

GONDWANA UNIVERSITY
GADCHIROLI

SYLLABUS

For

M. Sc.

BOTANY

SEMESTER I & II

Under
Choice Based Credit System

(CBCS)

(With effect from : 2016-17)

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Botany.

Semester I

| Core | Theory / Practical | Teaching Scheme | | | Credit | Examination Scheme | | | | | |
|--------------------------|--------------------|-----------------|-----------|-----------|-----------|--------------------|------------|------------|------------|---------------|-----------|
| | | Hrs/ week | | | | Duration in hrs. | Max. Marks | | Total | Minimum Marks | |
| | | Theory | Practical | Total | | | External | Internal | | Theory | Practical |
| PSCBOTT01 | Paper - I | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT02 | Paper - II | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT03 | Paper -III | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT04 | Paper - IV | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| Pract. – I PSCBOTP01 | Practical - I | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | 40 | 40 |
| Pract. – II PSCBOTP02 | Practical - II | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | 40 | 40 |
| Seminar - I | Seminar - I | 2 | - | 2 | 1 | | | 25 | 25 | 10 | |
| TOTAL | | 18 | 16 | 34 | 25 | | 480 | 145 | 625 | 170 | 80 |

Semester II

| Core | Theory / Practical | Teaching Scheme | | | Credit | Examination Scheme | | | | | |
|---------------------------|--------------------|-----------------|-----------|-----------|-----------|--------------------|------------|------------|------------|---------------|-----------|
| | | Hrs/ week | | | | Duration in hrs. | Max. Marks | | Total | Minimum Marks | |
| | | Theory | Practical | Total | | | External | Internal | | Theory | Practical |
| PSCBOTT05 | Paper - V | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT06 | Paper - VI | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT07 | Paper -VII | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT08 | Paper -VIII | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| Pract. – III PSCBOTP03 | Practical - III | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | 40 | 40 |
| Pract.- IV PSCBOTP04 | Practical - IV | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | 40 | 40 |
| Seminar - II | Seminar - II | 2 | - | 2 | 1 | | | 25 | 25 | 10 | |
| TOTAL | | 18 | 16 | 34 | 25 | | 480 | 145 | 625 | 170 | 80 |

Project Work/Dissertation Scheme / Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out a project work in semester IV. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.

Experimental Project Work and Field Based Project Work:

Student can carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work / Field work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

*The supervisors for the Project Work shall be from the following.

A person shall be an approved faculty member in the relevant subject.

OR

Scientists of National Laboratories / Regional Research Laboratories/ Experts from R&D in Industry who are approved by competent authority in such facilities by the Union Government / the State Government / Gondwana University / Other Universities recognized by UGC.

The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.

The examiners will evaluate the Project Work/Dissertation taking into account the coverage of subject matter, arrangement and presentation, references, etc.

| | | |
|---------------------------------|------------|--|
| For written Project work | 40 | Marks – Evaluated jointly by External & Internal examiner |
| Oral Presentation | 20 | Marks – Evaluated jointly by External & Internal examiner |
| For Viva-Voce | 20 | Marks – Evaluated by External examiner |
| Internal Assessment | 20 | Marks – Evaluated by Internal examiner |
| Total | 100 | |

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in two copies to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.
3. For the purpose of internal assessment the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
4. If the student does not appear for the Practical Exam he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.
5. General guidelines for Internal Assessment are:
 - a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
 - b) There shall be three assignments (as described above) per course.
 - c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the Internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
 - d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
 - e) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she proposes to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).
 - f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

Practical Examination

1. Each practical carries 100 marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.
4. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

5. The certificate template shall be as follows:

CERTIFICATE

Name of the college / institution _____

Name of the Department: _____

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _____ of M. Sc. _____ Semester _____ during the academic year _____. The candidate has satisfactorily completed the experiments prescribed by Gondwana University Gadchiroli for the subject _____

Dated ___ / ___ / _____

Signature of the teacher who taught the examinee

Head of the Department

1. _____

2. _____

SEMESTER I

PRACTICAL I Course code : PSCBOTP01

Credit - 04

Time : 6 Hours

Full marks : 80

| | |
|--|----|
| Q. 1 To identify the given Cyanobacterial material A . | 06 |
| Q.2 To identify two algal forms B, C , from the given mixture. | 06 |
| Q.3 To identify the given fungal culture D | 06 |
| Q. 4 To identify the given pathogen in the given material E . | 06 |
| Q. 5 To prepare a Temporary micropreparation of the given Bryophytic F material and identify it. | 12 |
| Q 6. To prepare a Temporary micropreparation of the given Pteridophytic G material and identify it. | 12 |
| Q. 7 Comment on the given spot H (Cyanobacteria/Bacteria), I (Algae), J (Fungi), K (Plant Pathology) L (Bryophyte) , M (Pteridophyte). | 12 |
| Q.8 Viva-voce | 10 |
| Q. 9 Practical Record and tour report | 10 |

SEMESTER I

PRACTICAL II Course code : PSCBOTP02

Credit - 04

Time : 6 Hours

Full marks : 80

| | |
|---|----|
| Q. 1 To prepare a double stained micropreparation of the given gymnospermic material A and identify it. | 12 |
| Q.2 Comment on the given fossil specimen B | 12 |
| Q.3 One experiment from Cytology C | 12 |
| Q. 4 One experiment from Genetics D | 12 |
| Q. 5 Comment on the given spot E (Gymnosperm) F (Paleobotany), G (Cytology), H (Genetics) | 12 |
| Q.6 Viva-voce | 10 |
| Q. 7 Practical Record and tour report | 10 |

SEMESTER II

PRACTICAL III Course code : PSCBOTP03

Credit - 04

Time : 6 Hours

Full marks : 80

| | |
|--|----|
| Q. 1 To perform the given physiological experiment A and report The findings | 15 |
| Q.2 To quantify the given metabolite in the given sample B | 10 |
| Q.3 To study the cytohistological zonation in SAM of given material C | 10 |
| Q. 4 To perform the given exercise based on plant development D | 10 |
| Q. 5 Write a note on given stage of micro- or megasporogenesis E | 06 |
| Q. 6 Spotting: F (Physiology), G (Plant development), H (Reproduction) | 09 |
| Q. 7 Viva-voce | 10 |
| Q. 8 Practical Record | 10 |

SEMESTER II

PRACTICAL IV Course code : PSCBOTP04

Credit - 04

Time : 6 Hours

Full marks : 80

| | |
|---|----|
| Q. 1 One experiment from paper VII A | 14 |
| Q.2 One experiment from paper VII B | 10 |
| Q.3 One experiment from paper VIII C | 14 |
| Q. 4 One experiment from paper VIII D | 10 |
| Q. 5 Spotting: E (Paper VII), F (Paper VII), G (Paper VIII), H (Paper VIII) | 12 |
| Q. 6 Viva-voce | 10 |
| Q. 7 Practical Record and field diary | 10 |

M. Sc. Botany Syllabus

Semester I

Course code- PSCBOTT01

Credit - 04

PAPER –I: Microbiology, Algae and Fungi

UNIT – I

General Microbiology :

History – Contributions made by Leeuwenhoek, Pasteur, Robert Hook, Jenner, Waksman, Iwanowsky. Koch” s Postulate.

Bacteria – Structure, morphology, reproduction.

Viruses – General account; Morphology and ultrastructure of TMV, Bacteriophage;

Introduction to viroids, prions and interferon.

Archaeobacteria and eubacteria: General account; ultrastructure, nutrition and reproduction, biology and economic importance; **Cyanobacteria:** *Microcystis, Lyngbya, Nostoc, Scytonema, Gloeotrichia and Stigonema.*

UNIT - II

Phycology:

Criteria for classification of algae: Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Pheophyta and Rhodophyta; pigments, reserved food, flagella

Algae in diversified habitats (terrestrial, freshwater, marine), thallus organization; cell ultrastructure; reproduction (vegetative, asexual, sexual); algal blooms, algal biofertilizers; algae as a food, feed and uses in industry.

UNIT –III

General account: Classification of Fungi (recent trends and criteria used in classification); Physiology of Fungi (with reference to biotrophs, hemibiotrophs, symbionts); Fungal Cytology : Heterothallism, heterokaryosis, parasexual cycle.

Comparative study, classification and evolutionary trends in the following:

Myxomycota: Protist characters and general account with special reference to *Physarium* and *Plasmodiophora*

Eumycota: i. Oomycetes : *Saprolegnia, Synchytrium, Phytophthora, Peronospora*, ii.

Zygomycetes : *Mucor, Rhizopus, Syncephalastrum, Cunninghamella*

UNIT – IV

Comparative study, classification and evolutionary trends in the following: iii.

Ascomycetes: *Saccharomyces, Phyllactinia, Chaetomium, Xylaria*, iv. Basidiomycetes:

Melampsora, Puccinia, Ravenelia, Ustilago, Polyporus, v. Deuteromycetes:

Helminthosporium, Fusarium, Colletotrichum, Phoma

Plant Pathology : Symptomology, histopathology, etiology and identification of diseases with reference to following fungal, bacterial and viral diseases (Paddy blast, wheat rust, bunt of wheat, smut of jowar, black arm of cotton, red rot of sugarcane, citrus canker, gummosis, leaf curl of papaya, potato blight.)

Laboratory Exercises:

Classification and type study of the following classes

Cyanobacteria: *Microcystis, Lyngbya, Nostoc,*

Scytonema, Gloeotrichia and Stigonema.

Prochlorophyta : *Prochloron*

Chlorophyta: *Pandorina, Eudorina, Stigeoclonium, Ulva, , Chlorella, Scenedesmus,*

Caulerpa, Valonia, Acetabularia.

Phaeophyta : *Spacelaria, Padina, , Turbinaria.*

Rhodophyta : *Nemalion, Gelidium, Gracilaria, Corallina, Polysiphonia.*

Euglenophyta : *Euglena, Phacus.*

Bacillariophyta : *Cyclotella, Synedra, Cymbella, Navicula, Gomphonema.*

Morphological Studies of Fungi (any 15 of the following)

Stemonities, Perenospora, Phytophthora, Albugo, Mucor, Rhizopus, Yeast, Aspergillus,

Penicillium, Chaetomium, Taphrina, Peziza, Erisyphe, Phyllactenia, Uncinula, ,

Melamosora, Uromyces, Drechslera, Ravenallia, Ustilago, Polyporus, Morchella, Cyathus, ,

Alternaria, Helminthosporium, Curvularia, Colletotrichum, Phoma, Plasmodiophora,

Cercospora, Fusarium, Claviceps.

Symptomology of some diseased plants (any 7 of the following).

White rust of Crucifers, Downy mildew, powdery mildew, Rusts, Smuts, Ergot, Groundnut

leaf spot (Tikka disease), False smut of paddy, red rot of Sugarcane, Wilt disease, Citrus

canker, Angular leaf spot of cotton, Potato blight, Leaf mosaic of bhindi/ papaya, Leaf curl

of tomato/Potato/Papaya, Little leaf of brinjal.

Identification of Fungal cultures (Any 5)

Rhizopus, Mucor, Aspergillus, Penicillium, Drechslera, Curvularia. Phoma, Colletotrichum,

Alternaria, Helminthosporium.

Field study: For collection and studying fungal flora

Suggested Readings:

1. Kumar HD (1988) Introductory Phycology. Affiliated East-West Press Ltd. New Delhi
2. Morris I (1986) Introduction to the Algae. Cambridge University Press, UK
3. Round FE 1986 The Biology of Algae. Cambridge University Press, UK
4. Mandahar CL 1978 Introduction to Plant Viruses. Chand & Co. Ltd., New Delhi
5. Agrios, G.N. (1980) Plant Pathology, academic Press, INC, New York.
6. Ainsworth, G.C. and A.S.Sussman (eds). The Fungi, An advance Treatise Vol.I, II, III & IV Academic Press, New York.
7. Alexopoulos, C.J. (1962). Introductory Mycology John Wiley Eastern Pvt.Ltd.
8. Alexopoulos, C.J. and Mims C.W. (1979). Introductory Mycology 3rd Edition, John Wiley and Sons, Inc. Wiley, New York.
9. Alexopoulos, C.J., Mims and Black well (1996) 4th ed. John Wiley and Sons, Inc.Wiley, New York
10. Aneja, K.R. (1993) Experimental in Microbiology, Plant Pathology & Tissue Culture, Wiswa Prakashan, New Delhi.
11. Bessey, E.A. (1950) Morphology and Taxonomy of Fungi. The Blakiston co. Philadelphia.
12. Bilgrami, K.S. and H.C.Dube (1985) A text Book of Modern Plant Pathology, Vikas Publication House, New Delhi.
13. Barnett, J.H. (1968) Fundamentals of Mycology. The English Language Book Society and Edward Arnold Publication, Limited.
14. Dube, R.C. and D.K.Maheshwari (1999) A.Text Book of microbiology, S. Chand & Co. Ltd.
15. Dube, R.C. and D.K.Maheshwari (2000) Practical Microbiology - S.Chand & Co. Ltd.
16. Gupta, V.K. and M.K.Behl (1994) Indian Plant Viruses and Mycoplasma Kalyani Publishers, 1/1, Rejinder Nagar, Ludhiana.
17. Jha, D.K. (1993) A Text Book of Seed Pathology, Vikas Publication House.
18. Mehrotra, R.S. (1989) Plant Pathology, Tata McGraw Hill.
19. Mehrotra, R.S. and K.R.Aneja (1998) An Introduction to Mycology, New Age Intermediate Press.
20. Pelzer, M.J. , Jr.Cahn, E.C.S. and N.R.Krieg (1993) Microbiology, Tata McGraw Hill.
21. Preece and Dickeson. Ecology of leaf surface microorganism Academic Press, New York.
22. Rangaswamy, G. and A.Mahadevan (1999) Diseases of Crop Plant in India, Prentice Hall of India.
23. Raychoudhari, S.P. and Nariani, T.K. (1977) Virus and Mycoplasma Diseases of Plant in India, Oxford and IBH Publication Co.
24. Schlegel, H.G. (1996) General Microbiology, 7th Edition, Cambridge University Press.
25. Snowdon, A.L. (1991) A colour Atlas of Post harvest diseases & disorders of fruits & vegetables Vol.I & II Wolfe Scientific, London.
26. On line Journals available on UGC -VSAT

M. Sc. Botany Syllabus

Semester I

Course code : PSCBOTT02

Credit - 04

PAPER –II: Bryophytes & Pteridophytes

UNIT - I

General characters, distribution, classification, ecology of Bryophytes, Bryophytes as ecological indicators, morphogenesis in bryophytes, fossil history of bryophytes, cytology of bryophytes, regeneration in bryophytes, modern trends in taxonomy.

