NORTH MAHARASHTRA UNIVERSITY, JALGAON

(NAAC Re-Accredited)

FACULTY OF SCIENCE

SYLLABUS FOR
M.Sc. (PART-I)
IN BOTANY

To Be Implemented From

Academic Year 2014-15

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus for Theory and Practical Courses for M.Sc. In Botany

M.Sc. Part-I

(w.e.f. Academic Year 2014-2015)

Semester-I

BOT.1.1 Angiosperm Taxonomy

BOT.1.2 Environmental Botany and Biostatistics

BOT.1.3 Cytogenetics, Plant breeding and Molecular Biology

BOT.1.4 Practical –I (Based on BOT.1.1)

BOT.1.5 Practical –II (Based on BOT.1.2 and BOT.1.3)

Semester-II

BOT.2.1 Diversity of Lower Cryptogams

BOT.2.2 Diversity of Higher Cryptogams

BOT.2.3 Plant Physiology and Biochemistry

BOT.2.4 Practical –I (Based on BOT.2.1)

BOT.2.5 Practical –II (Based on BOT.2.2 and BOT.2.3)

Note: i) Each theory course requires 05 lectures of 60 minutes each.

ii) Each practical course requires 02 practical's per week of 04 hours duration.

Semester -I

Bot. 1.1 Angiosperm Taxonomy

Total: 60 Lectures

Aims and Objectives:

- **i)** To study conceptual development of 'taxonomy' vis-à-vis 'systematics'.
- **ii)** To study general range of variations in the group of angiosperms.
- **iii)** To trace history of development of systems of classification emphasizing angiospermic taxa.
- **iv)** To study characters of biologically important families of angiosperms
- **v)** To study range of floral variations in angiospermic families, their phylogeny and evolution.
- **vi)** To study various rules, principles and recommendations of plant nomenclature
- **vii)** To know modern trends in taxonomy
- **viii)** To study major evolutionary trends in various parts of angiospermic plants.

ChapterI - Introduction: (03 L)

- **i)** Taxonomy and Systematics : Conceptual Development
- **ii)** Aims and Principles
- **iii)** Approaches and importance
- **iv)** Diversity of angiosperms with respect to :
  a) Form, structure and function
  b) Evolutionary status of Angiosperms

Chapter II - Classifications: History of Development : (09 L)

- **i)** Review of Pre-Darwinian classifications
- **ii)** Review of Post-Darwinian classifications
- **iii)** Recent Systems

ChapterIII - Discussion of the following families with respect to salient (10L)

features and points of biological importance:

Sarraceniaceae, Lentibulariaceae, Droseraceae, Nepenthaceae, Cuscutaceae, Orobanchaceae, Balanophoraceae, Refflesiaceae, Santalaceae, Loranthaceae, Podostemaceae, Rhizophoraceae, Cactaceae, Orchidaceae, Aristolochiaceae

Chapter-IV : Discussion of following families with reference to range of floral (12 L)

variations, taxonomy, phylogeny and evolutionary trends :

1) Ranunculaceae,2) Malvaceae, 3)Rutaceae,4) Cactaceae,
5)Umbelliferae, 6) Compositae, 7) Asclepiadaceae,

8)Scrophulariaceae, 9) Euphorbiaceae, 10)Liliaceae,
11)Orchidaceae,12) Scitamiane, 13) Graminae.

Chapter V: Sources of Taxonomic Information: Role of the following: (10 L)

- **i)** Micromorphology and Ultrastructure
- **ii)** Embryology
- **iii)** Phytochemistry
- **iv)** Reproductive biology
- **v)** Plant geography and Ecology
- **vi)** Genetics and Cytogenetics
- **vii)** Paleobotany

Chapter VI: General Evolutionary Trends In Angiosperms: (08L)

- **i)** Habitat and growth habit
- **ii)** Leaf structure : Simple and compound, phyllotaxy
- **iii)** Phyllode theory
- **iv)** Evolution of inflorescence
- **v)** Primitive stamen
- **vi)** Primitive carpel
- **vii)** Nature of inferior ovary : Foliar (Appendicular) and receptacular (Axial) theories
- **viii)** Evolution of gynoecium
- **ix)** Evolution of floral nectaries
- **x)** Evolution of fruit

Chapter VII : Study of Botanical Nomenclature with respect to : (08 L)

- **i)** Scientific names and Common names
- **ii)** International Code of Botanical Nomenclature (ICBN)
- **iii)** Review of various codes
- **iv)** Principles of the code I-V
- **v)** Type method (Typification) and working of Type method
- **vi)** Author citation
- **vii)** Rejection of names
- **viii)** Retention of names
- **ix)** Conservation of names
- **x)** New Names
- **xi)** Names of cultivated and hybrid plants

REFERENCE BOOKS:

