

SHIVAJI UNIVERSITY, KOLHAPUR.



B

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(2009)**

Revised Syllabus For

Bachelor of Science (Part III) Botany

**Semester- V-Paper -IX, X, XI, XII
and**

Semester –VI- Paper -XIII, XIV, XV, XVI

Syllabus to be implemented from June 2012 onwards.

A] **Ordinance and Regulations:-**
(As applicable to Degree Course)

B] **Shivaji University, Kolhapur**
Revised Syllabus For
Bachelor of Science

1. **TITLE : Subject- Botany**
Optional under the Faculty of Science
2. **YEAR OF IMPLEMENTATION:-** Revised Syllabi will be implemented from June 2012 onwards.

3. **PREAMBLE:-**

[Note :- The Board of Studies should briefly mention foundation, core and applied components of the course/paper. The student should get into the prime objectives and expected level of study with required outcome in terms of basic and advance knowledge at examination level.]

4. **GENERAL OBJECTIVES OF THE COURSE:**
(as applicable to the Degree concerned)

Objectives:-

- 1) To impart knowledge of Science is the basic objective of education.
- 2) To develop scientific attitude is the major objective to make the students open minded, critical, curious.
- 3) To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.
- 4) To understand scientific terms, concepts, facts, phenomenon and their relationships
- 5) To make the students aware of natural resources and environment.
- 6) To provide practical experience to the students as a part of the course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.
- 7) To The students are expected to acquire knowledge of plant and related subjects so as to understand natural phenomenon, manipulation of nature and environment in the benefit of human beings.
- 8) To develop ability for the application of the acquired knowledge to improve agriculture and other related fields to make the country self reliant and sufficient.
- 9) To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.

5. **DURATION**

The course shall be a full time course.

6. **PATTERN:-**

Pattern of Examination will be Semester for Theory and Annual for practical.

7. **FEE STRUCTURE :-**
 As per Government /University rules.
 1. Refer brochure and prospectus of concern affiliated college/institute to Shivaji University, Kolhapur.
 2. Other fee will be applicable as per rules and norms of Shivaji University, Kolhapur.

8. **ELIGIBILITY FOR ADMISSION:**
 As per guidelines obtained from Shivaji University, Kolhapur by following rules and regarding reservations by Govt. of Maharashtra.
9. **MEDIUM OF INSTRUCTION:**
 The medium of instruction shall be in English.
10. **STRUCTURE OF COURSE- B. Sc. III Botany (Optional)**

THIRD YEAR (SEMESTER V/VI) (NO. OF PAPERS- 8)

Sr. No.	Subjects/Papers	Theory	Internal	Total Marks
1.	Paper-IX	40	10	50
2.	Paper-X	40	10	50
3.	Paper-XI	40	10	50
4.	Paper-XII	40	10	50
5.	Paper-XIII	40	10	50
6.	Paper-XIV	40	10	50
7.	Paper-XV	40	10	50
8.	Paper-XVI	40	10	50
	Practical -I			50
	Practical -II			50
	Practical -III			50
	Practical -IV			50
	Total			600

11. **SCHEME OF TEACHING AND EXAMINATION:-**
 [The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

THIRD YEAR - SEMESTER – V/ VI : Botany (Optional)

Scheme of Teaching and Examination

Sr. No.	Subject/Paper	Teaching Scheme (Hrs/Week)				Examination Scheme (Marks)		
		L	T	P	Total	Theory	Term Work	Total
	Semester- V							
1	Paper-IX	3	-			40	10	50
2	Paper-X	3	-			40	10	50
3	Paper-XI	3	-			40	10	50
4	Paper-XII	3	-			40	10	50
	Semester- VI							
5	Paper-XIII	3	-			40	10	50
6	Paper-XIV	3	-			40	10	50
7	Paper-XV	3	-			40	10	50
8	Paper-XVI	3	-			40	10	50
	Practical- I (annual)			5				200
	Practical- II (annual)			5				
	Practical- III (annual)			5				
	Practical- IV (annual)			5				
	Total	12	-	20	32			600

12. SCHEME OF EXAMINATION :-

- The examination shall be conducted at the end of each term for semester pattern.
- The Theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination of 40 + 10 marks.
- Question Paper will be set in the view of the /in accordance with the entire Syllabus and preferably covering each unit of syllabi.

13. STANDARD OF PASSING:-

As Prescribed under rules & regulation for each degree.

14. NATURE OF QUESTION PAPER COMMON MENTIONED SPERATELY:**15. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)
(Introduced from June 2012 onwards)**

Old Syllabus (Annual pattern)		Revised Syllabus (Semester pattern)		
Paper No.	Title of Old Paper	Semester No	Paper No.	Title of New Paper
V.	Section I- Biology of Cryptogams. Section II- Microbiology and Plant Pathology	Semester- V	IX X	Biology of Cryptogams. Microbiology and Plant Pathology
VI.	Section I- Gymnosperms, Palaeobotany Section II- Angiosperms and Environmental Biology	Semester- VI	XIII XIV	Gymnosperms & Palaeobotany Angiosperms and Environmental Biology
VII.	Section I- Genetics Section II- Microbial Genetics, Plant Breeding and Biostatistics	Semester- V Semester- VI	XI XV	Genetics Microbial Genetics, Plant Breeding and Biostatistics
VIII.	Section I- Plant Biochemistry Section II- Molecular biology and Biotechnology	Semester- V Semester- VI	XII XVI	Plant Biochemistry Molecular biology and Biotechnology

16. SPECIAL INSTRUCTIONS, IF ANY.

REVISED SYLLABUS FOR BOTANY
B. Sc. (Part III) (Semester V)
(Introduced from June 2012 onwards)

Paper – IX
Biology of Cryptogams

(40 periods)

Unit 1. Algae : **(10)**

- Sub-unit 1.1 Occurrence and distribution of algae.
- Sub-unit 1.2 Origin and evolution of sex in algae. Various theories.
- Sub-unit 1.3 Types of life cycles in algae – Haplontic, Diplontic, Haplodiplontic, Isomorphic, Heteromorphic, Haplobiontic, Diplobiontic. Triphasic.
- Sub-unit 1.4 Study of life cycles – *Chara* and *Ectocarpus*
 (Excluding development of sex organs and sporophyte).

Unit 2. Fungi **(10)**

- Sub-unit 2.1 Reproduction in Fungi.
- Sub-unit 2.2 Study of following types with emphasis on classification, Structure of mycelium, nutrition, reproduction and economic importance.
 a) *Albugo* b) *Uncinula* c) *Agaricus*.
 (Excluding developmental stages.)
- Sub-unit 2.3 Mushroom Cultivation – *Pleurotus sajor-kaju*

Unit 3. Bryophytes **(8)**

- Sub-unit 3.1 Evolution of gametophyte and sporophyte.
- Sub-unit 3.2 Study of life cycle of *Plagiochasma*
 (Excluding developmental stages).
- Sub-unit 3.3 Alternation of generations in Bryophytes.

