



**DEPARTMENT OF BOTANY
GULBARGA UNIVERSITY
GULBARGA – 585 106**

**Syllabus, Scheme of examination, pattern of question
papers for B.Sc. Botany Semester Course for the academic
year 2014-15 and onwards**

**Board of Studies in Botany
Dept. of Botany
Gulbarga University Gulbarga
2014-15**

GULBARGA UNIVERSITY, GULBARGA
B.SC BOTANY SEMESTER COURSE - SYLLABUS

SEMESTER - I	Paper 1: DIVERSITY OF MICROBES AND ALGAE
SEMESTER - II	Paper 2: MYCOLOGY, PLANT PATHOLOGY, LICHENS, BRYOPHYTES, BIOFERTILIZERS AND BIOPESTICIDES
SEMESTER - III	Paper 3: PTERIDOPHYTES, GYMNOSPERMS, PALAEOBOTANY AND PLANT ANATOMY
SEMESTER- IV	Paper 4: MORPHOLOGY AND EMBRYOLOGY OF ANGIOSPERMS
SEMESTER - V	Paper 5.1 : TAXONOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNO BOTANY
SEMESTER- V	Paper 5.2: PLANT ECOLOGY, ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY.
SEMESTER - VI	Paper 6.1 : CELL BIOLOGY GENETICS, PLANT BREEDING AND PLANT PROPOGATION
SEMESTER- VI	Paper 6.2: PLANT PHYSIOLOGY AND BIOTECHNOLOGY

Chairman, BOS (UG)
Botany

SEMESTER – I

PAPER-1: DIVERSITY OF MICROBES AND ALGAE

64 h

Microbiology: Introduction aim and scope of microbiology. General account of microbes from soil, air and water.

02 h

Viruses

08 h

1. History and Discovery- Characteristic features of Viruses,
2. Structure of TMV and Bacteriophage,
3. Multiplication of Bacteriophage by Lytic and lysogenic methods.
4. Disease caused by viruses:
 - i) Leaf curl of Papaya,
 - ii) Bunchy top of Banana

5. A brief account of viroids and prions.

Mycoplasma: A general account. Sandal spike disease.

02 h

Bacteria

12 h

1. Occurrence and, classification of bacteria based on Berger's method
2. Contribution of Leeuwenhoek. Louis Pasteur,
3. Ultra structure of Bacterial cell,
4. Chemistry of Gram positive and gram negative bacterial cell walls.
5. Reproduction in Bacteria.
6. A brief account of plasmids, Economic importance of bacteria.
7. Diseases caused by Bacteria:
 - i) Citrus canker,
 - ii) Angular leaf spot of Cotton

Cynobacteria

10 h

- A general account: Characters, occurrence, thallus organization and ultra structure of cyano- bacterial cell.
- Structure, reproduction and type study of *Scytonema*, *Anabaena* and *Spirulina*.
- Economic importance of cyano bacteria with reference to Nitrogen fixation and Single cell protein (SCP).

Algae (Phycology)

30 h

- A general account, Fritsch classification of algae, characters, habitat, thallus structure, reproduction and life cycle of
 - i} *Chlorella*,
 - ii} *Volvox*,
 - iii} *Oedogonium*,
 - iv} *Vaucheria*,
 - v} Diatoms (*Pinnularia* and Diatomaceous earth and its importance).
 - vi} *Sargassum* and
 - vii} *Polysiphonia*.

- Economic importance of Algae.

Reference Books:

- 1) Hans G. Schlegel. (1993) General Microbiology Volume I. Cambridge University Press. Cambridge.
- 2) P.D. Sharama. Microbiology and Plant pathology. Rastogi Publication Meerut.
- 3) B.P.Pandey. Plant pathology. S.Chand Publication New Delhi.
- 4) C.L.Mandahar (1978). Introduction to plant Viruses.
- 5) Mathews (1981). Plant Viruses.
- 6) F.Whitco and J.G. Turil. (1978). The Mycoplasmas-III Plant and insect Mycoplasmas.
- 7) Fritsch.F.E. (1935).The Structure and reproduction of algae. Cambridge University Press, England.
- 8) B.R. Vashishta. A Text Book of Algae, S.Chand Publication New Delhi.
- 9) V.Singh, Pandey and Jain. A Text book of Lower Botany. Rastogi Publication Meerut.