1. **Bhojwani, S.S. and S.P.Bhatnagar (1974)** The Embryology of Angiosperms, Vikas Publishing House (P.) Ltd. New Delhi, India
2. **Davis, P.H and V.H Heywood (1963)** Principles of Angiosperm Taxonomy, Oliver and Boyd, Edinburgh, Scotland.
3. **Eames, A.J. (1961)** Morphology of Angiosperms, McGraw-Hill, NewYork, U.S.A.
4. **Erdtman, G. (1952)** Pollen Morphology and Plant Taxonomy, Angiosperms, Almquist & Wicksell, Stockholm, Sweden.
5. **Gibbs, R.D. (1974)** Chemotaxonomy of Flowering Plants, McGill- Queen's University Press, Montreal & London, U.K.
6. **Harborne, J.B., D. Boulter and B. Turner (1971)** Chemotaxonomy of Leguminosae, Academic Press, London, U.K.
7. **Heywood, V.H. (1968)** Modern Methods in Plant Taxonomy, AcademicPress, London, U.K.
8. **Heywood, V.H. , J.B.Harborne and B.L.Turner (1977)** The Biology and Chemistry of Compositae Vol. I & II, Academic Press, London, U.K.
9. **Jain, S.K. and R.R.Rao (1977)** A Handbook of field and Herbarium Methods, Today and Tomorrow Publishers, New Delhi, India
10. **Johri, B.M. (1984)** Embryology of Angiosperms, Springer- Verlag Berlin Heidelberg New York, (U.S.A.)Tokyo, Japan
11. **Johri, B.M., K.B. Ambegaokar and P.S. Srivastava (1992)** The Familiesof Flowering Plants arranged according to a new system based on their probable phylogeny, Springer Publications, Switzerland.
12. **Kubitzki, K. (1977)** Plant Systematics and Evolution, Springer erlag, New York, U.S.A.
13. **Lawrence, G.H.M. (1951)** Taxonomy of Vascular Plants, MacMillan, New York, U.S.A.
14. **Maheshwari, P. (Ed.)** Recent Advances in the Embryology of Angiosperms, (International Society of Plant Morphology, University of Delhi, Delhi, India.
15. **Maheshwari, P. (1950)** An Introduction to Embryology ofAngiosperms, Mc Graw Hill, New York, U.S.A.
16. **Metcalfe, C.R. and L. Chalk (1950)** Anatomy of the Dicotyledons Vol.I &II Oxford Uni. Press. Oxford, U.K.
17. **Naik, V.N. (1984)** Taxonomy of Angiosperms Tata McGraw-Hill Publishing Co. Ltd. New Delhi, India.
18. **Singh, V. and D.K.Jain (1992)** Taxonomy of Angiosperms, Rastogi Publications, Meerut, India.

19. **Sivarajan, V.V. (1984)** Introduction to Principles of Plant Taxonomy,Oxford and IBH Publication Co. New Delhi, India.

20. **Smith, P.M. (1996)** The Chemotaxonomy of Plants, Edward Arnold. London, U.K.

21. **Sporne, K.R. (1974)** The Morphology of Angiosperms: The Structure and Evolution of Flowering Plants, Hutchinson University Library, London, U.K.

22. **Stace, C.A. (1980)** Plant Taxonomy and Biosystematics, Edward Arnold, London, U.K.

23. **Stebbins, G.L. (1974)** Flowering Plants: Evolution Above The Species Level, Arnold Press, London, U.K.

24. **Swain, T. (Ed.) (1963)** Chemical Plant Taxonomy, Academic Press, London, U.K.

Semester – I
BOT. 1.2
ENVIRONMENTAL BOTANY AND BIOSTATISTICS

Total: 60 Lectures

Aims and Objectives:

- **i)** To understand the environmental botany.
- **ii)** To study the nature and its co-relation with human society.
- **iii)** To study the impact of human activities on environment.
- **iv)** To understand global issues concerned with environment.
- **v)** To understandthe sustainable development and care of environment.

(I) Environmental Botany (42 Lectures)

Chapter I - Environmental Botany: **(03L)**

- **i)** Introduction, scope and Importance
- **ii)** Interdisciplinary nature, Physical environment, Biotic environment and Biotiotic &abiotic interactions.

Chapter II - Ecosystem Ecology: **(08L)**

- **i)** Ecosystem – Definition, Concept, Types and Components of Ecosystem.
- **ii)** Major Ecosystems – Food Chain & Food Web,Aquatic Ecosystem (Fresh water ecosystem, Marine ecosystem and Estuarine ecosystem), Terrestrial Ecosystem (Forest ecosystem and grassland ecosystem)
- **iii)** Productivity of different ecosystems – Primary productivity and secondary productivity.

Chapter III- Fundamentals of Remote Sensing and GIS: **(08L)**

- **i)** Definition, concept and history of remote sensing, Electro-magnetic radiation(EMR), Energyinteraction with atmosphere, interaction with Earth's surface materials.
- **ii)** GIS: Definition, history and introduction, components of GIS, Concept of data, information,knowledge Data: spatial and non-spatial data, raster and vector data, GIS file formats.
- **iii)** Applications of RS and GIS in Forestry and Ecology**:** Introduction - forest density, Foresttype mapping, inventory of forests, delineation of degraded forests, damage assessment,Landscape characterization, Biomass assessment, Forest ecosystem management

Chapter IV - Forestry: **(05L)**

- **i)** Agro forestry
- **ii)** Social forestry
- **iii)** Forest conservation
- **iv)** Watershed Management
- **v)** Wetland Management

Chapter V - Solid Wastes: **(03 L)**

- **i)** Introduction
- **ii)** Types and Sources of Solid Wastes
- **iii)** Solid Waste Management (Collection, Resource &Disposal Recovery andsustainablemanagement)

Chapter VI - Environmental Management: **(05L)**

- **i)** Concept, Scope and Procedure of EIA
- **ii)** Environment Management Plan(EMP)
- **iii)** Environmental Auditing
- **iv)** Green Belt
- **v)** Kyoto Protocol

Chapter VII- Environmental Legislation: **(06L)**

- **i)** Forest Conservation Act
- **ii)** General account of legislation related to environment
- **iii)** Wild life Protection Act – 1972
- **iv)** Water Act – 1976
- **v)** Environment Protection Act – 1985
- **vi)** Biodiversity Act (2002)

Chapter VIII - Global Environmental Issues and Conference : **(04L)**

- **i)** Global Warming, Green House Effect, Acid Rain, Ozone layer depletion
- **ii)** Earth Summit, The United Nations Conference on the Human &Environment, 1972, UnitedNations conference on climate change 2009

(II) Biostatistics (18 Lectures)

Chapter IX- Sampling Methods: **(02L)**

Chapter X - Measure of Central Tendencies: **(02L)**

- **i)** Mean
- **ii)** Mode
- **iii)** Median

Chapter XI - Measure of Dispersion: **(03L)**

- **i)** Range
- **ii)** Standard Deviation, Mean Deviation
- **iii)** Coefficient of Variation, Co-efficient of co-relation
- **iv)** Standard Error

Chapter XII - Distribution: **(02L)**

Probability and Distribution (Normal)

Chapter XIII- Test of Significance: **(04L)**

- i) Concept of Significance
- ii) Students test
- iii) Chi square (X^2) test

Chapter XIV - Analysis of Variance (ANOVA) **(03L)**

i) Introduction and Application in Biology
ii) ANOVA table and F ratio, least significant difference