Unit 4. Pteridophytes **(12)**

- Sub-unit 4.1 General account of Pteridophytes with reference to
 a. Structure of gametophytes.
 b. Alternation of generations in pteridophytes.
- Sub-unit 4.2 Study of life cycle of *Marsilea*
 (Excluding developmental stages.)

Paper – X

Microbiology and Plant Pathology (40 periods)

Unit 1 :Microbiology

Sub-unit 1.1 Methods in Microbiology – Staining, Sterilization methods, Culture media, Pure culture methods. **(8)**

Sub-unit 1.2 Micro-organisms in biological world and characteristic features of different groups – **(7)**
 a) Bacteria
 b) Viruses,
 c) Phytoplasma
 d) Actinomycetes.

Sub-unit 1.3. Industrial applications of micro-organisms- organic acids, alcohol, antibiotics and bio-pesticides. **(10)**

Sub-unit 1.4. Microbial Biofertilizers. Rhizobium,PSB, BGA & Trichoderma **(3)**

Unit 2. Plant Pathology (5)

Sub-unit 2.1 Classification of plant diseases based on Pathogens, Crops,and Symptoms.

Sub-unit 2.2 Transmission of pathogen-Seed born, Soil born and Air born.

Unit 3. Study of Plant diseases (7)

Sub-unit 3.1 Phytoplasma – Grassy shoot disease of Sugarcane.

Sub-unit 3.2 Viral – Yellow vein mosaic of Bhendi.

Sub-unit 3.3 Bacterial – Citrus canker.

Sub-unit 3.4 Fungal – a. Downy mildew of Bajara.
 b. Leaf spot of Turmeric
 c. Grain Smut of Jowar.
 d. Anthracnose of Bean.

Paper – XI**Genetics****(40 periods)****Unit 1. Mendelism****(6)**

Sub-unit 1.1 Introduction and Basic terminologies in genetics.

Sub-unit 1.2 Principles of Inheritance.

Law of Dominance

Law of Segregation

Law of Independent Assortment

Back Cross and Test Cross

Sub-unit 1.3 Gene Interactions

a) Complementary gene interactions

b) Supplementary gene interactions

c) Epistasis and Hypostasis.

Sub-unit 1.4 Linkage and Recombination

(7)

a) Introduction

b) Cytological Proof for recombination

c) Crossing over and its significance, crossing over a measure of genetic distance

d) Linkage phases, Linkage groups, Complete and incomplete linkages

Unit 2. Multiple Allelism**(3)**

Sub-unit 2.1 Introduction and definition

Sub-unit 2.2 Self incompatibility in plants

Unit 3. Sex Chromosomes and Sex linked inheritance**(12)**

Sub-unit 3.1 Autosomes and sex chromosomes.

Sub-unit 3.2 Chromosomal theory of Sex determination.

Sub-unit 3.3 Mechanism of Sex determination.

Sub-unit 3.4 Quantitative Inheritance

a) Quantitative traits versus qualitative traits and analysis of quantitative traits.

b) Population Genetics - Hardy-Weinberg Law

Unit 4. Maternal Inheritance**(12)**

Sub-unit 4.1 Mendelian inheritance versus extrachromosomal inheritance

Sub-unit 4.2 Plastid inheritance.

Sub-unit 4.3 Alterations in the genetic make-up and it's significance

a) Introduction

b) Changes in chromosome structure.

c) Changes in chromosome number

Paper XII

Plant Biochemistry

(40 Periods)

Unit 1. Carbohydrate Metabolism : (10)

- Sub-unit 1.1 Introduction, broad classification of Carbohydrates.
- Sub-unit 1.2 – Properties of Monosaccharides
Examples- Pentose and Hexose
- Sub-unit 1.3 Properties of Oligo saccharides
Examples- Sucrose and Lactose.
- Sub-unit 1.4 Properties of Polysaccharides
Examples -Starch and Cellulose
- Sub-unit 1.5 Isomers, enantiomers and epimers
- Sub-unit 1.6 Biosynthesis and degradation of starch.
- Sub-unit 1.7 Significance of Carbohydrates.

Unit 2. Lipid Metabolism (11)

- Sub-unit 2.1 Introduction and classification of lipids
- Sub-unit 2.2 Saturated fatty acids- properties and examples-Stearic and Palmitic acid.
- Sub-unit 2.3 Unsaturated fatty acids- properties and examples- Linoleic and Linolenic acids.
- Sub-unit 2.4 General outline of fatty acid biosynthesis.
- Sub-unit 2.5 Beta Oxidation.
- Sub-unit 2.6 Gluconeogenesis of fatty acids during germination.
- Sub-unit 2.7 Significance of lipids

Unit 3. Protein Metabolism (12)

- Sub-unit 3.1 Introduction, structure, properties and characteristics of amino acids
- Sub-unit 3.2. Brief outline of biosynthesis of amino acids – Aspartate and Proline
- Sub-unit 3.3 Protein - structure and classification
- Sub-unit 3.4 Outline of protein biosynthesis in prokaryotes and eukaryotes
- Sub-unit 3.5. Post translational modification.

Unit 4. Nucleic Acids (7)

- Sub-unit 4.1 Composition of nucleic acids.
- Sub-unit 4.2 Structure of - DNA, A, B and Z forms
- Sub-unit 4.3 Structure and Types of RNA and their role.

B. Sc. (Part III) (Semester VI)

Paper -XIII
Gymnosperms and Palaeobotany (40 Periods)

Unit 1. Gymnosperms : (20)

Study of following gymnosperms with reference to distribution, organography, anatomy and reproductive structures, sporophytes and gametophytes, fertilization, embryogeny, seed structure and phylogeny.

Sub-unit 1.1 Cycadales - *Zamia*,

Sub-unit 1.2 Coniferales - *Thuja*,

Sub-unit 1.3 Gnetales – *Gnetum*

Unit 2. Palaeobotany (7)

Sub-unit 2.1 a Geological time-scale

b. Carbon dating

Sub-unit 2.2 Concept of form genera and nomenclature

Unit 3. Study of following form genera with reference to systematic position, external morphology, anatomy and affinities (8)

a. *Calamites*

b. *Lyginopteris*

c. *Enigmocarpon*

Unit 4. Applications of Palaeobotany (5)

Sub-unit 4.1 Role of microfossils in oil and coal exploration.

Sub-unit 4.2 Oil and coal as fossil fuels.

Sub-unit 4.3 Biotic origin of oil and coal.

Paper –XIV

Angiosperms and Environmental Biology (40 Periods)

Unit 1. Angiosperms (11)

Subunit 1.1 Phylogeny of angiosperms: A general account of the origin of Angiosperms (With special reference to Gnetalean theory)

Subunit 1.2 Systems of Classification.

- a. Engler and Prantl's system.
- b. Takhtajan's system.