UNIT - II

General account in-

Hepaticopsida: Sphaerocarpaceae, Takakiales

Anthocerotopsida: Anthocerotales,

Bryopsida: Sphagnales, Polytrichales..

UNIT - III

General characters, distribution, classification, evolution of stele, heterospory and seed habit, apospory and apogamy; Important contributions of Indian Pteridologists, General account of Ryniopsida, Psilopsida, Lycopsida [protolpidodendrales, Lycopodiales, Selaginiales, Isoetales.

UNIT - IV

General account of Sphenopsida [Hyeniales, Equisetales], Filicopsida [Ophioglossales, Filicales, Salviniales, Marsileales], Tracheophyta [Progymnospermosida].

BRYOPHYTES:

Laboratory Exercises:-

Study of morphological and reproductive characters of representative members mentioned in the syllabus using cleared whole mount preparations, dissections and sections. Preparation of permanent slides is necessary. Study of bryophytes in their natural habitats.

Botanical excursion outside the state is compulsory to study the bryophytes in their natural conditions.

PTERIDOPHYTES:

Laboratory Exercises:-

Pteridophytes-

Study of fossil forms (specimens and permanent micropreparations).

Study of living forms: Morphological, anatomical and reproductive characters of the forms mentioned in the syllabus. Anatomical characters to be studied either by taking free hand sections (t.s./ l.s.) and by observing the permanent micropreparations. Preparations of permanent slides are essential.

Suggested Readings

1. Andrews H.N. Jr. (1961) *Studies in Paleobotany* (Jonh Wiley & Sons, New York)
2. Arnold C.A. (1947) *An introduction to Paleobotany* (McGraw Hill, New York) 13
3. Banks H.P. (1968) *The early history of Land plants. In evolution and environment*, ed. E.T. Drake. New Haven: Yale Univ. Press, pp, 73-107.
4. Banks H.P. (1970) *Evolution and plants of past.* (Belmont, California, Wadsworth).
5. Banks, H. P. (1975). *Reclassification of Psilophyta*, *Taxon*. 24, 401-13.
6. Berrie, G. K. (1963). *Cytology and Phylogeny of liverwoets.* *Evolution* 17, 347-357.
7. Bierhorst D.W (1971) *Morphology of vascular plants*, New York (Mac Millan)
8. Campbell, D. H. (1961). *The evolution of the Land Plants* (central Book Depot, Allahabad)
9. Cavers, F. (1910). *The interrelationship of Bryophyta I-IV.* *New Phytologist*. 9
10. Cavers, F. (1911). *The interrelationship of Bryophyta VII-IX.* *New Phytologist*. 10.
11. Chrysler M.A. (1910) *The fertile spike in Ophioglossaceae.* *Ann. Bot.* 24:1-18.
12. Delevoryas T. (1962) *Morphology and Evolution of fossil plants* (Holt, Rinehart and Winston, New York).
13. Eames A.J (1936) *Morphology of vascular plants, lower groups* (McGraw Hill, New York).
14. Foster A.S.and E.M Gifford Jr. (1959) *Comparative morphology of vascular plants* Freeman, San Fransisco.
15. Grolle, R. (1963). *Takakia in Himalayas*, *Ost. Bot. Zeitscher*, 110:444-447.
16. Gupta K.M. (1962) *Marsilea*, *Botanical monograph no. 2* (CSIR, New Delhi).
17. Ingold, C. T. (1939). *Spores discharge in land plants* (Oxford London)
18. Kashyap S.R. (1929). *Liverworts of the western Himalayas and The Punjab Plain1*(*Chronica Botanica*)
19. Kashyap S.R. (1933). *Liverworts of the western Himalayas and The Punjab Plain2*(*Chronica Botanica*)
20. Lacey, W. A. (1969). *Fossil Bryophytes.* *Biological Reviews*, 44,189-205.
21. Mehra , P.N. and O. N. Handoo (1953). *Morphology of Anthoceros erectus and A. himalayensis and the phylogeny of the anthocerotales.* *Bot. Gaz.*114:371-382.
22. Parihar N. S. (1976). *An introduction to Embriyophyta, Bryophyta* (Centaral Book House,

Allahabad)

23. Parihar N.S. (1977) The biology and morphology of the Pteridophytes (Central Book Depot, Allahabad).
24. Pichi- Sermolli REG (1959) Pteridophyta in vistas in botany, WB Turrill, ed. (Pergamon Press, London) pp 421-493.
25. Proskauer J. (1951). Study in Anthocerotales, III, The Bryologist 53,165-172.
26. Puri Prem (1985) Bryophytes- A broad perspective.
27. Ramanujam CGK (1992) Origin and evolution of lycopods Paleobotanist 41, 51-57.
28. Rashid A. (1982) (4th edn) An introduction to pteridophyta (Vikas Publ House Pvt Ltd.)
29. Schuster R. (1966). The Hepaticae and Anthocerotae of North America. East of the Hundredth meridian, Newyork (Colombia University Press).
30. Scott D.H. (1908) Studies in fossil botany. London, Black Part 2.
31. Scott D.H. (1920-1923) Studies in fossil botany. (A & C Black London.)
32. Sharma O.P (1996) Textbook of pteridophyta (Mac Millan India Ltd, New Delhi)
33. Smith A. J. E. (1986). Bryophyte phylogeny fact or Fiction? Journal of Bryology, 14,83-
34. Smith G. M. (1955). Cryptogamic Botany-vol. 2 Bryophyta and Pteridophyta (McGraw Hill Book compony, Newyork)
35. Smith W. N. and G. W. Rothwell (1993). Paleobotany and the evolution of plants (Cambridge Univ. press)
36. Sporne K.R. (1962) The morphology of pteridophyta (Hutchinson Univ. Library, London)
37. Steil W.N. (1939) Apogamy, Apospory and Parthenogenesis in the pteridophyta, Bot. rev, 5, 433-453.
38. Steward W.N. (1983) Paleobotany and the evolution of plants. 1st ed. New York, (Cambridge Univ. press)
39. Surange K.R and S. Chandra (1972) Fructification of Glossipteridae from India, Paleobotanist 21, 1-17.
40. Taylor T.N. (1988) the origin of land plants- Some answers more questions, Taxon, 37, 805-33.
41. Udar ram (1970) An introduction to bryophyte (Shashidhar malviya Prakashan, Lucknow)
42. Udar Ram, Srivastava S.C. and Kumar Dinesh (1970) Genus *Buxbaumia* in India, Curr. Sci. (India) 39, 14-15.
43. Walton J. (1925) Carboniferous Bryophyta I. Hepaticae. Annals of Botany, 39, 563-72.
44. Walton J. (1928) Carboniferous Bryophyta II. Hepaticae & Musci. Annals of Botany, 42, 707-16.
45. Walton J. (1940) An introduction to the study of fossil plants. A& C Black, London.
46. Watson E.V. (1967) The structure and life of Bryophytes, 2nd ed, London, Hutchinson.
47. Wilson C.W. (1942) The telome theory and the origin of the stamen. Am. J Bot., 29, 759-764.
48. Zimmermann W. (1952) Main results of the "Telome theory". The Paleobotanist, Birbal Sahni Memorial Volume, 456-70.

M. Sc. Botany Syllabus

Semester I

Course code ; PSCBOTT03

Credit - 04

PAPER –III: Gymnosperms and Paleobotany

UNIT - I – Paleobotany

Introduction : Plant fossils – Preservation, preparation, age determination, geological time scale; Fossil record – systematic, reconstruction and nomenclature; Applied aspects of paleobotany.

UNIT - II – Gymnosperms

General account, distribution (living, Fossil), origin, systems of classification, economic importance.

Comparative morphology and evolutionary tendencies of

1. Pteridospermales – Lyginopteridaceae (*Calymotheca hoeninghausii*, *Heterangium*, *Spherostoma*) Medullosaceae (*Medullosa*, *Trignocarpus*)
2. Cycadales – Cycadaceae; Fossil history (*Baenia*, *Nilssonia*, *Androstrobus*)
3. Cycadeoidales – Williamsoniaceae, Cycadoeoidaceae

UNIT - III

4. Cordaitales (General account and relationships)
5. Caytoniales (General account and relationships)
6. Glossopteridales (General account and relationships)
7. Pentoxylales (General account and relationships)
8. Gnetales (General account and relationships)

UNIT - IV

9. Ginkgoales – *Ginkgo*, *Baiera*, *Trichopitys*
10. Coniferales – (Morphology, reproductive organs, gametophytes, embryo)
11. Taxales – *Taxus*

Laboratory Exercises:-

Comparative Study of vegetative and reproductive parts of – *Cycas*, *Zamia*, *Cedrus*, *Abies*, *Pinus*, *Cupressus*, *Cryptomeria*, *Taxodium*, *Podocarpus*, *Agathis*, *Thuja*, *Gnetum*, *Ephedra*, *Juniperus*, *Cephalotaxus*, *Taxus*

Permanent micropreparations to be submitted by the students.

Ginkgo: Morphology to be studied from Museum specimens & anatomy from permanent slides only.

Study of important fossil gymnosperms from material and permanent slides.

Visit to palaeobotanical Institutes, localities and collection of specimens.

Field visits to ecologically different localities to study living gymnosperms.

Suggested Readings:

1. Stewart, W.N. and Rothwell G.W. (1993), *Palaeobotany and the Evolution of Plants*, Cambridge University Press.
2. Foster A.S. & Gifford F.M. (1967): *Comparative morphology of vascular plants*, Freeman Publishers, San Fransisco.
3. Eames, A.J.(1974): *Morphology of Vascular Plants- lower groups*, Tata Mc-Graw Hill publishing Co., New Delhi.
4. Arnold, C.A. (1947): *Introduction to Palaeobotany*, Mc-Graw Hill Book Co. Inc., New York and London.
5. Kubitzki K. (1990), *The families and genera of vascular plants Pteridophytes and Gymnosperms*, Springer Verlag, New York
6. Agashe, S.N. (1995), *Palaeobotany*, Oxford & IBH, New Delhi.
7. Biswas, C & Johri, B.N. (2004), *The Gymnosperms*, Narosa Publishing House, New Delhi.
8. Coulter J.M. & Chamberlain C.J.(1978): *Morphology of Gymnosperms*, Central Book Depot, Allahabad.
9. Kakkar, R.K.and Kakkar, B.R. (1995), *The Gymnosperms (Fossils & Living)*, Central Publishing House, Allahabad.
10. Sharma O.P. (2002) *Gymnosperms*, Pragati Prakashan, Meerut.
11. Siddiqui, K.A. (2002) *Elements of Palaeobotany*, Kitab Mahal, Allahabad.
12. Bhatnagar, S.P. and Moitra A. (1996), *Gymnosperms*, New Age International Pvt. Ltd., New Delhi.
13. Singh, H. (1978), *Embryology of Gymnosperms*, Encyclopedia of Plant Anatomy X, Gebryder, Bortragear, Berlin.
14. Pant, D.D. (2003): *Cycas and allied Cycadophytes*, BSIP, Publications.
15. Bierhorst D.W. (1971): *Morphology of vascular plants* McMillan, New York.
16. Thomas, B.A. & Spicer R.A. (1987): *The Evolution and Palaeobiology of land plants*. Discordies Press, Fortland, USA.
17. Spicer, R.A. & Thomas, B.A. (1986) *Systematic and taxonomic approaches in Palaeobotany*. Systematic Association Special Volume.
18. Chamberlain C.J. (1986); *Gymnosperms, structure and Evolution*, CBS publishers and distributors, New Delhi. On line Journals available on UGC -VSAT

M.Sc. Botany Syllabus

Semester I

Course code : PSCBOTT04

Credit - 04

Paper- IV Cytology and Genetics

UNIT - I

Mendel's laws of inheritance; chromosome theory of inheritance; deviations from Mendel's findings; Penetrance and expressivity; Modifiers, suppressors and pleiotropic genes; multiple alleles and isoalleles (example Corn, *Drosophila* and *Nicotiana*); multigene families (globin and immunoglobulin genes); sex determination and dosage compensation in plants, *Drosophila*, *C. elegans*.

UNIT – II

Chromatin organization: Chromosome structure and packaging of DNA; molecular organization of centromere and telomere, rRNA genes, euchromatin and heterochromatin; Karyotype analysis and evolution, banding patterns; specialized types of chromosomes: polytene, lampbrush, B-chromosome, sex chromosome; molecular basis of chromosome pairing, C- value paradox, Cot curve and its significance.

UNIT – III

Structural and numerical changes in chromosomes; origin, breeding behavior of duplications, deficiency, inversion and translocation heterozygotes; effect of aneuploidy on plants; transmission of trisomics and monosomics and their use in chromosome mapping; complex translocation heterozygotes, translocation tester sets; Robertsonian translocation.

UNIT – IV

Mutations: Spontaneous and induced; physical and chemical mutagens; molecular basis; transposable genetic elements; site directed mutagenesis; role of mutations in crop improvement; induction of polyploidy

Epigenetics: Introduction; paramutations in maize; Callipygh sheep; role of histones; DNA methylation; Epigenetics and Lamarckism; Epigenome and epigenomics.

Laboratory Exercises:-

1. To study the effect of mutagen treatment on germination, seedling height and cell division.
2. To study the spontaneous and induced chromosomal aberrations in pollen mother cells.
3. To study the effect of mutagen treatment on pollen fertility.
4. To study the karyotype of given organism.
5. To study the chiasma frequency in the given material.
6. To study linear differentiation of chromosomes by chromosome banding.
7. To perform the site directed mutagenesis in the given system.

Suggested Reading

Gupta P K 2007 Genetics: Classical to Modern. Rastogi Publications, Meerut.

18

Hexter W and Yost Jr. H T 1977 The Science of Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.

Hartl D L and Jones E W 1998 Genetics: Principles and Analysis (4th ed.). Jones and Barflett Publishers, USA.

Khush G S 1973 Cytogenetics of Aneuploids. Academic press, New York.

Snustad D P and Simmons M J 2000 Principles of Genetics (2nd ed.) John Wiley and Son Inc., USA.

