

॥ अंतरी पेट्कू हानज्योत ॥

उत्तर महाराष्ट्र विधापीठ, जगणांच.

जा.क्र.उमेश/१४/६/२६/२८७५

दिनांक : २०. ६. १९६४

प्रति,

उत्तर महाराष्ट्र विधापीठाशी संलग्न
अहंकार सर्व कला, विद्यान व वाणिज्य
महाविद्यालयाचे मा.प्राचार्य यांसी.

विषय :- सुधारित अभ्यासक्रम छून, १९६४ पासून.

महोदय,

विधापीठ अधिकार गंडाने घेतलेत्या निर्णयाद्वारा आपणात
कर्तव्यांत येते की, जून, १९६४ पासून दृतीष्वर्ष विद्यान या वर्गातील
"बॉटनी" विष्यावर सुधारित अभ्यासक्रम अंपलात येत आहे. आपल्या
महाविद्यालयात सदरचा विष्य शिक्षिला जात असल्यामुळे "बॉटनी"
विष्याचा नवीन अभ्यासक्रम सोबत आपल्या माहितीसाठी पाठवित आहोत.

करितां सर्व मा.प्राचार्य, कला, विद्यान व वाणिज्य महाविद्यालय
यांना चिनंती करण्यांत येते दी, त्यांनी या पत्राचा आशय व नवीन
अभ्यासक्रम सर्व संघीथित प्राध्यापकांच्या झाणि विद्यार्थ्यांच्या नवरेत आणावा.

कठादे,

सोबत :- अभ्यासक्रम.

आपला विश्वासू,

उप कुलसचिव.

प्रत माहितीसाठी सादर रवाना :-

- १] मा.अधिकारी, विद्यान विधापाखा, उ.ए.वि., जगणांच.
- २] मा.कुलसचिव, उ.ग.वि., जगणांच.
- ३] मा.उपकुलसचिव, परीक्षा-पूर्वी/उत्तरार्थ, प्रशासन विभाग, उमयि., जगणांच.
- ४] मा.सहा.कुलसचिव, परीक्षा-पूर्वी/उत्तरार्थ, प्रशासन, पाकाचा, भवा व अभिलेख विभाग, उ.ग.वि., जगणांच.
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द्वाता/-

NORTH MAHARASHTRA UNIVERSITY, JALGAON

T.Y.B.Sc. BOTANY SYLLABUS
(W.E.F. JUNE 1994)

PAPER I (BOT 3.1) CRYPTOGAMS :-

FIRST TERM - LOWER CRYPTOGAMS -
(ALGAE & FUNGI)

ALGAE :

A- Introduction -

(2)

A-1 General characters, classification of algae up to classes according to C.M. Smith.

A-2 Contribution of Late Prof. M.P.O. Iyengar

B- Study of Life history of-

B-1. Volvox - with respect to

(3)

Systematic positions, occurrence form size & structure of thallus, cell structure, reproduction - asexual & sexual, structure of sex organs, fertilization, germination of oospore.

OR

B-1 Chara - with respect to-

(3)

Systematic position, occurrence, structure of thallus, cell structure, reproduction - vegetative & sexual, structure & development of sex organs, fertilization, germination of oospore,

B-2 Ectocarpus - with respect to -

(2)

Systematic position, occurrence, structure of thallus, reproduction, alternation of generation.

B-3. Batrachospermum : with respect to

(3)

Systematic position, occurrence, organization of thallus, cell structure, reproduction- asexual, sexual, structure & development of sex organs, fertilization post-fertilization changes, germination of oospore, alternation of generation.

C- Range of thallus in algae :-

(4)

C-1. Unicellular thallus,

C-2. Colonial thallus.

C-3. Filamentous thallus.

C-4. Siphonaceous thallus.

C-5. Pseudoparenchymatous (uniaxial & multiaxial) thallus.

C-6. Parenchymatous thallus.

D- Origin & evolution of sex in algae -

(2)

D-1. Origin of gametes - evidences for zoosporic origin of gametes.

D-2. Evolution of sex - isogamy, anisogamy, oogamy.

- E- Economic importance of algae - (4)
- E-1. Role in industry.
 - E-2. Role in agriculture.
 - E-3. Role in space travel.
 - E-4. Role of algae as a food & fodder.
 - E-5. Algae & sewage disposal.
 - E-6. Role of algae in petroleum & fuel gas.
 - E-7. Algae & water supplies.
 - E-8. Parasitic algae.

FUNGI:-

- F-Introduction. (3)
- F-1. General characters of fungi.
 - F-2. Classification of fungi (outline-only) by-
 - i) G.M. Smith
 - ii) Ainsworth

- G- Study of Myxomycetes with respect to - (3)
- G-1. Thallus structure.
 - G-2. Nutrition.
 - G-3. Reproduction - i) Asexual
 - ii) Sexual.
 - G-4. Economic importance.

- H- Study of life history of Penicillium: with respect to (5)
- H-1. Systematic position, occurrence & structure of mycellium.
 - H-2. Reproduction - a) Asexual
 - b) Sexual
 - H-3. Outline of life cycle.
 - H-4. Industrial production of antibiotics - Penicillin (process in short)
 - H-5. Penicillin antibiotic industry in Maharashtra & in India.
 - H-6. Economic importance.

- I- Study of life history of Puccinia graminis, the black stem rust of wheat with respect to - (4)
- I-1. Systematic position.
 - I-2. Occurrence, symptoms of disease.
 - I-3. Primary & Secondary mycellium.
 - I-4. Stages of development of -
 - a) uredospores
 - b) Teleutospores
 - c) Basidiospores
 - d) Spermatia or pycniospores
 - e) Accidiospores.
 - I-5. Control & forecasting measures.

- J- Study of Deuteromycetes with respect to - (2)
 J-1. General characters
 J-2. Vegetative structure.
 J-3. Reproduction
 J-4. Fruiting bodies
 J-5. Parosexuality
 J-6. Economic importance.
- K- Economic importance of fungi :- (4)
 a) positive
 b) Negative

<u>List of Books:-</u>	<u>Total Periods</u>	<u>44</u>
1. Cryptogamic Botany Vol. I - G.M. Smith.		
2. Botany for Degree students - B.R. Vashishta, Part I - Algae		
3. A Text Book on Algae - D.C. Pandey.		
4. Systematic Botany for degree - Jagjit Singh. Students Part- I		
5. A text book of Botany Vol.I. - Saxena & Sarabhai.		
6. A text book of Botany - S.N. Pandey, Vol.I. Algae & fungi - P.S. Trivedi.		
7. Text book of Algae - H.D. Kumar .		
8. Introduction to Algae - Bold H.C. & Structure & reproduction - Wyne M.J.		
9. The Algae - Chapman V.J. & Chapman D.J.		
10. Topics in Algae - N.D. Kamat.		
11. Fungi - B.R. Vashishta.		
12. Introduction of Mycology - Alexopoulos.		
13. Introduction of Mycology - R.S. Mehrotra & C.R. Aneja.		
14. Fungi - H.C. Dubey.		
15. Fungi - P.D. Sharma.		
16. Fungi - O.P. Sharma.		

Paper - I (BOT.3.I.) : Cryptogams.

Second Term - Higher Cryptogams.

(Bryophyta & Pteridophyta)

Bryophyta:-

- A- Introduction & distinguishing characters of Bryophyta (2)
 classification of Bryophyta with reasons upto orders as
 Per G.M. Smith.
- B- Studies of life history of Marchantia, Anthoceros & (14)

Polytrichum/sphagnum with respect to:
systematic position, habit & habitat, occurrence, external & internal Morphology of the gametophytes, vegetative reproduction, sexual reproduction-position, structure & development of sex organs, fertilization, structure & development of sporophyte, dehiscence of capsule & dispersal of spores, structure & germination of spore, alternation of generation.

(Development of sex organs & sporophyte of Polytrichum/sphagnum is not expected).

Affinities of Anthoceros & evolutionary features in its sporogonium of it to be emphasized.

- C- Evolution of Bryophytic gametophyte according to (3) the regressive & the progressive theory.
- D- Evolution of Bryophytic sporophyte according to ('3) the theory of sterilization & the theory of reduction.
- E- Economic importance of Bryophyta.

Pteridophyta:-

- F- Introduction, distinguishing characters & classification of Pteridophyta with reasons upto order as per G.M. Smith. (2)
- G- Studies of life history of Psilotum & Lycopodium - (10) with respect to :-
systematic position distribution & occurrence, external & internal morphology of sporophyte, vegetative reproduction, position, structure, development & dehiscence of sporangia, (morphological nature of synangium of Psilotum to be emphasized) structure & germination of spores, development of gametophyte, structure of nature prothallus & sex organs, fertilization, post fertilization changes leading to the formation of embryo, alternation of generation. (Development of sex organs are not expected).
- H- Study of life history of Marsilea - with respect (5) to- systematic position habit & habitat external & internal morphology of sporophyte vegetative reproduction external & internal morphology of sporocarp & its morphological nature, dehiscence of the sporocarp morphological structure of mature male & female gametophyte, (Development of gametophytes & sex organs are not expected).
Fertilization, development of embryo, alternation of generation.

I- Stellar evolution:-

(3)

Concept, types & evolution of stеле in Pteridophyta

J- Heterospory & seed habit-

(2)

Definition, origin, significance, heterospory
as precursor to seed habit

Total periods .44.

List of Books.