Subunit 1.3 Modern Taxonomy: Taxonomy in relation to anatomy, embryology, palynology, cytology (Cytotaxonomy) in plants .

Unit 2. Flower (15)

Subunit 2.1 Concept of flower as a modified shoot .

Subunit 2.2 Structure of anther – Microsporogenesis and development of male gametophyte.

Subunit 2.3 Structure of Pistil – Structure of typical ovule, ovule types, megasporogenesis, development of female gametophyte (embryo sac), embryo sac types – monosporic, bisporic and tetrasporic

Subunit 2.4 Pollination

- a) Mechanism of pollination – Vallisneria, Calotropis , Maize.
- b) Pollen stigma interaction.
- c) Double fertilization and endosperm formation
- d) Apomixis

Subunit 2.5 Development of embryo in Monocotyledons and Dicotyledons

Unit 3. Environmental Biology (07)

Sub-unit 3.1 Introduction – Interrelationship between the living world and the environment, components and dynamism, homeostasis, & relevance to man

Sub-unit 3.2 Impact of human activities on environment – Causes, Prevention and control of – Air, water and Soil Pollution

Sub-unit 3.3 Brief account of environmental toxicology – Eutrophication, bioaccumulation and biomagnifications (2)

Unit 4. Environmental Crisis (5)

Sub-unit 4.1 Desertification, Ozone depletion and Global warming

Sub-unit 4.2 Role of National and International Organizations in environmental management.

Paper – XV

Microbial Genetics, Plant breeding and Biostatistics (40 periods)

Unit 1. Microbial Genetics (6)

- Sub-unit 1.1 Introduction
- Sub-unit 1.2 Bacterial genome
- Sub-unit 1.3 DNA viruses
- Sub-unit 1.4 RNA viruses
- Sub-unit 1.5 Recombination in Bacteria - Transformation, Transduction and Conjugation

Unit 2. Methods of Plant Improvement (16)

- Sub-unit 2.1 Introduction.
- Sub-unit 2.2 Aims and objectives of plant breeding.
- Sub-unit 2.3 Methods of plant breeding.
 - a) Introduction and Acclimatization.
 - b) Selection
 - i) Mass Selection,
 - ii) Pure line Selection
 - iii) Clonal Selection
 - c) Hybridization techniques in self-pollinated crops and cross pollinated crops.
 - d) Male sterility and significance in plant breeding.
 - e) Hybrid vigour

Unit 3. Breeding in field crops (9)

- Sub-unit 3.1 Breeding in Groundnut
- Sub-unit 3.2 Breeding in Sugarcane
- Sub-unit 3.3 Role of Mutation and Polyploidy in plant breeding

Unit 4. Biostatistics (9)

- Sub-unit 4.1 Collection and presentation of data
- Sub-unit 4.2 Measures of central tendency - Mean, Mode and Median
- Sub-unit 4.3 Variance and standard deviation, Coefficient of variation
- Sub-unit 4.4 Test of Significance (T-text), Chi-square test (X^2 test)
- Subunit 4.5 Application of Computers in Biological Education

Paper –XVI

Molecular Biology and Biotechnology

(40periods)

Unit 1. DNA replication and recombination

(13)

- Sub-unit 1.1 Replication of DNA and role of DNA polymerases
- Sub-unit 1.2 Denaturation and renaturation of DNA.
- Sub-unit 1.3 Recombination at molecular level.
- Sub-unit 1.4 Gene Structure, expression and regulation
Operon concept – lac operon

Unit 2. Recombinant DNA Technology

(12)

- Sub-unit 2.1 Introduction and principles.
- Sub-unit 2.2 Enzymes involved in recombinant DNA technology.
- Sub-unit 2.3 Vectors.-Concept
- Sub-unit 2.4 Southern and northern blotting.
- Sub-unit 2.5 DNA fingerprinting – RFLP, RAPD, AFLP.
- Sub-unit 2.6 PCR.
- Sub-unit 2.7 Genomics and DNA libraries.

Unit 3. Genetic Engineering

(6)

- Sub-unit 3.1 Introduction to transgenic plants.
- Sub-unit 3.2 Reporter genes.
- Sub-unit 3.3 Role of Agro bacterium in crop biotechnology
- Sub-unit 3.4. Achievements in Plant Biotechnology.

Unit 4. Plant Tissue Culture

(9)

- Sub-unit 4.1 Principles of tissue culture.
- Sub-unit 4.2 Terminology in tissue culture.
- Sub-unit 4.3 Cellular differentiation and Totipotency.
- Sub-unit 4.4 Organogenesis and embryogenesis.
- Sub-unit 4.5 Application of plant tissue culture
 - a. Protoplast culture.
 - b. Somatic hybridization.
 - c. Micropropagation.

Shivaji University, Kolhapur
Revised Syllabus
B. Sc. PART - III
BOTANY
(Introduced from 2012-2013)

Practical- I

(Based on Paper IX and X: Biology of Cryptogams and Microbiology and Plant Pathology)

Unit 1. Algae

- Sub-unit 1.1 Identification of following algae (any four) 2 Pr.
 a) *Hydrodictyon* b) *Zygnema* c) *Padina* d) *Caulerpa* e) *Diatoms*
 Sub-unit 1.2. Life cycle of following genera 2 Pr.
 a) *Chara*
 b) *Ectocarpus*

Unit 2. Fungi

- Sub-unit 2.1 Identification of following Fungi (any four) 1 Pr.
 a) *Phyllchora* b) *Alternaria* c) *Clavaria* d) *Melampsora* e) *Rhizopus*
 Sub-unit 2.2 Life cycle of following types 3 Pr
 a) *Albugo*
 b) *Uncinula*
 c) *Agaricus*
 Sub-unit 2.3 Cultivation of mushrooms 1 Pr

Unit 3. Bryophytes

- Sub-unit 3.1 Identification of following Bryophytes (any four) 1 Pr
 a) *Marchantia* b) *Targionia* c) *Cyathodium*
 d) *Notothyllus* e) *Fossombronia* f) *Asterella*
 Sub-unit 3.2 Life cycle of *Plagiochasma* 2 Pr.

Unit 4. Pteridophytes

- Sub-unit 4.1 Identification of following Pteridophytes (Any four) 1 Pr
 a) *Isoetes* b) *Adiantum* c) *Lygodium* d) *Osmunda*
 e) *Asplenium* f) *Azolla* g) *Blechnum* h) *Ophioglossum*
 Sub-unit 4.2 Life cycle of *Psilotum* (Permanent slides only)
 Sub-unit 4.3 Life cycle of *Marsilea*
 Sub-unit 4.4 Preparation of PDA (Slants and Plates) and sterilization 2 Pr
 Sub-unit 4.5 Isolation and inoculation 1 Pr

Unit 5. Microbiology and Plant Pathology

- Sub-unit 5.1 Micrometry 1 Pr
 Sub-unit 5.2 Plant diseases as per theory 4 Pr
 Sub-unit 5.3 Study of fermentation by yeast. 1 Pr
 Sub-unit 5.4 Study of bio-fertilizers. 1 Pr

Practical – II

(Based on Paper XIII and XIV: Gymnosperms, Palaeobotany, Angiosperms and Environmental Biology)

Unit 1. Gymnosperms and Palaeobotany

5Pr

Sub-unit 1.1 Anatomical structure in rachis of *Cycas* and *Zamia* by sections.