M. Sc. Botany Syllabus

Semester II

Course code : PSCBOTT05

Credit - 04

Paper- V Plant Physiology and Biochemistry

UNIT – I

1) The Scope of plant physiology

2) Photosynthesis: Evolution of photosynthetic apparatus, pigments, Light, light harvesting complex, Mechanism of electron transport, Photo protective mechanism, CO₂ fixation, C₃, C₄ and CAM pathway, Photorespiration, photosynthesis Physiological and ecological consideration (photosynthetic responses to light by the intact leaf, photosynthetic responses to carbon dioxide and temperature) coupled reaction and ATP Synthesis, the chemiosmotic-coupling hypothesis, ATP Synthesis in chloroplast and in mitochondria

UNIT –II

Respiration:- introduction, the respiratory substrate, fermentation, anaerobic and aerobic respiration, mechanism of respiration ,Glycolysis, Citric acid cycle, oxidative pentose phosphate pathway, Plant mitochondrial electron transport, alternative pathway of electron transport chain, cyanide resistant chain, metabolic pool, respiratory ratio, measurement of R.Q., Regulation of respiration ,respiratory enzymes, the non oxidat ive enzymes, the oxidative enzymes, factor affecting the rate of respiration

UNIT –III

1) Carbohydrates Metabolism

General classification and properties of carbohydrates, synthesis of starch and Sucrose, catabolism (degradation) of starch and sucrose

2) Lipids Metabolism

General classification and properties of lipids, fatty acid biosynthesis, synthesis of membrane

lipids, synthesis of structural lipids, synthesis and catabolism of storage lipids.

3) **Metabolism of amino acids**

General classification and properties of amino acids, amino acid biosynthesis in plants, assimilation of inorganic nitrogen into n-transport amino acids, GS/GOGAT Cycle

4) **Nitrogen metabolism**

Nitrogen cycles, Biological Nitrogen fixation by free-living and symbiotic bacteria, nif genes

5) **Sulfur and Phosphate assimilation by the plants**

UNIT -IV

Enzymes: - nomenclature and classification of Enzymes, Isoenzymes, Allosteric Enzymes, Multienzymes, Ribozymes, Lysozymes, Ribozymes & Abzymes and Coenzymes enzyme kinetics, mode and mechanism of Enzyme action (Regulation of Enzyme activity), Activators & Inhibitors, properties of Enzymes, factors affecting Enzyme activity pH, Buffer, reaction kinetics, colligative properties

Solute transport and photo-assimilate translocation:- Mechanism of water transport through xylem; Pathway of translocation patterns of Translocation through phloem;

Source and sink, Materials Translocated in the Phloem i.e. Sucrose, Amino acids, Hormones and some inorganic ions, Rate of Movement, Phloem loading: from chloroplast to sieve elements, Phloem Unloading: sink-to-source Transition, mechanism of translocation in the phloem

Laboratory Exercises:-

To study the effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. phosphatase, nitrate reductase).

To study the effect of substrate concentration on activity of enzyme and determination of its K_m value.

Demonstration of the substrate inducibility of the enzyme nitrate reductase.

Determination of succinate dehydrogenase activity, its kinetics and sensitivity to inhibitors.

To determine the total carbohydrate content in the given sample

Estimation of Pectic Substances-gravimetric method

To prove Berr-Lambert's law using a suitable solution.

Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophyll and carotenoids.

To determine the chlorophyll a/ chlorophyll b ratio in C3 and C4 plants.

Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.

Preparation of standard curve of protein (BSA) and estimation of protein content in extracts of plant material by Lowry's or Bradford's method.

Preparation of Leaf Protein Concentrates from green vegetables.

Determination of reducing sugars by Nelson – Somogyi Method

Suggested Readings (for laboratory exercises):

- 1 **Bajracharya, D. 1999.** Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
- 2 **Cooper, T.G. 1977.** Tools in Biochemistry. John Wiley, New York, USA.21
- 3 **Copeland, R.A. 1996.** Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis. VCH Publishers, New York.
- 4 **Dennison C. 1999.** A guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht, The Netherland.
- 5 **Devi, P. 2000.** Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
- 6 **Dryer, R. L. and Lata, G. F. 1989.** Experimental Biochemistry. Oxford University Press, New York.
- 7 **Hames, B.D.(Ed.).1998.** Gel Electrophoresis of Proteins: A Practical Approach, 8th edition. PAS, Oxford University Press, Oxford, UK.
- 8 **Harborne, T.C. 1981.** Phytochemical Methods: A Guide to Modern Techniques of Plants Analysis. Chapman& Hall, London.
- 9 **Moore, T.C. 1974.** Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
- 10 **Ninfa, A. J. and Ballou, D. P. 1998.** Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.
- 11 **Plummer, D.F. 1988.** An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- 12 **Scott, R.P.W. 1995.** Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.
- 13 **Wilson, K. and Goulding, K.H.(Eds), 1986.** A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London,UK.
- 14 **Wilson, K. and Walker, J. 1994.** Practical Biochemistry: Principles and Techniques, 4th edition. Cambridge University Press, Cambridge, UK.
- 15 **Sadasivam and Manikum: Biochemical Methos , New Age International (p) Limited Publishers 4835/24, Ansari Road, Daryaganj, New Delhi- 110002**

SUGGESTED READINGS (FOR THEORY):

- 1 **Buchanan, B. B., Gruissem, W. and Jones, R.L. 1989.** Biochemistry and Molecular Biology of plants. American Society of Plant Physiologists, Maryland, USA.
- 2 **Dennis, D.T., Turpin, D. H., Lefebvre, D.D. and Layzell, D.B. (eds).1997.** Plant Metabolism (2nd Ed.) Longman, Essex, England.
- 3 **Gaiston, A.W.1989.** Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.

- 4 **Hooykass P.J.J., Hall, M. A. and Libbenga, K.R.(eds).1999.** Biochemistry and Molecular Biology of plant Horm. Elsevier, Amsterdam, The Netherlands.
- 5 **Hopkins, W.G. 1995.** Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
- 6 **Lodish, H., Berk, A., Zipursky S.L., Matsudaira, P., Baltimore, D and Darnell, J. 2000.** Molecular Cell Biology (4th ed). W. H. Freeman and Company. New York ,USA.
- 7 **Moore, T.C. 1989.** Biochemistry and Physiology of Plant Hormones (2nd ed). Springer-Verlag, New York, USA.
- 8 **Nobel, P.S.1999.** Physicochemical and Environmental Plant Physiology (2nd ed). Academic Press, Diego, USA.
- 9 **Salisbury, F.B. and Ross, C.W.1992:** Plant Physiology (4th ed). Wadsworth Publishing Co., California, USA.
- 10 **Singhal G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee.1999:** Cocepts in Photobiol Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
- 11 **Taiz, L. and Zeiger, E. 1998:** Plant Physiology. Sinaucr Associates, Inc., Publishers, Massachus, USA.
- 12 **Thomas,B. and Vince-Prue,D.1997:** Photoperiodism in Plants (2nd ed). Academic Press, San Diego, USA.
- 13 **Westhoff, P.1998:** Molecular Plant Development: From gene to plant. Oxford University Press, Oxford, UK.
- 14 **Dey, P. M. And Harborne, J. B. 2000:** Plant Biochemistry ,Harcourt Asia PTE Ltd. A Harcourt Publishers International Company, 583 Orchard Road 09-01 Forum Singapore-238884
- 15 **Ranjan, purohit, Prasad 2003:** Plant Hormones Action and Application, Agrobios(India), agro house, behind Nasrani cinema Chopasani Road, Jodhpur -34

M. Sc. Botany Syllabus

Semester –II

Course code : PSCBOTT06

Credit - 04

Paper- VI: Plant Development and Reproduction

UNIT - I

Plant growth

Kinetics and pattern of growth

Shoot Development – Organization of shoot apical meristem (SAM); cytological and molecular analysis of SAM; control of cell division and cell communication; control of tissue differentiation.

Phytohormones: Classification, chemical nature and their role in plant development.

UNIT - II

Leaf growth and differentiation – Determination; phyllotaxy; control of leaf form; differentiation of epidermis (with special reference to stomata & trichomes) and mesophyll.

Root Development – Organization of root apical meristem (RAM); vascular tissue differentiation; lateral root hairs; root microbe interactions.

Flower Development – Physiology of flowering, florigen concept and photoperiodism, Genetics of floral organ differentiation; homeotic mutants in *Arabidopsis* and *Antirrhinum*.
Pollination mechanisms and vectors

UNIT - III

Male Gametophyte – Structure of anther, microsporogenesis, tapetum; pollen development and gene expression; male sterility; sperm dimorphism; pollen germination; pollen tube growth and guidance.

Female Gametophyte – Ovule types; megasporogenesis; organization of embryo sac; structure of embryo sac cells.

Pollen – pistil interaction and fertilization; Structure of the pistil; pollen – stigma interactions, double fertilization; *in vitro* fertilization.

UNIT - IV

Seed Development and fruit growth – Endosperm development; embryogenesis; ultrastructure and nuclear cytology; storage proteins of endosperm and embryo; polyembryony; apomixes; embryo.

Germination of seed: Biochemical and hormonal control.

Latent life – Dormancy : Importance and types of dormancy; seed dormancy; overcoming seed dormancy; bud dormancy.

Senescence and Programmed Cell Death (PCD) – Basic concepts; types of cell death, PCD in life cycle of plants; metabolic changes associated with senescence and its regulations; influence of hormones and environmental factors on senescence.

Laboratory Exercises/ Field Exercises (Any 12):

1. Tissue systems, meristem, vascular and cork cambium
2. Internal structure of root, stem and leaf (dicot and monocot), advanced secondary growth in dicot stem and root.
3. Anomalies in primary and secondary structure of stem
4. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
5. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as *Coleus*, *Kalanchoe*, *Tobacco*. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
6. Study of alternate and distichous, alternate and superposed, opposite and superposed; opposite and decussate leaf arrangement.
7. Examination of rosette plants (*Launaea*, *Mollugo*, *Raphanus*, *Hyoscyamus* etc) and induction of bolting under natural conditions as well as by GA treatment.
8. Microscopic examination of vertical sections of leaves such as *Cleome*, *Nerium*, Maize and Wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C3 and C4 leaf anatomy of plant.
9. Study of epidermal peels of leaves such as *Coccinia*, *Gaillardia*, *Tradescantia*, *Thunbergia*, etc. to study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.
10. Study of whole roots in monocots and dicots. Examination of L.S. of root. from permanent preparation to understand the organization of root apical meristem and its derivatives. (use maize, aerial roots of banyan, *Pistia*, *Jussieua* etc.). Origin of lateral roots. Study of leguminous roots with different types of nodules.
11. Study of microsporogenesis and gametogenesis in sections of anthers.
12. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena*, etc.)
13. Tests for pollen viability using stains and *in vitro* germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
14. Estimating percentage and average pollen tube length *in vitro*.
15. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
16. Pollen-pistil interaction, self-incompatibility, *in vitro* pollination.
17. Study of ovules in cleared preparations; study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent stained serial sections.
18. Field study of several types of flower with different pollination mechanisms (wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
19. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate outcrossing systems. Study of cleistogamous flowers and their adaptations.
20. Study of nuclear and cellular endosperm through dissections and staining.
21. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun (*Syzygium cumini*) etc. by dissections.

22. Study of seed dormancy and methods to break dormancy.

Suggested Readings:

- 1) Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
- 2) Fageri, K. and Van der Pol, L. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
- 3) Fahn, A. 1982. Plant Anatomy, (3rd edition). Pergamon Press, Oxford.
- 4) Fosket, D.E. 1994. Plant Growth and Development. A molecular Approach. Academic Press, San Diego.
- 5) Howell, S.H. 1998, Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
- 6) Leins, P., Tucker, S.C. and Endress, P.K. 1988. Aspects of Floral Development. J. Cramer, Germany.
- 7) Lyndon, R.F., 1990. Plant Development. The Cellular Basis. Unwin Hyman, London.
- 8) Murphy, T.M. and Thompson, W.F. 1988. Molecular Plant Development. Prentice Hall, New Jersey.
- 9) Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
- 10) Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
- 11) Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
- 12) Raven, P.H., Evert, R.F. and Eichhorn, S.E. 1992. Biology of Plants (5th Edition). Worth, New York.
- 13) Steeves, T.A. and Sussex, I.M. 1989. Patterns in Plant Development (2nd edition). Cambridge University Press, Cambridge.
- 14) Sedgely, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops, Academic Press, London.
- 15) Waisel, Y., Eshel, A. and Kafkaki, U. (eds) 1996. Plant Roots: The Hidden Hall (2nd edition.) Marcel Dekker, New York.
- 16) Shivanna, K.R. and Sawhney, V.K. (eds) 1997. Pollen Biotechnology for Crop Production and Improvement, Cambridge University Press, Cambridge.
- 17) Shivana, K.R. and Rangaswamy, N.S. 1992. Pollen Biology: A Laboratory Manual. Springer-Verlag, Berlin.
- 18) Shivana, K.R. and Johri, B.M. 1985. The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd., New York.
- 19) The Plant Cell. Special issue on Reproductive Biology of Plants, Vol. 5(10) 1993. The American Society of Plant Physiologists, Rockville, Maryland, USA.
- 20) On line Journals available on UGC -VSAT

M. Sc. Botany Syllabus

Semester II

Course code : PSCBOTT07

Credit - 04

Paper- VII Cell and Molecular BiologyBiology- I

UNIT - I

Cell wall: Structure; function; biogenesis and growth; cell differentiation

Plasma membrane: Membrane architecture (fluid mosaic model); sites for ATPases; membrane transport - ion carriers, channels, pumps and aquaporins; receptors.

Plasmodesmata: Structure, role in movement of molecules and macromolecules; comparison with gap junction.

UNIT – II

Cellular organelles: Ultra-structure and function of golgi complex, lysosomes, peroxisomes, **endoplasmic** reticulum, mitochondria, chloroplast and plant vacuoles.

Cell shape and motility: The cytoskeleton; organization and role of microtubules and microfilaments; motor movements, implications in flagellar & other movements, cell division.

UNIT – III

Nucleus: Ultrastructure, nuclear pores, nucleolus, DNA structure A, B and Z forms, replication in prokaryotic and eukaryotic cells, DNA replication proteins, damage and repair.

UNIT – IV

Molecular biology of stress responses: Definition and classification of stress; Plant defence mechanism (passive and active); HR and SAR; modulation of plant metabolism in response to biotic stress: early and late response; production of ROS, induction of enzymes, induction of genes involved in phenylpropanoid metabolism; PR proteins and R- genes

Suggested Readings:

Atherly, A.G., Griton, J.R. and Mc Donald, J. F. 1999. The Science of Genetics.

Saunders College Pub. Fort Worth, USA

Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.

Bush, H. Rothblum, L. 1982. Vol. X. The Cell Nucleus RDNA part A. Academic Press.

Dc, D. N. 2000 Plant cell vacuoles: An introduction. CSIRO Publication, Collingwood, Australia.

De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8th Ed. B. I. Waverly Pvt. Ltd., New Delhi.

Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.

Kleinsmith, L.J. and Kish, V.M. 1995 Principles of Cell and Molecular Biology (2nd Edi.) Harper Collins Coll. Publisher, New York, USA.