- 1) Cryptogamic Botany Vol. II :- G.M. Smith.
- 2) An Introduction to Embryophyta - N.S. Parihar
Bryophyta Vol. I
- 3) A Text book of Botany Vol. II - Saxena & Sarabai
- 4) An Introduction to Embryophyte
Pteridophyta - Vol. II - N.S. Parihar
- 5) Pteridophyta & Vascular cryptogams- Vasishtha.
- 6) The Morphology of pteridophytes - K.R. Sporne.
- 7) Comparative morphology of - A.S. Foster.
Vascular plants E.M. Gifford.
- 8) Bryophyta, pteridophyta & Gymnosperms - K.P. Saxena.
- 9) Pteridophyta. - Rashid.

Botany Syllabus

Paper - II (BOT 3.2) Angiosperm Taxonomy.

Gymnosperm & Palcobotany

First Term :- Angiosperm Taxonomy

A- Origin of Angiosperm:-

(5)

A-1. Age of angiosperms.

A-2. Probable ancestors of angiosperms- Stress should
be given on following ancestors.

i)-Pteridosperms

ii)-Bennettitales

iii)-Gnetales.

B- Systems of classification:-

(6)

Pre - Darwinian & post - Darwinian - systems of
classification.

(I) Pre - Darwinian - Linnean system-
(II) Post - Darwinian.

Assumptions & outline of Engler & Pranties &
Hutchinson's system of classification, merits &
demerits & their comparison.

C- Study of the following families :- (24)

(According to Bentham & Hooker's system)
with respect to geographical distribution morphological
characters, distinguishing features, floral variations,
points of biological interest, economic importance,
phylogeny & interrelationships of the following families
with suitable examples-

Magnoliaceae, Annonaceae, Zygophyllaceae, Combretaceae
Cucurbitaceae, Compositae, Sapotaceae, Asclepiadaceae,
Convolvulaceae, Acanthaceae, Amaranthaceae, Casuarinaceae,
Orchidaceae, Elatinaceae, Commelinaceae, Gramineae,
Cyperaceae.

D- Botanic Gardens:- (4)

D-1. Definition, functions of botanic gardens.

D-2. Botanic features of -

i) National Botanic Garden - Lucknow.

ii) Indian Botanic Garden - Calcutta.

iii) Kew Garden - England.

E- Ethnobotany :- (3)

E-1. Definition, scope & importance of ethnobotany.

E-2. Ethnobotany of sacred groves.

E-3. Ethnobotany of magic & religious plants.

E-4. Ethnobotany of medicinal plants.

E-5. Ethnobotany of khandesh.

F- Botanical survey of India. (2)

F-1. Organisation - Regional & zonal centres, botanical
activities, contribution of Santapau.

F-2. Floristic studies in Maharashtra .

Total periods .44

List of Books:-

1. Lawrence G.H.M. - Taxonomy of vascular plants.
2. Mathur & Chavhan - Systematic Botany
(Agro Book House)
3. Naik V.N. - Taxonomy of Angiosperm's
(Tata Mc Graw Hill Pub.)
4. Vasnishta P.C. - Taxonomy of Angiosperm's
(R.Chand Pub.)
5. Pandey C.P. - Angiosperm Taxonomy, Anatomy,
Embryology, Economic Botany
(S. Chand Pub.)
6. Shukla, Priti & Mishra Sunita .- An Introduction to
Taxonomy of Angiosperms.

7. Sporne K.R. - The Morphology of Angiosperms
(B. I. Pub.)
8. Eames A.J. - Morphology of Angiosperms.
(N.G. Hill. Pub.)
9. Sharma O.P. - Plant Taxonomy.
(Tata McGraw Hill. Pub.)
10. J.M. Mitra - Studies in Botany Vol. I;
D. Mitra &
S.K. Chaudhary.

PAPER II (BOT.3.2.) Angiosperm Taxonomy

Gymnosperms & Paleobotany

Second Term ~ Gymnosperms & Paleobotany

Gymnosperms:-

A- Classification of Gymnosperms (up to orders) by (2)

- i) D.D. Pant.
ii) Sporne.

B- Evolutionary status & importance of gymnosperms. (1)

C- Study of life history of Pinus - with respect to (10)
affinities of the genus & its distribution in India,
habit, external morphology of root, stem & leaf ,
primary internal structure of Stem & root, secondary
growth & secondary structure in stem & root, internal
structure of leaf.

Reproduction - structure of male cone & microsporophylls,
microsporangia & microspores, structure of female cone,
morphological nature of the bract scale & the ovuliferous
scale, structure of the ovule, structure & development
^{Pollination & development of male gametophyte} of female gametophyte, structure of archegonium, fertili-
zation, post fertilization changes & polyembryony, structure
& germination of seed, alternation of generations, eco-
nomic importance of Pinus.

D- Study of life history of Gnetum with respect to:- (10)

Distribution in India, habit, external morphology
of root, stem & leaf, primary internal structure of
root & stem, anatomy of leaf, normal secondary growth
& secondary structure in root & stem, anomalous second-
ary growth & secondary structure in stem of G. ulna.

Reproduction- structure of male & female strobili,
structure of male flower, structure of ovule & morpho-
logical nature of its envelope, pollination & develop-
ment of male gametophyte, development of female
gametophyte, fertilization, post fertilization changes
& polyembryony, structure & germination of the seed,

economic importance, alternation of generations, affinities of Gnetum.

Paleobotany:

E- Paleobotany:

- E-1. Introduction, scope & objectives (1)
E-2. Application of Paleobotany in oil & coal exploration (2)
 i) Oil & coal as fossil fuels.
 ii) Role of microfossils in exploration.
 iii) Biotic origin of oil & coal.
 iv) Oil excavation.

F- Fossils:

(3)

- F-1. Definition.

- F-2. Process of fossil formation.

- F-3. Conditions favourable for fossilization.

- F-4. Different types of fossil formations- impression, compression, petrifaction casts, coal balls, amber, chemical, fossils, pseudofossils & micro fossils.

G- Concept of form genera & nomenclature

(1)

H- Plant life through ages -

(2)

- H-1. Geological time scale - eras, periods & epochs.

- H-2. Major plant groups of Paleozoic, Mesozoic & coenozoic.

- H-3. Climatic conditions during major era & their impact on plant life.

I- Study of following fossil groups (including their affinities) :-

I-1. Psilopsida :-

(1)

Distinguishing characters of the order psilotales, external & internal morphology of Rhynia, different views regarding the gametophyte of Rhynia.

I-2. Lycopida :-

(2)

External & internal morphology of Lepidodendron - scolagi, stigmaria, Lepidophyllum, Lepidostratus & Lepidocarpon.

I-3. Sphenopsida :-

(2)

External & internal morphology of calamites, Anularia, Asterophyllites, calamostachys, & Paleostachya

I-4. Pteridosperms :-

(2)

External & internal morphology of Lyginopteris, oldhamia, (stem, microsporophylls & megasporophylls), Lygenostoma.

I-5. Bennettitales :-

(2)

Distinguishing characters, external & internal

morphology of cycadocides (stem , leaf & strobilus i.e. Fructification)

I-6. Fossil Angiosperms :- (3)

Distinguishing characters & internal morphology of Rhizopalmoxylon, Enigmocarpon, sahnipushpam.

Total periods ..44.

List of Books :-

1. Botany for degree students Vol. V. Gymnosperms.
by P.C. Vashishta,
 2. A Text book of Botany Vol. II - Saxena & Sarabhai
 3. Gymnosperms - Chopra & Verma.
 4. Morphology of Gymnosperms - Coulter & Chamberlain.
 5. Gymnosperms - structure & reproduction - Chamberlain.
 6. Morphology of Gymnosperms - Sporne K.R.
 7. Comparative morphology of vascular plants -
A.S. Foster & A.M. Gifford.
 8. Pinus - by Maheshwari & Konar.
 9. College Botany - Vol. II by H.C. Ganguly & A.K. Kar.
 10. Botanical monograph on Gnetum by P Maheshwari & V. Vasil
(CSIR New Delhi).
 11. Studies in Paleobotany - Andrews H.N.
 12. Paleobotany - Arnold.
 13. Paleobotany & introduction to fossil Plant biology
- Tayler T.N.
 14. Essentials of Paleobotany - A.C. Shukla & S.P. Misra.
-

Paper III (BOT. 3:3) ENVIRONMENTAL BOTANY.

Plant Geography & Plant Physiology.

First Term - Environmental Botany & Plant Geography.

Environmental Botany :-

A- Introduction : (3)

A-1. Scope & importance (emphasis be given on impact of development on environment).

A-2. Sub-divisions of environment-

Lithosphere, hydrosphere, atmosphere, stratosphere, & biosphere.

B.- Community dynamics :-

B-1. Succession - definition, causes & types. (5)

- B-2. Process of succession as occurs in xeroseres & hydroseres.
- B-3. Climax concept - Monoclimax, Polyclimax, Pseudoclimax.
- C- Phytosociology :- (7)
 - C-1. Definition.
 - C-2. Qualitative characters - Physiognomy, Phenology, Periodicity, aspectation & stratification.
 - C-3. Quantitative characters - Density frequency abundance.
 - C-4. Frequency diagram & Rannkiaer's Law of frequency.
- D- Ecosystem :- (5)
 - D-1. Concept & kinds (Natural & Man made)
 - D-2. Components of natural ecosystem.
 - D-3. Food chains, food webs, Homeostasis
 - D-4. Ecological pyramids & energy relations.
 - D-5. Mention of major ecosystem of the world.
- E- Environmental Productivity :- (3)
 - E-1. Concept.
 - E-2. Gross & net Productivity.
 - E-3. Primary & secondary productivity.
 - E-4. Energy flow in an ecosystem (Box & Pipe Model)
- F- Environmental Conservation :- (6)
 - F-1. Introduction - concept & necessity of conservation.
 - F-2. Soil conservation.
 - F-3. Biodiversity.
 - F-4. Conservation of endangered plants, animals & their habitats.
 - F-5. Mention importance of sanctuaries, National parks biosphere reserve, gene pool with examples.
- G- Environmental Pollution. (5)
 - G-1. Concept - definition of pollution by various workers.
 - G-2. Kinds & causes of Pollution.
 - G-3. Study of air & water pollution with reference to causes, hazards, remedial measures & green house gases.
- H- Plant Indicators :- (2)
 - H-1. Introduction.
 - H-2. Indicators of soil P^H , altitude, water, minerals & Pollution.