Chapter XV : Correlation and Regression **(02L)**

REFERENCE BOOKS:

1. **Ambasht, R. S. (1976)** Principles of Ecology (I st Eds.)Students Publications, Varanasi, India.
2. **Arumugam, N (1996)** Concept of Ecology (VII th Eds.) Saras Publication, Kanyakumari, India.
3. **Bagyaraj, D. J. *et.al.*(1999)** Modern Approaches And Innovation In Soil Management,RastogiPublications, Meerut, India
4. **Baily, N. T. J. (1959)** Statistical Methods in Biology, ELBS and the English University Press Ltd. U.K.
5. **Dash, M. C. (1994)** Fundamentals of Ecology. Tata McGraw Hill Publication Comp. Ltd. New Delhi, India .
6. **Gupta, S. C. (1998)** Fundamentals of Statistics, Himalaya Publishing House, New Delhi, India.
7. **Kang-Tsung Chang. (2002)** Introduction to Geographical Information System. McGraw Hill, U.K.
8. **Panda, B. C. (2005)** Remote sensing Principles and applications, Viva Books Private, New Delhi, India.
9. **Prayag, V. R. and Dixit, P. G. (1998)** Statistics – Discrete Probability and Probability Distribution.
10. **Rao, K. S. (1993)** Practical Ecology, Anmol Publication, New Delhi, India.
11. **Reddy M. A. (2006)** Textbook of Remote sensing and geographical information systems, B.S. Publications, Hyderabad, India.
12. **Rosner, B. (1982)** Foundations in Biostatistics. Duxbury Press, Bosten.
13. **Roy, P.S. and R.S. Dwivedi.** Remote Sensing Applications, Technical Report of NRSC/ISRO.
14. **Santra, S. C.**(2001) Environmental Science, New Central Book Agency Pvt. Ltd., Delhi, India.
15. **Saxena, M. M. (1990)** Applied Environmental Biology (Resource and management) AgroBotanical Publisher, Bikaner, India.
16. **Seth, S.M.,S.K. Jain and M.K. Jain .(2002).**Remote Sensing and GIS application studies at National Institute of Hydrology,Roorkee , U.P., India.
17. **Sharma, P. D. (1993)** Ecology and Environment, Rastogi Publications, Meerut, India.
18. **Sudhir, M. A., M. AlankaraMasillamani, M. A. (2003)** Environmental Issues, Reliance

Publishing House, New Delhi, India.

19. **Tor Bernhardsen (2002)**Geographic Information System- an introduction, 3rd edition, , Wiley Publication, New York, USA.

20. **Triwedi, P. R. (1990)** Encyclopedia of World Environment. A. P. H. Publishing Corporation,Delhi, India.

Important Web links:

http://www.geospatialworld.net/Paper/Application/index.aspx

http://www.isro.org/scripts/remotesensingapplications.aspx

http://www.itc.nl/ilwis/applications/application14.asp

BOT. 1.3: Cytogenetics, Plant Breeding and Molecular Biology
Total 60 Lectures

Aims and Objectives:

i) To study structural organization and variation in chromosome as well as karyotype analysis.

ii) To study extra-chromosomal inheritance in plant system.

iii) To study plant breeding system for improvement of economically important plants.

iv) To study molecular biology in relation to genetic material, its inheritance, modification, replication and repair.

v) To study transcription, translation post translation modification and targeting sorting of protein to organelles.

vi) To study gene regulation in prokaryotes and eukaryotes.

(I) Cytogenetics
(25 Lectures)

Chapter I - Organization of genes and chromosomes: (05L)

i) Structure of chromatin and chromosomes

ii) Unique and repetitive DNA, heterochromatin, euchromatin, transposons.

Chapter II- Genetic recombination: (07L)

i) Molecular mechanism of recombination, role of RecA and RecBCD enzymes

ii) Chromosome mapping, linkage group, genetic markers, construction of linkage maps, correlation of genetic and physical maps.

Chapter III - Karyotype analysis: (05L)

i) Chromosome markers, variation in chromosome structure-(Deletion, Duplication, Inversion and Translocation), Variation in chromosome Number (Euploidy, Eneuploidy, methods of inducing Auto and Alloploidy).

ii) Banding pattern Q, C, G, and R-bandings, Special types of chromosomes. C-value, C-value paradox.

Chapter IV - Cell Cycle, its Regulation and control: **(05L)**

i) Mitosis, Meiosis, Check Points, Cyclins and Cyclin dependent Kinases.

ii) Apoptosis and program cell death.

Chapter V - Cytoplasmic inheritance: **(03L)**

Cytoplasmic inheritance involving Chloroplast (*Mirabilis jalpa, Maize*), Mitochondria (Mail sterility in higher plant).

(II) Plant Breeding
(10 Lectures)

Chapter VI - Scope, Importance and Objectives. **(02L)**

Chapter VII - Reproductive Systems in Crop Plants: **(02L)**
Sexual, Asexual and Vegetative Reproduction .

Chapter VIII: Methods of Crop Improvements: **(06L)**

- **i)** Pure line theory, Pure line selection, Pedigree selection, Bulk methods.
- **ii)** Concept of Heterosis, Hybrid vigour, Inbreeding depression, Dominance and Overdominance hypothesis.
- **iii)** Hybrid Seed Production.

(III) Molecular Biology
(25 Lectures)

Chapter IX: Structure and Properties of Nucleic acid: **(03L)**

- **i)** Physical and chemical nature of nucleic acid, Cot Curve, cot 1/2 value and its significance.
- **ii)** Unique , moderately repetitive and highly repetitive DNA.

Chapter X: DNA Replication: **(02L)**

- **i)** Unit of replication, various enzymes involved in replication
- **ii)** replication origin and replication fork.

Chapter XI: Gene Mutation: **(03L)**

- **i)** Molecular basis of mutation
- **ii)** Mechanism of Spontaneous and induce mutation.