Practicals:

- 1) **Study of Microscope:** Dissection and Compound microscope its parts, how to handle microscope, uses of microscope.
- 2) **Staining techniques:** Staining technique of cyanobacteria and algae specimens using Safranin and mounting in Glycerine.etc.
- 3) **Study of viral disease in plants:** The local available viral disease plants i.e. Cajanus cajan, Papaya leaf curl disease and Banana bunchy top disease.
- 4) **Study of Rhizobium from root nodules:** Simple staining of *Rhizobium* from root nodules of any leguminous plants.
- 5) **Permanent slides of bacteria:** Study of permanent slides of bacteria i.e. *Coccus*, *Bacillus*, *Vibrio*, *Spirillum* types
- 6) **Grams staining of bacteria:** Study of *Lacto bacillus* bacteria from butter milk.
- 7) **Study of bacterial disease in plants:** The local available bacterial disease plants. ie Citrus canker, Angular leaf spot of Cotton.
- 8) **Scientist photography:** Brief history and Contribution of A. Leeuwenhoek. Louis Pasteur.
- 9) **Study of Cyanobacteria:** The available specimens and permanent slides of *Scytonema*, *Anabaena* and *Spirulina*.etc.
- 10) **Study of algae:** Study of algae structure from the available specimens and permanent slides based on theory syllabus.

11) Submissions: Every student is advised to submit any five disease specimens/algae.

Question Paper for Practical examination

Date:

Center.

Time: **3.Hrs.**

Paper-1

Max.Marks: 40

- | | | |
|-------------|--|-----------|
| I. | Stain the given material ‘A’ by positive staining using Safranin/Crystal violet, write procedure and identify with reasons. Leave the preparation for evaluation | 08 |
| II. | Prepare the temporary stained slide ‘B’ and ‘C’ sketch, label and identify with reason. Leave the preparation for evaluation. (Cyanobacteria and Algae) | 08 |
| III. | Identify the specimen ‘D’ and ‘E’ draw labeled diagram with reasons. (Viral and Bacterial disease) | 06 |
| IV. | Write critical notes on the following Slides ‘F’ ‘G’ ‘H’ and ‘I’ | 08 |
| V. | Identify the Micro slides / Photographs of scientists –‘J’ and ‘K’ | 05 |
| VI. | Records / submission. | 05 |
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Total Marks: 40

Internal practical examination: 10

Scheme for evaluation of practical papers:

I) Preparation of slide	04 marks
Procedure	02 ”
Identification with reasons (A- Bacteria)	02 ”
II) Staining and mounting (For each)	02 marks
Sketch and label (Viral and Bacterial disease)	01 mark
Identification with reasons (B&C)	01 ”
III) Identification of diseased specimen (For each)	01 mark
Labeled diagram with reasons (D & E), (Viral & Bacterial disease)	02 marks
IV) Identification of permanent slides of Algae (For each slide)	01 mark
Critical points of from (F to I)	01 ”
V) Identification of micro slide/ photograph J & K (Each)	01 mark
Reasons	1.5 marks
VI) Record book/Submission	05 marks
Total=	40 Marks

SEMESTER – II

PAPER-2: MYCOLOGY, PLANT PATHOLOGY, LICHENS, BRYOPHYTES, BIOFERTILIZERS AND BIOPESTICIDES

	64 h
Mycology	
1. General features occurrence and distribution of fungi.	02 h
2. Classification of fungi – a] Alexopolus	02 h
3. Indian Mycologist & there Significant Contributions	01 h
4. Structure and reproduction in-	12 h
• <i>Albugo, Rhizopus, Aspergillus, Puccinia</i> and <i>Cercospora</i>	
5. A brief account of Mycotoxins. Ex: Aflotoxins	02 h
6. Economic importance of Fungi.	02 h
7. Mushroom Cultivation: Spawn Production, cultivation methods of Pleurotus, [Paddy straw] polythene method Nutritional value of mushrooms.	03 h
Plant Pathology	
8. Plant Diseases: Definition; terminology, concepts of parasitism and saprophytism, Koch's postulate.	04 h
9. Symptoms, etiology (disease cycle), causal organism and control measures of the Following diseases:	12 h
• Downy mildew of Bajra	
• Wilt disease of Pigeon pea	
• Grain Smut of Sorghum	
• Red rot of Sugarcane	
10. Lichens -Habitat, types, structure and reproduction, economic importance of Lichens	03 h
11. Bryophytes	12 h
• General characteristics and classification of Bryophytes.	
• Morphological, anatomical features and reproduction in – <i>Marchantia, Anthoceros</i> and <i>Funaria</i> .	
• Evolution of Sporophyte in bryophytes.	
12. Biofertilizers and Biopesticides	
a. Definition & a brief note about biofertilizers	09 h
b. Bacterial inoculants – <i>Rhizobium</i> and its applications.	
c. <i>Nostoc</i> and <i>Anabaena</i> as biofertilizers.	
d. Mycorrhizal associations in plants and their applications.	

