and post fertilization in embryo sac

Practical based on Paper II- Code 402: Tissue Culture and Biotechnology **0.5 Credit**

1. Preparation of MS (Murashige and Skoog) basal medium for tissue culture
2. Preparation of medium for regeneration of *Bryophyllum*
3. To prepare medium for Anther culture *Datura innoxia* using IAA, MS medium

Practical based on Paper III- Code 403: Molecular Biology and Biological Techniques. **1 Credit**

1. Study of permanent slides of chromosomes and special chromosomes (Lampbrush, Polytene and B- chromosome)
2. Study of banding pattern of DNA by electrophoresis

3. Karyotypic studies- Preparation of mitotic metaphase plates and to draw Camera Lucida drawing of chromosome and study of chromosome morphology Calculation of arm ratios, chromosome formula and symmetry of karyotype, preparation of idiograms and drawing photograph.
4. Preparation of various stains- Safranin, Fast green, Hematoxylin and Carmine
5. Study of fixation of botanical materials
6. Method for preparation of permanent slides- section cutting by the use of Microtome
7. To study the use of ocular and stage micrometers for the measurement of pollen grains and stomata
8. To extract and to detect nucleic acid from cauliflower or any floral tissue: (i) DNA by Diphenylamine test, (ii) RNA by Orcinol test
9. Isolation and purification of DNA from various sample using Agarose gel electrophoresis
10. Use of spectrophotometer in biochemical estimations- chloroplastic pigments, proteins, carbohydrates etc.
12. Demonstration of instruments: Gel Electrophoresis, Microtome , pH meter, oven, incubator, autoclave and centrifuge.

Paper V- Practical -Code PGBOTP 405 A: Special Papers 50 Marks/ 2 Credits

Based on Paper IV A-Environmental Botany

1. Physico chemical analysis of polluted water- colour, acidity, alkalinity, taste, turbidity, total solids, total dissolved solids, conductivity, hardness, pH, Biological oxygen demand, Dissolved oxygen, Chemical oxygen demand.
2. Biological examinations of polluted water- microscopic and culturing method (Density count).
3. Physico chemical analysis of polluted soil, pH, Electric conductivity, soluble cations and anions, heavy metals (base deficiency).
4. To analyze distribution pattern of selected species in an ecosystem.
5. To measure the photosynthetic rate and the specific leaf area of five tree species and observe relation between them.

OR

Paper V- Practical-Code PGBOTP 405 B: Special Papers 50 Marks/ 2 Credits

Based on Paper IV B- Advanced Plant Physiology

1. To extract the pigment from green leaf and to estimate quantitatively the percentage of Chl a, Chl b and total chlorophyll and the carotenoids spectrophotometrically.
2. Estimate the percentage of total free amino acids in any plant material spectrophotometrically by using Ninhydrin.
3. To estimate the amount of Total Nitrogen in dry leaves by Micro- Kjeldahl method.
4. To estimate total protein of fresh moong, bean seedlings by biuret reagent and Lowry's Method.
5. To estimate the percentage of reducing sugar in any plant material by Somogy- Nelson's Method.
6. To estimate ascorbic acid in plant tissue.
7. To measure the activity of amylase in germinating barley and moong seeds and to study the effect of : (i) substrate concentration, (ii) pH, (iii) Temperature, and (iv) any Heavy metal on amylase activity.
8. To study the effect of any stress (temperature, water) on germination of seeds.
9. To test the presence of fatty acid in castor seed.
10. To measure the activity of the enzyme nitrate reductase (NR) in the leaves of *Vigna mungo* and to study the effect of: (1) substrate concentration, and (2) pH, on enzyme activity.
11. To study the effect of various Plant Growth Regulators (IAA, GA_3, Kinetin, Brassins and Polyamines) on germination parameters of legume seeds.
12. To study the effect of GA_3 on flower initiation and expression in any plant.
13. To study the phenomenon of Apical Dominance in Coleus and Tulsi.
14. To study the phenomenon of Phototropism in plants.
15. To study the phenomenon of Geotropism in plants.

OR

Paper V- Practical -Code PGBOTP 405 C: Special Papers 50 Marks/ 2 Credits

Based on Paper IV C- Plant Pathology

1. Preparation of culture media and sterilization
2. Isolation of fungi and bacteria from diseases plant
3. Inoculation experiment with fungal and bacterial plant pathogens
4. Measurement of fungal spores
5. Transmission experiments (mechanical and insect transmission) of plant virus
6. Use of fungicides and plant protection appliances
7. Field collection of 50 diseased plant specimens (fungal, viral and bacterial)

Ram K Singh