Sub-unit 1.2 Anatomical structure in wood of *Pinus* and *Thuja* by maceration.

Sub-unit 1.3 Structure of male and female cones of *Thuja* and *Gnetum*.

Sub-unit 1.4 Study of Pollen grain structure of *Thuja* and *Pinus* by shape, size, exine, germ pore number and number of constituent cell.

Sub-unit 1.5 Study of fossils – *Calamites*, *Lyginopteris*, *Enigmocarpon*.

Unit 2 : Embryology

6Pr

Sub-unit 2.1 Study of V.S. of typical ovule and types of ovules.

Sub-unit 2.2 Pollen grain germination by hanging drop and sitting drop techniques in *Impatiens* and *Catharanthus roseus* or any suitable material.

Sub-unit 2.3 Diversity in the structure of stigma, style, stigmatic papillae and transmitting tissue of style in suitable material (*Clitoria*, *Hibiscus*, *Maize*, *Ocimum* & *Citrus*)

Sub-unit 2.4 Microdissection of embryo with suspensor in *Cucumis*, *Grevillea*, *Boerhaavia* and *Cyamopsis* (any suitable material.)

Sub-unit 2.5 Study of self incompatibility in *Hamelia*, *Catharanthus roseus* & *Sesamum*.

Sub-unit 2.6 Study of seed dispersal with suitable materials.

Unit 3 : Angiosperms

Sub-unit 3.1 Study of fruit dispersal with suitable materials.

1Pr

Sub-unit 3.2 Study of following plant families.

8Pr

- i) Ranunculaceae/ Menispermaceae ii) Capparidaceae iii) Rutaceae
- iv) Meliaceae v) Myrtaceae vi) Cucurbitaceae vii) Fabaceae
- viii) Rubiaceae ix) Sapotaceae x) Apocynaceae xi) Lamiaceae
- xii) Amaranthaceae xiii) Polygonaceae xiv) Liliaceae
- xv) Musaceae xvi) Poaceae

Sub-unit 3.3 Identification of Genus and Species with the help of flora.

1 Pr.

Unit : 4 Environmental Biology

Sub-unit 4.1 Determination of DO (Dissolved Oxygen) and BOD (Biological Oxygen Demand) in polluted and non polluted water samples (any two)

1 Pr

Sub-unit 4.2 Titrimetric estimation of free CO₂ and bicarbonates in polluted and non polluted water samples (any two)

1 Pr

Sub-unit 4.3 Analysis of electrical conductivity, temperature and pH of different water samples.

1 Pr

Sub-unit 4.4 Report on environment by visits to nearby locality. Report be written in Journal.

1 Pr.

Practical – III

(Based on Paper XI and XV: Genetics, Microbial Genetics, Plant Breeding and Biostatistics)

(Each sub-unit should be completed in one practical unless Specifically mentioned)

Unit 1. Mendelian genetics.

- 1.1 Study of Mendelian traits in garden pea.
- 1.2 Examples of linkage and crossing over.
- 1.3 Examples on polygene inheritance.

Unit 2. Cytological techniques

- 2.1 Study of meiosis in *Allium* buds. (2 Pr)
- 2.2 Determination of chromosome count in PMCs in *Allium*. (2 Pr)
- 2.3 Preparation of karyotypes – idiograms by using photographs.
- 2.4 Determination of interspecific variations in chromosome number in *Allium*.

Unit 3 Meiotic anomalies in chromosomes

- Detection of meiotic anomalies in chromosomes in *Rhoeo*. (2 Pr)

Unit 4 Plant Propagation

- 4.1 Study of correlation of floral structure in insect pollinated plants (Any two) *Salvia*, *Sesamum*, Pea, *Plectranthus*, *Ceropegia*, *Helianthus*.
- 4.2 Study of correlation of floral structure with pollination system in castor and maize.
- 4.3 Field exploration for detection of male sterile lines in Maize.
- 4.4 Determination of pollen fertility by using staining technique.

Unit 5 Breeding techniques

- 5.1 Breeding technique in Brassicaceae.
- 5.2 Breeding technique in Fabaceae.
- 5.3 Breeding technique in Malvaceae.
- 5.4 Breeding technique in Poaceae .

Unit 6 Biometry

- 6.1 Camera Lucida drawings. (Minimum two)
- 6.2 Measure of central tendency of given data.
- 6.3 Analysis of the given data using computer / Study of frequency distribution and it's graphic presentation. (2 Pr)

Practical-IV

(Based on Paper XII and XVI: Plant Biochemistry and Molecular Biology and Biotechnology)

(Each sub-unit should be completed in one practical unless specifically mentioned)

Unit 1. Carbohydrates

- 1.1 Qualitative tests for sugars in plant material. (Any two tests)
- 1.2 Qualitative tests for starch and cellulose in plant material (Any two tests)

Unit 2. Proteins

- 2.1 Qualitative tests for proteins in plant material. (Any two tests)
- 2.2 Determination of isoelectric point of protein in plant material.
- 2.3 Identification of amino acids in plant extract by TLC.
- 2.4 Estimation of proteins in plant sample by Biuret method.

Unit 3 Lipids

- 3.1 Determination of fatty acid value of oil sample.
- 3.2 Qualitative tests for lipid in plant material. (Any two tests)

Unit 4 Nucleic acids

- 4.1 Colorimetric estimation of DNA using di-phenyl amine.
- 4.2 Isolation of plant genomic DNA and its spooling.
- 4.3 Isolation of total RNA from plant tissue and its calorimetric estimation. (2 Pr)

Unit 5 Tissue Culture

- 5.1 Preparation of tissue culture medium (M.S.) and its sterilization. (2 Pr)
- 5.2 Demonstration of techniques of in vitro culture of various explants. (3Pr)

Unit 6 Techniques in Biochemistry and Biology

- 6.1 Microtomy or Microphotography (4Pr)
- 6.2 Separation of alkaloids by TLC.
- 6.3 Separation of isozymes using gel electrophoresis. (4 Pr)

SHIVAJI UNIVERSITY, KOLHAPUR
B. Sc. Part-III: Practical Examination in Botany
February/March-2012
Practical-I

