

**SHIVAJI UNIVERSITY, KOLHAPUR.**

**DEPARTMENT OF BOTANY**

Syllabus for the Semester System Examination (Academic Flexibility, Credit System)  
w.e.f. June 2013 for M.Sc. Part - I (Semester I & II) **R. No. ....dated ....**

M.Sc. BOTANY REVISED SYLLABUS (Academic Flexibility) (Credit System) with  
effect from June 2013.

1. The entire course of M. Sc. (Botany) will be of four semesters spread over within two years.
2. There shall be four theory papers and four practicals (each based on one theory paper) in every semester. Each semester course shall comprise of four units per theory paper per week. One practical of two units per paper per week.
3. Every theory paper shall be having four units and every practical shall be having two units.
4. a) There shall be one choice based elective paper under choice based credit system. The students from this Department shall have to opt at least one choice based elective paper offered by other Departments.  
b) The students from other Departments can opt one elective paper from this Department either in Semester III/IV in their respective course. It will be commenced from academic year 2014-2015. There will be no practical unit for this course, only four credits are allotted for this elective paper. The decision regarding admission of such other departmental students will be made by the departmental committee.
5. Each unit in theory paper shall comprise of 15 lectures of 60 minutes duration and there shall be four lectures per paper per week. There shall be four practicals (each with not less than three hour duration) per week. Library (Reference) work/ Excursion/ Field Work/Seminar –Group/ Discussion/ shall also be conducted in every week.
7. There shall be at least a short ( up to 3 days) and a long tour ( up to 15 days) per year for all M.Sc. Part I students. For M.Sc. I students there shall be a long tour to a region out of the state covering various Botanical Regions, Research

Institutes, Centres etc. Tours are part of curriculum and are obligatory to each student, failing which students are not considered eligible to appear for the examination. Under unavoidable circumstances, if the student fails to attend the tour, he/she has to produce justifiable evidence for not attending the tour. However, in leave of tour the candidate will have to complete the work assigned by the Department.

8. Candidates shall require to submit the following at the time of practical examination:

- A workbook, field record book / tour report duly signed by the concerned teacher/s.
- A set of micro preparations (semi / permanent) of plant materials illustrating the subject matter of the relevant paper.
- Submission of at least 10-15 herbarium specimens (of weeds/cultivated plants) and preserved specimens collected by the student during the field work or botanical excursion.

9. The M. Sc. part-I (Semester-I & II) course in Botany will be of 1200 marks. Every semester will be of 600 marks; 400 marks for theory papers (4) and 200 marks for practicals (4).

10. Each theory paper will be of 100 marks comprising internal departmental examination of 20 marks and semester examination of 80 marks of three hours duration conducted by the university. In the mid of the semester, there will be an internal test of 20 marks of multiple choice questions.

11. Practical examination based on each theory paper will be of 50 marks comprising 10 marks for internal and 40 marks for examination conducted by the university. Each practical examination will be of 3 hours duration.

12. Each question paper of 80 marks based on theory paper consists of seven questions, of which the student shall have to attempt five questions. The last question is compulsory and comprises of short answer type questions. Each question carries 16 marks.

### **M.Sc. Part I (Semester - I)**

#### **Theory Papers:**

B O 1.1: Prerequisite Course

B O 1.2: Biology and Diversity of Algae, Fungi and Bryophytes

B O 1.3: Plant Ecology

BO 1.4: Biology and Diversity of Pteridophytes and Gymnosperms  
(Living and Fossils)

**Practicals:**

B O P 1.1: Prerequisite Course

B O P 1.2: Biology and Diversity of Algae, Fungi and Bryophytes

B O P 1.3: Plant Ecology

BO P 1.4: Biology and Diversity of Pteridophytes and Gymnosperms  
(Living and Fossils)

**M.Sc. Part I (Semester - II)**

**Theory Papers:**

B O 2.1: Cell and Molecular Biology

B O 2.2: Angiosperm Systematics

B O 2.3: Plant Pathology

B O 2.4: Plant Structure, Development & Reproduction

**Practicals:**

B O P 2.1: Cell and Molecular Biology

B O P 2.2: Angiosperm Systematics

B O P 2.3: Plant Pathology

B O P 2.4: Plant Structure, Development & Reproduction

**BO 1.1**  
**Pre – requisite course**

**Total Lectures: 60**

**Unit: I**

- **Microscopy:** Introduction, The light microscope, Compound microscope, Stereomicroscope, Phase contrast microscope, Fluorescence microscope, TEM, SEM, Confocal microscope, Principles and working. **(05)**
- **Biochemistry Laboratory:** Laboratory disciplines, safety and care, experimental report, SI units, pH and Buffers. **(02)**
- **Biostatics:** Measures of dispersion and variability, the variance and coefficient of variation. **(03)**
- **Computers in Biology:** Modern computers, its use in Biological science, Internet. **(02)**
- **Bioinformatics:** Definitions, (Analysing information using bioinformatics), data base. **(03)**

**Unit: II**

- **Separation Techniques:** Centrifugation: Basic principles of centrifugation, types, care and safety aspects of centrifuges, preparative and analytical centrifugation. **(04)**
- **Chromatographic Techniques:** principles, paper, thin layer (TLC), Column, HPTLC, HPLC, GC, Affinity and ion exchange. **(06)**
- **Electrophoretic Techniques:** General principles, support media, electrophoresis of proteins and nucleic acids, capillary, microchip electrophoresis. **(05)**

**Unit: III**

- **Spectroscopic Techniques:** Introduction, principles and applications in UV-Vis, fluorescence and AAS, Infrared and Raman, NMR, X-ray diffraction. **(09)**
- **Radioisotope Techniques:** Introduction, nature of radio activity, atomic structure, stability, radiation, types of radioactive decay, half life, units of radio activity, properties

of radioisotopes commonly used in biological sciences. Detection and measurement of radioactivity, autoradiography counters, safety aspects. (06)

#### **Unit: IV**

- **Culture Techniques:** Principles, types (Bacterial, fungal, algal, plant), media preparation, sterilization, inoculation. (07)
- **Equipments:** Laminar air flow, autoclaves, thermobath, shaker, stirrers, oven, incubators. (02)
- **Paleobotanical Techniques:** Peel technique, Paleopalynological techniques. (02)
- **Collection and preservation of plant material, cryopreservation.** (04)