Plant Geography :-

I- Plant Geography :-

(4)

I-1. Main Botanical region of India.

I-2. Detailed study of vegetational types in Maharashtra with suitable examples.

J- Endemism :-

J-1. Insular floras, Island floras - Madagascar, Java, Fiji Andamans, adjacent continental floras.

J-2. Concept & causes - Indian endemic genera & species

J-3. Contribution of at least two Indian ecologists.

Total periods44.

List of Books:-

1. Sharucha, F.R. - A Text Book of Plant Geography of -India.
2. Brij Gopal & H.Bharadwaj - Elements of Ecology.
3. Clark G.L. - Elements of Ecology.
4. Kormondy E.J. - Concept of Ecology.
5. Kochhar, P.L. - Plant Ecology.
6. Etherington J.R. - Environment & Plant Ecology.
7. Kotpal & Bali N.P.R.L.- Concept of Ecology.
8. Sharma P.D. - Elements of Ecology.
9. Vashishta, P.C. - Text Book of Plant Ecology.
- 10.Kumar, H.D. - Modern concept of Ecology.

Paper III (BOT 3.3) Environmental Botany, Plant Geography and Plant Physiology.

Second Term - Plant Physiology:-

A- Mineral Nutrition:-

(6)

A-1. Introduction

A-2. Macro & micro elements.

A-3. Techniques used for assessing essentiality of an element :- a) Sand culture
b) Solution culture

A-4. Occurrence, Role, Functions & deficiency symptoms of N, P, K, S, Ca, Mg, Fe, Mn, Zn, Cu, Mo.

B- Photosynthesis :-

(7)

B-1. Photosynthetic apparatus - ultrastructure of the chloroplast, grana & stroma, thylakoids, quantasomes as functional unit, Photosynthetic pigments, their distribution & roles, electron carriers & enzymes.

B-2. Light reaction - Hill reaction, Two pigment systems, cyclic & non cyclic photophosphorylation
Red drop, Emerson - effect.

B-3. Dark reaction:-

C₃ Pathway (calvin cycle)

C₄ (HCK) Pathway

CAM Pathway

Comparison between C₃ & C₄ Plants

Factors affecting photosynthesis.

C- Respiration:-

(7)

C-1. Respiration as an energy releasing process.

C-2. Respiratory substrates & respiratory quotient.

C-3. Mechanism of respiration.

a) Glycolysis, krebs cycle.

b) Respiratory chain (ETS), terminal oxidation.

c) PP Pathway.

d) Balance sheet of ATP generation.

e) Anaerobic respiration (alcoholic, Lactic & Acetic Acid fermentation).

f) Pasteur's effect,

g) Factors affecting respiration.

C-4. Comparison between Photosynthesis & respiration.

D- Nitrogen metabolism :-

(4)

D-1. Nitrogen Fixation

a) symbiotic

b) Non symbiotic

D-2. Ammonification & Nitrification.

D-3. Reductive amination & Trans - amination.

D-4. Methods of estimation of Nitrogen.

E- Growth & Development :-

(3)

E-1. Definition

E-2. Phases of growth.

E-3. Growth curve - grand period of growth.

E-4. Factors affecting growth (External & Internal)

F- Plant Hormone:-

F-1. Introduction.

F-2. General account & practical applications of auxins, Gibberellin & kinins.

F-3. Brief account of growth inhibitors & their importance.

G-A Photoperiodism & vernalisation.

G-1. Photoperiodism - Garner & Allards work,

G-2. Classification of Plants based on Photoperiods.

- G-3. Photoperiodic induction.
- G-4. Phytochrome & flowering.
- G-5. Practical application of Photoperiodism.
- G- B. Vernalisation.
- G-6. Introduction.
Gregory & Purvisis work.
- G-7. Mechanism & application of vernalisation.
- H- Contribution of at least two eminent Indian plant physiologists. (1)
- I- Tissue culture :- (4)
 - I-1. Introduction.
Knowledge of laboratory conditions & equipments (Autoclave, Laminar air flow, pH meter, Inoculation chamber etc) for tissue culture.
 - I-2. General techniques,
Media preparation, sterilization, aseptic manipulation, Maintenance of culture.
 - I-3. Types of culture.
Callus culture, cell suspension culture, single cell culture & embryo culture.
 - I-4. Application & importance in plant sciences.

Total periods44.

List of Books:-

1. Devlin, R.M. - Plant physiology van Nostrand Reinhold Co.
2. Devlin, R.M. & A.V. Barker - Photosynthesis Affiliated East West Press.
3. Koccher - Plant Physiology.
4. Leopold A.C. & P. E. Kriedemann - Plant growth & Development Tata McGraw Hill Publication.
5. Malik - Plant Physiology.
6. Noggle R, & G. F. Fritz- Introductory Plant Physiology, Prentice Hall India.
7. Pandey & Sinha - Plant Physiology.
8. Salisbury, F.B. & C. W. Ross- Plant Physiology. C.D.S. Publishers.
9. Wilkins, M.B. - Physiology of Plant Growth & Development, T.M. H. Edition.
10. Wilkins, M.B. - Advanced Plant Physiology, Pitman Publishers.

Paper IV (MOT 3,4.) Genetics, Plant, breeding & evolution.

First Term - Genetics:-

A- Explanation of following phenotypic ratios with suitable examples.

- A-1. 3:1 ratio.
- A-2. 9:3:3:1 ratio.
- A-3. 9:6:1 ratio.
- A-4. 9:7 ratio.
- A-5. 13:3 ratio.

(4)

B- Multiple alleles :-

(2)

- B-1. Concept & characteristics.
- B-2. Explanation of multiple alleles with suitable examples.

C- Linkage :-

(2)

- C-1. Discovery of linkage
- C-2. Concept of linked genes with the help of example in maize.
- C-3. Detection of linkage from F_2 data & test cross.

D- Crossing over:-

(4)

- D-1. Meaning of crossing over
- D-2. Meiosis & crossing over, stage at which crossing over takes place.
- D-3. No. of strands involved in crossing over.
- D-4. Single & double cross over.
- D-5. Concept of chromosome map by three point test cross;
- D-6. Molecular basis of crossing over-(Breakage & Reunion mechanism)

E- Structural organisation of chromosomes.

(5)

- E-1. Prokaryotic chromosomes
 - T.M.V.
 - Bacteriophage
 - Bacterial chromosome

E-2. Eukaryotic chromosome (ultra-structure)

F- Evidence to prove DNA as genetic material.

(4)

- F-1. Conjugation
- F-2. Transformation
- F-3. Transduction
 - generalised transduction.

G- DNA

- G-1. Molecular organisation.
- G-2. Types - I, II, & III.

- G-3. DNA .- replication types-
conservative, semiconservative & dispersive.
G-4. Experimental evidence for semiconservative repli-
cation.

H- Genetic code.

(4)

- H-1. Concept
H-2. Singlet, duplex, triplex codons. Evidence for
triplet codons, work of Nirenberg & Khorana.
H-3. Properties of genetic code (with exception)
universality, commaless, Non-overlapping, Degeneracy,
Ambiguity, start & stop signals.

I- Protein Synthesis.

(5)

- I-1. Salient characters of tRNA, rRNA & mRNA
structure of tRNA

- I-2. Role of following in protein synthesis. (5)

- a) DNA
- b) tRNA, mRNA & ribosomes
- c) ATP
- d) Enzymes

- I-3. Transcription & translation.

J- Contribution by eminent Indian Scientists in Genetics (1)

K- Gene mutation. (4)

- K-1. Types of mutation

- K-2. Mutagenesis

- K-3. Base Analogue mutagens

e.g. Bromouracils mutation
Thyamine mutation

- K-4. Ultraviolet Irradiation

L- Gene action:-

(5)

- L-1. Relations of genes & enzymes:-

One gene one enzyme (Polypeptide) hypothesis.

- L-2. Discussion of Lac operon mode of gene action

- L-3. Tryptophan synthesis.

Total periods ...44

List of Books:-

1. Ahluwalia - Genetics.
2. Burns, G.W. - Science of Genetics (The Macmillan company).
3. Cherayil, J.D. - Gene & Genetic code (T.M.H. India.)
4. Herskowitz - Molecular Genetics (Thoms Nelson & Sons.)
5. Klug & Cummings - Concept of Genetics (Merril publishing co.)
6. Pai Anna, C. foundation of Genetics (T.M.H. India)
7. Gardner, E.J. - Principles of Genetics.16

...16...

8. Sarin, C - Genetics (T.M.H. India).
9. Strickberger, M.W. - Genetics (Macmillan Publishing co.)
- 10 Swanson, Merz & Young - cytogenetics (Prentice Hall India)
11. Verma, P.S. & V.K. Agarwal - cell Biology , Genetics & ecology, (S. Chand & Co.)

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Paper IV (NOT 3.4) Genetics, Plant Breeding Evolution.

Second Term - Plant Breeding & Evolution.