- e. Definition & a brief note about biopesticide.
- f. Neem and *Trichoderma* as biopesticides.

PRACTICALS:

1. Study of the fungal forms: based on theory:
Albugo, Rhizopus, Aspergillus, Puccinia, Cercospora.
2. Study of plant diseases:
 - Downy mildew of Bajra
 - Wilt disease of Pigeon pea
 - Grain smut of Sorghum
 - Red rot of Sugarcane
3. Study of Lichens: Morphology, Apothecium L S (permanent slide)
4. Study of morphology, anatomy and reproduction in :
Marchantia, Anthoceros and *Funaria*
5. Staining and demonstration of vesicles and arbuscules in mycorrhizal roots.
6. A local study trip of two days to study the live forms of fungi/ plant diseases/ bryophytes as per the syllabus.
7. *Rhizopus*: Students should culture black bread mold in the Laboratory to study asexual stages from temporary mount.
8. Every student has to submit a minimum of five specimens at the time of practical examination.

Reference Books:

1. Introduction to Mycology **Alexopolus & M.I.M.S. C. V. John** Wiley & Sons.
2. **Aneja R. R.** Experiments in Microbial Plant Pathology, Tissue Culture & Mushrooms Cultivation Wishwa Prakashan New Delhi.
3. **Dule C. H.** Fungi, Bacteria & Viruses. Agro bios, Meerut.
4. **Sharma P. D.** Microbiology & Plant Pathology Rastogi Publications Meerut.
5. Botany For degree students, Bryophytes, **B. R. Vashishta, A. K. Sinha & Kumar A. S. Chand** Publications.
6. Plant Diseases 7th Edition, **R. S. Singh** Oxford & IBH New Delhi.
7. **Agrios G.N.** Plant Pathology, Academic press 1988. San Diego, London .
8. **Alexopolus & Mims C.N.**, Introductory Mycology. Willey Eastern, New York 1983
9. **Rangaswamy G**, Disease of crop plants of India., printice Hal of India
10. Chopra R.N., Biology of Bryophytes., Willey eastern ltd., New Delhi 1988
11. **Gangulee & Kar** , College Botany Vol-II., New Central Book agency, Kolkatta 1993.
12. **Mehrotra R.S.**, Plant Pathology, Tata Mc Grew Hills, 1976.

13. **Pandey B.P.**, Text book of Algae, Fungi, R Nath & Co. Merrut.
14. **Vashista B.R.**, Bryophytes, S Chand & Co. New Delhi 1988.
15. **Watson E.V.**, Structure & life of Bryophytes, Huchinson University, London 1989.
16. **Nita Bhal**, Hand book of Mushroom, Oxford/ I B H publication, New Delhi 1988.
17. **Chang S.T & Miles P.G**, Edible mushroom & their cultivation, CRC press Bocaraton, USA
18. **Conway L.L. Powell & Joseph B.**, VA mycorrhiza, CRC press Bocaraton, USA
19. **A Verma & B Hock**, mycorrhizae, Springer/ verlag, Berlin Heidelberg
20. **Premपुरi**, Bryophytes-Morphology growth Differentiation, Atmaram & Sons., New Delhi.

Model Question Paper Pattern for practical Examination

Time: 03 hrs.