#### **Practicals :**

##### **UNIT: I (Any four practicals)**

- Preparation of standard solutions : %, M, N, ppm, etc.
- ANOVA use of computer.
- Determination of Correlation coefficient.
- Accessing biological data bases, / E-mail operations
- Verification of Beer and Lambert's law

##### **Units: II (Any four practicals)**

- pH – measurement and preparation of buffers.
- Peel technique for fossil studies
- Separation of proteins by gel electrophoresis
- Study of instruments / equipments.-Radioactive counters, photomicrography, Flame photometer, R.C. X-Ray diffraction, NMR, GC, HPLC, AAS, SEM, TEM, Fluorescence microscope.
- Density gradient centrifugation – A separation technique
- Micrometry

#### **List of Books:**

1. Practical cytology, applied genetics and Bio-statistics Goswami H. K. and R. Goswami, Himalayan Publ. House, Bombay (1993)
2. Methods in plant molecular biology – M. A. Schwer and Zeclinskin publ. Academic Press New York (1989)
3. Plant histochemistry – Jensen.
4. Photosynthesis and production in a changing environment. A field and laboratory manual- Hall, Scurlik, BolharNordenkampt, Leagood and Long Chapman and Hall Publ. (1993)
5. Experimental plant physiology – J. Ardittiand Dunn, Publ. Academic Press (1970).
6. Techniques in Bioproductivity and photosynthesis by – Coombs, Hall, Long and Sourlock, Pergamon press Oxford (1985)
7. Methods in enzymology- Colowick and Kaplan Academic Press.
8. Handbook of field and herbarium techniques S. K. Jain and R. R. Rao.
9. Practical Biochemistry: Principles and Techniques. Ed. E. Wilson and J. Walker (2000) Cambridge Publ.
10. Studies in Paleobotany-Andrews, H. N. (1961)
11. Modern Experimental Biochemistry-Boyer, R.(2005). Pearsa, Education, Singapore.
12. Methods in Experimental Biology.-Ralph, R. (1975). Blakie, London
13. An Introduction to Biometry- Mungikar, A. M. (1997), Saraswati Printing Press Aurangabad.
14. Methods in Cell Research- Ruthmann August
15. Analytical quantitative methods in microscopy – G. A. Meek and H. Y. Elder
16. Microscope photometry – Horst Piller
17. Biological Ultrastructure – A. Engstrom and J. B. Finean
18. Techniques in Photomicrography – Brain and Ten Cate
19. Photomicrography: A comprehensive treatise – Roger P. Loveland.
20. Laboratory techniques in Botany – M. J. Purvis and D. C. Collier and D. Wallis.

## **B O 1.2**

### **Biology and Diversity of Fungi, Algae and Bryophytes**

**Total Lectures: 60**

#### **Fungi**

##### **UNIT: I**

- (a) General characters of Fungi. (1)
- (b) Classification of Fungi by Alexopolous, Mims and Blackwell (2002). (1)
- (c) Biodiversity and Taxonomy of following phyla up to the level of order. (13)

Phyla	Order
Chytridiomycota	Chytridiales
Zygomycota	Glomales
Ascomycota	Xylariales, Pezizales, Phallales, Nidulariales
Basidiomycota	Aphyllphorales, Uredinales, Ustilaginales

##### **Unit: II**

Biodiversity and Taxonomy of following phyla up to the level of order (13)

Oomycota, Saprologniales, Peronosporales, Hypochytridiomycota, Hypochytriales  
Labyrinthulomycota, Labyrinthulales, Hemiascomycetes, Taphrinales,  
Plasmodiophoromycota, Plasmodiophoromycetales, Dictyostelliomycota,  
Dictyostelliales, Myxomycota, Stemonitales

#### **Algae**

##### **Unit: III**

- Classification in Algae (2)

- Culture, Cultivation and methods of preservation. (2)
- Role of Algae in human welfare (2)
- Structure, Reproduction, Phylogeny and interrelationship of following classes(9)  
Cyanophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae,  
Phaeophyceae, Rhodophyceae.

## **Bryophytes**

### **Unit: IV**

- Classification of Bryophytes (2)
- Origin of Bryophytes (2)
- Distribution, habit, morphology, reproduction, phylogeny, and inter relationship of following orders (8)  
Sphaerocarpaceae, Takakiales, Jungermanniales, Sphagnum, Buxbaumiales
- Economic importance of Bryophytes. (2)
- Bryophytes as indicators of pollution. (1)

### **Practical Unit: I (15)**

#### **Fungi**

1. Isolation of fungi from soil, air, water and host, their inoculation on culture media. (1)
2. Detailed study of following types from each of the following orders. (5)

Class	Order	Types
Chytridiomycetes	Chytridiales	<i>Physoderma, Synchytrium</i>
Zygomycetes	Glomales	<i>Glomus</i>
Hemiascomycetes	Taprinales	<i>Taprina</i>
Pyrenomycetes	Clavicipitales	<i>Claviceps</i>
	Xylariales	<i>Xylaria</i>
Discomycetes	Pezizales	<i>Peziza</i>
Teliomycetes	Uredinales	<i>Melampsora, Uromyces</i>
	Ustilaginales	<i>Ustilago</i>
Hymenomycetes	Agaricales	<i>Agaricus.</i>
	Aphylllophorales	<i>Polyporus</i>
Gasteromycetes	Nidulariales	<i>Cyathus</i>
	Phallales	<i>Phallus</i>
Oomycetes	Saprolegniales	<i>Saprolegnia</i>
	Perenosporales	<i>Plasmopara, Bremia, Albugo.</i>
Plasmodiophoromycetes	Plasmodiophorales	<i>Plasmodiophora (Slide)</i>
Myxomycetes	Stemonitales	<i>Stemonitis</i>

### **Unit:II (15)**

#### **• Algae**

Study of Algae: Types mentioned against each class in theory paper (available specimens / slides)



*Gloeoecapsa, Oscillatoria, Scytonema, Spirulina, Mougeotia, Pithophora, Cladophora, Fritschella, Coleochaete, Draparnaldia, Ulva, Vaucheria, Botrydium, Pinnularia, Dictyota, Padina, Gracilaria*

#### • Bryophytes

Morphological, anatomical and reproductive studies of the following members (available specimens / slides)