Plant Breeding.

- A- Introduction (2)
 - A-1. Definition
 - A-2. Aims & Objectives
 - A-3. Scope & importance
 - A-4. Brief conriution of any three plant breeders in India.
T.S. Venkataraman, C.R. Dhansingh, B.P. Pal,
K- Ramaish, P.S. Swaminathan, Dr.Pushkaranath
Bosnison.
- B- Mode of reproduction in relation to breeding methods- (2)
Methods of reproduction-
 - i) Vegetative reproduction
 - ii) Sexual reproduction- Autogamy, Allogamy & Geitogamy.
- C- Methods of crop Improvement. (3)
Introduction & different types of crop improvement.
(General account)
- D- Selection:- Definition, procedure, merits & demerits of the following types. (4)
 - D-1. Selection for self pollinated crops- Furcline - selection.
 - D-2. Selection for cross pollinated crops - Mass - selection.
 - D-3. Selection for vegetatively propagated crops- clonal selection.
- E- Introduction & popularization:- (3)
 - E-1. Introduction
 - E-2. Definition
 - E-3. Objectives
 - E-4. Advantages , Disadvantages & achievements.
 - E-5. Germ plasm collection,
 - E-6. Plant Introduction agencies in India.

F- Hybridization:	
F-1. Definition	
F-2. Types	
F-3. Objectives & pre-requisites	
F-4. Hybridization procedure	
F-5. Difficulties & Precaution	
F-6. Achievement with examples	
G- Methods of Hybridization	(4)
G-1. Single cross method	
G-2. Double cross method.	
G-3. Three way cross method	
G-4. Top cross method.	
G-5. Pedigree method.	
G-6. Backcross method.	
H- Heterosis & Hybrid vigour	(4)
H-1. Definition.	
H-2. Effect of hybrid vigour	
H-3. Causes of heterosis (Dominance & overdominance hypothesis),	
H-4. Utilization & limitation.	
I- Mutation breeding.	(3)
I-1. Definition.	
I-2. Enlisting of mutagenic agents	
I-3. Gamma gardens	
I-4. Achievements with suitable examples.	
J- Polyploidy	(4)
J-1. Definition	
J-2. Types	
J-3. Characters of polyploidy	
J-4. Role of polyploidy in evolution of new species.	
J-5. Achievements in - <u>Nicotiana</u> & <u>Raphanobrassica</u> .	
<u>Evolution:-</u>	
K- Introduction, - Defination & historical view.	(1)
L- Variation.	(2)
L-1. Environmental.	
L-2. Heritable variations,	
1) Gene mutation	
2) Chromosomal aberration	
3) Recombination	
4) Polyploidy	
M- <u>Natural selection:-</u>	(3)
M-1. Natural selection as an operative Force in adaptive	

evolution as demonstrated by peppered moth-(Biston betularia) experiment.

M-2. Hardy- Weinberg's Law of genetic equilibrium

M-3. Genetic drift.

N- Mechanism of Isolation:-

(3)

N-1. Spatial isolation

N-2. Genetic isolation.

i) Promoting isolation - ecologic, edologic, & micro-

ecologic.

ii) Post-mating isolation - zygotic mortality, hybrid

inviability, & hybrid sterility

N-3. Significans of isolation.

O- Speciation:-

(2)

O-1. Origin of dome.

O-2. Origin of race.

O-3. Origin of species

P- Theories of Evolution:-

(1)

P-1. Classical theory of evolution (Charles Darwin's works)

P-2. Synthetic (organic) theory of evolution.

(Julius Huxley's work)

Total periods ..44

List of Books:-

1. Plant Breeding - B.L. Singh.

2. Elementary principles of plant breeding - H.K. Chaudhari

3. Cytogenetics & Plant Breeding .

Chandro Sekheran & Parthasarathy & Krishnaswamy

4. Introduction to Plant Breeding - A.C. Chaudhari.

5. Cytogenetics, Plant Breeding & Evolution- U.Sinha & Sunita Sinha.

6. Breeding Asian Field crops- John Milton Poehlman.

7. Evolution - J.M. Savage.

8. Mechanism of Evolution - Stellins

9. An Introduction to Evolutionary Biology.

-Dr. H. Swarup & Dr. J.P.N. Patnaik.

Paper V (BOT 3.5) HORTICULTURE; ANATOMY & EMBRYOLOGY.

First Term - HORTICULTURE.

- A- Introduction :- (4)
- A-1. Definition.
 - A-2. Scope & importance .
 - A-3. Branches of Horticulture.
 - a) Pomoculture.
 - b) Olericulture.
 - c) Floriculture.
 - d) Ornamental Horticulture.
 - e) Landscape gardening.
- B- Propagation of horticultural plants:- (4)
- B-1. Sexual Propagation (seed)
 - a) Merits & demerits.
 - b) Selection of seeds.
 - c) Pre-germination treatment.
 - d) Sowing of seeds.
 - e) Transplanting of seedlings.
 - B-2. Asexual propagation (Vegetative).
 - a) Merits & demerits.
- C- Cutting:- (4)
- C-1. Definition.
 - C-2. Advantages & disadvantages.
 - C-3. Types.
 - a) Stem cuttings-herbaceous, semi hard wood, hard wood & soft wood.
 - b) Root cutting.
 - c) Leaf cutting .
 - C-4. Anatomical basis of rooting in cutting- origin of adventitious roots.
 - C-5. Physiological basis of rooting in cutting - role of various factors.
 - a) Auxins.
 - b) Carbohydrates
 - c) Nitrogenous compounds.
 - d) Vitamins & cofactors in initiating adventitious roots (work of Hartman & Fadl)
- D- Layering:- (3)
- D-1. Definition.
 - D-2. Advantages.
 - D-3. Factors affecting root formation .
 - D-4. Special treatments for root formation.
 - D-5. Kinds of layering.

- a) Simple
- b) Tip
- c) Serpentine
- d) Trench
- e) Mound
- f) Gouge.

E- Graftage:-

(3)

- E-1. Definition.
- E-2. Advantages.
- E-3. Limitations.
- E-4. Stock-Scion incompatibility.
- E-5. Root - stock- scion relationship.
- E-6. Raising of root - stocks.
- E-7. Selection of scion.

F- Grafting:-

(3)

- F-1. Types of grafting.
 - a) whip
 - b) Tongue
 - c) cleft
 - d) bark
 - e) side
 - f) veneer
 - g) approach
 - h) stone,

G- Budding:-

- G-1. Types of budding
 - a) 'T' as shield budding.
 - b) Patch budding.

H- Training & Prunning of Plants:-

- H-1. Definitions.
- H-2. Difference between Training & Prunning.
- H-3. Objectives of Training & Prunning.
- H-4. Advantages of Training & Prunning.
- H-5. Methods of Training.
 - a) Central leader system
 - b) Open culture system.
 - c) Modified central leader system.
- H-6. Methods of prunning.
 - a) Heading back
 - b) Thinning out.

I- Pomology:-

(6)

- I-1. Introduction , scope & importance.
- I-2. Problems of unfruitfulness, difference between fruitfulness & unfruitfulness.
- I-3. Factors affecting fruitfulness.
 - a) External factors.
 - i) Nutrient supply.
 - ii) Irrigation.
 - iii) Season
 - iv) Locality & soil type,
 - v) Temperature
 - vi) Rain
 - vii) Wind
 - viii) Insect pests & diseases.
 - b) Internal factors -
 - i) Evolutionary
 - ii) Genetic
 - iii) Physiological

J - Methods of controlling unfruitfulness -

(6)

- J-1. Bahar treatment.
 - a) Definition.
 - b) Types of Bahar - Ambe- bahar, Mrig- bahar & Hast-bahar.
 - c) Steps in Bahar treatment.
 - i) Withholding of water.
 - ii) Cultivation of land.
 - iii) Manuring.
 - iv) Resumption of watering.
 - v) Choice of bahar.
- J-2. Root pruning & exposure.
- J-3. Ringing & Girdling.
- J-4. Notching.
- J-5. Bending.

K- Study of Mango, Rose, Brinjal (any one)

(6)

- K-1. Soil & Climatic conditions.
- K-2. Cultural practices.
- K-3. Suitable varieties.
- K-4. Special treatments if any.
- K-5. Diseases & pests.
- K-6. Harvestings & marketing.
- K-7. Uses & by- products.

Total periods ..44

Paper V (DOT 3.5) HORTICULTURE, ANATOMY &
PHYSIOLOGY.

Second Term - Anatomy & Embryology.

Anatomy:

- A- Concept of tissue systems. (1)
- B- Meristematic tissues- (3)
- B-1. Apical cell theory.
 - B-2. Histogen theory.
 - B-3. Tunica carpus theory.
- C- Epidermal tissue system - (4)
- C-1. Definition.
 - C-2. Structure.
 - C-3. Function.
 - C-4. Cutinisation, lignification, suberisation & silicification.
 - C-5. Epidermal outgrowth
 - C-6. Stomatal types - Ranunculaceous, cruciferous, Caryophyllaceous, subiacaceous, Gramineous.
- D- Mechanical tissue system - (5)
- D-1. Necessity in plants.
 - D-2. Types of mechanical tissues.
 - D-3. Principle involved in :-
Inflexibility, incompressibility, inextensibility.
Shearing stresses.
 - D-4. Distribution of mechanical tissues in -
 - i) Stem - Maize, Canna, Aristolochia.
 - ii) Leaf - Maize, Eucalyptus
 - iii) Root - Maize, cicer.
- E- Normal secondary growth.
- E-1. Definition.
 - E-2. Significance.
 - E-3. i) Process in stem of
 - a) an annual
 - b) a Perennial
 - ii) Process in root.
 - E-4. Development & structure of periderm & bark
 - E-5. Wood- elements of wood, structure & arrangement of the elements, ring porous & diffuse porous wood tyloses, growth rings.
- F- Anomalous secondary growth:- (5)
- F-1. Definition.
 - F-2. Causes of variations.
 - i) Unusual origin of the cambium.
 - ii) Unusual behaviour of cambium.