Krishnamurthy, K.V. 2000 Methods in Cell wall Cyto-chemistry. CRC Press, Boca Raton, Florida

Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA

Russel, P. J. 1998 Genetics (5th Edi.) The Benjamin/ Cummings Publishing Com. Inc., USA

Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA

Practicals

Orcein staining of the salivary gland chromosomes of *Chironomus* and *Drosophila*.

Cell fractionation & isolation of Chloroplast and mitochondria.

Isolation of plant DNA and its quantification by spectrophotometric method.

To perform flagellary staining.

Isolation of DNA and preparation of Cot-curve.

Demonstration of vital structure and functions of cell

To study the induction of defence genes by elicitors.

Suggested Readings (for laboratory exercises):

Fukui, K. and Nakayama, S. 1996. Plant Chromosomes: Laboratory Methods. CRS Press, Boca Raton, Florida.

Glick, B. R. and Thompson, J.E. 1993. Methods in Plant Molecular Biology and

Biotechnology. CRC Press, Boca Raton, Florida USA.

Goswami, H. K. 1986. Practical cytology – Applied Genetics and Biostatistics
Himalaya Pub. House, Bombay.

Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and Function.
Jones and Barlett Publishers, Boston, Massachusetts.

Hall, J.L. and Moore, A.L. 1983. Isolation of Membranes and Organelles from Plant
Cells Academic Press, London, U.K.

Harris, N. and Oparika, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL
Press, at Oxford University Press, Oxford, U.K.

Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation and
Engineering. Har Academic Publishers, Australia.

Shaw, C.H. (Ed.), 1988. Plant Molecular Biology: A Practical Approach. IRL Press,
Oxford. Techniques, 2nd edition. PAS, IRL Press at Oxford University Press, Oxford.

References: Online journals available on UGC V-SAT programme.

Review Journals:

Annual Review of Plant Physiology and Molecular Biology

Biochemistry and Cell Biology

Cell

Cell Biology International -

Cell Death and Differentiation -

Cell Motility and the Cytoskeleton -

Cellular Physiology and Biochemistry

Current Advances in Plant Sciences

Cytokine -

European Journal of Cell Biology -

Journal of Cell Science

Nature Reviews: Molecular and Cell Biology

Protoplasma- An International Journal of Cell Biology -

Trends in Cell Biology

Trends in Plant Sciences

M. Sc. Botany Syllabus
Semester II
Course code : PSCBOTT08
Paper- VIII Angiosperms- I

Credit - 04

UNIT - I

Angiosperm Morphology, structural units and floral symmetry, dicot and monocot flower; structure, diversity origin and evolution of stamen, carpels; placentation types and evolution. Floral adaptation to different pollinators

UNIT - II

Angiosperm Taxonomy: Scope, aims, principles of taxonomy, historical development of plant taxonomy, relative merits and demerits of major systems of classifications. Taxonomic structure: taxonomic hierarchy, concept of taxa, concept of species, concept of genus and family; Taxonomic character: HETEROBATHMY, ANALYTIC Vs. synthetic character, qualitative Vs quantitative characters.

UNIT - III

Taxonomic evidence: Morphology, anatomy, embryology, palynology, cytology, phytochemistry, genome analysis.

Taxonomic tools: herbarium, floras, monographs, botanical gardens, biochemical and molecular techniques, computers and GIS.

UNIT - IV

Biosystematics: The population concept phenotypic plasticity, biosystematic categories, methods of biosystematics studies. Numerical taxonomy: principles, aims and objectives, cladistics in taxonomy, polarity of characters, homology, homoplasy, monophyly, polyphyly. Plant nomenclature: Salient features of ICBN

Laboratory Exercises:-

1. To study the floral symmetry in various taxa.
2. To study and work out the differences in dicot and monocot flower.
3. To study the variation in stamens and carpels.
4. To study placentation types in various taxa.
5. To study the floral adaptations for pollination.
6. To study anatomical features of various taxa.
7. To study embryological features of various taxa.
8. To study palynological features of various taxa.
9. To study cytological features of various taxa.
10. To prepare a cladogram on the basis of various morphological features of the species belonging to a genus.

Suggested Readings

- Devis, P.H. and Heywood, V. H. 1973. Principles of angiosperms taxonomy. Robert E. Kreiger Pub. Co. Newyork.
- Grant, V. 1971. Plant Speciation, Columbia University press, London.
- Grant W. F. 1984. Plant Biosystematics. Academic press, London.
- Harrison, H.J. 1971. New concept in flowering plant Taxonomy. Hickman educational books Ltd. London.
- Hislop-Harrison, J. 1967. Plant Taxonomy. English Language Book Sco. And Edward Arnold Pub. Ltd, UK.
- Heywood, V. H. and Moore, D. M. 1984. Current concepts in Plant Taxonomy. Academic Press, London.
- Jones, A. D. and Wiggins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co. New York.
- Jones, S. B., Jr. and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw- Hill Book Co., New York.
- Nordstrom, B., El Gazaly, G. and Kassas, M. 2000. Plant systematic for 21st century. Portland press. Ltd, London.
- Radford, A. E. 1986. Fundamentals of plant systematic. Harper and Row publication, USA.
- Solbrig, O.T. 1970. Principles and methods of plant Systematics. The Macmillan Co. Publication Co. Inc., USA.
- Woodland, D. W. 1991. Contemporary Plant Systematics, Pentice Hall, New Jersey.
- Takhtajan, A. L. 1997. Diversity and classification of Flowering Plants. Columbia University Press, New York.
- Stebbins, G. L. 1974. Flowering Plants-evolution Above species Level. Edward Arnold Ltd, London.
- Jones, A. D. and Wiggins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co.
- Jones, S. B., Jr. and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw Hill Book Co., Newer RH 1975 Communities and Ecosystems (2nd ed) MacMillan, New York.

**GONDWANA UNIVERSITY
GADCHIROLI**

SYLLABUS
For
M. Sc.
BOTANY
SEMESTER III & IV

Under
Choice Based Credit System
(CBCS)

(With effect from: 2017-18)

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc. Program in Botany.

Semester III

| Core | Theory/ Practical | Teaching Scheme | | | Credit | Examination Scheme | | | | | |
|-----------------------|----------------------|-----------------|-----------|-----------|-----------|---------------------|------------|------------|------------|--------------------|-----------|
| | | Hrs/week | | | | Duration in hrs. | Max. Marks | | Total | Min. Marks | |
| | | Theory | Practical | Total | | | External | Internal | | Theory/ Seminar | Practical |
| PSCBOTT09 | Paper - IX | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT10 | Paper - X | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSDBOTT11 | Paper - XI | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSSBOTT12 | Paper - XII | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| Pract-V PSCBOTP05 | Practical - V | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | | 40 |
| Pract-VI PSDBOTP06 | Practical - VI | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | | 40 |
| Seminar - III | Seminar - III | 2 | - | 2 | 1 | | | 25 | 25 | 10 | |
| TOTAL | | 18 | 16 | 34 | 25 | | 480 | 145 | 625 | 170 | 80 |

Semester IV

| Core | Theory/ Practical | Teaching Scheme | | | Credit | Examination Scheme | | | | | |
|-------------------------|-------------------|-----------------|-----------|-----------|-----------|---------------------|------------|------------|------------|--------------------|-----------|
| | | Hrs/week | | | | Duration in hrs. | Max. Marks | | Total | Min. Marks | |
| | | Theory | Practical | Total | | | External | Internal | | Theory/ Seminar | Practical |
| PSCBOTT13 | Paper - XIII | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSCBOTT14 | Paper - XIV | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSDBOTT15 | Paper - XV | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| PSSBOTT16 | Paper - XVI | 4 | - | 4 | 4 | 3 | 80 | 20 | 100 | 40 | |
| Pract-VII PSCDBOTP07 | Practical - VII | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | | 40 |
| Pract-VIII PSPBOTP08 | Practical - VIII | - | 8 | 8 | 4 | 6 | 80 | 20 | 100 | | 40 |
| Seminar - IV | Seminar - IV | 2 | - | 2 | 1 | | | 25 | 25 | 10 | |
| TOTAL | | 18 | 16 | 34 | 25 | | 480 | 145 | 625 | 170 | 80 |

Project Work/Dissertation Scheme / Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out a project work in semester IV. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.

Experimental Project Work and Field Based Project Work:

Student can carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work / Field work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

Review writing based Project Work.

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator / Director of the Department / Centre or the Principal of the College.

*The supervisors for the Project Work shall be from the following.
A person shall be an approved faculty member in the relevant subject.
OR

Scientists of National Laboratories / Regional Research Laboratories/ Experts from R&D in Industry who are approved by competent authority in such facilities by the Union Government / the State Government / Gondwana University / Other Universities recognized by UGC.

The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College.

The examiners will evaluate the Project Work/Dissertation taking into account the coverage of subject matter, arrangement and presentation, references, etc.

| | | |
|---------------------------------|-----------|--|
| For written Project work | 40 | Marks – Evaluated jointly by External & Internal examiner |
| Oral Presentation | 20 | Marks – Evaluated jointly by External & Internal examiner |
| For Viva-Voce | 20 | Marks – Evaluated by External examiner |
| Internal Assessment | 20 | Marks – Evaluated by Internal examiner |

| | | |
|--------------|-----|--|
| Total | 100 | |
|--------------|-----|--|

Seminar

Guidelines for Students, Supervisors and Examiners

In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

The students should submit the seminar report typed and properly bound in two copies to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The marks of the seminar shall be forwarded to the university within due period through head of the Department. The record of the seminar should be preserved till the declaration of the final result.

Internal Assessment:

1. The internal assessment marks shall be awarded by the concerned teacher.
2. The internal assessment marks shall be sent to the University after the Assessment in the prescribed format.
3. For the purpose of internal assessment the University Department / College shall conduct any three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
4. If the student does not appear for the Practical Exam he shall be declared failed in Practical Examination irrespective of marks obtained in Internal Practical Assessment. However the Internal Practical Assessment marks will be carried forward for his next supplementary Practical Exam.
5. General guidelines for Internal Assessment are:
 - a) The internal assessment marks assigned to each theory paper as mentioned in Appendix 1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.
 - b) There shall be three assignments (as described above) per course.
 - c) There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the Internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
 - d) The concerned teacher / department / college shall have to keep the record of all the above activities until six months after the declaration of the results of that semester.
 - e) At the beginning of each semester, every teacher / department / college shall inform his / her students unambiguously the method he / she proposes to adopt and the scheme of marking for internal assessment. (Prescribed in syllabus of respective Subjects).
 - f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / Principal.

Practical Examination

1. Each practical carries 100 marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.
4. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

5. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _____

Name of the Department: _____

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _____ of M. Sc. _____

Semester _____ during the academic year _____. The candidate has satisfactorily completed the experiments prescribed by Gondwana University Gadchiroli for the subject _____

Dated ___/___/_____

Signature of the teacher who taught the examinee

Head of the Department

1. _____

2. _____

Practical Schedule: Semester III PRACTICAL V

Course code: PSCBOTP05

Credit - 04

Time : 6 Hours

Full marks : **80**

| | |
|---|----|
| Q. 1 To perform the given Ecological exercise - [A] | 15 |
| Q. 2 Soil analysis/Ecological adaptation - [B] | 10 |
| Q. 3 One experiment from paper X - [C] | 15 |
| Q. 4 One experiment from paper X - [D] | 10 |
| Q. 5 Spotting: [E] (Paper IX), [F] (Paper IX), [G] (Paper X), [H] (Paper X) | 20 |
| Q. 6 Viva-voce | 05 |
| Q. 7 Practical Record | 05 |

Semester III PRACTICAL VI

Course code: PSDBOTP06

Credit - 04

Time : 6 Hours

Full marks : **80**

| | |
|--|----|
| Q. 1 Experiment from Major Exercise | 15 |
| Q. 2 Experiment from Minor Exercise | 10 |
| Q. 3 Experiment from Major Exercise | 15 |
| Q. 4 Experiment from Minor Exercise | 10 |
| Q. 5 Spotting: E (Major Exercise), F (Minor Exercise), G (Major Exercise), H (Minor Exercise) | 20 |
| Q. 6 Viva-voce | 05 |

M. Sc. Botany Syllabus
Semester III
Course code- PSCBOTT09
PAPER –IX: Plant Ecology

UNIT - I:

Vegetation organization: Concepts of community and continuum, analysis of communities (analytical and synthetic characters): interspecific associations, concept of ecological niche.

Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristic and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession, Autecology.

UNIT - II:

Ecosystem organization: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); global biogeochemical cycles of C, N, P, and S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

UNIT - III:

Air, Water and Soil pollution: Kinds; sources; quality parameters; effects on plant and ecosystems.

Climate change: Greenhouse gases (CO₂, CH₄, N₂O, CFCs; sources, trends and role); ozone layer and ozone hole; consequences of climate change (Global warming, sea level rise, UV radiation).

UNIT - IV:

Ecosystem stability: Concept (resistance and resilience); Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; environmental impact assessment; ecosystem restoration.

Ecological management: Concepts; sustainable development; sustainability indicators.

Practicals:

1. A trip to the grass land/ forest/ water body to get acquainted with their plant species.
2. Distribution pattern of different plant species determined by Quadrat/ Transat/ Point centered Quadrat methods.
3. Qualitative parameters of distribution of plant species, Frequency, Density, Basal cover, dominance, Abundance and IVI.
4. Analysis of soils of two different areas i.e. Cropland and forest/ grassland for certain nutrients, CO₃, NO₃, Base deficiency.
5. Analysis of water quality for physical properties like colour, BOD, COD, O₂, CO₂ contents etc.
6. Study of adaptations in plants of Hydrophytic, Xerophytic and Halophytic zones.