Marchantiales : *Asterella, Targionia, Cyathodium*

Jungermanniales : *Fossombronia, Porella*

Anthocerotales : *Notothylus*

Polytrichales : *Polytrichum*

#### Reference Books and Journals.

##### Algae

1. Kumar, H.D. and H. N. Singh (1971) Textbook of Algae
2. Sharma, O.P. (1986) Textbook of Algae
3. Pandey, B. P. (1994) Textbook of Botany – Algae
4. Vashista, B. R. (1995) Botany for degree students-Algae
5. Gangulee, H.C. and A. K. Kar (1992) College Botany Vol. III
6. Desikachary, T.V. (1972) Taxonomy and Biology of Blue -green algae
7. Fritsch, F. E. (1965) Structure and Reproduction of Algae
8. Venkataraman et al. (1974) Algae-Form and Function
9. Chapman, V.J. and D. J. Chapman (1965) The Algae

##### Journals

1. Phycos.
2. Phycologia
3. Seaweed Research.
4. Mahasagar
5. Indian Journal of Marine Biology

##### Fungi.

1. Alexopoulos, C.J. and C. W. Mims (1979) : Introductory Mycology
2. Sharma, O.O. (1989) : Textbook of Fungi
3. Ainsworth, G. G. and A.S. Sussman : The Fungi Vols. I, II, III, IV- A and IV-B
4. Bessey, E. A. (1967) : Morphology and Taxonomy of Fungi
5. Gangulee, H.S. and A. K. Kar (1992) : College Botany Vol. I
6. Thind K. S. (1977) : The Myxomycetes of India
7. Subramanan, C. V. (1971) : Hyphomycetes
8. Mundkur B.B. and M.J. Trimukchar (1952) : Ustilaginales of India
9. Sparrow F.K. (1960) : Aquatic phycomycetes
10. Dayal (1995) : Aquatic Fungi of India

##### Bryophytes

1. Cavers, R. (1964) : Inter-relationship of Bryophytes
2. Kashyap, S. R. (1929) : Liverworts of Western Himalayas and the Punjab Plains Part I and II

3. Parihar, N. S. (1959) : An introduction to Embryophyta. Bol. I –Bryophyta
4. Ram Udar (1976) : Bryology in India
5. Smith, G. M. (1955) :Cryptogamic Botany Bol. II
6. Watson, E.V, (1964) : The Structure and life of Bryopytes
7. Watson, E.V, (1963) : British Mosses and Liverworts
8. Vashista, B.R. (1996) : Botany for degree students -Brtophyta
9. Chopra, R. N. and P. K. Kumra (1988) : Biology of Bryophytes.

### **B O 1.3**

#### **Plant Ecology**

**Total Lectures: 60**

#### **UNIT: I**

Major ecosystemsof the world

Biomes: Concept, biomes of world, biome distribution, Biomes of North America: Tundra, Boreal coniferous forest (5)

Temperate deciduous forest, Grassland, Eastern pine-oak biome, Sub-tropical biome, Broad-sclerophyll biome, Tropical biomes: Tropical rain forest, Tropical savannah, Temperate deciduous forest biome, Biomass & biomes. (5)

Aquatic Ecosystems:

Fresh water ecosystems: Lotic and Lentic ecosystems.

Marine Ecosystems:Oceans, seas, estuaries (5)

## **UNIT: II**

### **Population Ecology:**

Properties of Population: Population density, biomass, trophic relationship, methods of estimating population density, natality, mortality, survivorship curves, population age distribution. (5)

Basic concepts of Rate: Birth rate, percentage growth rate, instantaneous rate.

Intrinsic rate of natural increase: Specific growth rate, biotic potential.

Concepts of carrying capacity: J-shaped growth form, S-shaped growth form, Maximum carrying capacity. (5)

Population fluctuations and cyclic oscillations: Seasonal changes, annual fluctuations, various examples of population cycles, extrinsic theories, intrinsic theories.

Density independent and density dependent mechanisms of population regulation

Patterns of Dispersion: Basic patterns of dispersion of individuals within a population.

The Allee Principle of Aggregation and Refuging (5)

Meta population Dynamics: Concept, Meta population distribution.

Energy partitioning and Optimization:  $r$  &  $k$  selection, A general model for  $r$  &  $k$  selection. Population genetics: Gene frequency, genotypes.

Life History Traits and Tactics: Four life history traits and predictive theories

## **UNIT: III:**

### **Community Ecology:** (5)

Types of interaction between two species, Co-evolution, Evolution of Co-operation

Inter specific competition and Co-existence, Positive / Negative interactions:

Predation, Herbivory, Parasitism and Allelopathy (4)

Positive interactions: Commensalism, co-operation, mutualism.

Concept of Habitat: Ecological niche, Guild, Biodiversity & stability, Biodiversity & productivity. Paleocology: Community structure in past ages.

(6)

## **UNIT: IV**

**Phytogeographical regions of India:**

North-west Himalayas, Western Himalayas, Central Himalayas, Eastern Himalayas, Indus Plains, Gangetic plain, Assam Region, Central India & Deccan Plateau, Malabar Region west coast, Andaman Region. (5)

**Succession:** Allogenic, Autogenic, Climatic climax, Regulation of Communities and Role of species diversity, Role of predators, Models of succession, Temporal and Spatial aspects. (5)

**Environmental Education Programmes:** Role of NGO's, Institute involved in various ecological activities like NIE, UNESCO, MAB, Biosphere Reserve, UNEP, WWF etc. (5)

**Practicals: (2 Units, Any 8)****Unit: I**

- Study of phytoplankton.
- Evaluation of abiotic components of aquatic ecosystem (pH, Temperature and Transparency).
- Determination of phytomass.
- Study of Species diversity index.
- Study of population dynamics.

**Unit: II**

- Determination of field capacity of soil.
- Estimation of primary productivity of an aquatic ecosystem.
- Determination of hardness of water.
- Determination of residual Chlorine from water sample.
- Ecological reports based on tour and / or analysis.