- F-3. Study of secondary growth in
i) Stem - Aristolochia, Bignonia, salvadora, Dracaena
ii) Root- Carrot/Beet.

Embryology:-

G- Definition & scope (1)

H- Descriptive, comparative, & experimental embryology.(1)

I- I-1. microsporangium - structure of tetrasporangiate anther (5)

I-2. Tapetum, types & functions.

I-3. Microsporogenesis- types of divisions- successive & simultaneous, types of microspore tetrads.

I-4. Structure & germination of pollen grain, formation of male gametophyte.

J- J-1. Megasporangium (ovule) structure, (5)

Nucellus- Crassinucellate & tenuinucellate ovules, types of ovules- Orthotropous, anatropous, hemi-anatropous, amphitropous, campylotropous, & circinotropous.

J-2. Megasporogenesis- types of megasporite tetrads.

J-3. Female gametophyte - structure of embryo sac, development & organisation of monosporic (polygonum) bisporic (Allium) tetrasporic (peperomia) embryo sacs.

K- Fertilization:- (2)

K-1. Definition. Pollen tube

K-2. Entry of the/pogamy, mesogamy & chalazogamy.

K-3. Double fertilization - syngamy, triple fusion.

K-4. Post fertilization changes.

L- Endosperm:- (2)

L-1. Types of endosperm - nuclear,cellular & helobial.

L-2. Ruminant endosperms.

M- Embryo: (4)

M-1. Development & structure of mature embryo in capsella & sagittaria.

M-2. Polyembryony- Definition & causes.

Total periods ..44.

-X-X-X-X-X-X-

Lists of Books:-

1. Esau K. - Anatomy of Seed plants.
2. Esau K. - Plant Anatomy
3. Pandey B.P. - Plant Anatomy - S. Chand publication.
4. Maheshwary P. - An Introduction to Embryology of Angiosperms.

M.G. H. Publication.

5. Bhojwani, Bhatnagar - Embryology of Angiosperms.
6. Chandukar P.J. - Plant Anatomy.
7. Foster - Practical Plant anatomy.
8. Gupta S.K. - A text book of Angiosperm Histology.
9. Johnson D.I. - Plant Embryology.
10. Tyal N.S. - Plant Anatomy.
11. Metcalfe & Chalk - Anatomy of Cicots Vol. I & II.
Anatomy of Monocots Vol. I.

Paper VI (BOT 3.6) Gardening- I & II.

First Term - Gardening - I.

- A-1. Introduction - Definition of garden & gardening. (4)
- A-2. Types:
- a) Formal
 - b) Informal
 - c) Botanical
 - d) Terrace
 - e) Park.
- A-3. Importance of garden. (1)
- a) Aesthetic.
 - b) Academic.
 - c) Economic.
- B-1. Ancient Indian Gardens. (3)
- a) Hindu.
 - b) Buddhist.
 - c) Meghul.
- B-2. a) Japanese gardens
b) English gardens. (2)
- C- Planning of gardens. (1)
- C-1. Consideration of following in planning.
Originality in planning, variety & surprise, colour scheme, Fragrance, space for kitchen garden, privacy, beauty, comfort, flexibility.
- C-2. Importance of following in planning. (1)
- a) Unity & variety.
 - b) Rhythm & Balance.
 - c) Accent & contrast.
 - d) Scale & proportion.
- C-3. Study of physical, structural & biological features of the gardens. (3)

- a) Fences.
- b) Hedge & border.
- c) Paths & avenue.
- d) Water garden.
- e) Rockery.
- f) Lawns.
- g) Green house.
- h) Arches & pergola.

D- Soil & soil management.

(6)

D-1. Soil composition, nature, & types.

D-2. Manures.

- a) bulky organic manures- Leaf mould
compost, composting & Farm Yard Manure (FYM)

- b) Concentrated organic manure- Liquid manure.

D-3. Fertilizers.

D-4. Irrigation.

D-5. Agrochemicals.

E- Garden tools & implements.

(3)

E-1. Implements:- sickle, trowel, rake, hoe, secateurs, pruning, shears, grafting & budding knife.

E-2. Use & upkeep of following:-

- a) Mower
- b) Sprayer
- c) Duster
- d) Budding & grafting knife.

F- Routine Garden operations.

(7)

F-1. Preparation & importance of

- a) seed beds
- b) seed pans

F-2. Collection & sowing of seeds

F-3. Seedling transplantation,

F-4. Transplantation of large tree.

F-5. Preparation of pits.

F-6. Pruning.

F-7. Wintering.

F-8. Mulching.

F-9. Methods of propagation : cutting, layering, grafting & budding (Home assignment).

F-10. Weeding

G- Indoor Gardening.

(4)

G-1. House plants & indoor gardening.

G-2. Characters of indoor plants.

G-3. Terrarium - jar, bottle, gardening

G-4. Miniature gardens- gardens in dishes & trays.

G-5. Hanging baskets.

G-6. Maintenance of indoor plants.

- H- Pot- culture (4)
H-1. containers
H-2. selection of plants.
H-3. potting & repotting.
H-4. Maintenance & care.
H-5. Importance.
- I- Bonsai (4)
I-1. Principle.
I-2. Containers.
I-3. Selection of Plants.
I-4. Techniques.
I-5. Styles
I-6. Maintenance.

Total periods: ...44

Paper VI (30T 3.6) GARDENING I & II
Second Term: Gardening - II.

A- Study of ornamental Plants (5)

A-1. Annuals -

- a) Derivation classification, list of -
 - i) Rainy season annuals
 - ii) Winter season annuals
 - iii) Summer season annuals
- b) Selection of annuals for different purposes -
For bedding, cut flowers, loose flowers, hanging baskets, rock gardens, pots & for screening purposes.
- c) Herbaceous border -
 - 1) Size
 - 2) Fore ground & back ground
 - 3) Colour scheme of border.
 - i) Monochromatic colour scheme.
 - ii) Analogous colour scheme.
 - iii) Contrast colour scheme.
- d) General method of cultivation for annuals-
Raising of nursery - seedlings, preparation of land, transplanting of seedling.
- e) Discussion of nine annuals- three for each season with respect to botanical name, flowering/blooming period, varieties with special features.

- A-2. Shrubs & shrubberies:- (4)
- a) Definition.
 - b) Importance.
 - c) Classification.
 - d) Growing of shrubs (Methods of cultivation)
Preparation of soil, planting, watering, gap filling, weeding & pruning.
 - e) Discussion of at least five shrubs with respect to
 - i) Botanical name.
 - ii) Choice of place.
 - iii) Ornamental value.
- A-3. Climbers:- (4)
- a) Classification of climbers based on -
 - i) Different situation
 - ii) Growth.
 - iii) Purpose.
 - b) Methods of cultivation.
 - c) Pruning & training of climbers.
 - d) Discussion of at least five climbers with respect to
 - i) Botanical name.
 - ii) Choice place.
 - iii) Ornamental value.
- A-4. Trees:- (5)
- a) Introduction.
 - b) Importance.
 - c) Selection of trees - as a specimen tree, shady trees, flowering trees, trees of avenue , along high ways, screening purpose for fragrant flowers for checking Pollutions.
 - d) Methods of cultivation.
 - i) Preparation of Pit/Soil Planting time.
 - ii) Maintenance & care -
staking, fencing, weeding, irrigation, gap filling, training of young trees.
 - d) Discussion of at least 10 trees with respect to
 - i) Botanical name.
 - ii) Purpose of planting.
 - iii) Special features/ ornamental value
- A-5. Hedges, Edges & Topiary :-
- I - Hedges:- (4)
- i) Definition.
 - ii) Characteristics of plants which can be used as hedges
 - iii) Classification of hedges -
 - a) Tall Protective
 - b) Dwarf protective
 - c) Tall ornamental
 - d) Dwarf ornamental

- iv) Growing of hedges -
 - a) Preparation of soil, planting time, planting method.
 - b) Maintenance - irrigation, weeding, trimming, gap filling.
 - v) List of shrubs, trees & climbers which can be used for hedges, their botanical names & ornamental value
 - vi) Utility/Importance of hedges.

II - Edges: - (1)

- a) Suitable plants for edging.
 - b) Importance of edging.

III- Topiary:-

- i) Introduction.
 - ii) Suitable plants, method/training.
 - iii) Importance.

4-6. Bulbous plants :- (3)

- a) Introduction.
 - b) Methods of cultivation.
 - c) Discussion of any three bulbous plants with respect to
 - i) Botanical name.
 - ii) Planting time, flowering period.
 - iii) Ornamental value.

A-7. Cacti & succulents :- (3)

- a) Characters.
 - b) Growing of cacti & succulents -
Propagation, note of grafting soil preparation,
planting, maintenance.
 - c) Discussion of any three cacti & three succulents
with respect to
 - i) Botanical name
 - ii) Special features/ornamental
value.

B :- Rocheries:- (a)

- a) Selection of site.
 - b) Design/Construction/Preparation.
 - c) Selection of plants.
 - d) Maintenance & care.