Max. Marks: 40

I.	Identify & classify giving reasons of the given specimens	12
	A. Fungi	
	B. Fungi.	
	C. Lichens.	
	D. Bryophytes.	
II.	Identify the disease of the given specimen 'E', describe the symptoms and Etiology of the causal organism.	04
III.	Micro preparation of the given material 'F' and identify giving reasons (Show the preparation to the examiner for evaluation) (as per syllabus)	04
IV.	Identify the Slides / Specimens giving reasons.	15
	G. slide – Fungi / Lichens	
	H. slide – Bryophyte.	
	I. slide / specimen – Pathology	
	J. questions regarding Biofertilisers	
	K. questions regarding Mushroom	
V.	Records and Submissions	05
	Total -	40
	Internal Assessment -	10

Scheme for evaluation of practical papers:

1)	Identification of specimens (for each),	01 mark
	Reasons	02 marks
2)	Identification (For each)	01 mark
	Name the casual organism	01 ”
	Symptoms of Disease	02 marks
3)	Preparations of Biofertilizer	01 mark
	Identification	01 ”
	Reasons	02 marks
4)	Identifications (for each)	01 mark
	Reasons	02 marks
5)	Record book/Submission	05 ”

SEMESTER –III

PAPER-3: PTERIDOPHYTES, GYMNOSPERMS, PALAEOBOTANY AND PLANT ANATOMY

Pteridophytes	64 h
1. General Characteristics features of Pteridophytes	01 h
2. Classification of Pteridophytes (Smith 1955)	01 h
3. Morphology, Anatomy and Reproduction of the following types	15 h
i) <i>Lycopodium</i>	
ii) <i>Selaginella</i>	
iii) <i>Equisetum</i> ,	
iv) <i>Marsilea</i> and	
v) <i>Nephrolepis</i>	
Gymnosperms	
1. General account of Gymnosperms	01 h
2. Classification of Gymnosperms (Gangulee 1968)	01 h
3. Morphology, Anatomy and Reproduction of the following types	09 h
i) <i>Cycas</i> , ii) <i>Pinus</i> iii) <i>Gnetum</i>	
4. Economic importance of Gymnosperms	01 h
Paleobotany	
1. Brief account of Geological time scale	01 h
2. Types and process of fossilisation and coal formation	02 h
3. Contribution of Birbal Sahani (Father of Indian Paleobotany) to the field of Paleobotany	01 h
4. Brief study of fossil plants: <i>Rhynia</i> , <i>Calamites</i>	04 h
Anatomy of Angiosperms (Plant Histology)	
1. Meristems: Histogen theory, Tunica Carpus theory	03 h
2. Brief account of Simple and complex permanent tissues	03 h
3. Tissue system in plants: Epidermal (trichomes and types of stomata), Ground and Vascular tissue system, types of vascular bundles	05 h
4. Anatomy of Dicot: Stem, Root and Leaf (Sunflower)	03 h
5. Anatomy of Monocot: Stem, Root and Leaf (Grass)	03 h
6. Secondary growth: Concept nature of Secondary growth	01 h
a. Normal secondary growth in Dicot Stem (Stelar and extra stellar)	04 h
b. Anomalous secondary growth: Concept & importance	01 h
c. Anomalous secondary growth in 1. <i>Boerhavia</i> , 2. <i>Achyranthus</i>	04 h

PRACTICALS:

Pteridophytes

1. Preparation of stain : Aqueous and alcoholic (Safranin and fast green)
2. Critical study of Morphological, anatomical and reproductive structures in
 - i) *Lycopodium*
 - ii) *Selaginella*
 - iii) *Equisetum*,
 - iv) *Marsilea*
 - v) *Nephrolepis*

Gymnosperms

1. Critical study of Morphological, anatomical and reproductive structures in
 - i. Cycas (Corolloid root, T.S. of leaflet, Male cone and female cone)
 - ii. Pinus (T.S. of needle, and L.S. of male cone and female cone, seed)
 - iii. Gnetum (T.S. of Stem & Leaf, L.S of male cone and female cone, ovule and seed)

Paleobotany

1. Study of Fossil specimens: i) *Rhynia* ii) *Calamites*

Plant Histology and Plant Anatomy

1. Study of permanent tissues (fresh mount/permanent slides)
2. Maceration technique: Observation of tissues and types of sclereids and vessels
3. Microscopic studies on: Stomata (Monocot and dicot) and epidermal hairs (Tridax/Vinca/Tomato)
4. Anatomical study of following by making double stained temporary slides
 - i) Anatomy of Young Dicot stem : T.S. of Sunflower
 - ii) Anatomy of Young Dicot root : T.S. of Sunflower
 - iii) Anatomy of Monocot Stem : T.S. of Grass/Maize
 - iv) Anatomy of Monocot Root : T.S. of Grass/Maize
 - v) Anatomy of Dicot Leaf : T.S. of Sunflower/Bengal gram
 - vi) Anatomy of Monocot Leaf : T.S. of Grass/Maize
 - vii) Anatomical studies of anomalous secondary structures by making double stained temporary/permanent slides in the following
 - a) T.S. of Stem of *Boerhavia*.
 - b) T.S. of stem *Achyranthus*