Time: 11.00 a.m. onwards **Total Marks: 50**

N. B. : Do not write about points of theoretical information, unless asked specifically.

- Q. 1. Identify and classify the specimens A, B, C and D. Draw neat labeled sketches. Leave at least one slide of each specimen for inspection. (20)**
- Q. 2. Inoculate the given culture E of the fungus on the slants of PDA (No written answer) (4)**
- Q. 3. Measure the dimensions of the given spore/pollen grain from specimen F under low and high power. Record your readings. (Show at least one reading to the examiner) (4)**
- Q. 4. Set up the experiment showing fermentation (No written answer) (4)**
- Q. 5. Identification-**
- a) Identify and describe the specimen G and H. (4)**
- b) Identify the plant disease I and J. Give their causal organisms, symptoms or control measures. (4)**
- Q. 6. a) Submission (5)**
- b) Journal (5)**

SHIVAJI UNIVERSITY, KOLHAPUR
B. Sc. Part-III: Practical Examination in Botany
February/March-2012
Practical-II

Time: 11.00 a.m. onwards **Total Marks: 50**

N. B. : Do not write about points of theoretical information, unless asked specifically.

- Q. 1. Identify and describe the structures observed in the specimen A and B. Leave at least one slide of each specimen for inspection. (6)**
- Q. 2. Assign the specimen C and D to their respective families on the basis of characters observed by you in them. Mention important vegetative and floral characters. Draw the floral diagram of specimen C. Show your preparation to the examiner. (8)**
- Q. 3. With the help of flora, identify the genus and species of the given specimen. (4)**
- Q. 4. Dissect the specimen E to expose the embryo. (No written answer) (4)**

OR

- Show the structure of stigma and style in the specimen E. (No written answer) (4)**
- Q. 5. Set up the experiment assigned to you. (No written answer) (5)**
- Q. 6. Identification-**
- a) Identify and describe the specimen /slide F. (2)**
- b) Identify and describe the specimen /slide G.**
- c) Identify and describe the specimen H.**
- d) Identify and describe the specimen /slide I.**
- Q. 7. a) Tour report (5)**
- b) Submission (5)**
- c) Journal (5)**

SHIVAJI UNIVERSITY, KOLHAPUR
B. Sc. Part-III: Practical Examination in Botany
February/March-2012
Practical-III

Time: 11.00 a.m. onwards

Total Marks: 50

N. B. : Do not write about points of theoretical information, unless asked specifically.

Q. 1. Solve the given problem on linkage/crossing over/polygene inheritance. (6)

Q. 2. Show the chromosomal abnormalities from the specimen A.

(No written answer) (5)

Q. 3. a) Prepare the ideogram using given Photograph B. (5)

b) Determine the mean, median and mode by using sample C. (5)

OR

Determine the frequency distribution and prepare a histogram/polygon/line graph from specimen C. (5)

Q. 4. a) Show the breeding technique in given plant material D and E.

(No written answer) (8)

b) Find out the pollen fertility in given specimen E. (No written answer) (5)

Q.5. Cut the given material embedded in paraffin and prepare the slides.

Keep the slides for drying.

OR

Take microphotograph of prepared permanent slide and transfer the image on computer.

Q. 6. Identification-

a) Identify and describe the mutant type. (2)

b) Comment on floral structure and pollination mechanism. (2)

c) Identify and describe. (2)

Q.7. a) Submission – including cytological slides. (5)

b) Journal (5)

SHIVAJI UNIVERSITY, KOLHAPUR
B. Sc. Part-III: Practical Examination in Botany
February/March-2012
Practical-IV

Time: 08.00 a.m. onwards

Total Marks: 50

N. B. : Do not write about points of theoretical information, unless asked specifically.

Q. 1. Demonstrate the presence of carbohydrates/lipids/proteins by using biochemical tests from given plant material A. (10)

Q. 2. Isolate RNA/DNA.

OR

Estimate Proteins/DNA/ Determination of fatty acid value.

OR

Separate amino acids/alkaloids from given sample or plant material B by TLC. (8)

Q. 3. Demonstrate the technique of inoculation of explant C on culture medium. (No written answer) (6)

Q. 4. Stain the slides of Microtomy prepared earlier and show it to the examiner. (No written answer) (10)

OR

Microphotography- Edit and Format the image of photograph, label, print and show to the examiner. (No written answer) (10)

Q. 5. Identification-

a) Identify and comment upon biochemical test D. (3)

b) Identify and describe. (3)

Q.7. a) Submission of Microtomy slides/ Submission of Microphotographs. (5)

b) Journal (5)

- (iii) **Specific Objectives: As per general objectives of the course.**
- (iv) **Unit: Unitwise number of lectures are given for all papers.**
- (v) **Recommended Reading :**

List of Books Recommended for B. Sc. III (Botany)

1. Blod, H.C., Aloxiopoulos, G. J. and Delevoryas, T. 1980. Morphology Plant and Fungi (4th Edition) Harper and Foul Co., New York.
2. Clifton, A. 1958 Introduction to the Bacteria. McGraw Hill Co., New York.
3. Dube, H. C. 1990. An Introduction to Fungi Vikas Publishing House Pvt. Ltd., Delhi.
4. Gifford, E. M. and Foster, A. S. 1989. Morphology and Evolution of Vascular Plants W.H. Freeman & Co., New York.
5. Gilbert, M. S. 1985. Cryptogamic Botany Vol. I & II (2nd Edition), Tata McGraw Hill Publishing Co., Ltd New Delhi.
6. Kumar, h. D. 1988, Introductory Phycology. Affiliated East-West Press Ltd., New York.
7. Mandahar, C. L. 1998 Introduction to plant Viruses Chand & Ltd., Delhi.
8. Puri, P. 1985. Bryophytes. Amarm & Sons, Delhi.
9. Rangswamy, G. and Mahadevan A. 1999. Diseases of Crop Plants in India Prentice Hall India Pvt. Ltd., New Delhi.
10. Sporne, K. R. 1991. The Moropology of Gymnosperms. B. I. Publications Pvt., Bombay, Calcutta, Delhi.
11. Wilson, N. S. and Rothwell, G. W. 1983 Palaeobotany and the Evolution of Plants (2nd Edition). Cambridge University Press U.K.
12. Cronquist, A.. 1968. The evolution and classification of flowering plants. Thomas Nelson (Printers) Ltd., London & Edinburgh.
13. Delevoryas, Th. 1965 Plant Diversification. Modern Biology Series, Half Rinehart & Winston, New York.
14. Foster, A. S. and Gifford, A.E.M. jr. 1967. Comparative Morphology of Vascular Plants Vakils, Pfeffer & Simons Pvt., Ltd.
15. Sporne, K.R 1977. The Mor[hology of Angiosperms. B.I. Publication, Bombay.
16. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms 4th revised and enlarged edition. Vikas Publishing House, Delhi.
17. Johri, B.M. 1984. Embryology of Angiosperms. Springer-Verlag Berlin.
18. Raghvan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press N. Y.
19. Agrios. G. N. 1997. Plant Pathology Academic Press London.
20. Albajes, R., Gullino, M.L. van Lenteren, J.C. and Elad, Y. 2000. Integrated Pest and Disease Management in Greenhouse Crops, Kluwer Academic Publishers.
21. Bridge. P. et.al 1998. Molecular Variability of Fungal Pathogens. CAB International UK.
22. Bridge. P. et. al. 1999. Application of PCR in Mycology CAB International, UK.
23. Bridge. P. Moore, D.R. and Scott, P.R. 1998. Informational Technology, Plant Pathology and Biodiversity CAB International. UK.