C- Lawns::-

- a) Preparation of soil
 - b) Selection of grasses- merits & demerits of Cynodon .-
dactylon, zeysia ,+ japonica.
 - c) Planting methods.
 - d) Maintenance
 - e) Importance.

D- Green House:- (2)

- a) Importance of green house.
- b) Salient features of green house.
- c) Climatron,

E- General account of pests & diseases in garden plants (2)
with respect to pathogen host, symptoms, damage &
control .

F- Garden calander:- (2)

Review of different activities to be carried in garden
throughout the year.

Total Periods...44

List of Books:-

1. Gardening in India- Lancaster, revised by Dose & Mukerjee
2. Beutifying India - M.S. Randhava.
3. Gardens through ages - M.S. Randhava.
4. Beautiful gardens - M.S. Randhava.
5. Landscape gardening - Time life book.
6. Prunning & grafting - Time life book.
7. How to grow Roscs ? - A.
8. Tropical Bonsai - Jyoti Parekh.
9. Pushpa Bharati - Bhujbal.
- 10.Rose in India - B.P. Pal.
- 11.Everday Gardening in India- E.W. Grindal.
- 12.Climbers in India- B.P. PAL.
- 13.Home gardening - Pratibha Trivedi.
- 14.Lawns & Gardens - S.C. Jindal.
- 15.Complete gardening in India - Gopalswami Iengair.

T.Y.B.Sc. BOTANY SYLLABUS.PAPER-VI (BOT. 3.6) : PLANT PROTECTION-I&II.FIRST TERM - PLANT PROTECTION-I.A--Plant Pathology:-

(4)

Introduction, Definition.

- A-1. A short historical account of plant Pathology with reference to the work of the following pathologists.- Theophrasus, Prevost, Ge-Dary, Butler, Mundkur, K.C.Mehta.
A-2. Importance & scope of Plant Pathology.

B--Terminology:-

(2)

Definitions of the following terms-

Disease, pathogen, Host, Parasite, Hyper parasite,
Inoculum, Penetration, Infection, Pathogenesis,
Pathogenicity, Etiology, Incubation period, disease-
cycle, Symptoms & Epidemiology.

C--Causes of Plant-diseases :-

(4)

Introduction.

C-1. Animate causes:-

A brief survey of diseases caused by the following organisms with a few examples of each :- Bacteria, viruses, fungi, Algae, Nematodes & Mycoplasma.

C-2. Inanimate causes:-

A brief survey of the diseases caused by the following:-

- i) Adverse climatic conditions such as those of high & low temperature, unfavourable intensity of light, excess of water.
- ii) Deficiency & excess of minerals.
- iii) Chemical injuries caused by atmospheric pollutants, Faulty application of fungicides, insecticides, weedicides etc.

D--Classification of plant-Diseases :-

(3)

Broad outline of the classification of plant diseases based on the following points :-

- i) Nature of the causal agencies-
animate, inanimate.
- ii) Types of crop affected:-
Cereals, Pulses, etc.
- iii) Types of Symptoms:-
Necrotic, atrophic, hypertrophic, wilting,
die-back, rusts, smuts, mildews etc.
- iv) In relation to occurrence:-
Epidemic, epiphytotic, Sporadic.

- v) Type & Sources of inoculum:-
Soil-borne, Seed-borne, air-borne.
- vi) Localised & Systemic.

E--Symptoms & damage done:- (4)

Various symptoms of plant diseases along with the kind of damage done.

F--Inoculum dispersal:- (4)

- i) Active or autonomous:-
Soil Seeds & plants.
- ii) Passive dispersal through:-
 - a) wind.
 - b) water.
 - c) insects.
 - d) fungi.
 - e) nematodes.
 - f) birds.
 - g) mammals.
 - h) man.

G--Development of diseases (pathogenesis):- (5)

Introduction: Inoculum - Potentiation.

G-1. Infection:-

Definition, leading of inoculum on the host.

G-2. Penetration:-

Modes of penetration of viruses, bacteria, fungi & nematodes.

G-3. Mechanism of Penetration:-

- i) Through wounds.
- ii) Through natural openings-stomata, hydathodes, lenticels.
- iii) Direct penetration-Purely mechanical process, partly chemical process evidences in support of both.
- iv) Establishment & colonization of host.

H--Host-Parasite relationship:-(post penetration phase):-(4)

H-1. Host parasite interactions leading to the establishment of nutritional parasitic relationship between the host & parasite.

H-2. Degree of parasitism:-

- i) Establishment of obligate parasites & facultative saprophytes.
- ii) Differences in their mode of nutrition.
- iii) Secretions of enzymes, toxins etc. by the host/parasite.
- iv) Interruption & alteration in host metabolism.
- v) Development of symptoms.

- I--Epidemiology & disease forecasting:- (4)
- I-1. Introduction, Simple interest & compound interest
diseases, slow & rapid epiphytotics, their outbreak & decline.
- I-2. Factors affecting rate of epiphytotics.
- I-3. Broad idea of disease forecasting with one or two suitable examples.

J--Study of diseases:-

- J-1. Inanimate Diseases:- (2)
- a) Diseases caused due to nutritional deficiencies of the following elements:-
Fe-chlorosis, Bo-Mango necrosis.
 - b) Diseases due to unfavourable temperature-freezing injury to potato, black heart of potato, sun scald of vegetables.
- J-2. Animate diseases:- (8)
- a) Viral diseases-TMV/PMV.
 - b) Bacterial disease-Citrus canker.
 - c) Fungal diseases:-
 - i) Powdery mildew of grapes/teak/Acacia.
 - ii) Downy mildew of bajara (Green ear disease).
 - iii) Ergot of bajara.
 - iv) Tikka disease of ground nut.
 - v) Loose smut of wheat.

Total Periods..44

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T.Y.B.Sc.BOTANY-SYLLABUS.PAPER-VI (BOT.3.6) : PLANT PROTECTION-I&II.SECOND TERM - PLANT PROTECTION-II.(DISEASE CONTROL)A--Plant Protection:-

(1)

- i) Introduction.
- ii) Definition.
- iii) Importance.
- iv) Scope.

B -Disease Control:-

(2)

- i) Introduction.
- ii) Basic principles of disease control.
- iii) Control planning against:
 - a) a disease (single disease control).
 - b) a crop (multiple disease control).
- iv) Disease control on co-operative basis.
- v) Repeated use of control measures.
- vi) Use of preventive instead of curative measures.
- vii) Cost-benefit ratio.

C- General principles of disease control:-

(6)

- i) Preventive.
 - a) Avoidance of the pathogen.
 - b) Exclusion of the inoculum.
 - c) Eradication.
 - d) Protection.
 - e) Disease resistance.
- ii) Curative-therapy.

C-1.Mechanical control:-

Choice of geographic area, selection of field, proper time of sowing, use of disease escaping varieties, selection of seed & planting stock, high budding.

C-2.Control through cultural practices:-

Crop rotation, mixed cropping, removal & destruction of diseased plants & plant organs, roguing, destruction of alternate & collateral hosts.

C-3.Field Sanitation:-

Destruction of crop residue, deep ploughing, improved soil drainage system, following, flooding, crop-free period of crop free zone, Depth of sowing of seeds, regulation of fertility level of soil.

C-4. Soil treatment:-

- i) Heat.
- ii) Flooding.
- iii) Fallowing.
- iv) Use of chemicals.

D--Elimination of pathogen from infected plant material:-(9)

- i) Sorting.
- ii) drying & aging of seeds.
- iii) Thermal treatment.
- iv) Chemical treatment.

E--Biological control:-

(4)

- E-1. i) Introduction.
- ii) Definition.
- iii) Biocidal control & biostatic control.

E-2. Methods:

- i) Amendment of soil with organic matters.
- ii) Predaceous fungi methods.

E-3. Mechanism:

- i) Antibiosis.
- ii) Exploitation.
- iii) Competition.

F--Legal Control:-

(2)

- F-1. Introduction.

F-2. Plant quarantine-Introduction, definition, limitations & importance.**F-3. Plant quarantine organisation in the world & in India.****G--Chemical control:-**

(8)

G-1. Introduction, importance.**G-2. Classification of chemicals according to their ..**

- i) Chemical nature.
- ii) Mode of action - systemic, eradicants, protectants, therapeutics, non - systemic,
- iii) Plant part treated,
- iv) Nature of the pathogen against which used,

G-3. Criteria of a good fungicide & mechanism of action of fungicide.**G-4. Chemicals used in plant disease control-nature, mode of action & uses.****a) Sulphur:-**

- i) Inorganic compounds.
- ii) Sulphur powder.
- iii) Wettable sulphur.
- iii) Lime sulphur.

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2) Organic compounds : Dithiocarbamates.

b) Copper:-

- i) Bordeaux mixture.
- ii) Burgundy mixture.
- iii) Copper oxychloride.

c) Mercury:-

- 1) Inorganic compounds:
 - i) Mercuric chloride.
 - ii) Mercurous chloride.
- 2) Organic compounds:
 - i) Ceresan.
 - ii) Agrosan.
 - iii) Arstan.

d) Heterocyclic nitrogen compounds:-

- i) Captan.
- ii) Glyodin.

e) Antibiotics:-

Introduction, definition, mode of action.
i) Streptomycin.
ii) Tetracycline.
iii) Groseofulvin.
iv) Aurofungin.

f) Soil Fumigants:-

Methods of applying antipathogenic chemicals.

H--Control through disease resistance:-

(3)

H-1. Introduction:-

Use of resistant varieties, difference between disease escape, tolerance & disease resistance.

H-2. Inheritance of resistance:-

Monogenic & polygenic resistance, vertical & horizontal resistance.