**List of Books:**

- Plant Ecology. Ambast R. S. (1990)
- Ecology: The experimental analysis of distribution and abundance. C. J. Krens, Horper and Row (1978).
- Patterns of primary production in the biosphere. H.F.W. Lieth (1978).
- Fundamentals of Ecology. Agarwal S. K. (1992).
- The Biosphere. Bradbury I. K. (1990)
- Handbook of Limnology and water pollution with practical methodology Das S. M. (1989).
- Environment and Plant Ecology. Etherington J. R. (1975).
- Deterministic mathematical models in population ecology. Freedman H. I. (1980).
- Quantitative Plant Ecology. Greig Smith P. (1983).
- Comparative Plant Ecology. Grisms J. P. *et al* (1988).
- Quantitative and dynamic ecology. Kershaw K. S. (1964).
- Concept of ecology. Kormondy E. J. (1966).
- Ecology. Krebs C. J. (1978).
- Manual of plant Ecology. Misra K. C. (1989).
- Proceedings of the school of plant ecology. Misra R. and Das R. R. (1971).
- Ecology. Odum E. P. (1971).
- Fundamentals of Ecology. Odum E. P. (3<sup>rd</sup> ed. 1996).

- Fundamentals of Ecology. Odum E. P. and Gary W. Barrett (6<sup>th</sup> ed. 2010).
- Principles of Environment Sciences. Pandeya S. C. *eta .l* (1963).

## B O 1.4

### Biology and Diversity of Pteridophytes and Gymnosperms (Living and fossils)

**Total Lectures: 60**

#### UNIT: I

- 1) Brief outline of Classification of Pteridophytes (Extant) (01)
- 2) Morphology, reproduction, phylogeny and interrelationship of following orders with reference to the forms mentioned against each. (Extant) (12)  
*Psilotales- Tmesipteris*, *Lycopodiales- Lycopodium*, *Isoetales- Isoetes*, *Filicales- Microsorium*, *Marattiales- Angiopteris*, *Salviniales- Salvinia*.
- 3) Current trends of research in Pteridophytes (02)

#### UNIT: II

- Morphology, anatomy and evolutionary trends of extinct groups- *Lepidodendrales*, *Sphenophyllales*, *Psilophytales*, *Marattiales*, *Filicales*. (10)
- Evolution in reproductive structures of Cycadales ( Extant) (03)
- Woods of Coniferales (Extant) (02)

#### UNIT: III

- Classification of Gymnosperms (Latest system) (03)
- Study of morphology, anatomy, reproductive organs and affinities of extant members of following orders. *Ginkgoales*, *Taxales*, *Ephedrales*, *Welwitschiales* (10)
- Applied aspects of Gymnosperms (02)

#### UNIT: IV

- Morphology, anatomy and evolutionary trends of following extinct groups. *Pteridospermales*, *Bennettitales*, *Cordaitales*, *Cycadales* (08)
- Indian fossil flora – *Glossopteris* flora, Rajamahall Hill flora , Deccan Intertrappean flora (05)
- Techniques used in the study of different fossil types- Pétification, Impression, compression. (02)
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#### Practicals -

##### UNIT: I

Morphological, anatomyl and reproductive studies of the following members (available specimens / slides) (Extant)

<i>Psilotales</i>	:	<i>Tmesipteris</i>
<i>Lycopodiales</i>	:	<i>Lycopodium</i> ,
<i>Isoetales</i>	:	<i>Isoetes</i>

<i>Filicales</i>	:	<i>Microsorium</i> ,
<i>Marattiales</i>	:	<i>Angiopteris</i>
<i>Salviniales</i>	:	<i>Salvinia</i>

## UNIT: II

Study of the morphology and anatomy of (Extant) the vegetative and reproductive parts of *Araucaria*, *Cupressus*, *Podocarpus*, *Ginkgo*, *Taxus*, and *Ephedra* from available specimens / slides.

### Study of following specimens:

• Sigillariales	:	<i>Sigillaria</i> Stem
• Sphenophyllales	:	<i>Sphenophyllum</i> Stem
• Marattiales	:	<i>Psaronius</i> stem
• Medullosales	:	<i>Pachytesta</i> Seed
• Coniferales	:	<i>Elatocladus</i> ,
• Cycadales	:	<i>Ptilophyllum</i> ,
• Glossopteridales	:	<i>Gamnopteris</i> leaf
• Angiosperms	:	<i>Palmoxydon</i> stem, <i>Saharianthus</i> flower

### Reference Books :

Trivedi, A. N. (2002)	- Advances in Pteridology
Bierhorst, D.W. (1971)	- Morphology of Vascular plants
Eames, A. J. and E. M. Giffard (1950)	- Comparative morphology of vascular plants
Rashid, A. (1978)	- An introduction to Pteridophytes
Spome, K.R. (1966)	- Morphology of Pteridophytes
Bower, F. O. (1963)	- The Ferns
Jerny, A. G. (1973)	- The Phylogeny and Classification of ferns.
Vashishta, B.R. (1996)	- Botany for degree students – Pteridophytes
Parihar, N.S. (1959)	- An Introduction to Pteridophyta
Arnold, C.A. (1972)	- An introduction to paleobotany
Darrah, W.C. (1968)	- Principles of paleobotany
Surange, K.R. (1968)	- Indian Fossil Pteridophytes

### Journals –

#### *American Fern Journal*

International Journal of plant sciences.

Bierhorst, D.W. (1971)	– Morphology of vascular plants
Chamberlain, C.J. (1966)	- Gymnosperms, Structure and Evolution
Coulter and Chamberlain, J. M.	- Morphology of Gymnosperms

- Foster, A. S. and Gifford, E. M. (1959)- Comparative morphology of vascular plants
- Ramanujan, C.G.K. (1979) - Indian Gymnosperms in Time and Space
- Spome, K.R. (1967) - Morphology of Gymnosperms
- Vashistha, P.C. (1976) - The Gymnosperms
- Bhatnagar, S.P. and MoitraAlok (1996)- The Gymnosperms.
- Arnold, C. A. (1972) - An Introduction to Pateobotany
- Andrews, H.N. (1961) - Studies in Pateobotany
- Darroh, W.C. (1960) - Principles of Paleobotany
- Surange, K. R. (1968) - Indian Fossil Pteridophyles
- Shukla, A.C. and Mishra, S.D. (1975)-Essentiales of Paleobotany
- Bhatnagar, S.P. and MoitraAlok (1975) - The Gymnosperms
- Stewart, W. N. (1983) - Paleobotany and the evolution of plants, Cambridge U.S.