24. Persley, G.J. 1996. Biotechnology and Integrated Pest Management CAB International, UK.
25. Skeritt, J.H. and Apples, R. 1995. New Diagnostics in Crop Sciences. CAB International, UK.
26. Davis, P.H. and Haywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Royd, London.
27. Heywood, V.H. and Moore D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
28. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
29. Lawrance. G.H.M. 1951. Taxonomy of Vascular Plants. MacMillan, New York.
30. Naik, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill, New York.
31. Radford. A.E. 1986. Fundamentals of Plant Systematics Harper and Row, New York..
33. Singh. G. 1999. Plant Systematics: Theory and practice Oxford & IBH Pvt., Ltd. New Delhi.
34. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge London.
35. Stace. C.A. 1989. Plant Taxonomy and Biosystematics. 2nd ed. Edward Arnold, London.
36. Woodland. D.E. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey.
37. Nordenstam. B., El-Gazaly, G. and Kassas. M. 2000. Plant Systematics for 21st Century Portland Press Ltd., London.
38. Ambasht. R.S. 1988. A Text Book of Plant Ecology Students Friends Co. Varanasi.
39. Botkin, D.B. and Keller, E.A. 2000. Environmental Science (2nd edition). John Wiley & Sons Inc. New York.
40. Chapman. J.L. and Reiss. M.J. 1995. Ecology: Principles and Applications Cambridge University Press.
41. Cunningham. W.P. and Safo S.W. 1997. Environmental Science: A Global Concern WCB. McGraw Hill.
42. Dash M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
43. Buchanan. B.B. Grussem. W. and Jones. R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
44. Collins. H.A. and Edwards D.H. Lefebvre. D.D. and Layzell. D.B. (eds) 1997. Plant Metabolism (2nd Edition) Longman, Essex, England.
45. Lea. P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology (2nd Edition). John Wiley and Sons, Chichester, England.
46. Lodish. H. Berk, A. Zipursky. S.L. Matsudaira. P. Baltimore. D. and Darnel. J. 2000. Molecular Cell Biology (4th Edition) W.H. Freeman and Co. New York USA.
47. Old. R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation. Blackwell Scientific Publications. Oxford. UK.
48. Raghavan.V. 1986. Embryogenesis in Angiosperms: A Development and Experimental Study. Cambridge University Press New York. USA.
49. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture Kluwer Academic Publishers, The Netherlands.

50. Hackett. P.B. Fuchs. J.A. and Messing J.W. 1988. An Introduction to Recombinant DNA Techniques : Basic Experiments in Gene Manipulation. The Bengamin/Cummings Publishing Co., Inc., Menlo Park California.
51. Hall.R.D. (Ed). 1999. Plant Cell Culture Protocols. Humana Press Inc. New Jersey, USA.
52. Ninfa.A.J. and Ballou.D.P. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press. Inc., Maryland USA.
53. Scott. R.P.W. 1995. Techniques and Practics of Chromatography Marcel Dekker, Inc. New Work.
54. Daubenmire.R.F. 1974. Plants and Environment- A Text Book of Plant Ecology (3rd edition). John Wiley & Sons. New York.
55. Kendeigh.S.C. 1980. Ecology with Special Reference to Animals and Man. Prentice Hall of India Pvt. Ltd., New Delhi.
56. Kumar.H.D. 1996. Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.
57. Kumar.H.D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
58. Kermondy.F.J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
59. Miller.W.R. and Donahue.R.L. 1992. Soils-An Introduction to Soil and Plant Growth (6th edition). Prentice Hall of India Pvt. Ltd., New Delhil.
60. Odum.E.P. 1996. Fundamentals of Ecology. Natraj Publishing, Dehradun.
61. Pickering.K.T. and Owen L.A. 1997. An Introduction to Global Environmental Issues (2nd edition). Butter and Tanner Ltd., Great Britain.
62. Smith.L.R. 1996. Ecology and Field Biology (5th edition). Harper Collns College Publishers, USA.
63. Smith L.R. and Mith T.M. 1998. Elements of Ecology. (4th edition). An imprint of Addison Wesley, Longman ink., California.
64. Tyler. M.G. Jr. 1997. Environmental Science: Working with Earth (6th edition). Wadsworth Publishing Co.
65. Weaver. J.E. and Clements. S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.
66. Eklund C. and Lankiord. C.W.E. 1967. Laboratory Manual for General Microbiology. Prentice-Hall Inc. Engle-wood Cliffs. N.J.
67. Cunasekaran.P. 1995. Laboratory Manual in Microbiology. New Age International Pvt. Ltd.
68. Pawsey. R.K. 1974. Techniques with Bacteria-A Guidebook for Teachers. Hutchinson Educational.
69. Pelezor.M.J. and Chan. E.C.S. 1972. :Laboratory Exercies in Microbiology. McGraw Hill Book. Co.
70. Meynell, E and Meynell. G.G. 1970. Theory and Practice in Experimental Bacteriology University Press, Cambridge.
71. Wistreich G.A. and Lechtman. M.D. 1973. Laboratory Exercises in Micorlogy. Flencoe Press New York, Deverly Hills Collier Macmillan Publishers, London.
72. Fukui. K. and Nakayama S. 1996. Plant Chromosomes: Laboratory Methods CRC Press, Boca Raton, Florida.
73. Sharma A.K. and Sharma A. 1999. Plant Chromosomes: Analysis Manipulation and Engineering Hawood Academic Publishing, Australia.
74. Aneja.K.R. 1993 Experiments in Micrology, Plant Pathology and Tissue