H-3: Sources of resistance:-

i) Selection & multiplication of resistant individuals from existing varieties.

H-4. Developing resistant varieties:-

- i) Selection.
- ii) Hybridization.
- iii) Mutation.

I--Defense of plant:

(5)

I-1. Introduction.

I-2. Disease resistance in plants.

i) Protection.

a) Structural protection-epidermal, stomatal mechanical tissues.

- b) Chemical protection-chemicals of the surface layer, exudation of toxic chemicals.
- c) Absence of nutrients.
- d) Absence of common antigen.

ii) Defence:

- a) Histological defence.
- b) Accumulation of toxic substances.
- c) Hypersensitive defence reaction.
- d) Defence through growth substances & enzymes.
- e) Tolerance to disease.

K--Nematology:-

(4)

1) Introduction.

Nematodes as plant pathogens.

2) Study of the following nematodal diseases with respect to causal organism, damage caused, symptoms & control.

- i) Root-knot of vegetables.
- ii) Ear cockle of wheat.
- iii) Molya disease of barley.

Total periods --44

LIST OF BOOKS:

1. Introduction to principles of plant pathology- R.S.Singh.	
2. Plant Diseases.	- R.S.Singh.
3. Essentials of plant pathology.	- V.N.Pathak.
4. A Text book of plant pathology.	- K.S.Bilgrami & H.C.Dube.
5. An Introduction to plant Diseases.	- B.E.J.Wheeler.
6. Fungi & plant Diseases.	- B.B.Mundkur.
7. Diseases of crop plants in India.	- G.Rangastwami.
8. Introductory plant pathology.	- M.N.Kamat.
9. Plant Diseases.	- Mathur.
10. Fundamentals of plant pathology.	- D.A.Roberts & C.W.Beerthroyd.
11. Fungi & Diseases in plants.	- E.J.Butler.
12. Principles of plant pathology.	- Stakman & Harrar.
13. Fungi.	- B.R.Vashishta.
14. College Botany Vol.	- Ganguly & Kar.
15. Viruses & Myco plasma diseases of plants.	- Ray Chaudhari & Naraini.
16. Plant protection.	- Sill.
17. Systemic fungicides.	- Yvas.
18. Plant pathology.	- Mohnotra.
19. Plant protection-Principles & Taxonomy.	- Mukundan.
20. Fungicides.	- Nene.

PAPER VI (BOT. 3.6)MOLECULAR BIOLOGY AND BIOTECHNOLOGY.FIRST TERM - MOLECULAR BIOLOGY.

A) Introduction,

A-1. History, scope and importance. (2)

B) Molecular organization of micromolecules and macromolecules.

B-1. Micromolecules and macromolecules.

B-2. Molecular organization of

i) Carbohydrates - Monosaccharides, disaccharides and Polysaccharides.

ii) Proteins.

iii) Lipids.

iv) Nucleic acids.

B-3. Macromolecular interaction. (16)

C) Molecular Organization of plasma membrane.

C-1. Composition, molecular organization - fluid

Mosaic Model

(2)

C-2.

D) Molecular organization of prokaryotic cell and Eukaryotic cell. (1)

E) Structure and Synthesis of ATP with reference to organization of respiratory chain in mitochondria. (3)

F) Molecular structure of photosynthetic pigments and their organization in thylakoids. (5)

G) Enzymes and their regulation.

G-1. Co-factors and co-enzymes.

G-2. Enzyme kinetics.

G-3. Types, zymogen, isozymes, Allosteric enzymes. (5)

H) Modern Concept of gene.

Pseudogenes, gene regulation, gene regulation in Eukaryotes, transcriptional control in Eukaryotes, Termination (Reverse transcription) mutations, gene synthesis, principles of Recombinant DNA Technology and Genetic Engineering. (10)

REFLECTIONS OF BOOKS :

1. Essentials of Molecular Biology .
By David freifelder.
2. Elements of molecular Biology .
Sandhya Mitra.
3. Molecular Biology and Biotechnology -
H.D.Kumar.
4. Cell-Biology - C.B.Pawar.
5. Genes IV - Benjamin Lewin.
6. Cell and Molecular Biology EDP De Robertis
(8th Edition) EMF De Robertis
7. Genetics - V. Goedenargh.
8. Principles of Genetics - L.J.Gardner.

PAPER VI (BOT. 3.6)

MOLECULAR BIOLOGY & BIOTECHNOLOGY.

SECOND TERM - BIOTECHNOLOGY.

A--Biotechnology scope & Importance. (2)

- A-1. Definition.
- A-2. History of Biotechnology.
- A-3. Biotechnology in India.
- A-3. Achievement of Biotechnology.
- A-4. Brief contribution of following scientists in Biotechnology-as Indra & Vimal vasil, F. Maheshwari, N.S.Subbarao, Y.P.S.Bajaj.

B- Plant tissue culture. (18)

- B-1. Introduction, Introduction of callus, culture media & composition, callus growth, organogenesis, somatic embryogenesis, Embryogenesis, Sub-culturing, Applications of tissue culture.
- B-2. Anther culture.
Techniques, culture media, induction of androgenesis, Stability of haploid cell culture, significance & use of haploid.

C- Biofertilizers. (2)

Introduction, Mass cultivation of Rhizobium, Blue green algae & Azolla & its application.

D- Biological control of plant pathogens & weeds. (4)

D-1. Predation & parasitism, Mycoparasitism, Nematology & mycophagy.

Application of biological control like seed inoculation, vegetative part inoculation, use of mycorrhizal fungi.

D-2. Biological control of weeds.

Plant pathogens as bio-control agents.

E--Fungal Biotechnology.

E-1. Primary metabolites.

(3)

Definition, different type of primary metabolites, production of citric acid & industrial alcohol with respect to source, culture, fermentation medium, procedure & harvest recovery.

E-2. Secondary metabolites.

(8)

Antibiotics.

Introduction, different types of antibiotics produced by Fungi.

Penicillin fermentation with respect to source, fermentation medium procedure, harvest & recovery of penicillin.

F--Single cell protein (SCP):-

(3)

Advantages of producing microbial proteins.

Micro-organisms as a source of scp-

Substrate use for scp.

Nutritional value of sep-

Production of algal biomass - Spirulina.

G--Biomass & Bioenergy.

(4)

G-1. Biomass as a source of energy.

G-2. Composition of biomass.

G-3. Terrestrial & aquatic biomass.

G-4. Industrial & agricultural waste as a source of biomass.

G-5. Production of biogas fuel,-Methane.

Total periods.. 44

LIST OF BOOKS:

1. Baker E.S. & Venkatesan C.V. - A manual on the cultivation & proceedings of algae as a source of SCP.
2. Dilgramy & Condey - Introduction to Biotechnology.
3. Cacida L.E. - Industrial microbiology.
4. Dube H.C. - Text-book of Biotechnology.
5. Kumar H.D. - Molecular biology & Biotechnology.
6. Prachit - Fundamentals of Biotechnology.
7. Subbarao N.S. - Biofertilizers.
8. Trichan keshav - Biotechnology.

Yadav*

§§ PRACTICALS §§

PAPER-VII (BOT.3.7) : PRACTICAL-I. (PAPER-I&VI)

PAPER-I. CRYPTOGAMS.

Pract. No.:

- 1&2. Study of life cycle of volvox/chara, Ectocarpus & Batrachospermum with the help of material & permanent slides.
- 3,4&5. Study of range & thallus structure in algae with the help of material/permanent slides.
- a) Unicellular thallus -
Chlamidomonas chlorella.
 - b) Colonial thallus -
Pondorina Eudorina, Hydrodictyon, Pediastrum, Scenedesmus Microcystis.
 - c) Filamentous thallus -
Oscillatoria, Zygnema, Chodophora, Pithophora, Chaetophora, Coleochaetae, Stigeoclonium, Draparnaldia/ Draparnaldiopsis, Fritchella.
 - d) Siphonaceous thallus -
Vaucheria, Caulcrapa.
 - e) Pseudoparenchymatous (uniaxial/multiaxial) thallus -
Batrachospermum, Polysiphonia.
 - f) Parenchymatous thallus -
Ulva, Enteromorpha.

Note:- Students should submit at least 10 algal samples duly preserved along with the tour report.

- 6: Study of life cycle of penicillium sps. with the help of culture material/preserved material/permanent slides.
 - i) Mycelial structure.
 - ii) Conidial phase.
 - iii) Permanent slide of perfect stage.
7. Study of life cycle of Puccinia-greminis with the help of material & permanent slides.
8. Study of Myxomycetes & Deuteromycetes.
(At-least any two forms from each).

9. Identification of any six fungal forms from the following:-

Synchytrium, Saprolegnia, Cystopus, Mucor, Erysiphe, Uncinula, Phyllactinia, Claviceps, Peziza, Geaster, Polyporus, Specelotheca & Dusturella.

- 10&11. Isolation of Fungal forms at least four-from soil by P.D.A. medium.

Note:-Field tour is essential students should collect & submit at least five fungal specimen at the time of examination.

12. Study of life cycle of Marchantia.

13. Study of life cycle of Anthoceros.

14. Study of life cycle of Polytrichum/^bsphagnum.

15. Study of life cycle of psilotum with the help of material & or slides.

16. Study of life cycle of Lycopodium.

17. Study of life cycle of Marsilea.

18. Study of stellar evolution in pteridophyta with the help of section of materials & or permanent slides.

Note:-Study tour is compulsory. Students are expected to submit at least ten specimens of Bryophytes & pteridophytes

PAPER - VI.

GARDENING - I & II.