## **Semester - II**

### **B O 2.1**

#### **Cell and Molecular Biology**

**Total Lectures: 60**

#### **UNIT: I**

##### **1. Dynamic cell:**

General account of plant cell structure and its organization, cell organelles (5)

##### **2. Plasma membrane: Structure, models and functions, sites for ATP ion carriers, channels and pumps, receptors, transport (4)**

##### **3. Plasmodesmata: structure, role in movement of molecules, comparison with gap junctions Cell signaling and cellular communication. (6)**

#### **UNIT: II**

##### **1. Organization and expression of chloroplast and mitochondrial genome (4)**

##### **2. Cell shape and motility: The cytoskeleton, organization and role of microtubules and microfilaments, motor movements implications in flagellar and other movements (4)**

##### **3. Cell division: Mitosis and meiosis (2)**

##### **4. Cell Cycle: Cell cycle control system, cell cycle check points,Cyclin dependent kinases, and cyclines, cell division control in animals, meiotic cell division and dynamics of chromosome movement during cell division, proteolysis (6)**

#### **UNIT: III**

Concept of gene, Chemistry of gene and organization of genetic material: a) DNA replication in prokaryotes and eukaryotes, Reverse transcription, DNA modification and repair (4), b) Packaging of DNA and repetitive and unique DNA sequences (4), c) Split genes, overlapping genes, pseudogenes and cryptic genes (4), d) The Genetic code (3)

#### **UNIT: IV**

Gene expression and Gene regulation: a) Transcription in Prokaryotes and Eukaryotes (4), b) RNA processing (2), c) Synthesis and Transport of proteins (Prokaryotes and Eukaryotes) (4), d) Gene expression in Prokaryotes and gene expression in eukaryotes with variety of mechanisms (5)

#### **Practicals:**

##### **UNIT I**

- Isolation of chloroplasts
- Study of enzyme peroxidase/catalase
- Study of enzyme glycolate oxidase
- Study of acid phosphatase
- Estimation of DNA from dividing root tip cells of *Allium cepa*

##### **UNIT II**

- Preparation of feulgen stained chromosome in root tip cells
- Effect of colchicine on chromosome movements during mitosis
- Demonstration of Nitrate reductase (Substrate inducible enzyme)
- Demonstration of ATPase
- Estimation of protein from germinating and developing seeds
- Separation of protein from germinating and developing seeds

#### **Reference Books:**

- Johnson Lewys – 2004 : Cell Biology ; sarup and sons, New Delhi
- E.J. Dupraw – 1970: Cell and Molecular Biology; Academic Press, London
- De Robertis and De Robertis – 1997 : Cell and Molecular Biology (VIII); B.I. Waverly Pvt. Ltd., New Delhi
- C. P. Swanson, T. Merz, and W.J. Young – 1982 : Cytogenetics ; Prentice – Hall of India Pvt. Ltd., New Delhi
- P.C.L. John (Ed.) – 1981 : The cell cycle; Cambridge University press
- Benjamin Lewin : Genes – VI, VII and VIII ; Oxford Press.
- R. A. Chapoldi 1977: Membrane proteins and their interactions with lipids; Marcel Dekker, inc. N. York
- 8. A. N. Mortonosi (Ed.) – 1985: The enzymes of Biological Membranes Vol. I, II and III; Plenum press, New York
- 9. Watson and others – 2004: Molecular Biology of the gene (V); pearse's Educatias, Inc India



- P.C. Turner and others – 2002 : Molecular Biology (II); Viva Books, Pvt. Ltd., New Delhi.
  - W. Ream and K. G. Field – 1999: Molecular Biology Techniques; Academic Press, London.
  - Brace Albertsetal – 1983 : Molecular Biology of the cell ; Garland Publ. Inc., New York.
  - Charlothe J. Avers – 1986: Molecular cell Biology; Addison. Wesley Publ. Company
  - SandhyaMitra – 1988 : Elements of Molecular Biology ; McMillan India Ltd., N. Delhi
15. C. B. Powar – 1992 : Cell Biology; Himalaya Publishing House.

**Current and Back Volumes of following Periodicals:**

- Annual review of plant Biology
- Cell
- Cytologia
- Journal of Genetics
- The Journal of cytology and Genetics
- Journal of Experimental Biology
- The journal of Biochemistry
- Indian journal of Biochemistry and Biophysics.
- Trends in Biotechnology

**B O 2.2**

**ANGIOSPERM SYSTEMATICS**

**Total lectures: 60**

**UNIT: I**

**TAXONOMY:** Aims, principles and significance in charting, documentation, bioprospecting and CBD implementation, Taxonomy as the cornerstone of conservation and sustainable use of plants. (5)

**TAXONOMIC TOOLS:** Herbarium and botanical gardens, their role in teaching, research and conservation, important herbaria and botanical gardens of the world, checklists, floras, revisions and monographs. (5)

**INTERNATIONAL CODE OF NOMENCLATURE OF ALGAE FUNGI AND PLANTS (ICN):** Brief history, Principles, Scientific names, Principle of priority, typification, valid and effective publication, nominaconservanda, nominarejicienda. (5)

**UNIT: II**

**EVOLUTIONARY CONCEPTS:** Key concepts in evolution - origin of intra-population variation, population and environment, general biological

principle, transference of function, adaptive radiation, punctuated equilibrium. (5)

**PLANT SPECIATION:** Morphological, biological species concepts; allopatric, abrupt, sympatric, hybrid and apomictic speciation. (5)

**REPRODUCTIVE ISOLATING MECHANISMS:** Premating-temporal, habitat, floral, reproductive mode; post mating, prezygotic-incompatibility; post mating, postzygotic- Incompatibility, Hybrid inviability, hybrid floral isolation, hybrid sterility, hybrid breakdown. (5)

#### **UNIT: III**

**TAXOMETRICS:** Principles, Numerical taxonomy, methodology and merits and demerits. (5)

**CLADISTICS:** Principles, cladistics, methodology. (5)

**PHYLOGENETIC SYSTEMS OF ANGIOSPERM CLASSIFICATION:** Cronquist's systems of classification (up to subclass level), Angiosperm Phylogeny group, APG III (2009) classification. (5)

#### **UNIT: IV**

**FAMILIES OF ANGIOSPERMS:** characteristic features, interrelationships, classification (APG) and economic importance of families: **ANITA grade:** Amborellaceae, Nymphaeaceae, Hydatellaceae; **MAGNOLIIDS:** Magnoliaceae, **MONOCOTS:** Araceae, **COMMELINOIDS:** Arecaceae, **EUDICOTS:** Papaveraceae, **CORE EUDICOTS:** Amaranthaceae, **EUROSIDS-I:** Malpighiaceae, **EUROSID-II:** Malvaceae, **ASTERIDS:** Sapotaceae, **EUASTERIDS-I:** Gentianaceae, Acanthaceae, **EUASTERID-II:** Apiaceae, Asteraceae. (15)

#### **Practicals:**

##### **UNIT: I**

**Practical 1-8:** Study of families of flowering plants as mentioned in theory and their classification as per APG III.

i. Data base on morphology, ii. Determination of family, iii. Diagnostic features of series, order and family. iv. Complete classification by Bentham and Hookers System of classification, v. Floral formula, vi. Floral diagram.