- Culture. Wishwa Publication, New Delhi.
75. Mahadevan A. and Sridhar R. 19986. Methods in Physiological Plant Pathology Sivakami Publication Madras.
 76. Schaad N.W. 1988. Plant Pathogenic Bacteria: Laboratory Guide for Identification of Plant Pathogenic Bacteria Academic Press.
 77. Atherly. A.G., Girton. J.R. and McDonald. 1999. The Science of Genetics Saunders College Publishing Co., Fort Worth USA.
 78. Gardener. J., Simmons. H.J. and Snustad. D.P. 1991. Principles of Genetics (8th Edition). John Wiley & Sons, New York.
 79. Gupta.P.K. 1994. Genetics Rastogi Publications. Shivaji Road, Meerut.
 80. Gupta.P.K. 1995. Gytogenetics. Rastogi Publications, Meerut.
 81. Hartl.D.L. and Jones.E.W. 1998. Genetics: Principles and Analysis (4th Edition) Jones & Barlett Publishers. Massachusetts. USA.
 82. Poehimann. J.M. and Sleeper. D.r. 1995. Breeding Field Crops. Panima Publishing House, New Delhi.
 83. Russel. P.J. 1998. Genetics (5th Edition). The Benjamin/Cummings Publishing Co., Inc., USA.
 84. Simmonds. N.W. 1979. Principles of Crop Improvement. Longman, London and New York.
 85. Snustad. D. P. and Simmons. M.J. 2000. Principles of Genetics (2nd Edition). John Wiley & Sons Inc., USA.
 86. Sharma J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publisng Co., Ltd., New Delhil.
 87. Alberts B., Bray D., Lewis, J., Raff, M. Roberts, K. and Wastson, J.D. 1999. Molecylar Biology of Cell. Garland Publishing Co., Inc., New York USA.
 88. Bhojwani S.S. 1990. Plant Tissue Culture: Applications and Limitions Elsevier Science Publishers, New York, USA.
 89. Devi.P. 2000. Priciples and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
 90. Dixon.R.A. (Ed.) 1987. Plant Cell Culture : A Practical Approach. IRL Press Oxford.
 91. Dryer.R.L. and Lata G.F. 1989. Experimental Biochemistry. Oxford University Press, New York.
 92. Glick B.R. and Tompson, J.E, 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
 93. Ambasht.R.S. 1990. Environment and Pollution Students Friends and Co. Varanasi, India.
 94. Kapur.P. and Govil.S.R. 2000. Experimental Plant Ecology, S.K. Jain for CBS Publishers and Distributors, New Delhi.
 95. Ambasht.R.S. 1990. Environment and Pollution. Students Friends and Co. Varanasi, India.
 96. Kapur.P. Givil. S.R. 2000. Experimental Plant Ecology S.K. Jain for CBS Publishers and Distributors, New Delhi.
 97. Misra R. 1968. Ecology Work Book. Oxiord and IBH, New Delhi.
 98. Moore.P.W. and Chapman.S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publication.
 99. Piper.C.S. 1950. Soil and Plant Analysis. University of Adelaide, Australia.
 100. Smith.R.L. 1966. Ecology and Field Biology. Harper Collins, New York.
 101. Smith. R.L. 1990 (4th edition). Ecology and Field Biology. Harper Collins New York.
 102. Hot Spocts of Endemic Plants ad India Burma & Nepai M.P.

103. Nayar 1996 R.S. 600 T.E.F. a R.I., Patoce Chawala.
104. Plant Protection – P.R. Mehta and Verma.
105. Microbiology – Peicar and Reid.
106. Microbiology life – W.R. Sustrom.
107. Morphology of vascular Plant (lower groups) – A. J. Eames.
108. Introduction pteridophyta – A Rashid.
109. Morphology of Gymnosperms – J. M. Coulter and C. J. Chamberlain.
110. Gymnosperms – Structure & Evolution – C. J. Chamberlain.
111. Press – P. Macheshwari and V. Vasid.
112. Morphology of Gymnosperms – K. R. Sporne.
113. An Introduction to Palaeobotany – C. A. Arnold.
114. Studies in Palaeobotany – H. N. Andrews.
115. Essentials of Palaeobotany – A. C. Shukla and S. P. Mishra.
116. The flora I, II & II – T. Cooke.
117. Taxonomy of the Angiosperms – A. J. Eames.
118. Text book of systematic botany – R. N. Sutar.
119. Methods of Descriptive systematic Botany – A. S. Hitchcock.
120. Taxonomy of the Angiosperms – U. N. Naik.
121. Methods of Descriptive systems Botany – A. S. Hitchcock.
122. Flora of Khandala – H. Santapan.
123. An Introduction to Embryology of Angiosperms – P. Maheshwari.
124. Hand Book of Agriculture – I. C. A. R.
125. Field Crops of India – A. K. Aiyer.
126. An Introduction to plant Anatomy – A. J. Eames and M. C. Danialls.
127. Physiologoy Plant Anatomy – G. Haberlandf.
128. Forest Production andf wood Science – J. G. Naygreen & Bowyer.
129. Pollen granis of Westen Himalayan plants. P.K.K. Nair.
130. Essentials of Palynology – P. K. K. Nair.
131. Pollen morphology of Angiosperms – P. K. K. Nari.
132. Pollen morphology and plant Taxonomy – G. Erdtman.
133. Fundamentals of Cytology – L. W. Sharp.
134. Cytology Cytogenetics – C. P. Swanson.
135. Cytogenetics and Plant Breeding.
136. -S N. Chandrashekharan and S. V. Partha Sarathy.
137. The Physiology of flowering – W.S. Hiiman.
138. Phytochemical Methods – Hartoren.
139. Plant growth substances – H. N. Krishnamurty.
140. Introduction to Practical Biochemistry – D. T. Plummee.
141. Neggle and Fritz (New Edition) introduction to plant physiology.
142. Dr. Naik V.N. – Toxonomy of Angiosperms.
143. V. Varma – A text book of plant Physiology.
144. Malik and Shrivastava – Plant Physiology (S. Chanda Co.)
145. Dnyansagar – Cytology and Genetics (T. Magrewith & Co.)
146. Shobel G.A. & D. E. Mathre 1970 – Outline of plant pathology van Nostrakh Ramhold.
147. Agrias G.N. – Plant Pathology AP., N. Y. & London 1969.
148. Wheeler B. E. J. – An Introduction to Plat Diseases.
149. Mehrotra R. S. Plant Pathology, Tata MacHill Co. op. New Delhi. 1980.
150. Tarr. S. A. J. Principles of Plant Pathology Macmilion.
151. Ahmeduilah M. & Nayar M. P. – Endemic plants of India
152. Region Vol. I.BSZ Pub. 1987 Rsico.

153. Biodiversity in India – Floristic aspects R. R. Rao – 1995
154. Hand book of plant cell culture – Evans D. A.
155. Plant tissue and Organ culture – UNESCO and University of Delhi.
156. Plant Ecology – J. E. Weaver and F. E. Clements.
157. Botanical Micro technique – Saks.
158. Plant Micro Technique – D. A. Johanson.
159. Shivanna- Pollen.

C] OTHER FEATURES:

1. INTAKE CAPACITY / NUMBER OF STUDENTS:-

As per university rules.

2. TEACHERS QUALIFICATIONS:-

- As prescribed by norms.
- However required number of core faculty should be given for particular course along with paper wise and Specialization wise work load allocation.
- Work load details should be as per Apex body/UGC/State Govt./University norms.

3. The Board of studies should clearly mention the required Books, Journals and specific Equipments necessary for the Course.

(A) LIBRARY: Library be equipped with the required Reference and Text Books, Journals and Periodicals for higher and advanced studies as per stated in revised syllabus and approved by BOS.