Suggested Readings:

1. Ambasht R.S. 1968. Freshwater ecosystem- Manual of Ecology 123-137 (See Misra KC et al 1968)
2. Ambasht R.S. 1966 Conservation Ecology, Abs Proc School on Plant Ecol (Full paper in press Oxford and IBH Calcutta).
3. Ambasht R.S. 1995 A text book of plant ecology Student and co. Varanasi-5
4. Anderson JM Ecology for environmental sciences: biosphere ecosystems and man
5. Billings WB 1964 Plants and the ecosystem Macmillan & co, London.
6. Clements FE 1916 Plant succession, An analysis of the development of vegetation. Carnegie Institute of Washington.
7. Cragg JB 1968 The theory and practice of conservation, IUCN Publ, New Series No. 12, 25-35.
8. Dash MC 1993 Fundamentals of Ecology WB Saunders and co. Philadelphia USA.
9. Deangelis DL Energy flow, nutrient cycling and ecosystem resilience. Ecology 56, 238-43.
10. Dwivedi Rama Shankar 1968. The decomposer system manual of ecology See Misra KC et al 1970)
11. Frankel OH, Soule ME, 1981, Conservation and Evolution, Cambridge Univ Press.
12. Grace J 1983, Plant atmosphere relationships. Champman & Hall.
13. Greig Smith P 1983, Quantitative plant ecology, Univ California Press, California.
14. Hutchings MJ (ed) 1988, Plant population biology, Blackwell.
15. Hutchinson GE 1978, An introduction to population ecology. Yale Univ. Press.
16. Kochhar PL 1986 Plant Ecology Ratan prakashan, Mandi, Agra.
17. Krebs GJ 1972 Ecology Harper and Row Publ, New York.
18. Kumar HD 1994 Modern concepts of ecology. Vikas publishing house pvt ltd, New Delhi.
19. May RM (ed) 1981 Theoretical Ecology, Blackwell.
20. Odum EP 1963 Ecology Holt Reinhart and Winston Inc.
21. Odum EP 1983 Basic Ecology, Saunders Publ Philadelphia.
22. Reynolds CS 1984 The ecology of phytoplankton, Cambridge Univ Press
23. Silvertown JW 1982 Introduction to plant population ecology, Longman.
24. Southwick CH 1983 (ed) Global Ecology Sinauer.
25. Whittaker RH 1975 Communities and Ecosystems (2nd ed) MacMillan, New York.

M. Sc. Botany Syllabus

Semester III

Course code- PSCBOTT10

PAPER –X: Cell and Molecular Biology- II

UNIT - I:

Ribosomes: Structure and function

Transcription & Translation: Transcription in prokaryotic and eukaryotic cells, plant promoters, transcription factors, types of RNA and their function, splicing, mRNA transport, rRNA biosynthesis; translation in prokaryotic and eukaryotic cells, structural levels of proteins, post-translational modification; structure and role of tRNA.

UNIT - II:

Gene structure and expression: Fine structure of gene, Cis-trans test; fine structure analysis in eukaryotes; introns and their significance, RNA splicing; regulation of gene expression in pro- and eukaryotes.

Protein sorting: Machinery involved, vesicles, coat proteins; protein targeting to plastids, mitochondria, peroxisomes, nucleus, vacuoles; modification during transport.

UNIT - III:

Genome organization in prokaryotes and eukaryotic organelles: Phage genome, genetic recombination in phage and mapping phage genes; mapping of bacterial genes through transformation, conjugation and transduction; genetics of mitochondria and chloroplast.

Genetic recombination and genetic mapping: Recombination, independent assortment and crossing over; molecular mechanism of recombination, role of RecA and RecBCD enzymes; site-specific recombination; chromosome mapping, linkage group, genetic markers, construction of molecular maps, correlation of genetic and physical maps; Somatic cell genetics - an alternative approach to gene mapping.

UNIT - IV:

Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; programmed cell death in plants; regulation in plant growth and development.

Signal transduction: Overview, receptors and G- proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascades, diversity in protein kinases and phosphatases.

Techniques in cell biology: Electrophoresis, immunotechniques, FISH, GISH, confocal microscopy

Practicals:

1. Isolation of nuclei and identification of histones by SDS-PAGE.
2. Isolation of chloroplast and demonstration of two subunits of RUBISCO by SDS PAGE
3. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis, visualization by ethidium bromide staining.
4. To study in vitro transcription.
5. To study in vitro translation.
6. To study conjugation in bacterial cells.
7. To detect the presence of specific antigen by ELISA
8. Isolation of RNA and quantification by spectrophotometric method.

References: Online journals available on UGC V-SAT programme

Suggested readings:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. *Molecular Biology of Cell*, Garland Publishing, Inc., New York.
2. Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 *Biochemistry and Molecular Biology of Plants*. American Soc. Of Plant Physiologists, Maryland, USA.
3. De Robertis, E.D.P. and De Robertis, E.M.F. *Cell and Molecular Biology* 8th Ed. B. I. Waverly Pvt. Ltd., New Delhi.
4. Karp, G. 1999 *Cells and Molecular Biology; Concepts and Experiments*. John Wiley & Sons, Inc., USA.
5. Khush, G.s. 1973 *Cytogenetics of Aneuploids*, Academic Press, New York, London
6. Kleinsmith, L.J. and Kish, V.M. 1995 *Principles of Cell and Molecular Biology* (2nd Edi.) Harper Collins Coll. Publisher, New York, USA.
7. Lewin, B. 2000 *Gene VII* Oxford Univ. press, New York.
8. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 *Molecular Cell Biology* Edi. W.H. Freeman and Co., New York, USA.
9. Malacinski, G. M. and Freifelder, D. 1998 *Essentials of Molecular Biology* (3rd Edi.) Jones and Bartiet Pub. Inc., London.
10. Russel, P. J. 1998 *Genetics* (5th Edi.) The Benjamin/ Cummings Publishing Com. Inc., USA
11. Sunstad, D. P. and Simmons, M. J. 2000 *Principles of Genetics* (2nd Edi.) John Wiley & Sons Inc., USA.
12. Tamarin, R. H. 2001 *Principles of Genetics* 7th Edi. The McGraw–Hill Companies.
13. Wolf, S.L. 1993. *Molecular and Cellular Biology*, Wadsworth Publishing Co., California, USA.
14. Gerhard, Krauss, Wieley, VCH Third revised edition, *Biochenmistry of Signal Transduction and Regulation*.

M. Sc. Botany Syllabus
Semester III
Course code- PSDBOTT11 (DSE-I)
PAPER –XI: Reproductive Biology of Angiosperm-I

UNIT - I:

General: Need for reproductive system as experimental material, Interdisciplinary approaches: genetic and molecular perspective,

Anther: Structure, anther wall;: endothecium, middle layer, tapetum-Structure, types-structure-function relationship, role of tapetum, microsporogenesis- sporogenous cells cytoplasmic reorganization during sporogenesis (Ultrastructural changes), molecular biology of meiosis, DNA and RNA synthesis, Protein synthesis, meiosis specific genes. Pollen tetrad development, pollen wall proteins, adaptive significance of pollen wall.

UNIT - II:

Male gametophyte development: formation of vegetative and generative cells, differential behavior of sperms, gene expression during pollen development.

Pollen: Physiological and biochemical aspects, pollen storage, viability causes for loss of viability. pollen abortion and male sterility, structural, developmental and functional aspects of male sterility environmental factors, role of mitochondrial genome in male sterility, gametocides.

UNIT - III:

Pistill: Carpel determination, ovule and its structural details.

Megasporogenesis: Meiosis, functional megaspores, organization of female gametophyte structure of the embryo sac, egg, synergid-ultrastructure, role central cell, antipodal cell, haustoria, cytoskeleton of the embryo sac, enzymatic isolation of embryo sac, types of embryo sac, nutrition of embryo sac.

UNIT - IV:

Pollination-pollination mechanism, biotic and abiotic pollination, floral attractants and rewards,

Pollen-pistil interaction; The stigma-Types and structure, stigmatic exudates, style-transmitting tissue, canal cell, post pollination events (stigma receptivity, pollen adhesion, pollen hydration, pollen germination and pollen tube growth, biochemistry of pollen germination, RNA and protein metabolism during pollen tube, calcium gradient in the pollen tube (Chemotropism) pollen allelopathy.

Incompatibility: General concept, self incompatibility (Intraspecific type) heteromorphic, homomorphic types, mechanism of self compatibility, importance of self compatibility, methods of overcoming self incompatibility, Parasexual hybridization.

Practicals :**Major exercises:**

1. Short term exercises on pollen production, viability and their percentage of germination. Rate of growth of germ tube to be studied in a given period.
2. Cytology of pollen inhibition in self and interspecific incompatibility, application of some techniques to overcome incompatibility.
3. Techniques, Familiarity with phase contrast, polarizing, fluorescence and electron microscopy, whole mounts, dissection and macerations, permanent double stained microtome sections, photo microscopy.
4. Interpretation of electron micrographs (SEM, TEM) of pollen.
5. Preparation of permanent slides using micro-technique: Embedding and block making.
6. Preparation of permanent slides using micro-technique: Section cutting and processing for staining.
7. Study of pollen morphology (polarity, symmetry, shape, size, aperture) using acetolysis method.

Minor exercises:

8. Study from the permanent preparations.
 - a. Development and structures of anther pollen.
 - b. Structure and types of ovule.
 - c. Megasporogenesis,
 - d. Embryo sac and its types.
 - e. Development of endosperm, types.
 - f. Structure and development of embryo- types
 - g. Pericarp and seed coat structure from sections and macerations.
 - h. Sketching of ovular structure, embryo sac, anther wall, embryo with the help of camera lucida.
9. Preparation of dissected whole mounts of endothecium, tapetum, endosperm and embryo, squash preparations of tapetum, microspore mother cells, dyads, tetrads pollinia and massulae.
10. Study of mitosis and meiosis and identification of various stages.
11. Experiments on intra- ovarian pollination.

Suggested Readings:

1. Asker S. 1979, Progress in apomixis research. *Hereditas* 91, 231-240.
2. Barnier, G. 1986, The flowering process as an example of plastic development. *Soc. Expt.. Biol.* 40: 257-286.
3. Barth, F.G. 1991, insects and flowers, Princeton Univ. Press. Princeton.
4. Battaglia, E. 1963. Apomixis In recent advances in the embryology of angiosperms (ed P. Maheshwari), pp- 264, Intt. Soc. Plant Morphologists, Univ. Delhi.
5. Bhandari N. N. 1984, The microsporangium in embryology of angiosperms (ed B.M. Johri) Springer- Verlag, Berlin, pp. 53-121.
6. Bhandari N.N., M. Bhargava and P. Chitralkha 1986, Cellularization of free nuclear endosperm of *Papaver somniferum* L. *Phytomorphology*, 36, 357-366.
7. Bhojwani S.S. and M.K. Rajdan 1983, Plant tissue culture, Theory and Practice Elsevier, Amsterdam.
8. Boesewinkel F.D. and Boman F. 1984, The seed structure in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 567-610.
9. Bouman F. 1984 The ovule in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 123-157.
10. Cartson P.S., Smith N.H., Dearing R.D. (1972) Parasexual interspecific plant hybridization. *Proc. Nat. Acad. Sci. USA*, 69, 2292-2294.
11. Cartson P.S. (1973) The use of protoplasts of genetic research. *Proc. Nat. Acad. Sci. USA*, 70, 598-602.
12. Chitralkha P. and N.N. Bhandari 1991, Post fertilization development of antipodal cells in *Ranunculus scferatus*. *Phytomorphology* 41, 200-212.
13. Ciampolini F.M., Nepi and E. Pacini 1993, tapetum development in *Cucurbita pepo* (Cucurbitaceae) *Pt. Syst. Evol. (Suppl)* 7-13-22.
14. Cocking E.C. 1960, A method for the isolation of plant protoplasts and vacuoles. *Nature (London)* 187-927-929.
15. Cocking E.C. 1970, Virus uptake, cell wall regeneration and virus multiplication in isolated plant protoplasts. *Int. Rev. Cytol* 28-89-124

M. Sc. Botany Syllabus

Semester III

Course code- **PSDBOTT11 (DSE-I)**

PAPER –XI: Molecular Biology and Plant Biotechnology-I

UNIT- I:

DNA replication: DNA replication in prokaryotic organism – Initiation, elongation, and termination, DNA replication in eukaryotes – origin, replication form, replication proteins, Comparative account of DNA replication in prokaryotes and eukaryotes, DNA replication proteins

DNA damage and repair: Types of DNA damage, factors for DNA damage,

Repair system: Single base change, direct repair, mismatch repair, SOS response.

UNIT- II:

Isolation of gene and nucleotide sequence: DNA manipulation enzymes; General methods of gene isolation.

Molecular probing: Recombinant DNA libraries (gDNA and cDNA, oligonucleotide probes); nucleic acid hybridization (southern, northern, dot-blot and slot-blot); antibodies as probe for proteins (immunoblotting or western blotting, immunoprecipitation, southwestern screening).

UNIT- III:

Splicing of foreign DNA into cloning vector: Vectors for prokaryotes; ligation.

Introduction of foreign DNA into host cell: Transformation; transfection; transgenesis

Isolation of genes or protein products from clones: Expression vectors- Characteristics; vectors producing fusion proteins

Polymerase chain reaction: Types of PCR's and their applications in molecular biology

UNIT- IV:

Sequence alignment and phylogenetic trees: Dot plots, sequence similarity, pairwise and multiple alignment, significance of alignment, phylogeny and phylogenetic trees and evolution.

Genomics: Definition; genome analysis (genetic polymorphisms, genetic mutations); microarray technology and applications (gene expression and diseases).

Proteomics: Protein stability and folding; application of hydrophobicity; DALI (Distance-matrix alignment); Protein structure- evolution, classification, prediction and modeling, prediction of function. DNA microarrays, mass spectrometry, network and graphs, protein complexes and aggregates, protein interaction networks, regulatory networks.

Practicals:**Major Exercises -**

1. Detection of DNA damage by mutagens.
2. Bacterial transformation and selection of transformed cells.
3. To detect molecular polymorphism of different species.
4. To demonstrate the presence of particular polypeptide by Western blotting.
5. To design PCR primers for isolation of given gene and to clone it in the given vector.
6. Amplification and sequencing of nr DNA by PCR

Minor Exercises-

7. To find the sequences of a given protein in SWISS-Prot, Uni-Prot.
8. To work out the sequence from given autoradiogram and to identify it from Gene Bank by BLAST method.
9. To generate Pairwise and multiple sequence alignment of a given organisms.
10. To generate phylogenetic tree using given sequences.
11. To predict a protein from given sequence by using online tools from NCBI.

Suggested Readings:

1. Alberts, Bruce; Johnson Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter,
2. Peter, C. 2002 Molecular Biology of the Cell, Garland Science, New York and London.
3. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
4. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics
5. Bergman, N.H 2007 Comparative Genomics Humana Press Inc., Part of Springer Science+ Business Media
6. Brown, T. A. 1999. Genomes, John Wiley & Sons(Asia) Pvt. Ltd., Singapore
7. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8th Ed. B. I. Waverly Pvt. Ltd., New Delhi.
8. Glover, D.M. and. Hames, D.B 1995 DNA Cloning : A practical approach, R.L. Press, Oxford.
9. Hackett, P. B. Fuchs, J. A. and Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin/cummings Publishing Co., Inc. Menlo Park, California.
10. Jolles, O. and Jornvall, H. (eds) 2000. Proteomics in Functional Genomics. Birkhauser Verlag,

Basel, Switzerland.

11. Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc., USA.
12. Lehninger' Principles of biochemistry-Nelson, Cox, 4th Edn., W.H.Freeman and Co.,2005.
13. Lewin, B. 2000 Gene VII Oxford Univ. press, New York.
14. Lewin, B. 2010 Gene X Oxford Univ. press, New York.
15. Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA
16. Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub. New Delhi
17. Old and Primrose , 1994, Principles of gene manipulation. Blackwell Scientific Publ.
18. Raymond Schuler and Zielinski, E. 2005, Methods in plants Molecular biology - Acad. Press.
19. Russel, P. J. 1998 Genetics (5th Edi.) The Benjamin/ Cummings Publishing Com. Inc., USA
20. Sambrook and Russel. 2001. Molecular cloning Vol. 1-3 CSH press.
21. Shaw, C.H. 2006, Plant Molecular Biology: A practical approach. Panima Pub. Corp.
22. Stryer, Berg, Biochemistry- 6th Edition, W. H. Freeman and Co.,2007.
23. Voet, D.; Voet, J.; Biochemistry – 3rd Edn. John Wiley and sonsInc., 2004.
24. Wilson Keith and Walker John 2005 Principles and techniques of biochemistry and molecular biology, 6th Ed. Cambridge University Press, New York.

25. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA
Suggested Readings(for laboratory exrcises)

1. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
2. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics.
3. McEntyre, J.; Ostell, J., editors Bethesda (MD) The NCBI Handbook: National Library of
4. Medicine (US), NCBI; 2002-2005
5. Sambrook and Russel. 2001. Molecular cloning Vol. 1-3 CSH press.
6. Tools & updated literature available at www.ncbi.com

References: Online journals available on UGC V-SAT programme.

M. Sc. Botany Syllabus
Semester III
Course code- PSDBOTT11 (DSE-I)
PAPER –XI: Paleobotany-I

UNIT – I:

Introduction to the science of Petrology- The earth zones, chemical composition of earth crust. The classification of rocks i.e. Endogenetic and Exogenetic (igneous, metamorphic and sedimentary) and their brief account. Glaciations, volcanic eruption and earthquake.

UNIT–II

Geological column and time scale. Physiography of India. Fossilisation, modes of preservation, preparation and age determination and techniques. Systematics, reconstruction and nomenclature. Life in Precambrian, greening of earth –speculation.

UNIT–III:

Study of Rhyniopsida (primitive vascular plants) Cooksonia, Steganotheca, Uskiella, Renalia, Horniophyton, Aglophyton, Zosterophylopsida (ancestors of microphyllous plants) Zosterophyllum, Sawadonia, Asteroxylon. Prelycopods and Lycopsidea-Hebaceous Lycopods of Devonian – Baragwanthia, Protolopododendron and Miadnesia, Arborescent Lycopods of Carboniferous-study of Lepidodendrales members.

UNIT –IV:

Sphenopsida-Its origin and evolutionary consideration .Study of Hymeniales and Sphenophyllales. Horsetails and their relatives-Calamitales members. Filicopsida-Study of primitive ferns and their relatives- Cladoxylales, Stauropteridales, Zygopteridales. Filicales-classification and study of its members, Coenopteridales-Ankyropteris. Marratiales - Psaronius.

Suggested Laboratory and Field Exercises

Major Exercises:

1. Different techniques to study fossils. (Ground sectioning, peel technique) Study different types of fossils.
2. Study of plant fossils as per syllabus based on specimens and slides.
3. Arborescent Lycopods of Carboniferous-study of Lepidodendrales members.
4. Study of Sphenophyllales, Calamitales members.
5. Study of primitive ferns and their relatives Cladoxylales, Stauropteridales, Zygopteridales. Filicales- Coenopteridales-Ankyropteris, Marratiales - Psaronius

Minor Exercises:

6. Study of Rhyniopsida (primitive vascular plants).
7. Stratigraphy Maps of the India and World.
8. Geological Maps of India.
9. Geological column and time scale.

10. Study of different rocks.
11. Preparation of practical record.

Suggested Readings

1. Agashe S.N. (1995) - Palaeobotany, Plants of the past, their evolution, palaeoenvironment and application in exploration of fossil fuels. Oxford & IBH publishing company - New Delhi.
2. Andrews H.N. (1961) - Studies in Palaeobotany, Wiley and Sons - New York.
3. Arnold, C.A. (1947) - An Introduction to Palaeobotany, McGraw-Hills., New York.
4. Beck, C. B. and Wight, D. C. (1988) - Progymnosperm, In origin and evolution of Gymnosperms, Columbia Uni. Press - New York.
5. Beck, C.B. (1976) - Current status of the Progymnospermosida, Review of Palaeobotany and Palynology.
6. Darrah, W.C. (1960) - Principles of Paleobotany.
7. Erdtman, G. (1957) - Pollen and Spore morphology and plant taxonomy. (An introduction to palynology) Hafner Publishing Comp - New York.
8. Chandra, S. and Surange, K.R. (1979) - Revision of the Indian species of Glossopteris, Monograph, Birbal Sahni Institute of Palaeobotany.
9. Hoffmeister, W.S. (1960) - Palynology has an important role in oil exploration. World oil - 150:1001-140.
10. Meyen, S.V. (1987) - Fundamentals of Palaeobotany Chapman and Hill, London, New York.
11. Parihar, N.S. (1995) - Essentials of Palaeobotany, Central Book - Allahabad.
12. Sahni, B. (1964) - Revisions of Indian fossils plants, -III (Monocotyledons) - BSIP - Lucknow.
13. Stewart, W.N. & Rothwell, G.V. (1993) - Palaeobotany and Evolution of Plants, Cambridge Univ., Press - Cambridge.
14. Venkatchala, B.S. & Maheshwari, H.K. (1991) - Palaeobotanical Researches in India. Jour. Ind. Bot. Society - 70; 1-12.
15. Wadia, D.N. (1953) - Geology of India, Mac, Millan - Co. London.
16. Prasad, K.N. (1999) - An introduction to palaeobotany, APH Pub.
17. Cleal, J. Christopher. & B.A. Thomas (2009) Introduction to Plant Fossils, Cambridge Univ., Press - Cambridge.
18. Willis, K. J. & McElwain, J. C. (2014). The Evolution Of Plants (second edition) OXFORD University Press.
19. Stewart, W.N. and Rothwell G.W. (1993), Palaeobotany and the Evolution of Plants, Cambridge University Press.
20. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.
21. Agashe, S.N. (1995), Palaeobotany, Oxford & IBH, New Delhi.
22. Siddiqui, K.A. (2002) Elements of Palaeobotany, Kitab Mahal, Allahabad.
23. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.
24. Spicer, R.A. & Thomas, B.A. (1986) Systematic and taxonomic approaches in Palaeobotany. Systematic Association Special Volume.

M. S c. Botany Syllabus
Semester III
Course code- PSSBOTT12 (SEC-I)
PAPER –XII: Biofertilizers-I

UNIT I

Historical account of Biofertilizer, types of Biofertilizer, Microbial inoculant from bacteria, algae, fungi and other groups ,their isolation ,identification . Mass inoculation of microbial inoculants, effect of inoculant on crop yield. Marketing and work done on biofertilizer in India

UNIT II

Bacterial inoculants :- Rhizobial culture packing and quality control , method of inoculation , effect of Rhizobial inoculant on crop yield . Azotobacter inoculants on , Azospirillum inoculants and mass cultivation ; Phosphate solubilizing microorganism , Phosphate biofertilizer

UNIT III

Algal inoculants:- Algalization, biological nitrogen fixation , nonsymbiotic and symbiotic microorganism, Diazotrops; genetics and ecology of Diazotrops, special features of nitrogen fixation in Cyano bacteria, Frankia-induced nodulation. Factors affecting growth, Azolla as bio fertilizers, Azolla association of Anabaena, mass cultivation of Azolla, practical application in rice field.

Unit IV

Fungal inoculants:- Mycorrhiza fungi as bio fertilizers; Methods of Inoculation, Mechanism of symbiosis, Growth and yield – Colonization of VAM-Isolation and production of VAM. Benefits from mycorrhizas to plants as biofertilizer.

Practicals:

Based on theory syllabus.

Suggested reading:-

1. The complete technology book on biofertilizers and organic farming –NIIR, New Delhi.
2. Somani L.L, P.Shilpkar and D.Shilpkar (2011) Biofertilizers commercial production technology and quality control. Agrotech publisher Academy Udaipur.
3. The complete technology book on Vermiculture and Vermicompost NIIR- New Delhi.

M. Sc. Botany Syllabus
Semester III
Course code- PSSBOTT12 (SEC-I)
PAPER –XII: Nursery and Gardening -I

Unit-I:

Garden Planning- Formal and informal gardens, originality in planning, view from the house, variety and surprise, overcrowding (density of planting), colour scheme, spacing, fragrance, spacing for vegetables and fruits, water supply and garden accessories, choice of plants, arches and pergolas, wall aspect, hill features, situation, landscaping and garden features.

Unit-II:

Garden Operation- Procurement of material. Preparation of soil. Drainage. Digging and trenching. Soil enrichment. Organic manures. Inorganic manures.

Unit-III:

Garden Style- Informal garden, Romantic Garden, Wildlife garden, Container garden, Roof garden, Planned garden, Small garden, Japanese garden, Exotic garden, Kitchen garden, Vegetable garden, Herb garden, Fruit garden.

Unit-IV:

Lawns and hedges, Flowers, herbaceous border and annuals, Roses, Chrysanthemums and Carnations, Bulbous plants, Climbers, Trees and shrubs, Orchids, Ferns and Palms, Cacti and other succulents.

Practicals:

Based on theory syllabus.

Suggested Readings:

1. Trivedi, P. P. (1987) Home Gardening. ICAR New Delhi.
2. Deena Beverley and Barty Phillips (2002) Encyclopedia of Gardening, Parragon Book, UK.

M. Sc. Botany Syllabus

Semester III

Course code- PSSBOTT12 (SEC-I)

PAPER –XII: PLANT DIVERSITY AND HUMAN WELFARE-I

Unit-I:

Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa.

Unit-II:

Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

Unit-III:

Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss

Unit-IV:

Management of Plant Biodiversity: Organizations associated with biodiversity management- Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

M. Sc. Botany Syllabus
Semester III
Course code- PSSBOTT12 (SEC-I)
PAPER –XII: FLORICULTURE-I

Unit-I:

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

Unit-II:

Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

Unit-III:

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

Unit-IV:

Diseases and Pests of Ornamental Plants.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

M. Sc. Botany Syllabus
Semester III
Course code- PSSBOTT12 (SEC-I)
PAPER –XII: BASIC BOTANY-I

UNIT I

Diversity of cryptogams:- classification, general description, economic importance of cryptogams with examples- viruses, micoplasma, bacteria, fungi, lichens, bryophytes and plant pathology.

UNIT II

Diversity of phenorogamas:- classification, general description, economic importance with examples of pteridophytes, gymnosperms, monocotyledonous and dicotyledonous.

UNIT III

Morphology of angiosperms:- description of monocotyledonous and dicotyledonous plants in technical terminology for the identification of plants in your region, habit and habitate, types of roots, leaves inflorescence, flowers, fruits, seeds identification of some important local plants from families of angiosperms.

UNIT IV

Anatomy of angiosperms:- Histological accounts of cell and tissue, tissue system in monocotyledonous and dicotyledonous plants. Anatomy of root, stem, leaf, primary structure and normal secondary growth in stem and root, Anomalous secondary growth in stem and root, Healing of wounds and fall of leaves.

Practicals:

Based on theory syllabus.

Suggested Readings:-

- 1) S.Sundara Rajan College Botany Vol I to IV Himalaya publishing house.
- 2) Saxena And Sarsbhai A textbook of botany Vol. I to III Kitabghar Gwalior.
- 3) Gangulee And Kar College botany Vol.I and II.
- 4) K.S.Bilgrami, L.M.Shrivastava, J.L.Shremali Fundamentals of botany Vol. I and II Vikas Publishing House PVT.LTD. Sahibabad UP.
- 5) A.C.Dutta Botany for degree students.
- 6) S.N.Pande And P.S.Trivedi Text book of botany Vol I and II. Vani educationa

Semester IV PRACTICAL VII

Course code: PSCDBOTP07

Credit - 04

Time: 6 Hours

Full marks: **80**

| | |
|--|----|
| Q. 1 One Major exercise from paper XIII – [A] | 10 |
| Q. 2 One Minor exercise from paper XIII- [B] | 05 |
| Q. 3 One Major exercise from paper XIV – [C] | 10 |
| Q. 4 One Minor exercise from paper XIV- [D] | 05 |
| Q.3 One Major exercise from paper XV [E] | 15 |
| Q. 4 One Minor exercise from paper XV [F] | 10 |
| Q. 5 Spotting: [G] (Plant Biotechnology), [H] (Angiosperms) [I] (Core Elective-I) | 15 |
| Q. 7 Viva-voce | 05 |
| Q. 8 Practical Record and tour report | 05 |

Semester IV PRACTICAL VIII

Course code: PSPBOTP08

Credit - 04

PROJECT

Full marks: **80**

M. Sc. Botany Syllabus
Semester IV
Course code- PSCBOTT13
PAPER –XIII: Plant Biotechnology

UNIT- I:

Recombinant DNA technology: Gene cloning and principles and technique; vectors- types and their properties; construction of DNA libraries; splicing of insert into the vector; screening of DNA libraries and introduction of the recombinant DNA into the host cells.

Genetic engineering of plants: Aims, strategies for development of transgenics (with suitable examples); Agrobacterium- the natural genetic engineer; T-DNA and transposon mediated gene tagging.

UNIT- II:

Microbial genetic manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics: Molecular markers for introgression of useful traits; high throughput sequencing; functional genomics; Protein profiling and its significance.

DNA synthesis; DNA sequencing; polymerase chain reaction; DNA fingerprinting

UNIT- III:

Plant tissue culture: Basic concepts; Principles and scope; tissue culture media; callus induction and cell suspension; aspects of morphogenesis; haploid and triploid production; production of somatic embryos; applications of plant tissue culture; protoplast isolation and culture; production of cybrids

Transgenic production: Methods to introduce gene in plants; selection of transformed plants/explants; salient achievements in crop biotechnology.

UNIT- IV:

Bioinformatics: Introduction, History, Definition and applications of bioinformatics.

Database: Types and classification of databases – Primary Databases (Nucleic acid sequence, protein sequence, protein structure), Secondary databases (Genomic, cDNA, Organellar, gene expression), special databases (Human, *Escherichia coli*, *Saccharomyces cerevesaie* and *Arabidopsis thaliana*), Literature database (PubMed, OMIM), Information Retrieval system (Entrez). Other databases: GeneBank, KEGG, Taxonomy databases

Data analysis, prediction and submission tools and their uses: ORF finder, Blasts, FASTA, RASMOL, Prediction of pro- and eukaryotic genes and promoters (Genscan); protein structure (SWISS-Prot, pfam, PDB, PIR); **sequin**, webin, AutoDep tools.