##### **UNIT: II**

**Practical 9 & 10:** Identification of genus and species of locally available wild plants using regional and state floras.

(Atleast 20 plants species belonging to locally available families of flowering plants)

**Practical-11:** Preparation of Botanical keys:

Types of keys, Uses of keys, selection of characters in preparation of botanical keys ex. For members of Acanthaceae, *Cassia*, *Grewia*, *Ipomoea* etc

**Practical-12.:** Field trips within and around the University campus, compilation of field notes and preparation of herbarium sheets of such plants.

**Books and References:**

**Briggs David 2009.** *Plant microevolution and Conservation in Human-influenced Ecosystems*. Cambridge University Press.

**Cronquist, A. 1981.** *An Integrated System of Classification of Flowering Plants* Columbia University Press, New York.

**Cronquist, A. 1988.** *The Evolution and Classification of Flowering Plants* (2<sup>nd</sup> ed.) Allen Press, U.S.A.

**Davis, P. H. and V. H. Heywood 1991.** *Principles of Angiosperm Taxonomy*. Today and Tomorrow Publications, New Delhi.

**Hutchinson, J. 1959.** *Families of Flowering plants*.

**Judd W. S., Campbell, C. S., Kellogg, E. A., Stevens P. F. and M. J. Donoghue 2008.** *Plant Systematics: A phylogenetic Approach*. Sunderland, Massachusetts, USA.

**Lawrence George H. M. 1951.** *Taxonomy of Vascular Plants*. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.

**Leadlay E. and S. Jury (ed.) 2006.** *Taxonomy and Plant conservation*. Cambridge University Press.

**Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998.** *A Handbook of Taxonomic Training*. DST, New Delhi.

**Naik, V. N. 1984.** *Taxonomy of Angiosperms*. Tata McGraw-Hill Publication Com. Ltd. New Delhi

**Quicke, Donald, L. J. 1993.** *Principles and Techniques of Contemporary Taxonomy*. Blakie Academic & Professional, London

**Takhtajan, A. 1962.** *Flowering plants- Origin and Dispersal*.

**Taylor, D. V. and L. J. Hickey 1997.** *Flowering Plants: Origin, Evolution and Phylogeny*. CBS Publishers & Distributors, New Delhi.

**B O 2.3**

**Plant Pathology**

**Total Lectures: 60**

**UNIT: I**

**1. History of plant diseases:**

- (i) Beginnings of modern plant pathology, conformation of Prevost's work.
- (ii) Contribution of following plant pathologists to plant pathology: Anton De Bary, Kuhn, Woronin, S. D. Garrett, J. G. Horsfall, K.C. Mehta, T. S. Sadavasivan, M. J. Trimulachari and A. Mahadevan.
- (iii) Plant pathology in 20th century. (3)

**2. Symptomology and Epidemiology:** Disease identification based on symptoms, (external and internal). Epidemiology: epiphytotics (Slow and rapid), disease forecasting. (6)

**3. Methods of Studying plant diseases and their diagnosis:** Field observation, collection of samples, laboratory studies, culturing of pathogenic organisms (fungi, bacteria and mycoplasma) , Koch's postulates. (6)

## UNIT: II

**1. Introductory Virology:** History of virology, Nomenclature and classification of plant viruses, ultrastructure of TMV, TYMV, and Bacteriophage. Chemistry of plant viruses, isolation and purification of plant viruses. Economic importance of viruses. (5)

**2. MLO:** Classification, morphology and characteristics of MLO's Identification techniques of MLO's (3)

**3. Stages of disease development:** Pre penetration, Penetration, post penetration and colonization. (3)

**4. Defence mechanism in host:** Structural, physiological genetical and chemical. (2)

**5. Role of environmental factors in disease development.** (2)

## UNIT: III

**1. History, symptomology, causal organism, etiology and management of diseases of :**

Rice, Sugarcane, Jowar, Wheat, Bajra, Pigeonpea, Rajmah, Tomato, Cabbage, Bhendi, Brinjal, Cucurbits, Chilly, Onion, Potato, Ginger, Turmeric.

(15)

## Unit: IV

**1. History, symptomology, causal organism, etiology and management of diseases of:** Banana, Grapes, Coconut, Papaya, Citrus, Tobacco, Gerbera, Roses, Coffee, Cotton, Sunflower, Groundnut, Soybean, Sesamum, Teak, Dalbergia, Bamboo and Pomegranate. (15)

## Practicals:

**UNIT: I**

1-6 Fungal Diseases: Club root, Damping off, White rust, Early and late Blight, Downy mildew, Powdery mildew, Smut, Rust, Bunt, Blast, leaf spot, Tikka, Anthracnose, Rot and Wilt.

**UNIT: II**

7. Bacterial Diseases : Bacterial Blight of Pomegranate and Leaf Spot.

    Mycoplasmal Diseases : Grassy shoot disease and Little leaf

8. Viral Disease : TMV, PMV and YVMV.

    Phanerogamic plant Diseases : Total and Partial root and stem parasites

9. Nematode Disease : Root knot

10-12 Estimation of chlorophylls, sugars and polyphenols from healthy and infected leaves.

**Reference Books:**

Agrios, G. N. 2006: Plant Pathology, 5<sup>th</sup> Edition

Aneja, K. R. 1993. : Experiments in Microbiology, plant pathology and Tissue culture

Cooke, A. A. 1981. Diseases of Tropical and Subtropical field, Fiber and oil plants

Gangopadhyay, S. 2004: Clinical Plant Pathology

Kuijit, J. 1969: The Biology of parasitic flowering plants.