Chapter XII: Gene Repair: **(02L)**
Direct repair, Excise Repair, Mismatch repair and SOS repair.

Chapter XIII: RNA Synthesis and Processing: **(04L)**

- **i)** **Transcription**: RNA polymerases and their role, Transcription apparatus,
- **ii)** Transcription in prokaryotes and eukaryotes, initiation, elongation and termination, RNA processing.

Chapter XIV: Protein Synthesis and Processing: **(03L)**

- **i)** Initiation, elongation and termination of translation.
- **ii)** Post- translation, modification of protein.

ChapterXV: Protein Sorting and Targeting: **(03L)**

- **i)** Chloroplast, Vacuoles, Mitochondria, and Peroxisomes.
- **ii)** ProteinTraffickin

ChapterXVI: Regulation of gene expression: **(05 L)**

- **i)** Eukaryotic transcriptional regulation (promoter enhancer and silencer, gene battery) and post transcriptional regulation

ii) Prokaryotic transcriptional regulation (Lac Operon and Trp Operon) and post transcriptional regulation.

REFERENCE BOOKS:

1. **Benjamin Lewin(2009)**Genes– VI, VII, VIII and IX; Oxford , Univ. Press ,USA .
2. **Chaudhari , B.D. (2000)**Elementary Principles of plant Breeding(2nd Edt.)Oxford& IBH pub. New Delhi, India.
3. **De Robertis and De Robertis (2005)** Cell and Molecular Biology, 8thEd, Lippincott William and Wilkins U.S.A.
4. **Eldon john Gardner, Michel J. Simmons and D. Peter Snustad(1991)** Princiles of genetics 8thEd . Wiley India edition, New Delhi, India.
5. **Gupta, P. K. (2007)** Genetics: Classical to Modern. Rastogi Publications , Meerut, India.
6. **Hartl D L and Jones E W (1998)** Genetics Principles and Analysis ; (4thed.). Jones and Barflett Publishers, USA.
7. **Hexter W and Yost Jr. H T., (1977)** The Science of Genetics ; Prentice Hall of India Pvt. Ltd. , New Delhi, India.
8. **Kar and Halder, (2009)**Cell Biology Genetics Molecular Biology; New Central Book Agency (P) Ltd. Kolkata, India.
9. **Karp, G. (1999)** Cells and Molecular Biology concepts and Experiments; Hohn Wiley & Sons Inc. USA.
10. **Phundan Singh, (1996)** Essentials of Plant Breeding; Kalyani publication , New Delhi, India.
11. **Powar,C. B. (1992)** Cell Biology, Himalaya Publishing House Nagpur, India.
12. **Powar, C. B (2003)** Genetics I & II Himalaya Publishing House, Nagpur, India.
13. **Swanson, C. P. T. Merz, and W.J. Young (1982)** Cytogenetics ; Prentice Hall of India Pvt. Ltd., New Delhi, India.
14. **Russel, P.J. (1998)** Genetics (5th edition); The Benjamin/ Cummings Publishing Company Inc., USA.
15. **Verma, Agarwal, (2005)** Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: S.Chand and Company , New Delhi, India.

BOT 1.4 Practical –I

(Based on Bot 1.1 Angiosperm Taxonomy)

(Total: 24 Practicals)

Practicals1-15: Study of following families with respect to morphological characters using botanical terms, floral formula, floral diagram and classification giving reasons as per Bentham and Hooker's system covering major groups of it (Any 30 families in angiosperms locally available)

Menispermaceae, Nymphaeaceae, Papaveraceae, Crucuferae, Capparidacaee, Polygalaceae, Caryophyllaceae, Portulacaceae, Elatinaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rhamnaceae, Celastraceae, Vitaceae, Sapindaceae, Moringaceae, Papilionaceae, Caesalpiniaceae, Mimosaceae, Combretaceae, Myrtaceae, Lythraceae,Passifloraceae, Cucurbitaceae, Molluginaceae, Aizoaceae, Umbelliferae, Rubiaceae, Compositae, Campanulaceae, Plumbaginaceae, Sapotaceae, Gentianaceae, Apocynaceae, Asclepiadaceae, Oleaceae, Boraginaceae, Convolvulaceae, Scrophulariaceae, Pedaliaceae, Bignoniaceae, Acanthaceae, Verbenaceae, Labiatae, Nyctaginaceae, Amaranthaceae, Polygonaceae, Aristolochiaceae, Loranthaceae, Santalaceae,Euphorbiaceae, Hydrocharitaceae,Scitaminae, Amaryllidaceae, Dioscoriaceae, Liliaceae, Commelinaceae,Typhaceae, Najadaceae, Potamogetonaceae, Eriocaulaceae, Cyperaceae, Graminae.

Practicals16-20: Identification of genus and species with the help of flora of the plant materials from the families mentioned above.

Practicals21-22: Preparation of artificial, bracketed/indented dichotomous keys based on vegetative and reproductive characters.

Practicals23-24: Study of morphological and biological peculiarities of the following :

i) Insectivorous plants : Drosera, Utricularia, Nepenthes
ii) Parasitic plants : Striga, Cuscuta, Dendrophthoe, Viscum
iii) Aquatic plants : Lemna, Wolffia, Vallisneria, Limnophila, Ottellia
iv) Inflorescences : Spadix, Cyathium, Catkin
v) Flowers : Typha, Orchid and Cleistogamous flowers.
vi) Phyllode : Australian Acacia
vii) Velamen tissue

Note: i) Botanical excursions and submission of scientific excursion reports from one locally andvegetationally different locality are compulsory.

ii) Duly certified journals are compulsory at the time of practical examination.