References:

1. Pteridophyta, Gymnosperm & Paleobotany, **Singh, Pandey & Jain**, Rastogi Publication, Meerut.
2. College Botany, Vol. II, **S. Sundarajan**, Himalaya Publishing house, New Delhi.
3. Text Book of Pteridophytes **D. P. Sharma** Macmillan India Ltd. New Delhi.
4. Introduction to Pteridophytes by **Sunder Rajan** New Age International Publishers,

New Delhi.

5. Text Book of Gymnosperms, **Shreevasthav H. N., S. Chand** New Delhi.
6. Gymnosperms, **Vashishta P. C., S. Chand Co. Ltd.** New Delhi.
7. Essentials of Paleobotany, **Mishra S. P. & Shulkla A. C.** Vikas Publishing House New Delhi.
8. Plant Anatomy 2nd Edition. **Esau K.** Wiley Eastern New Delhi.
9. Anatomy of Angiosperms **Sen D. N.** Nagini & Co.
10. Plant Anatomy **P. C. Vashishta Pradeep** Publications Jalandhar.

Model Question Paper Pattern for practical Examination

Time : 03 hrs.

Max. Marks: 40

1.	Identify & classify giving specimens giving reasons A. (Pteridophyte); B. (Pteridophyte); C. (Gymnosperm)	06
2.	Describe the anatomy of Specimens D (Pteridophyte); E (Gymnosperm)	08
3.	Identify and comment on the slides F (Pteridophyte), G (Gymnosperm), H (Pteridophyte), I (Fossil), J (Anatomy)	10
4.	Prepare a temporary safranin stained T.S. of material 'K' and identify with Reasons leave the preparation for observation/valuation	08
5.	Macerate/Mount the specimen 'L' identify any two types of elements (cells with Labeled sketches and give reasons/type of stomata/trichomes	03
6.	Records/Submission	05
Total -		40
Internal Assessment -		10

Scheme of Evaluation

1) Identification of specimen (For each)	01 mark
Reasons (C, D, & E),	01 “
2) Identification, Labeled sketch (For each)	02 marks
Critical points (F & G)	02 ”
3) Identification of micro slides of H, I, J, K &L. (Each)	01 mark
Reasons	01 ”
4) Preparation of slide	04 marks
Sketch and Label	02 ”
Identification with reasons (K-Stem)	02 ”
5) Staining and mounting	02 marks
Sketch and label (L)	01 mark
6) Record book/Submission	05 marks

SEMESTER- IV

PAPER –4: MORPHOLOGY AND EMBRYOLOGY OF ANGIOSPERMS

Morphology of Angiosperms 64h

1. **Morphology:** Dicot and Monocot plant, Habit: Herbs, Shrubs, Trees, 2 h
2. **Root :** Characteristics, functions and types (Tap root and Adventitious root)
Root modifications: for storage, support & vital functions (photosynthetic, respiratory, haustorial & epiphytic) 5 h
3. **Stem:** Characteristics and functions, types. Stem modification: Underground, Subaerial and Aerial modifications 4 h
4. **Leaf:** Structure , phyllotaxy, simple and compound leaves (types), Stipules: types with example. Leaf modification in Insectivorous plants: (*Drosera*, *Utricularia* and *Nepenthes*) 6 h
5. **Inflorescence:** Racemose, Cymose and Special types with examples. 4 h
6. **Flower :** Structure of a typical flower: 6 h
 - i. Bracts and Bractioles
 - ii. Calyx
 - iii. Corolla
 - iv. Androecium
 - v. Gynoecium
7. **Fruit:** Structure and Classification: Simple, Aggregate and Composite fruits 4 h
8. **Seed:** Structure of Dicot and monocot seeds. Albuminous and exalbuminous seeds with examples.