Mahadevan, A. and R. Shridhar, 1982. Methods in physiological plant pathology

Agarwal A. and Mehrotra, R. S. 2012: Plant Pathology

Nyvall, R. F. 1979 : Field Crop Diseases Handbook

Paul Khurama, S. M. 1998: Pathological Problems of Economic crop plants and their management

Planke, J. E. and, 1968: Disease Resistance in plants.

Planke, J. E. and Vander. 1963: Plant Diseases Epidemics and control

Rangaswami, G. 1979: Diseases of crop plants in India

Singh, R. S. 2009: Plant Diseases, 9<sup>th</sup> Edition

**Current and back – Volumes of following periodicals:**

1. Journal of phytopathology

2. Indian journal of phytopathology

3. Journal of Mycology and plant pathology

4. Annual review of plant pathology

## **B O 2.4**

### **PLANT STRUCTURE, DEVELOPMENT & REPRODUCTION**

**Total Lectures 60**

#### **Unit I: Embryology (15)**

1. Gametophyte in Angiosperms: outline of development of male and female gametophyte. (04)
2. Ultrastructure of gametophyte: Vegetative cell, generative cell, pollen wall, pollen tube, abnormal male gametophyte and their function. (06)
3. Ultrastructure of female gametophyte: Synergids, Eggs, antipodal, central wall. (05)

#### **Unit: II (15)**

4. Pollen: Structure of stigma and style, Chemotropism, Pollen wall proteins, Stigma surface proteins, Post fertilization events. (04)
5. Experimental Embryology: Techniques for anther, ovary, nucellus, endosperms, embryoculture and their significance. (04)
6. Types of apomixis: Dilpospory, apospory. Causes, consequences and significances of apomixis. (04)
7. Polyembryony: Classification, causes, experimental induction and partial importance. (03)

#### **Unit III: Anatomy (15)**

- Shoots development:- Organisation of shoots apical meristem (SAM) cytological and molecular aspects of SAM; Control of cell division and cell to cell communication; Control of tissue differentiation especially xylem and phloem. (04)
- Leaf growth and Differentiation:- Determination, control and leaf forms: Differentiation of epidermis (with special Suggested readings:- to stomata and trichomes) and mesophylls. (04)
- Root development:- Organisation of root apical meristem (RAM), Vascular tissue differentiation, Lateral roots, root hairs, root- microbe's interaction. (04)
- Application:- Utility in systematics, archaeology climatic studies. (03)

#### **Unit: IV Palynology: (15)**

- Palynology: Scope and branches with special Suggested readings:- (01)
- Palynotaxonomy: Pollen morphology and plant taxonomy with Suggested readings: to Gymnosperms and Angiosperms. (03)

- Paleopalynology: Principles, microfossil recovery theory and techniques, microfossil groups and oil exploration. (02)
- Aeropalynology: Principles, techniques, pollen analysis, pollen and spore allergy, allergic properties of pollen, pollen calendar and importance. (03)
- 5. Melittopalynology: Bee colony, foraging behaviour of bees, unifloral/multifloral honey, application in crop productivity. (03)
- 6. Agropalynology: Pollen viability, pollen germination, pollen storage and their significance. (03)

## **PRACTICALS:**

### **Unit 1:**

#### **Anatomy:**

1. Study of living shoots apices by dissection using aquatic plants such as Ceratophyllum and Hydrilla.
2. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and doubly stained permanent slides of suitable plant such as Coleus, Kalanchoe, Tobacco.
3. Examine of shoot apices in monocotyledons in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
4. Study of whole roots in monocots and dicots
5. Examine of L.S. of root from a permanent preparation to understand the organization of root apical meristem & its derivatives (use maize, aerial roots of banyan, Pistia, Jussiaea etc.) origin of lateral roots.
6. Study of leguminous roots with different types of nodules.
7. Study of leaf anatomy – structure, stomata, trichomes, types of stomata.

### **Unit II:**

#### **Embryology:**

1. Study of ultrastructure of male gametophyte with the help of slides and microphotographs.
2. Study of ultrastructure of female gametophyte with the help of slides and microphotographs.
3. Culture of any one organ: anther / ovary / endosperm / nucellus / embryo.
4. Study of few apomicts with the help of any suitable material.
5. Study of polyembryonic seeds. (Mango, Citrus)

#### **Palynology:**

1. Study of pollen morphotypes (by at least 6 examples)
2. Acetolysis (Honey Analysis)

3. Study of aerospora ,aerospora analysis by Tilak Air Sampler and Gravity slide method.
4. Study of allergic plants and their pollen.
5. Study of fertility by TTC (Acetocarmine methods etc.)

## **SUGGESTED READINGS:-**

### **Embryology:**

- Maheshwari, P. 1950 :An introduction to the embryology of Angiosperm.
- Maheshwari, P.1963 : Recent advances on the embryology of Angiosperm.
- Johari, B M. 1963 : Experimental embryology of vascular plants.
- Stanley, R G and F.L. Linkens 1974: Pollen biology, Biochemistry management
- Shivanna, K. R. and B M Johari 1989: The Angiosperm pollen, structure

### **Anatomy:**

- Barnova, M A. 1987: Historical developments of the present classification of morphological
- types of stomata. Bot.Res.53:53-79.
- Cutter, E G 1971 Plant Anatomy
- Dilcher, D D 1974: Approaches to the identification of angiosperms leaf remains. Bot.Rev. 40:2- 157
- Emmes, E J. and M C Danials, 1947: An introduction to plant anatomy.
- Easau, K. 1962: Plant anatomy –anatomy of seed plants.
- Fahn, A.1969: Secretary Tissue system
- Foster, A S 1942: Practical plant anatomy
- Haberland, G.1965: Physiological
- Masueth, J D. 1936 : Plant anatomy
- Metcalfe, C R and L Chalk, 1950: Anatomy of the dicotyledons
- Solender, H. 1908 : Systematics anatomy of the dicots
- Tomlinson, P S 1961: Anatomy of the monocotyledons.

### **Palynology**

- Cunningham, D D1873 : Microscopic examination of air.
- Fageri, K and J Inversen, 1964: Text book of pollen analysis.
- Nair, P K K1964 : Advances in Palynology.
- Nair, P K K1966 : Essentials of Palynology.
- Heslop-Harrison, Y. 1971: Pollen development and physiology.
- Gregory, P H, 1973: Microbiology of atmosphere.
- Erdtman, G.1988 : Pollen morphology and plant taxonomy.
- Tilak, S T. 1989 : Airborne pollen and fungal spores.