Following floras may be consulted for practical purpose:

1. **Cooke, T. (1958)** Flora of Presidency of Bombay Vol.I-II, Botanical Survey of India, Calcutta, India.
2. **Hooker, J.D.(1872-1897)** Flora of British India, Vol. I-VII, Reeves & Co., London.
3. **Kamble, S.Y. and S.G. Pradhan (1988)** Flora of Akola District, Maharashtra, Botanical Survey of India, Calcutta, India.
4. **Kshirsagar, S.R. and D.A.Patil (2008)** Flora of Jalgaon District, Maharashtra, Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
5. **Kulkarni, B.G. (1988)** Flora of Sindhudurg, Botanical Survey of India, Calcutta, India.
6. **Lakshminarasimhan, P. & B.D. Sharma (1991)** Flora of Nashik District, Botanical Survey of India, Calcutta, India.
7. **Naik, V.N. (1999)** Flora of Marathwada, Vol. I-II, Amrut Prakashan, Station Road, Aurangabad, India.
8. **Patil, D.A. (2003)** Flora of Dhule and Nandurbar District (Maharashtra). Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
9. **Shah, G.L. (1978)** Flora of Gujarat State, Vol. 1-2, Vallabh Vidyanagar, Gujarat, India.

BOT 1.5 Practical –II

(Based on Bot 1.2 and Bot 1.3)

(Total: 24 Practicals)

Practicals 1-4: Practical's on study of vegetation by using following methods for Estimation of FICC, IVI, frequency, Density, Abundance and Histogram.

a) Quadrate Method:
   i) List count Quadrate
   ii) Chart Quadrate

b) Transect Method
   i) Line Transect
   ii) Belt Transect

c) Physiognomic Method
   i) Biological Spectrum.

Practical5: Estimation of Biomass

Practical 6: Instruments used for collection of meteorological data (any six)

Practical7: Studies on pond ecosystem (Polluted and unpolluted sites)any two parameters
a) Carbonates
b) Total alkalinity
c) Hardness
d) Chlorides

Practical8: Estimation of Phosphatic fertilizers from agricultural soil using colorimeter / spectrophotometer.

Practical9: Element of visual interpretation of aerial photograph and satellite image.

Practical10: Details and use of mirror stereoscope and pochet stereoscope for interpretation.

Practical11-12: Examples based on Biological Data

a) Measure of Central Tendencies
b) Measure of Dispersion
c) Test of significance X^2 test and t- test
d) Normal Distribution

Practical13: Preparation of Cytological fixative (Carnoy's fluid I,II, Navashin's fluid etc.)

Practical 14: Preparation of stains, Aceto-carmine, Haematoxylene, and Feulgen

Practical15-16: Squash and smear preparations to study Mitosis in onion root tips and Meiosis in Maize or Onion or *Rhoeo* flower buds.

Practical17: Determination of Mitotic index and Metaphase frequency in *Allium cepa* or other plant material.

Practical18: Demonstration of salivary gland chromosome preparations (Chironomous larvae/Drosophila).

Practical 19: Estimation of RNA by Orcinol Method.

Practicals20-21: Isolation and estimation of DNA from suitable plant material.

Practical22: Hybridization in plant(selection of male and female flower, emasculation, bagging, tagging, etc)

Practical23: Study of chromosomal aberrations in plant(*Rhoeo*).

Practical24: Isolation and Janus green staining of mitochondria.

Reference Books for remote sensing practical's

1. **Lillesand T.M. and Kieffer, R.M. (1987)** Remote sensing and image interpretation JohnWiley, New York, USA.
2. **Nag P. and Kudrat M. (1998).** Digital remote sensing Concept Publishing Company Pvt. Ltd.New Delhi, India.

Semester- II

BOT 2.1 Diversity ofLower Cryptogams

Total 60Lectures

Aims and Objectives:

- **i)** To study salient features of Algae and Fungi.
- **ii)** To study diversity of lower Cryptogamic plants in nature.
- **iii)** To study the life cycle patterns in lower cryptogams.
- **iv)** To study algae and fungi for human welfare.

Algae (30 Lectures)

Chapter I -Algae- Introduction: **(03L)**

- **i)** General characters ; Definition; Development of Phycology; The Scope of modern Phycology
- **ii)** Structure of algal cell : a)Prokaryotic, ii) Eukaryotic
- **iii)** Algae in human welfare

Chapter II -Classification of algae according to F. E. Fritsch (1945), G.W. Prescott and Parker (1982) up toclass and subclass: **(04L)**

- **i)** Basis of algal classification and nomenclature.
- **ii)** Summary of the principal characteristics of the algal classes, with respect topigments, reservefood, cellwall, chloroplast and eyespot, flagella.

Chapter III - Range of thallus organization: **(04L)**

- **i)** Unicellular organization : a) Rhizopodial forms, b) Coccoid form c) Flagelleted forms
- **ii)** Colonial organization : a) Palmelloid, Tetrasporal, and Dendriod types b) Coenobia
- **iii)** Filamentous organization: a) simple filaments b) Branchedfilaments
- **iv)** Parenchymatous organization
- **v)** Pseudoparenchymatous organization
- **vi)** Siphonoceous organization

Chapter IV-Cyanophyceae: **(03L)**

- **i)** General Characters
- **ii)** Ecology of Blue green algae, thallus Organization,
- **iii)** Ultra structure of Heterocyst, Nitrogen fixation and metabolism
- **iv)** Reproduction

Chapter V - Chlorophyceae **(05L)**

- **i)** General characteristics
- **ii)** Range of thallus structure
- **iii)** Method of reproduction and life cycle pattern.

Chapter VI -Phaeophyceae **(04L)**

- **i)** General characters
- **ii)** Range of thallus structure
- **iii)** Method of reproduction and life cycle pattern

Chapter VII -Rhodophyceae **(04L)**

- **i)** General characters
- **ii)** Range of thallus structure
- **iii)** Method of reproduction and life cycle pattern

ChapterVIII - General characters of divisions with examples: **(03L)**

- **i)** Xanthophyta : General characters
- **ii)** Bacillariophyta: Cell structure; classification, reproduction.
- **iv)** Euglenophyta: General characters
- **v)** Algae in human welfare

Fungi (30 Lectures)

Chapter IX -Fungi – Introduction: **(05L)**

- **i)** Distinguishing characters
- **ii)** Thallus- unicellular and multicellular filamentous
- **iii)** Nutrition
- **iv)** Hyphal modifications in Fungi
- **v)** Classification of fungi up to classes as per- Ainsworth et al., system (1973).
- **vi)** Economic importance- Fungi in biotechnology, fungi as food

ChapterX - Myxomycotina: **(03L)**

- **i)** Distinguishing characters
- **ii)** Structure of thallus and reproductive bodies
- **iii)** Life cycle pattern.