Practicals:

Major Exercise:

1. Growth characteristics of *E.coli* using plating and turbidimetric methods.
2. Isolation of plasmid from *E.coli* and its quantification.
3. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
4. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
5. Co-cultivation of the plant material (e.g. leaf discs) with *Agrobacterium* and study GUS activity histochemically.
6. To isolate protoplast and determine its viability.

Minor Exercise:

7. Preparation of media for plant tissue culture.
8. To surface sterilize the given seeds/explant for tissue cultural manipulation.
9. To fuse the protoplast for production somatic hybrid.
10. Demonstration of DNA sequencing by Sanger's dideoxy method.
11. To search literature of different organisms and genes from NCBI.
12. Use of various tools to retrieve information available from NCBI
13. To retrieve gene and protein sequences of various organisms from NCBI.
14. To locate gene(s) on chromosomes for a given disease/disorder.

Suggested Readings (for laboratory exercises)

1. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics, John-Wiley and Sons Publications, New York.
2. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
3. Gelvin, S. B. and Schilperoort, R. A (eds) 1994. Plant Molecular Biology Manual, 2nd edition. Kluwer Academic Publishers, Dordrecht, The Netherlands,
4. Glover, D. M. and Hames, B. D.(Eds) 1995. DNA Cloning 1: A Practical Approach: Core Techniques, 2nd edition PAS, IRL Press at Oxford University Press, Oxford.
5. Hackett, P. B. Fuchs, J. A. and Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin/cummings Publishing Co., Inc. Menlo Park, California.

6. Maniatis et al. Molecular cloning Vol. I, II and III. Cold-Spring Harbor Lab Press.
7. Shaw, C. H. (Ed.) 1988, Plant Molecular Biology : A Practical Approach. IRI Press, Oxford.

References: Online journals available on UGC V-SAT programme.

Suggested Readings:

1. Baxevanis, A. D., Davison, D. B.; Page, R. D. M.; Petsko, G. A.; Stein, L. D. and Stormo, G. D. 2008 Current Protocols in Bioinformatics, John-Wiley and Sons Publications, New York.
2. Baxevanis, A. D. and Ouellate, B. F. F. 2009 Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
3. Brown, T. A. 1999. Genomes, John Wiley & Sons(Asia) Pvt. Ltd., Singapore.
4. Callow, J. A., Ford-Lloyd, B. V. and Newbury, H. J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
5. Chrispeels, M. J. and Sadava, D. E. 1994, Plants, Genes and Agriculture. Jones & Barlett Publishers, Boston, USA.
6. Glazer, A. N. and Nikaido, H. 1995. Microbial Biotechnology. W. H. Freeman & Company, New York, USA.
7. Gustafson, R. J. 2000. Genomes. Kluwer Academic Plenum Publishers, New York, USA.
8. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
9. Jain, S. M., Sopory, S. K. and Veilleux, R.E. 1996. *In vitro* Haploid Production in Higher Plants, Vols. 1-5, Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, The Netherlands.
10. Jolles, O. and Jornvall, H. (eds) 2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
11. Kartha, K. K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida USA.
12. Kingsman, S. M. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, Blackwell Scientific Publications, Oxford, 1998.
13. Mount W. 2004 Bioinformatics and sequence genome analysis 2nd Edi. CBS Pub. New Delhi.
14. Old, R. W. and Primrose, S. B. 1989. Principles of Genome Analysis. Blackwell Scientific Publications. Oxford, UK.
15. Primrose, S. B.1995. Principles of Genome Analysis. Blackwell Scientific Ltd., Oxford, UK.
16. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
17. Watson, J. , Tooze and Kurtz Recombinant DNA: A short course

M. Sc. Botany Syllabus
Semester IV
Course code- PSCBOTT14
PAPER –XIV: Angiosperms - II

UNIT- I:

General account, distinguished characters, floral variation and evolution, affinities of :- Magnoliidae, Hamamelidae, Dilleniidae, Rosidae, Asteridae, circumscription as per Cronquist, 1968

UNIT- II:

General account, distinguished characters, floral variation and evolution, affinities of :- Alismatidae, Commelinidae, Aracidae, Liliaceae; Interesting features and systematic position of Cucurbitaceae, Cactaceae, Asteraceae, Amentiferae, Lemnaceae, Palmae, Orchidaceae.

UNIT- III:

Probable ancestors of angiosperms, primitive living angiosperms, speciation and extinction, IUCN categories of threat, distribution and global pattern of biodiversity.

UNIT- IV:

Biological diversity concept and levels, role of biodiversity in ecosystem functions and stability, Endemism, hotspots and hottest hotspots, invasions and introductions, local plant diversities and its socioeconomic importance.

Practicals:

Major Exercises:

1. Description of a specimen from representative, locally available families.
2. Description of a species based on various specimens to study intra specific variation: collective exercise.
3. Field trips within and around the campus; compilation of field notes and preparation herbarium sheets of such plants, wild or cultivated as are abundant.
4. Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.

Minor Exercises:

5. Description of various species of a genus, location of key characters and preparation keys at generic level.
6. Location of key characters and use of keys at family level.
7. Training in using floras herbaria for identification of specimens described in the class.
8. Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

Suggested Readings:

1. Devis, P.H. and Heywood, V. H. 1973. Principles of angiosperms taxonomy. Robert E. Kreiger Pub. Co. Newyork.
2. Grant, V. 1971. Plant Speciation, Columbia University press, London.
3. Grant W. F. 1984. Plant Biosystematics. Academic press, London.
4. Harisson, H.J. 1971. New concept in flowering plant Taxonomy. Hickman educational books Ltd. London.
5. Hislop-Harisson, J. 1967. Plant Taxonomy. English Language Book Sco. And Edward Arnold Pub. Ltd, UK.
6. Heywood, V. H. and Moore, D. M. 1984. Current concepts in Plant Taxonomy. Academic Press, London.
7. Jones, A. D. and Wibins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co. New York.
8. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw- Hill Book Co., New York.
9. Nordentam, B., El Gazaly, G. and kassas, M. 2000. Plant systematic for 2ft century. Portlant press. Ltd, London.
10. Radford, A. E. 1986. Fundamentals of plant systematic. Harper and Raw publication, USA.
11. Solbrig, O.T. 1970. Principles and methods of plant Sytematics. The Macmillan Co. Publication Co. Inc., USA.
12. Woodland, D. W. 1991. Contemporary Plant Syatematics, Pentice Hall, New Jersery.
13. Takhtajan, A. L. 1997. Diversity and classification of Flowering Plants. Columbia University Press, New York.
14. Stebbins, G. L. 1974. Flowering Plants-evolution Above species Level. Edvard Arnold Ltd, London.
15. Joncs, A. D. and Wibins, A. D. 1971. Variation and adaptation in Plant species Hickman and Co.
16. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw Hill Book Co., New Delhi.

M. Sc. Botany Syllabus

Semester IV

Course code- PSDBOTT15 (DSE-II)

PAPER –XV: Reproductive Biology of Angiosperms II

UNIT- I:

Fertilization: Cellular nature of sperm, the sperm cytoskeleton, the male germ unit, isolation and characterization of sperm, growth of the pollen tube through the style, passage of sperm into the embryo sac, fusion of nuclei, double fertilization, triple fusion, unusual features. In-vitro approaches to the study of fertilization-Intra-ovarian pollination, test tube fertilization, in-vitro fertilization, placental pollination, Gynogenesis.

Endosperm: types of endosperms, ruminant endosperm, cytological status. endosperm haustoria, chemical composition of endosperm, food reserve in endosperm, role of endosperm in embryo development, endosperm mutants.

UNIT- II:

Embryogenesis: Zygote and its ultra-structure, milieu of the developing embryo, symmetry and polarity, rest period in zygote embryonic formulae, embryonic law. **Suspensor-**Ultra structure of suspensor cells, cytology of suspensor cell, physiology and biochemistry of suspensor; Nutrition of embryo- nutrient supply of the zygote, embryo-endosperm relation.

Polyembryony: Definition, causes, classification, induction of polyembryony, practical importance of polyembryony.

UNIT- III:

Apomixis: Definition, causes, classification, - Diplospory, Apospory, pseudogamy, autogamous development of endosperm, causes of apomixis, significance.

Parthenocarpy: Definition, causes, practical importance

Mellitopalynology : Pollen analysis of honey, Role of apiary in crop production.

Biotechnology: Concept and scope of biotechnology; Cell structure, cellular totipotency

- a) **Anther and pollen culture,**
- b) **Ovule and nucellus culture**
- c) **Endosperm culture and its practical applications**
- d) **Embryo culture:** Techniques, nutritional aspects of embryo culture morphological and physiological considerations, culture of mature embryo and proembryo.
- e) **Somatic embryogenesis:** historical background, embryogenesis from callus, direct embryogenesis- recurrent embryogenesis; cytology of somatic embryogenesis, nutritional factors, hormonal factors.

UNIT- IV:

- a) **Protoplast culture and somatic hybridization-** isolation of protoplast, culture methods, fusion of protoplast, selection of fusion products, consequences of fusion, production of Cybrids and hybrids.
- b) **Biotransformation and production of useful compounds** through cell culture, factors affecting yield, biotransformation, bioreactors, perspective.

Practicals :

Major Exercises:

- 1) Organogenesis using appropriate explants.
- 2) Responses of calli to stress condition viz. temp, (low, high), moisture, salinity.
- 3) Induction of androgenesis through anther culture.
- 4) Isolation of protoplasts, fusion and its culture.
- 5) Induction of somatic embryogenesis
- 6) Physiology of embryo development, using electrophoretic and histochemical methods embryo culture.

Minor Exercises:

- 7) Viability of seed through germination, biochemical and excised embryo methods.
- 8) Preparation of plant tissue culture medium (MS).
- 9) Demonstration of sterilization methods employed in Plant Tissue Culture techniques.
- 10) Induction of secondary metabolite synthesis in suspension culture.
- 11) Endosperm culture.
- 12) Ovule and Nucellus culture.
- 13) Viability test for isolated protoplasts.

Suggested Readings:

1. Asker S. 1979, Progress in apomixis research. *Hereditas* 91, 231-240.
2. Barnier, G. 1986, The flowering process as an example of plastic development. *Soc. Expt.. Biol.* 40: 257-286.
3. Barth, F.G. 1991, insects and flowers, Princeton Univ. Press. Princeton.
4. Battaglia, E. 1963. Apomixis In recent advances in the embryology of angiosperms (ed P. Maheshwari), pp- 264, *Intt. Soc. Plant Morphologists, Univ. Delhi.*
5. Bhandari N. N. 1984, The microsporangium in embryology of angiosperms (ed B.M. Johri) Springer- Verlag, Berlin, pp. 53-121.
6. Bhandari N.N., M. Bhargava and P. Chitrlekha 1986, Cellularization of free nuclear endosperm of *Pappaver somniferum* L. *Phytomorphology*, 36, 357-366.
7. Bhojwani S.S. and M.K. Rajdan 1983, Plant tissue culture, Theory and Practice Elsevier, Amsterdam.
8. Boesewinkel F.D. and Boman F. 1984, The seed structure in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 567-610.
9. Bouman F. 1984 The ovule in embryology of angiosperms (ed B.M.Johri), Springer- Verlag, Berlin, pp. 123-157.
10. Cartson P.S., Smith N.H., Dearing R.D. (1972) Parasexual interspecific plant hybridization. *Proc. Nat. Acad. Sci. USA*, 69, 2292-2294.
11. Cartson P.S. (1973) The use of protoplasts of genetic research. *Proc. Nat. Acad. Sci. USA*, 70, 598-602.
12. Chitrlekha P. and N.N. Bhandari 1991, Post fertilization development of antipodal cells in

- Ranunculus scferatus*. Phytomorphology 41, 200-212.
13. Ciampolini F.M., Nepi and E. Pacini 1993, tapetum development in *Cucurbita pepo* (Cucurbitaceae) Pt. Syst. Evol. (Suppl) 7-13-22.
 14. Cocking E.C. 1960, A method for the isolation of plant protoplasts and vacuoles. Nature (London) 187-927-929.
 15. Cocking E.C. 1970, Virus uptake, cell wall regeneration and virus multiplication in isolated plant protoplasts. Int. Rev. Cytol 28-89-124.

M. Sc. Botany Syllabus

Semester IV

Course code- PSDBOTT15 (DSE-II)

PAPER –XV: Molecular Biology and Plant Biotechnology-II

UNIT- I:

Transgenics : Cloning vectors for higher plants; Methods for gene transfer, *Agrobacterium tumefaciens* mediated- Basis of tumor formation, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri genetic markers, use of reporter genes and introns; Direct DNA transfer; particle bombardment; electroporation; microinjection; macroinjection; liposomes; electrophoretic; pollen tube method; pollen transformation; PEG method; transformation of monocots; transgene stability and gene silencing; chloroplast transformation.

UNIT- II:

Applications of transformation: Herbicide resistance; insect resistance; Bt genes, disease resistance; Nutritional quality; biopesticides and biofertilizers; hazards and safety regulations for transgenic plants.

Metabolic engineering through transgenic plants: Production of secondary metabolites; industrial enzymes; biodegradable plastics (PHB and any other); edible vaccines; antibody production and other important drugs.

UNIT- III:

Plant tissue culture: History, Culture types: Callus culture, organ culture, suspension culture for production of secondary metabolites, protoplast culture, fusion and somatic hybrids, Somatic embryogenesis, anther and pollen culture, haploid plants, somaclonal variations, organogenesis (direct and indirect).

Gene expression: Gene expression in Mitochondria, chloroplast, yeast

Regulation of gene expression: Regulation of gene expression in translation and post-translation level

UNIT- IV:

Nitrogen fixing genes: Organization, function and regulation of nitrogen fixing genes in *Klebsiella*, *hup* genes.

DNA fingerprinting and marker assisted breeding: RFLP maps; linkage analysis; RAPD markers; STS; SSR (microsatellites); ISSR; SCAR (sequence characterized amplified regions); SSCP (single strand conformational polymorphism); AFLP; QTL: map based cloning; molecular marker assisted selection

Cleaner Biotechnology: Pollution control through genetically modified organisms.