(B) SPECIFIC EQUIPMENTS:

T.V., V.C.R. V.C.P., L.C.D., Overhead Projector, Computers and necessary software and operating systems etc. are necessary to run the course.

(C) LABORATORY SAFETY EQUIPMENTS:

- i) Fire extinguishers at least two sets in each laboratory of 600 sq.ft. Area.
- ii) Leakage of gases be avoided.
- iii) First aid kit be made available.
- iv) Sugar / Glucose –500gm pack- a pinch of sugar and a cup of drinking water in hypoglycemic condition or in extreme weakness of student or a person concerned

B) GENERAL SAFETY RULES FOR LABORATORY WORK

1) List of equipments needed for Laboratory Safety:-

1. Fire extinguisher
2. First Aid Kit
3. Good earthing and insulated wirings for electrical supply.
4. Emergency exit
5. Apron and goggles wherever necessary
6. Fuming Chambers
7. Masks flows and shoes while handling hazardous chemicals & gases (Good valves, manometers and regulators for gas supply)
8. Operational manuals for instruments (handling to be made as suggested.)
9. Rules of animals and blanks ethics.
10. Leakage of gases to be avoided.
11. Cylinders or flow pipes to handle Acids.
12. No weighings for NaOH and hygroscopic substances.
13. Stabilized supply in the laboratory.

2) **There Is No Substitute for Safety**

1. Any injury no matter how small, it must be reported to teacher immediately.
2. a) In case any chemical enters your eyes go immediately to eye- wash facility and flush your eyes and face with large amount of water.
b) For acid or phenol split, do not use water instead put some bicarbonate.
3. In case of fire, immediately switch off all gas connections in the laboratory and pour sand on the source of fire or cover it with asbestos or cement sheet.
4. While leaving laboratory, make sure that gas, water taps and electricity are switched off.
5. Remove your lab coat. Gloves and clean your hands before leaving laboratory.
6. Make your workplace clean before leaving the laboratory.
7. Keep your hands away from your face, while working in laboratory.
8. Each laboratory must have a first aid box.
9. Know what to do in case of emergency - e.g.
(a) Know the place of fire extinguisher and first aid box.
10. Don't use cell phones in the laboratory.
(a) Remember important phone numbers

3) **DO's**

1. Always wear lab coat, shoes in the laboratory. Every student must have their weight box, a napkin etc.
2. Maintain separate record book for each subject.
3. Keep your belongings at the place allotted for the same.
4. Maintain silence, order, cleanliness and discipline in the laboratory.
5. Work at the place allotted to you or specially used for certain operations.
6. Keep the working table clean.
7. Handle the laboratory equipments, glassware and chemical with great care.
8. Use only required quantities of material and apparatus of essential size.
9. Perform the test in their proper order.
10. Know the location of eye wash fountain and water shower.
11. Minimize your exposure to organic solvents.
12. The Metal like sodium should be kept under kerosene or liquid paraffin layer in a vessel with a cork stopper.
13. Sodium metal should be cut on dry filter paper. The cut off pieces of sodium should be immediately collected in a vessel containing kerosene or liquid paraffin.
14. Always pour acid into water when diluting and stir slightly.

15. All operations involving poisonous flammable gases and vapours should be carried out in the flame chamber (with exhaust facility)
16. Ladies should avoid wearing saree. If it is there, apron is essential.

4) DON'T

1. Don't work alone in the laboratory
2. Don't leave the glass wares unwashed.
3. Don't take apparatus, chemicals out of lab.
4. Don't leave any substance in a vessel or bottle without label.
5. Don't weigh the reagent directly on the balance pan.
6. Don't throw the cut off pieces of sodium metal in sink or water. Transfer it immediately in its container.
7. Don't take sodium metal with hands. Use forceps.
8. Don't panic and run in case of fire. Use the fire extinguishers or sand buckets.
9. Don't breathe the vapours of organic solvents.
10. Don't pour any unused reagent back in its stock bottle.
11. Don't eat or drink any food in laboratory.
12. Don't use inflammable solvents like benzene, ether, chloroform, acetone and alcohol around flame.
13. Don't distill to dryness.
14. Don't exchange stoppers of flasks and bottles containing different reagents.
15. Don't leave reagent bottle lying on the table.
16. Don't disturb the order of reagent bottles in which they are placed.
17. Don't bring reagent on your working table from the general shelf.
18. Don't throw burning matchstick into dustbin.
19. Don't leave the laboratory without permission.

5) LABORATORY / FIELD WORK CARE AND SAFETY FOR BOTANY STUDENTS

1. Unnecessary wastage of plant material during practicals should be avoided.
2. During study tour / personal collection, more emphasis be given on study of plants in nature and collection of wild plants should not be carried out.
3. If at all the collection of the plant material is needed, it should be carried out under supervision of concerned teacher. Collection of poisonous plants / poisonous mushrooms should be avoided.
4. Oral intake of unknown plant material, out of curiosity, during practical or collection tour is strictly prohibited.

5. If there is any allergic reaction while handling the plants / plant parts / pollen grains / fungal specimens it should be immediately brought to the notice of the concerned teacher and reported to the registered medical practitioner.
6. Wearing of hand gloves (and mask) is essential while handling poisonous plants / herbarium sheets / toxic and hazardous chemicals / reagents / strong acids / strong alkalis during the experiment should be made with vacuum pipette / auto pipette / burette under the supervision of concerned teacher / lab assistant.
7. Highly inflammable organic solvents (alcohol, acetone etc.) should not be kept in vicinity of spirit lamp.
8. The laboratory safety measures adopted for handling of hazardous chemicals in chemistry practicals should be followed for conducting practicals in plant biochemistry / microbiology.
9. Operational manuals for equipments such as centrifuge, autoclave, spectrophotometer should be followed.
10. In case of minor injuries, preliminary treatment should be undertaken with the help of first aid kit available in the laboratory. In case of serious injury, concerned teacher should be immediately contacted for consultation to the physician.
11. The instruction report for breeding, experimentation will be submitted in a week period. (Which are laid down by Ministry of Social Justice & Empowerment and Ministry of Environment and Forests, Govt. of India).

Note:

Practical Examination Instructions:

- A) Each candidate must produce a certificate from the Head of the Department stating that he/she completed practical course in satisfactory manner recommended by Board of studies and Laboratory journal has been properly maintained. Every candidate must have recorded his /her observations in the laboratory journal and written report on each exercise performed. Every journal is to be checked and signed periodically by a teacher-in charge and certified by the Head of the Department at the end of year. candidates are to produce their journal at the time of practical examination. without which he/she will be allowed to appear for practical examination.
- B) Excursions for the study of plants in their natural habitat in local areas or any suitable areas should be arranged. There shall be one teacher incharge for not more than 12 students and one additional lady teacher, one field collector and one peon are to be allowed for study tour. T.A. and D.A. be paid to the concerning staff as per university rules