Chapter XI -Mastigomycotina: **(03L)**

- **i)** Distinguishing characters
- **ii)** Thallus structure and reproduction (Asexual and sexual)
- **iii)** Life cycle pattern in Chytridiomycetes and Oomycetes.

Chapter XII -Zygomycotina: **(03L)**

- **i)** Distinguishing characters
- **ii)** Thallus structure, Heterothallism
- **iii)** Sexual reproduction, Evolution of Asexual reproduction
- **iv)** Life cycle pattern

Chapter XIII -Ascomycotina: **(05L)**

- **i)** Distinguishing characters
- **ii)** Thallus structure, structure of asci, Concept of Hamathecium and centrum, Fructifications
- **iii)** Life cycle pattern in Hemiascomycetes and Euascomycetes.

ChapterXIV-Basidiomycotina: **(05L)**

i) Distinguishing characters
ii) Thallus structure, Types and Structure of Basidia and basidiocarps
iii) Llife cycle pattern in Teliomycetes, Hymenomycetes and Gasteromycetes.

Chapter XV - Deuteromycotina: (03L)

i) Distinguishing characters
ii) Thallus structure, fructifications
iii) Types of conidia, Life cycle patterns

Chapter XVI -Lichens: (02L)

i) Types and Classification of lichens, Nature of association
ii) Morphology and anatomy of lichen thallus, reproduction
iii) Economic and Ecological importance.

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2. **Bony, A.D. (1978)** Phytoplankton.Edward Arnold Pub.Ltd. London, U.K.
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Fungi:

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22. **Deacon J.W. (2006)** Fungal Biology (4th Ed.) Blackwell Publishing, Oxford, U.K.
23. **Dube H.C. (2004)** An Introduction To Fungi. Vikas Publishers.New Delhi, India.
24. **Kendrick B. (1994)** The Fifth Kingdom (paperback), North America, New York Publisher: 3rd edn.
25. **Kirk et al. (2001)** Dictionary of fungi, 9th edn, Wallingford: CABI.
26. **Mehrotra R.S. and Aneja K.R. (1990)** An Introduction To Mycology. New Age Publishers, New Delhi, India
27. **Miguel U., Richard H., and Samuel A. (2000)** Illustrated Dictionary of the Mycology. Elvira Aguirre Acosta, Publisher: St. Paul, Minn: APS press.
28. **Sharma O.P. (2010)** A Text Book of Fungi. S.Chand's Publication,New Delhi, India
29. **Sharma, P.**D. **(1998**) The Fungi. Rastogi Publications, Merrut, India.
30. **Vashista, B.**R. **and Sinha** A.K. **(2008)** Botany for Degree Students –Fungi. S.Chand and company Ltd., New Delhi, India.
31. **Webster J. and Rpland W. (2007)** Introduction To Fungi (3rd Edn) Cambridge University, Press, U.K.

Semester II

BOT. 2.2 Diversity of Higher Cryptogam

Total: 60 Lectures

Aims and Objectives:

i) To make students aware of the status of higher cryptogams as a group in plant kingdom.

ii) To study habit and habitat of the higher cryptogams in the field.

iii) To study distinguishing features, interrelationships, phylogeny and evolutionary tendencies of selected orders with their affinities.

iv) To study economic importance of higher cryptogamic plants

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BRYOPHYTA(30 Lectures)

Chapter I - Introduction **(13L)**

i. Classification of Bryophytes proposed by G. M. Smith with reasons details up to orders

ii. Distribution of Bryophytes in India and their micro climate

iii. Contribution of Indian bryologists
   a) Prof Shiv Ram Kashyap
   b)Prof S.K.Pande
   c)Prof Ram Udar

Chapter II - Distinguishing features,interrelationships,phylogeny and evolutionary tendencies of thefollowingorders:

(i) Hepaticae : **(13L)**
Spherocarpales
Marchantiales
Jungermanniales
Takakiales
Calobryales

(ii) Anthocerotae : Anthocerotales

(iii) Musci :
Sphagnales
Andreales
Polytrichales

Chapter III - General Topics : **(04L)**

(i) Evolution of gametophytes and sporophytes of Bryophyta

(ii) Economic importance of Bryophytas

PTERIDOPHYTA (30 Lectures)

Chapter IV - Introduction: **(06L)**

i) Classification of pteridophytes proposed by Reimers uptorders with reasons

ii) Distribution of Pteridophytes in India

iii) Contribution of Indian Pteridologists
a)Rashid A
b)S. S. Bir

ChapterV - Morphology,anatomy, and comparative discussion of sporophytes,gametophytes,interrelationships,evolutionary tendencies and phylogeny of following living orders : **(17L)**

i) Psilotales
ii) Lycopodiales
iii) Isoetales
iv) Selaginellales
iv) Equisetales
v) Marattiales
vi) Ophioglossales
vii) Osmundales
ix) Filicales (any two families)
x) Marsileales
xi) Salviniales

Chapter VI -General Topics: **(07L)**

(i) Heterospory and seed habit
(ii) Soral evolution
(iii) Economic importance of Pteridophytes

REFERENCEBOOKS:

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1. **Cavers, F. (1976)** The interalationships of the Bryophytes. S.R. Technic, Ashok Rajpath, Patana, India.
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7. **Udar, R.(1970)** Introduction to Bryophytes. Shashidhar Malaviya Prakashan. Lucknow, India.
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11. **Rsashid, A.(1999)** An introduction to Pteridophyta. Vikas publishing House Pvt.Ltd. New Delhi, India.
12. **Sharma, O.P.(1990)** Textbook of Pteridophyta. MacMillan India Ltd. Delhi, India.
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14. **Sporne, K.R. (1986)** The morphology of Pteridophytes. Hutchinson Univerity Library, London, UK.
15. **Vashista, B.R., Sinha, A.K., Kumar, A.(2008).** Botany for degree students – Pteridophyta, S.Chand Publications, New Delhi, India.
16. **Gangulee and Kar (2006)** College Botany. New Central Book Agency, Delhi, India.
17. **Sundar Rajan S.(1999)** Introduction to Pteridophyta. New Age International Publishers. New Delhi,India.
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BOT.2.3 PLANT PHYSIOLOGY AND BIOCHEMISTRY

(Total 60 Lectures)

Aims and Objectives:

- **i)** To understand plant structures in the context of physiological functions of plants.
- **ii)** To understand plant water relations.
- **iii)** To study the mineral nutrition in plants in and ex flow of nutrients in plants.
- **iv)** To understand the physiological details of photosynthesis and respiration.
- **v)** To understand plant growth and development, and its regulation.