Embryology of Angiosperms:

- 1) **Introduction:** General account on Plant embryology 1 h
- 2) **Indian Embryologists:** B.G.L. Swamy, P. Maheshwari, brief history and contribution. 1 h
- 3) **Anther Development:** Microsporogenesis: Male gametophyte, types and role of Tapetum, Ubisch bodies, Pollen kit, concept of Male Germ unit (MGU) 4 h
- 4) **Palynology:** General account on Pollen morphology (pollen characters) and its role in taxonomy. 2 h
- 5) **Ovule Development:** Megasporogenesis: Female gametophyte- Structure and nutrition of mature embryo sac (Polygonum type). 4 h
- 6) **Types of Embryosacs:** Monosporic (Polygonumj) Bisporic (Allium) and Tetrasporic (Adoxa). 2 h
- 7) **Types of Ovule:** Orthotropous, Anatropous, Hemiantropous, Amphitropous, Camphyllotropous, and Circinotropous. 2 h
- 8) **Pollination:** Self and Cross Pollination and adaptations for cross pollinations. Contrivances for self and cross pollinations: Pollen-pistill interactions (brief) 4 h
- 9) **Fertilization:** Double fertilization and Triple fusion, Porogamy, Chalazogamy and Mesogamy. 3 h
- 10) **Endosperm:** Formation and its development and types (Cellular, Helobial and Free nuclear) 3 h

11) Structure of Dicot Embryo: development (Cruciform).	2 h
12) General account on: Polyembryony, Apomixis and Parthenocarpy.	3 h

References Books:

- 1) Bhojwani S S. & Bhatnagar S P.(2006) The Embryology of Angiosperms. Vikas publishing House Pvt. Ltd. New Delhi-110014
- 2) Pandey B P.(2007). Embryology of Angiosperms. S.Chand Publication New Delhi.
- 3) V.Singh, Pandey and Jain. Embryology of Angiosperms. Rastogi Publication Meerut.
- 4) Datta A.C (2006) Botany for Degree Students, Revised Oxford University Press
- 5) Gangulee & Kar (1993) College Botany. New Central Agencies Kolkata.
- 6) Sundarajan.S. (2007) College Botany Vol III Himalaya Publishing House. New Delhi.

PRACTICALS

Morphology:

1. Study of Monocot and Dicot plants
2. Vegetative and Floral Morphology: Specimens of Morphological interests based on theory (Root, stem, leaf, inflorescence, flower, fruit and seeds).

Embryology:

1. Study of Anther: Microsporogenesis (Permanent Slides)
2. Study of Ovule: Megasporogenesis/Female gametophyte (Permanent slides)
3. Mounting of Pollen grains (available flowers) Vinca, Legumes, Hibiscus
4. Types of Placentation (Permanent slides)
5. Endosperm Mounting: Cucumis/Croton/Tridax
6. Pollen Germination: By "Hanging Drop Method"
7. Study of embryo development: Heart shaped and mature dicot embryo (permanent slides)
8. Study of embryo of any monocot (Live specimens and permanent slides)
9. Palynological technique: (Woodhouse Acetolysis) observation of exine ornamentation.

Question Paper for Practical examination

Date:

Time: **3h.**

Center:

Max.Marks: **40**

I). Mount the endosperm/embryo of 'A'. Sketch and label the parts and leave the preparation for evaluation.	8
II) Mount/Take the T.S. of the given material 'B'. (Pollen grains,/pollenia,/ placentation.) Sketch and label the parts and leave the preparation for evaluation	6
III) Describe the micro slides of embryology 'C & D' with reasons	8
IV) Identify and describe the specimens E, F, G, H (Morphology)	8
V) Describe the specimen 'I' (in technical terms)	5
VI) Records and submissions	5
Total Marks:	40
Internal Assessment-	10

Scheme for evaluation of practical papers:

I) Preparation of slide 'A'	03 Marks
Sketch and Label	02 "
Identification with reasons	03 "
II) Mounting/ Taking section 'B'	03 marks
Sketch and label	03 "
III) Identification of Slide (For each)	01 mark
With reasons C & D (Embryology)	03 marks
IV) Identification of specimen, E, F, G, H. (Morphology) (Each)	01 mark
Description	01 "
V) Given specimen 'I' (Technical terms From Root to Fruits)	05 marks
VI) Record book/Submission	05 marks