Practicals:

Major Exercises:

1. *Agrobacterium tumefaciens* mediating gene transfer in a suitable plant.
2. Induction of secondary metabolite synthesis in suspension culture.
3. Use of RAPD/RFLP/SSCP etc. markers to detect molecular polymorphism of different species.
4. Isolation and protein profiling in different plant species by SDS-PAGE.
5. Raising of suspension culture and plotting of growth curve.
6. Bacterial transformation and selection of transformed cells.
7. Study of expression of inducible genes at biochemical level.

Minor Exercises:

8. Elisa testing of Bt gene in cotton.
9. Isolation of secondary metabolites by gel filtration.
10. Purification of plant metabolite/ protein by column chromatography.
11. DNA ligation and analysis of ligated DNA on agarose gel (cloning and analysis using GUS gene).
12. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seeds.
13. Demonstration of anther culture.

Suggested Readings (for laboratory exercises)

1. Gelvin, S. B. and Schilperoort, R. A (eds) 1994. Plant Molecular Biology Manual, 2nd edition. Kluwer Academic Publishers, Dordrecht, The Netherlands.
2. Glick, B. R. and Thompson, J. E. 1993, Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
3. Glover, D. M. and Hames, B. D.(Eds) 1995. DNA Cloning 1: A Practical Approach: Core Techniques, 2nd edition PAS, IRL Press at Oxford University Press, Oxford.
4. Hackett, P. B. Fuchs, J. A. and Messing, J. W. 1988. An Introduction to Recombinant DNA Techniques. Basic Experiments in Gene Manipulation. The Benjamin/cummings Publishing Co., Inc. Menlo Park, California.
5. Hall, R. D. (Ed.), 1999. Plant Cell Culture Protocols. Humana Press. Inc. New Jersey, USA.
6. Maniatis et al. Molecular cloning Vol. I, II and III. Cold-Spring Harbor Lab Press.
7. Sambrook and Russel. 2001. Molecular cloning Vol. 1-3 CSH press.
8. Shaw, C. H. (Ed.) 1988, Plant Molecular Biology : A Practical Approach. IRL Press, Oxford.
9. Smith, R. H. 2000. Plant Tissue Culture : Tecniques and Experiments. Academic Press, New York.

Suggested Readings:

1. Alberts, Bruce; Johnson Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter, C. 2002 Molecular Biology of the Cell, Garland Science, New York and London.
2. Bhojwani SS and Rajdhan MK 1996 Plant tissue culture: Theory and Practice. Elsevier Sci. Publ., New York.
3. Peter c2002 Molecular Biology of the Cell, New York and London: Garland Science.
4. Callow, J. A., Ford-Lloyed, B. V. and Newbury, H. J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use, CAB International, Oxon UK.
5. Charlwood, B. Y. and Rhodes, M.V. 1999 Secondary products from plant tissue culture, Clarendon Press. Oxford.
6. Chrispeels, M. J. and Sadava, D. E. 1994, Plants, Genes and Agriculture. Jones & Barlett Publishers, Boston, USA.
7. Collins HA and Edwards S 1998 Plant cell culture. BIOS Sci. Publ., Oxford UK.
8. Dicosmo F and Misawa, M. 1996 Plant Cell culture: Secondary metabolism towards industrial application, CRC press, Boca Raton, NewYork.
9. Glazer, A. N. and Nikaido, H. 1995. Microbial Biotechnology. W. H. Freeman & Company, New York, USA.
10. Gustafson, R. J. 2000. Genomes. Kluwer Academic Plenum Publishers, New York, USA.
11. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
12. Jain SM, Sopory SK and Veilleux RE 1996 In vitro haploid production in higher plants. Vols. 1-5. Kluwer Acad. Publ., The Netherlands.
13. Kurz, W.G.W 1989 Primary and Secondary metabolism of plant and Cell cultures, Springer Verlag, Berlin.
14. Old, R. W. and Primrose, S. B. 1989. Principles of Genome Analysis. Blackwell Scientific Publications. Oxford, UK.
15. Primrose, S. B. 1995. Principles of Genome Analysis. Blackwell Scientific Ltd., Oxford, UK.
16. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
17. Shantharam, S. and Montgomery, J. F. 1999. Biotechnology, Biosafety, and Biodiversity. Oxford & IBH Publication Co., Pvt., Ltd., New Delhi.

References: Online journals available on UGC V-SAT programme.

M. Sc. Botany Syllabus
Semester IV
Course code- PSDBOTT15 (DSE-II)
PAPER –XV: Paleobotany-II

UNIT- I:

Gymnospermopsida-- Study of Aneurophytales and Archaeopteridales. Gymnosperm and early evolution (Archeosperma, Elkinsia, and Morentia) of seed habit stages in evolution. Study of Pteridosprmales-Lyginopteridaceae, Medullosaceae, Cycadeoidales-Cycadeoidaceae, Williamsonsaceae, Wielandiellaceae. and Fossil Cycads (Nilssonina, Baenia, Androstrobus).

UNIT- II:

Gymnosper- Caytoniales, Glossopteridales, Penntoxylales.fossil Cordaitales, Voltziales and phylogenetic consideration of all the orders.

UNIT- III:

Study of Deccan Intertrappean flora of India. Formation of Deccan traps and Intertraps, age and its floristic composition in relation to Pteridophytes, Gymnosperms and Angiosperms. Paleocene and Paleogeography of Deccan Intertraps.

UNIT- IV:

Paleopalynology-Important features of spores and pollen morphology, their role in stratigraphy and in exploration of coal and oil. Paleopalynological studies, microfossils and its application. Paleocology and paleogeography.

Indian Gonwana-Its stratigraphy and classification (Two fold and three fold). Index fossil.

Suggested Laboratory and Field Exercises

Major Exercises:

1. Study of Deccan Intertrappean flora of India. Pteridophytes, Gymnosperms and Angiosperms-flowers and fruits.
2. Gymnosperm- Caytoniales, Glossopteridales, Penntoxylales.fossil Cordaitales.
3. Lyginopteridaceae, Medullosaceae, Cycadeoidales-Cycadeoidaceae, Williamsonsaceae, Wielandiellaceae and Fossil Cycads (Nilssonina, Baenia, Androstrobus).
4. Important features of spores and pollen morphology and technique to study them (Maceration)

Minor Exercises:

5. Study different types of fossils.
6. Study of plant fossils as per syllabus based on specimens and slides.
7. Study of wood anatomy of fossils.
8. Exploration and excursion to different fossiliferous localities.

9. Preparation of practical record/submission of collection and tour report of excursion.

Suggested Readings

1. Agashe S. N. (1995)-Palaeobotany, Plants of the past ,their evolution, palaeoenvironment and application in exploration of fossil fuels. Oxford & IBH publishing company-New Delhi.
2. Andrews H.N.(1961)-Studies in Palaeobotany, Willey and Sons –New York.
3. Arnold,C.A.(1947)-An Introduction to Palaeobotany ,MC-GrawHills.,New York.
4. Beck, C. B. and Wight, D. C.(1988)-Progymnosperm, In origin and evolution of Gymnosperms,Columbia Uni. Press-New York.
5. Beck, C.B.(1976)-Current status of the Progymnospermosida, Review of Palaeobotany and Palynology.
6. Darrah, W.C.(1960)-Principles of Paleobotany.
7. Erdtman,G(1957)-Pollen and Spore morphology and plant taxonomy.(An introduction to palynology) Hafner Publishing Comp-New York.
8. Chandra,S.andSurange, K.R.(1979)-Revision of the Indian species of Glossopteris, Monograph,BirbalSahni Institute of Palaeobotany.
9. Hoffmeister,W.S.(1960)-Palynology has an important role in oil exploration.World oil-150:1001-140.
10. Meyen, S.V.(1987) – Fundamentals of Palaeobotany Chapman and Hill,London,New York.
11. Parihar ,N.S.(1995) –Essentials of Palaeobotany,Central Book –Allahabad.
12. Sahni, B.(1964)- Revisions of Indian fossils plants, -III(Monocotyledons) –BSIP-Lucknow.
13. Stewart, W.N.&Rothwell,G.V. (1993)-Palaeobotany and Evolution of Plants,Cambridge Univ., Press-Cambridge.
14. Venkatchala, B.S&Maheshwari,H.K.(1991)-Palaeobotanical Researches in India.Jour.Ind.Bot.Society-70;1-12.
15. Wadia, D.N (1953)-Geology of India,Mac,Millan-Co.London.
16. Prasad, K.N. (1999). - An introduction to palaeobotany, APH Pub.
17. Cleal, J. Christopher. &B.A.Thomas (2009) Introduction to Plant Fossils, Cambridge Univ., Press-Cambridge.
18. Willis, K. J. & McElwain, J. C. (2014). The Evolution Of Plants (second edition) OXFORD University Press.
19. Stewart, W.N. and Rothwell G.W. (1993), Palaeobotany and the Evolution of Plants, Cambridge University Press.
20. Arnold, C.A. (1947): Introduction to Palaeobotany, Mc-Graw Hill Book Co. Inc., New York and London.
21. Agashe, S.N. (1995), Palaeobotany, Oxford & IBH, New Delhi.
22. Siddiqui, K.A. (2002) Elements of Palaeobotany, Kitab Mahal, Allahabad.
23. Thomas, B.A. & Spicer R.A. (1987): The Evolution and Palaeobiology of land plants. Discordies Press, Fortland, USA.
24. Spicer, R.A. & Thomas, B.A. (1986) Systematic and taxonomic approaches in Palaeobotany. Systematic Association Special Volume.

M. Sc. Botany Syllabus
Semester IV
Course code- PSSBOTT16 (SEC-II)
PAPER –XVI: BIOFERTILIZERS-II

UNIT I

Application and evaluation techniques of crop response to biofertilizers, simplified Anaerobic digester for biofertilizers; modified Anaerobic fermenter biofertilizer, Operation condition for anaerobic digestion of biofertilizer.

UNIT II

Soil fertility and Fertilizer:- Soil microbiology and biofertilizer; Biogas from liquid biofertiliser derived from ecologically hazardous water hyacinth; Municipal sewage, agricultural and industrial waste. Recycling of biodegradable waste.

UNIT III

Vermiculture and Vermitechnology:-Introduction; Advantages of vermicomposting, earthworm, ecological types of earthworm, Vermicomposting and their application in organic culture- compost making, Methods and field application

UNIT IV

Green manuring and Organic fertilizer:- Organic farming and organic manures, Methanogenesis- pest and disease management system in agriculture.

Practicals:

Based on theory syllabus.

Suggested reading:-

4. The complete technology book on biofertilizers and organic farming –NIIR, New Delhi.
5. Somani L.L, P.Shilpkar and D.Shilpkar (2011) Biofertilizers commercial production technology and quality control. Agrotech publisher Academy Udaipur.
6. The complete technology book on Vermiculture and Vermicompost NIIR- New Delhi.

M. Sc. Botany Syllabus
Semester IV
Course code- PSSBOTT16 (SEC-II)
PAPER –XVI: Nursery and Gardening-II

Unit-I:

Plant Protection- Difference between a pest and a disease, preventive measures, control measures, cultural control, mechanical control, chemical control, common pests, bird and animal pests, rodent pests, insect pests and diseases.

Unit –II:

Plant propagation- Sexual and vegetative methods of propagation, short and long term storage of propagules (seeds, fruits, bulbs, rhizomes etc).

Unit-III:

Bonsai and Indoor plants- Tools and containers, Procuring plants for bonsai, characteristic elements of bonsai, Shaping-pruning-wiring technique, form and style, root pruning and potting-repotting, Maintenance of growth. Indoor plants and foliage and ornamental plants.

Unit-IV:

Poly-house, Pots and potculture- Design and construction of Poly-house, maintenance and applications of poly-house. Popularity of pot culture, pot arrangements, selection of pots, filling up of pots, watering, repotting, boxes and baskets of potting.

Practicals:

Based on theory syllabus.

Suggested Readings:

3. Trivedi, P. P. (1987) Home Gardening. ICAR New Delhi.
4. Deena Beverley and Barty Phillips (2002) Encyclopedia of Gardening, Parragon Book, UK.

M. Sc. Botany Syllabus

Semester IV

Course code- PSSBOTT16 (SEC-II)

PAPER –XVI: PLANT DIVERSITY AND HUMAN WELFARE-II

Unit-I:

Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation.

Unit-II:

Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

Unit-III:

Role of plants in relation to Human Welfare:

Importance of forestry their utilization and commercial aspects
Avenue trees, Ornamental plants of India.

Unit-IV:

Role of plants in relation to Human Welfare. Alcoholic beverages through ages. Fruits and nuts:
Important fruit crops their commercial importance. Wood and its uses.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices.
Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

M. Sc. Botany Syllabus
Semester IV
Course code- PSSBOTT16 (SEC-II)
PAPER –XVI: FLORICULTURE-II

Unit-I:

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

Unit-II:

Landscaping Places of Public Importance: Landscaping highways and Educational institutions.

Unit-III:

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life;

Unit-IV:

Cultivation of Important cut flowers such as Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliium, Orchids.

Practicals:

Based on theory syllabus.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

M. Sc. Botany Syllabus
Semester IV
Course code- PSSBOTT16 (SEC-II)
PAPER –XVI: BASIC BOTANY-II

UNIT I

Plant physiology:-

- A) Water relation – Diffusion, Osmosis and Inbibition.
- B) Absorption of water and minerals by root.
- C) The loss of water from plants.
- D) The movement of water in plants.
- E) Metabolism of nitrogen, Photosynthesis, Respiration.
- F) Synthesis of protein, fat and there trans location.
- G) Plant growth, movement and reproduction.

UNIT II

Ecology and evolution:- Ecological groups of plants, ecological factors, the units of vegetation (communities), plant succession, ecological types of adaptation of plants, environmental pollution. Evolution of plant kingdom. The ideas of development of organic evolution (Darwinism and Lamarckism).

UNIT III

Economic botany:- General description of economically important plants, yielding food, fodder and forage, wood, oils, gums and resin, oil, drugs and narcotics, beverages, Spices and condiments.(any three examples from each type)

UNIT IV

Paleo botany:- Geological time scales, changes in organic life through ages, process of fossilization, types of fossils presarvations, economic importance of fossils.

Practicals:

Based on theory syllabus.

Suggested Readings:-

1. S.Sundara Rajan College Botany Vol I to IV Himalaya publishing house.
2. Saxena And Sarsbhai A textbook of botany Vol. I to III Kitabghar Gwalior.
3. Gangulee And Kar College botany Vol.I and II.
4. K.S.Bilgrami, L.M.Shrivastava, J.L.Shremali Fundamentals of botany Vol. I and II Vikas Publishing House PVT.LTD. Sahibabad UP.
5. A.C.Dutta Botany for degree students.
6. S.N.Pande And P.S.Trivedi Text book of botany Vol I and II. Vani educational book.