PLANT PHYSIOLOGY (40Lectures)

ChapterI - Introduction, **Scope and Importance** **(02L)**

ChapterII -Growth and Development: **(06L)**

- **i)** Bioassay of Auxins, Gibbrellins, Cytokinins.
- **ii)** Ttransport and storage of harmones.
- **iii)** Physiological effect of Auxins, Gibbrellins and Cytokinins.

ChapterIII -Photosynthesis: **(10L)**

- **i)** Introduction and Definition
- **ii)** Brief account of photosynthetic pigments
- **iii)** Light reaction
- **iv)** Dark reaction
- **v)** Formation of sucrose, starch and fructose
- **vi)** Factors affecting the rate of photosynthesis-Light, temperature, water, O_2 and CO_2.

ChapterIV -Respiration: **(10L)**

- **i)** Introduction and Definition
- **ii)** Respiratory Quotient (RQ)
- **iii)** Formation of Hexose sugars from reserve carbohydrates
- **iv)** Hydrolysis of fructans and sucrose
- **v)** Mechanism: a) Glycolysis b) Kreb's cycle c) Electron transport system (ETS)
- **vi)** Fermentation:
  a) Alcoholic fermentation
  b) Acetic acid fermentation
  c) Lactic acid fermentation
- **vii)** Factors affecting the rate of respiration

ChapterV -Translocations of Solutes: **(06L)**

- **i)** Introduction
- **ii)** Uptake and translocation of solute & microelements
- **iii)** Mechanisms of loading and unloading of photoassimilates

ChapterVI -Stress Physiology: **(04L)**

- **i)** Definition
- **ii)** Types of Stress
  - a) Water stress-Drought, Cold and Salt
  - b) Temperature stress-High and Low

ChapterVII -Biological clock: **(02L)**

- **i)** Concept of Biological Clock
- **ii)** Circadian and other Rhythms

BIOCHEMISTRY (20Lectures)

Chapter VIII - Introduction: **(03L)**

- **i)** Definition,Scope and Importance
- **ii)** Hydrogen ion Concentration
- **iii)** P^H and Buffers

ChapterIX - Primary and Secondary Plant Metabolites: **(06L)**

- **i)** Brief account of primary plant metabolites
- **ii)** Brief account of secondary plant metabolites
- **iii)** Biosynthesis of Trepenes, Phenols and Nitrogenous compounds and their role.

ChapterX - Biological Oxidation and Reduction: **(06L)**

- **i)** Introduction
- **ii)** Oxidation & reduction reactions
- **iii)** Redox reaction in biological system
- **iv)** Oxidation-reduction potential and measurement
- **v)** Biologically important Redox Systems.

Chapter XI -Biosignaling: **(05L)**

- **i)** General features of Signal and Transduction
- **ii)** G-protein mediator, couple receptor
- **iii)** Receptor Gateway

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1. **Amarsingh (1977)** Practical Plant Physiology. Kalyani Publishers, New Dehli, India.
2. **Anand, B. K. & S. K. Manchanda (1976)** Text Book of Physiology. Tata McGraw Hill Publications Co. Ltd, Dehli, India.
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20. **Mehta, S. L. Lodha, M. L. and P.V. Sane(Eds.) (1989)** Recent advances in Plant Biochemistry. Pub. ICAR, New Delhi, India.
21. **Meinder, H. & T.A. Monsfield (1968)** Physiology of Stomata. Tata McGraw Hill Publications Mumbai & New Delhi, India.
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29. **Strafford, G. A. (1967)** Essential of Plant Physiology. Heineman Educational Books Ltd. London, UK.
30. **Street, H. E. and H. Opik (1980)** The Physiology of Flowering Plants. Edward Arnold Ltd. London, UK.
31. **Witham, F. H. Blaydes and R. M. Delvin (1971)** Experiments in Plant Physiology. Van Nostrand Reinhold Co. New Delhi, India.

BOT 2.4 Practical-I

(Based on BOT 2.1 (Total Practical's – 24)

Algae : (12 Practicals)

Morphological observations, description and classification according to Fritsch with reason of taxa belonging to at least two examples from each order.

Practicals1- 3: **Cyanophyta:** Any 10 forms

Practicals 4-7: **Chlorophyta:**Any 25 forms

Practical8: **Charophyceae-** *Chara, Nitella*

Practicals 9-10: **Xanthophyceae –** *Vaucheria, Botrydium*

Bacillariophycece- *Navicula, Pinnularia, Fragillaria, Synedra, Nitzchia, Cymbella,Cyclotella, Pleurosigma, Gyrosigma, Coconeis*, (any 4 forms)

Practical 11: **Phaeophyta –** Any 5 forms

Practical12: **Rhodophyta-** Any 4 forms

Fungi: (12 Practicals)

Practical 13: Preparation of cotton blue, Lactophenol and culture medium - PDA

Representative genera belonging to following subdivisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth et al. (1973).

Practical 14: Myxomycotina -Any three forms

Practical 15: Mastigomycotina - Any five forms

Practical 16: Zygomycotina - Any three forms

Practicals 17-19: Ascomycotina - Any eight forms

Practicals 20-22: Basidiomycotina- Any eight forms

Practical 23: Deuteromycotina - Any five forms

Practical 24: Study of Lichens -Any three forms

Note:

i) **Excursion tour is compulsory to observe algae and fungi in nature. Tour report along with photographs must be submitted at the time of practical examination.**

ii) **Duly certified journals are compulsory at the time of practical examination**.