Total= 40 Marks
Internal practical- 10 Marks

SEMESTER V

PAPER-5.1: TAXONOMY OF ANGIOSPERMS, ECONOMIC BOTANY AND ETHNO BOTANY

64 h

Taxonomy of Angiosperms

1. Characteristic of Angiosperms: and brief History 01 h
2. Scope and importance of Plant Taxonomy 01 h
3. Botanical nomenclature: Binomial Systems, Brief Outline of IUCN (Principles, Rules, Taxonomic ranks, type concept, principles and rules of priority) 04 h
4. Salient features Plant Classification: Bentham and Hooker, Engler and Prantle, Linnaeus Systems, Merits and Demerits of these systems. 05 h
5. Brief account of Angiosperm Phylogeny Group 01 h
6. Sources of Taxonomic Evidences: 04 h
 - i) Chemotaxonomy as sources of taxonomic Characters.
 - ii) Palynotaxonomy
 - iii) Botanical & Numerical taxonomy
7. Botanical Gardens: Concept and importance: Botanical Gardens of India and world 02 h
8. Herbarium: Herbarium techniques, importance of herbarium, centers of herbarium 02 h
9. Floras: Study of flora and their importance. 02 h
10. Critical study of flowering plants as illustrated by following families: 20 h

DICOTYLEDONS: A) **Polypetalae:** Brassicaceae (Cruciferae), Malvaceae, Rutaceae, Leguminosae (sub families: papilionaceae, Caesalpinaceae, Mimosae), Cucurbitaceae, Apiaceae

B) **Gamopetalae:** Rubiaceae, Asteraceae, Asclepiadiaceae, Solanaceae, Acanthaceae, Lamiaceae

C) **Apetalae:** Amaranthaceae, Euphorbiaceae

MONOCOTYLEDONS: Liliaceae, Arecaceae, Poaceae

Economic Botany: Introduction:

15 h

Economic Importance: (Mention botanical names, Family, part used and uses)

- i) **Millets & Cereals:** Brief Account of Millets, Role of Millets in food
Fox Tail Millet (Navane), Little Millet (Saame) & Bajra (Pearl millet), Sorghum:
- ii) **Pulses:** Pigeon Pea, Bengal Gram, Black Gram and Green Gram.
- iii) **Fibre Yielding Plants:** Cotton, Jute, Coir, Deccan Hemp and Agave.
- iv) **Spices:** Cardamom, Clove, Cinnamomum, Pepper, Coriander & Mustard.
- v) **Timber:** Teak & Rose Wood.
- vi) **Pepper & Pulp:** Bamboo & Eucalyptus.
- vii) **Narcotic Plants:** *Cannabis sativa* & *Papaver somniferum*.
- viii) **Medicinal & Aromatic Plants:** *Rauwolfia*, (Sarpa gandha), *Withania*, (Ashwagandha) *Azadirachta* (Neem) & *Aloe* (kumari) Symbopogon (Lemongrass),

Mentha (mint).

ix) **Masticatories & Fumitories:** Tobacco & health Hazards.

x) Biofuels: Jatropa & Pongamia

xi) Oil yielding Plants: Groundnut & Sunflower

Ethnobotany: Introduction, Definition, concept and importance in the field of medicine used in daily life. 03 h

Pharmacognosy: Introduction, principles, and significance. 02 h

1. *Hemidesmus, indicus* (sogade beru)

2. *Tribulus terrestris* (neggin mullu)

Floriculture: Introduction, significance and role in economy and trade 02 h

PRACTICALS:

1. Systematic study of plants, families based on local flora (1 or 2 plants from each family) using flora
2. Herbarium Technique:
3. Economic botany of the specimens based on theory
4. Floriculture based on theory (Visit to field)
5. Identification of selected Taxa using taxonomic key's
6. Pharmacognosy: study of raw drugs (submission of report)
7. Submission of five herbariums of different flowering plants
8. Visit to nearby forests/Botanical Gardens (submission of reports)
9. Botanical Study tour is compulsory

References:

- | | | |
|-------------------------------|--|---|
| 1. Bender & Kumar | Economic Botany | Restogi Publication Meerut. |
| 2. Singh & Jain | Taxonomy of Angiosperm | Restogi Publication Meerut. |
| 3. Saxena & Saxena | Plant Taxonomy | Restogi Publication Meerut. |
| 4. C.D. Patil | Susthira Abhiruddhigaagi Jeevi
Vaividya | Karnataka Vijyana Parishattu,
Bangaluru (written in Kannada) |

Model Question Paper Pattern for practical Examination

Time : 03 hrs.