19. (a) Techniques of pot culture.
(b) Observation, listing & uses of
 i) Manures & fertilizers.
 ii) Growth hormones.
 iii) Chemicals used in control of diseases.
(c) Observation, listing & uses of various garden tools.
20. Preparation & after care of a Bonsai.
21. Study of different indoor plants & preparation of a "Hanging Basket"/plant grown on a "Moss-Stick".
22. Study of different ornamental plants such as annuals, perennials, shrubs, climbers, trees, cacti & succulents, hedge plants (two examples of each) with respect to botanical name, ornamental value & important features.

23. Plantation & observation of seasonal plants, their successional maintenance along with record (to be submitted at the time of examination).
24. Visit to a suitable garden to study various salient features such as lay-out, components, list of plants & special features, (if any).

Note:-Students should submit the following at the time of examination.

- a) Report of their visit to a garden.
- b) Well-maintained specimens from the following.

(any four)-

- i) Hanging basket.
- ii) Plant on moss-stick.
- iii) Grafted plant.
- iv) Plant propagated by cutting.
- v) Plant propagated by layering.
- vi) Plant propagated by budding.
- vii) Bonsai.

PAPER - VI.

PLANT PROTECTION - I&II.

Pract. No.

- 19, 20, 21. Study of the following plant diseases with reference to the causal organism, symptoms, nature of the damage done & control measures. (any nine).

- i) Powdery mildew.
- ii) Downy mildew.
- iii) Whip-smut of sugarcane.
- iv) Grain smut of Jawaar.
- v) Citrus canker.
- vi) Tikkha disease of groundnut.
- vii) Red rot of sugarcane.
- viii) Wilting of seedlings by fusarium.
- ix) Bunchy top of Banana.
- x) Yellow vein mosaic of lady's Finger.
- xi) Root knot of vegetables.
- xii) Black-arm (leaf angular-spot) disease of cotton.

- 22.(a) Preparation & application of Bordeaux mixture on diseased plants & observation of its effect.
(b) Demonstration of various chemicals used as -

Fungicides, bactericides, insecticides, viricides, weedicides, & nematicides, Application of some of some of them on the diseased plants & observation of their effects.

23. Visit to a nearby agriculture college/University to observe various methods of disease control.
24. Field trips to collect samples of diseased materials.

Note:- Students should submit at least ten diseased specimen along with the report of the field trips at the time of practical examination.

PAPER -VI. MOLECULAR BIOLOGY & BIOTECHNOLOGY.

Pract. Nos

19. DNA isolation & estimation.
20. Principle, working & uses of following instruments.
 - a) Autoclave.
 - b) Incubation chamber/Laminar air flow cabinet.
 - c) PH meter.
 - d) Colorimeter.
 - e) Centrifuge.
21. Embryo culture of sea-mays.
22. Demonstration of anther culture.
23. Mass cultivation of blue green algae.
24. Isolation of Rhizobia/Bacteroids - (demonstration)
 - from root nodules.
25. Qualitative detection of organic acid production by Fungi (A.niger)

Caco₃ dissolution/change in indicator colour.

Note:- Students are expected to visit any one of the Biotechnological Institutes or Laboratories-like,

NCL-National Chemical Laboratory - Pune.

Department of Botany & Biochemistry, University of Pune.

HA-Hindustan Antibiotics Trimpri-Pune.

BAIF-Bhartiya Agro Industrial foundation-Pune.

NBRI-National Botanical Research Institute-Lucknow.

CBT-Centres of Biotechnology at JNU Delhi.

Madurai Kamaraj University.

G.B.Pant Agricultural University - Pantnagar.

M-Phule Agriculture University-Poona.
(BGA, mushra m : rjects) etc.

PAPER - VIII (DOP.3.8) :- PRACTICAL - II. (PAPER II&IV)

PAPER - II. - ANGIOSPERM TAXONOMY, GYMNOSPERM & PALEOBOTANY.

Pract.No.

- 1-5. Study of any ten families as per theory syllabus with respect to morphological characters, systematic position with reasons, floral diagram & Floral Formula of locally available plant species.
6. Preparation of artificial key based on Androecium, Gynoecium and other morphological characters.
- 7-9. Use of flora to identify the specimens upto species level.
10. Morphological peculiarities of the following.
 - a) Inflorescence of compositae.
 - b) Gynostegium in Asclepiadaceae.
 - c) Pollinia in Asclepiadaceae.
 - d) Cuscuta-Haustoria.
 - e) Jaculator in Acanthac ae.
 - f) Stem axis in casuarina.
 - g) Orchid flower/volamen tissue.
 - h) Flower of canna & curcuma or Hedychium.
 - i) Floret of a grass & r sedge.
- 11-13. Study of life cycle of pinus with the help of slides & specimens. (chamberlain's classification)
 - i) T.S., T.L.S., R.L.S. of stem & T.S. of needle.
(double stained preparation).
 - ii) Mounting of pollen grains.
- 14-15. Study of life cycle of Gnetum with the help of slides & Specimens. (chamberlains classification).
 - i) T.S. of stem & leaf of Gnetum.
- 16-18. Study of different types of Fossils-

Impression, compression, tetrification, coal balls,
Pith casts, pseudofossils.
Study of Rhynia - (stem T.S., Sporangium).
Study of Lepidodendron (stem T.S., Lepidophyllum,

Cont

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Lepidostrobus, Lepidocarpon, Stigmaria rootlet T.S.)
Study of calamites. (-calamite pith casts, canamite stem T.S))
Annularia, calamostachys & Paleostachya
Study of cycadoida fructification.
Study of Lyginopteris oldhamia (stem T.S.)
Study of fossil Angiosperms-
Rhizopalmoxylon, Enigmocarpon & Sahnipushpam.

PAPER - IV. GENETICS & PLANT BREEDING.

19. Study of stages during mitosis in onion root tips.
(Squash preparation).
20. Study of stages during meiosis (smear preparation).
21. Extraction of DNA from cauliflower (Brassica-oleracea) or germinating seeds.
22. Hybridization techniques.
23. Compulsory visit to-Breeding station/Agriculture school, college.
 - Agriculture college, Dhule.
 - Oil seed research centre, Jalgaon.
 - Banana research centre, Jalgaon.
 - Kalyon Agro Seeds Corporation.
 - Pimpalkotha-(Erandole).

Note:-

- i) One compulsory botanical excursion of long duration to an area other than their own. (ecologically different).
- ii) At least two one-day excursions to local areas for collection of plants in different season.
- iii) Submission of record of field observations during excursions mentioned above.
- iv) Submission of atleast 15 identified herbarium sheets prepared by the candidates.

For all practicals, submissions & reports of the visits & Field trips should be duly certified by the Head of the department.

PAPER-IX (BOT.3,9) : PRACTICAL - III. (Paper - III & V)PAPER-III: ENVIRONMENTAL BOTANY, PLANT GEOGRAPHY & PLANT PHYSIOLOGY.

Pract.No.

1. To determine the minimum size of the quadrat by species area curve.
2. Study of the vegetation by list count quadrat method. Calculate the Frequency, density, abundance, % of Frequency, Frequency classes & plot a graph.
3. Study of soils with reference to soil texture, water holding capacity, F^H , tests for CO_3^- , SO_4^{2-} & NO_3^- .
4. Demonstration, working & uses of any three of the following ecological instruments-
 - i) Rain Gauze.
 - ii) Cup Anemometer.
 - iii) Hair hygrometer.
 - iv) Soil thermometer.
 - v) Minimum & maximum thermometer.
 - vi) Dry & wet bulb thermometer.
5. Estimation of O_2 & CO_2 from the water sample.
6. Extraction & separation of amino acids by ascending/ circular paper chromatography.
7. Qualitative assessment of the macroelements in plant ash. ($\text{P}, \text{K}, \text{Mg}, \text{Mn}, \text{Ca}, \text{Na}_3$).
8. Extraction & separation of leaf pigments by solvent method.
9. Extraction & separation of Anthocyanin pigments by TLC method.
10. Extraction & estimation of oils using soxhlet apparatus. (Demonstration practical).
11. Determination of RQ value of fatty & starchy seeds. (Demonstration practical).
12. Effect of synthetic Growth hormones on plants.
13. Study of lipase activity in germinating oily seeds.

PAPER - V: HORTICULTURE, ANATOMY & EMBRYOLOGY.

14. Propagation of plants by-
 - i) Cutting.
 - ii) Layering.
 - iii) Grafting.
 - iv) Budding.

- 15-17. Preparation of
 - i) Jam.
 - ii) Jelly.
 - iii) Squash.
 - iv) Ketchup.

18. Techniques of hybridization.
 - i) Emasculation.
 - ii) Collection of pollens.
 - iii) Cross pollination.
 - iv) Labelling.

19. Study of epiderman tissue system as per theory syllabus based on local available plant material.
 - a) Stomatal types -
 - i) Ranunculaceous.
 - ii) Cruciferous.
 - iii) Caryophyllaceous.
 - iv) Rubiaceous.
 - v) Gramineus.
 - b) Types of trichomes (covering all types).

20. Study of mechanical tissue system with at least one example each from root, stem & leaf.

21. Study of normal secondary growth in stem & root of woody dicot (double stained preparation).

Stem - Sunflower, Neem.
Root - Cicer.

- 22-23. Study of anomalous secondary growth in Salvadora, Bignonia, Aristolochia, Carrot, Dracaena. (double stained preparation).

24. Study of the following with the help of permanent slides:-
 - a) T.S. of microsporangium.
 - b) Types of ovules.
 - c) Capsella or any Dicot adult embryo.

25. Mounting of multiple embryos in citrus/ Gowar or any locally available material.