Books/Monograph for identification of Algae:

1) **Desikachary, T.V. (1959)** Cyanophyta. Indian Council for Agricultural Research, India

2) **Desikachary, T.V., V.Krishnamurthy and Balakrishnan, M.S. (1991)** Rhodophyta Vol.2 Madras Science Foundation, India.

3) **Philipose, M.T. (1967)** Chlorococcales. Indian Council for Agricultural Research, India

4) **Ramnathan, K.R. (1962)** A monograph Ulotrichales. Council of scientific and Industrial research, New Delhi.

5) **Sarode P.T. and Kamat N.D.(1984)** Fresh water Diatoms of Maharashtra, Srikripa prakashan , India.

6) **Srinivasan, K.S. (1969)** Phycologia Indica (Vol.I). Botanical Survey of India.Calcutta, India.

Books/Monograph for identification of Fungi:

1) **Barron G L (1968)** The genera of Hyphomycetes from soil, The Williams and Wilkins Co., Baltimore.

2) **Bhat, D. J.(2010)**Fascinating microfungi (Hyphomycetes) of Western Ghats-India,by Broadway Book Centre Publishers & Distributors, Pungim, Goa, India.

3) **Borse, BD, Bhat, DJ, Borse, KN, Tuwar, AR, Pawar NS (2012)** Marine Fungi of India, Broadway Publishers, Goa, India.

4) **Gauri Rane and R. V. Gandhe (2011)**Diversity of Fungi From Some Indian Soils, LAP Lambert Academic Publishing,Germany.

5) **Ellis M B (1971)** Dematiaceous Hyphomycetes, Commonwealth Mycological Institute, Kew, England.UK.

6) **Ellis M B (1976)**More Dematiaceous Hyphomycetesby Commonwealth Mycological Institute, Kew, England, UK.

7) **Kiffer E & Morelet M (2000)**The Deuteromycetes, Mitosporic fungi Classification and Generic Keys , New Hampshire,

8) **Kirk P M, Cannon P F, Minter D W & Stalper J A.(2008)**Ainworth & Bisby's Dictionary of fungi, 10th editionby CAB International, Wallinford.

9) **PandeAlaka (2008)**Ascomycetes of Peninsular India, Scientific Publishers (India), Jodhpur, India

10) **Rao, G. P., Manoharachary, C., Bhat, D. J., Rajak, R. C., & Lakhanpal**, **T. N. (eds.)(2003)** Frontiers of Fungal Diversity in India - Prof. Kamal Festschrift Volume,**)** International Book Distributing Co. Lucknow, India.

11) **Subramanian, CV (1971)**Hyphomycetes, ICAR, New Delhi,India .

12) **Watanabe, Taylor and Francis(2010)** Pictorial Atlas of Soil and Seed fungi**,** Asia Pacific, Singapore.

BOT 2.5 Practical II (Based on BOT. 2.2 & BOT 2.3)

(Total Practicals -24)

Bryophyta (6 Practicals)

Morphological, Anatomical and Reproductive studies of the following:

Practicals 1 -2: *Marchantiales: Plagiochasma, Targionia, Asterella Conocephallum & Dumortiara.*

Practicals 3-4: *Jungermanniales: Pellia, Fossombronia, Pallavicinia, Porella and Frullania.*

Practical 5 : *Anthocerotales – Anthoceros, Notothylus*

Practical 6: *Musci: Polytrichum, Pogonatum*, *Sphagnum*

Pteridophyta (6 Practicals)

Morphological, Anatomical and Reproductive studies of the following

Practical7: *Lycopodium*

Isoetes

Practical 8: *Ophioglossum*

Osmunda

Practical 9: *Gleichenia, Pteris, Adiantum.*

Practical 10: *Asplenium, Lygodium.*

Practical 11: *Pleopeltis, Cheilanthes*

Practical 12 : *Marsilea, Salvinia, Azolla*

Note:

i) **Excursion tour is compulsory to observe Bryophytes and Pteridophytes in nature. Tour report along with photographs must be submitted at the time of practical examination.**

ii) **Duly certified journals are compulsory at the time of practical examination**.

Plant Physiology and Biochemistry (12 Practicals)

Practical 13 : Determine diaurnal fluctuations in titrable acid number (TAN) values of CAM succulents (e.g. Aloe, Bryophyllum, Kalanchoe- any one)

Practicals 14-15 : Determine the absorption spectrum of chlorophyll pigments and estimate the amount of Chl-a, Chl-b and total Chlorophylls by spectrophotometer method.

Practical 16 : Extraction and separation of free amino acid of germinating seed by circular paper chromatography.

Practical 17 : Extraction and separation of free sugars from ripe fruits by ascending paper chromatography.

Practical 18: To extract and estimate the amount of Ascorbic acid present in green paper (raw)/ lemon (Fresh).

Practicals 19-20: Extraction and Detection of secondary plant metabolites from suitable plant material i) Alkaloids ii) Phenols iii) Terpenoids iv) Proteins.

Practical 21: Estimation of amount of CO_2 evolved during respiration (Germinating Pea seeds).

Practical 22: Estimation of ether soluble fat oil of Ricinus/ Arachis seeds by Sohxlet apparatus.

Practical 23: Estimation of total nitrogen in plants.

Practical 24 : Estimation of alcohol in fermented grape juice.

Note :

Apart from grooming in basic science of botany, the first year of M.Sc. Botany syllabus included courses with applied avenues as the following:

1. Govt. Department of Environment and Forestry.
2. NGO's writing for environmental concerns
3. NGO's and Govt.Department concerning hazards of pollutions
4. Industries or companies of Plant Breeding & Crop Improvements
5. Industries or Companies of Plant-based agricultural or horticultural procedures

Some applied courses are included in the syllabus of M.Sc IInd year. This syllabus is to be framed yet.