- Shivanna K R and N S Rangaswami 1992 : Pollen Biology, A Laboratory manual.
- Bhattacharya, K. , M R Majumdar and S G Bhattacharya 2006: A Text book of Palynology.
- Shivanna K R and B M Johari, 1985: The Angiosperm Pollen, structure and function.
- Pandey and Chadha, 1992: Plant Anatomy and Embryology .

#### **Journals:**

- Journal of Plant Sciences,
- Experimental Biology
- Developmental Biology
- Phytomorphology
- Currents sciences
- Plant Biology
- Int. Journal of Plant Sciences
- Pollen Biology and Fertilization
- Pollen Morphology
- Journal of Paleontology

### **Department of Botany Choice Based Credit System BO Elective I**

#### **PLANT SCIENCES, HUMAN PROGRESS AND PROSPERITY**

**Total Lectures: 60  
(15)**

#### **Unit-I: Biodiversity and its Conservation**

- **Biodiversity of cryptogams**
  - Biodiversity of Viruses (1)
  - Biodiversity of Bacteria (1)
  - Biodiversity of Fungi (3)
  - Biodiversity of Bryophytes (1)
  - Biodiversity of Pteridophytes (1)
- **Biodiversity of Phanerogams**
  - 1) Biodiversity of Gymnosperms (2)
  - 2) Biodiversity of Angiosperms (6)

#### **Unit-II: Plant Disease Management (15 lectures)**

- Methods of studying plant disease (2)

- Symptoms of plant Diseases (2)
- Principles of plant Disease control (3)
- Diseases of following crops & their management (8)
  - Sugarcane 2) Grape 3) Soybean 4) Rose & 5) Carnation

### **Unit-III: Green house Technology (15 lectures)**

- Glass house, polyhouse, shadehouse, mist chambers and growth chambers (5)
- Construction, operation, maintenance and management of greenhouse (5)
- Greenhouse environment: watering, fertigation and pest control(5)

### **Unit-IV: Horticulture and Gardening (15 lectures)**

- Methods of propagation: Propagation through Seeds, vegetative and micro-propagation (3)
- Avenue trees, Climbers and lianas, Edge and hedge plants, Foliage and flowering plants, Bulbous plants, Cycads and palms, Orchids and aquatic plants (5)
- Types of gardens, Landscape gardening, Indoor gardening and Kitchen gardening (5)
- 4. Wild plants from Western Ghats having ornamental potential (2)

### **References:**

Complete Gardening of India. K. S. Gopalaswaniengar, Rengedhy G. Parthasarathy and P. Mukadam. Publ. By G. Parthaocruthy Bangalore (1991)

Rangaswami, G, Mahadevan A. 2010: Diseases of crop plants in India.

Singh, R. S. 2009: Plant Diseases, 9<sup>th</sup> Edition.

Handbook of Agriculture, ICAR New Delhi (1969)

Nelson, P.V.1973.Greenhouse operation and management. Reston Publishing Co.Inc.

## **Department of Botany Choice Based Credit System BO Elective II**

### **PLANTS: A BIOLOGICAL CAPITAL IN DAY-TO-DAY LIFE**

**Total lectures: 60**

#### **Unit-I: Plants, Human and Environment**

**(15)**

- Introduction to plants, plant resources and their importance in progress, prosperity and survival of human race (5)
- Plants as key solution for major global problems viz. Energy, pollution control, agricultural productivity, global warming, climate change, soil fertility and conservation etc. (10)

#### **Unit-II: Plants and Industries**

**(15)**

- Medicinal plants of India (3)
- Ayurvedic medicines & their industrial formulation (3)
- Fermentation and Cottage Industries
  - Ethyl Alcohol Fermentation (2)
  - Citric acid Fermentation (2)
  - Mushroom Cultivation (4)

### **Unit-III: Understanding Plant life (15)**

- Seed germination, growth & Flowering (4)
- Soil and mineral Nutrition of plants (5)
- Organic farming (2)
- Storage of Agricultural produce (4)
  - Fruits b)Vegetables c) Food grains

### **Unit-IV: Plants and plant products (15)**

- Vegetables, oil yielding plants, wild edible plants, food crops, spices and condiments, Forage- fodder plants (5)
- Fibre yielding plants, textile fibres, cordage fibres, fibres for stuffing (3)
- Important timber yielding plants and non-wood forest products (2)
- Petro and sericulture crops (1)
- Resin, dye, tannin and gum yielding plants and their applications in industry(2)
- Grasses, their economic importance and human civilization (2)

### **References**

- A manual of ethnobotany Ed., S. K. Jain, Eciatific publications Jodhpur
- Advances in Oilseeds Production and Technology, G. V. Ramanamurthy. ICAR New Delhi (1985)
- Agricultural Botany. N. T. Gill and K. C. Vear. GaralDuekworth and Co. Ltd. London (1969)
- Agrofrestry India Perspeetive. L.K. Jha and P. K. Sengupta. Ashish Publishing House., New Delhi
- Applied Ethnobotany – E.Varghesee S-VD
- Crop Protection Principles and Practices, S.R. Chapmen and L.P. Carter. Publ. W. H. Freeman and Company Son Fran (1976)
- Economic Botany, Hill A. Mcgrow Hill Book Company (1962)
- Energy Plant Species. Their use and impact on environment and development. N. El. Bassam. Publ. James and James (Science Publishers) U. K. (2005)
- Field crops of India by A.K. Aiyer. Banglore Printing and Publishing Company Bangalore (1966)
- Forest Resources – Crises and Management Natraj Publishers, Dehradun. Vandana Shiva, V. M. Meherhomji and N.D. Joryal (1992)
- Forestry and the People (1994) L. K. Jha and P. K. SenSharma .Ashish Pub. House, New Delhi.

- Forestry Research and Education in India. P.D. Dogra and R C. Dhiman (edt.) 1994. ADiamond Jubilee Publication by INSA, New Delhi.
- Handbook of Agriculture, ICAR New Delhi (1969)
- New Crops for Food and Industry. Ed. G. E. Wickens. N. Hag, P.Day, Chapmen and Hall Publi. London Ogorzaly, McGraw Hill Intenational Edition (1986)