Max. Marks: 40

1. Assign the plants A,B,C,D to their respective Families giving important Characters 16
2. Give the Floral Formula and Diagram of Specimen E 04
3. Identify and mention the Economic Importance of Specimens F,G & H 09
4. Explain Pharmocognsy Technique 06
5. Records and submissions 05

Total - 40

Internal Assessment - 10

Scheme of Evaluation

I.	Identification and classification	02 Marks		
	Important distinguishing character	02 Marks	4 x 4	= 16 Marks
II.	Floral Formulae + Diagram	2 + 2		= 04 Marks
III.	Botanical Name	01 Mark		
	Part of Economic Importance	01 Mark	3 x 3	= 09 Marks
	Uses	01 Mark		
IV.	Pharmacognosy Technique (each)	06 Marks		= 06 Marks
V.	Records/Submission	05 Marks		= 05 Marks
			Total	= 40
			Internal Assessment	= 10

SEMESTER –V

PAPER-5.2: PLANT ECOLOGY, ENVIRONMENTAL BIOLOGY AND PHYTOGEOGRAPHY.

Plant Ecology	64 h
1. Basic concept of plant ecology & Scope	
2. Concept and components of Ecosystem: Types of ecosystem, food chains & food web. Tropic organisation, Ecological pyramids	05 h
3. Energy flow models	02 h
4. Preliminary idea on: Habitat and Niche, Ecotone and edge–effect, Microclimate, Ecads, ecotype and ecoclines,	02 h
5. Plant process of succession: Xerosere, Hydrosere, Climax concept.	03 h
6. Ecological Adaptations in plants: Hydrophytes, xerophytes, Halophytes, Epiphytes, Parasitic angiosperm	10h
7. Soil profile: Role of Climate in soil development.	02h
Environmental Biology	
1. Introduction: Dynamics of environment and interaction among various environmental factors	02 h
2. Geological Information System (GIS) and Remote Sensing and its application in resource identification (Agriculture & water management)	02h
3. Intellectual property rights.	02 h
4. Biodiversity: Definition, current concept and status in India. Types of biodiversity, Keystone species, Hot spots, Endemic species, Endangered species, Red Data Book.	08h
5. Activities of NEERI, IUCN, WWF, CPCB & BNHS.	02h
6. Brief account of global warming.	01h
Phytogeography	
1 . Definition scope and importance of Phytogeography.	
2. Major Plant communities:	
i) Aquatic: Fresh water, Marine, Easturian communities	
ii) Terrestrial: Grassland, Desert forest	
iii) Forest communities: Tropical rain forests, Tropical deciduous forest,	12h
3. Floristic Regions of India (Botanical regions)	02h
4. Biosphere Resources.	02h
5. Ex situ & In situ Conservation, National park, wild life sanctuaries	02h
6. Cryopreservation: Seed Bank & Gene Bank	01h
7. Vegetation of Karnataka with spl. Ref. to Hyderabad Karnataka Region.	02h
8. Sacred groove: Introduction, concept, significances of sacred grooves and threats to sacred groves	02 h

PRACTICALS

1. Study of structure of plant community by determining frequency, density and abundance by quadrat method
2. Morphological & Anatomical adaptation of Hydrophytes, Xerophytes, halophytes & epiphytes.
3. Study of pH of Soil & water.
4. Ecological Instruments
 - a) Anemometer
 - b) Rain gauge
 - c) Maximum & Minimum Thermometer
 - d) Dry & wet Bulb Thermometer
 - e) Hygrometer
 - f) Soil thermometer
5. Identification of Endangered & Endemic species.
(Photographs)
6. Air Sampling to determine Air born pollen grains & fungal spores.
7. Every student has to undertake the compulsory trip at least for 4 days to study vegetation & submit report.
8. Project work.

References:

- | | | |
|--|--|--|
| 1. Agarwal K.C | Biodiversity | Agro Botanical Publishers |
| 2. Ambasht R.S | Text Book of Plant Ecology | Students Friends Company, Varanasi |
| 3. Ashby M. | Introduction to Plant Ecology | McMillan Co. Ltd. New York |
| 4. Bharucha F.R. | A text Book of Plant Geography | Oxford University Press, India |
| 5. P.K. Gupta | Methods in Environmental Analysis- Water, Soil and Air Ecology, Environmental and Pollution. | Agro Bios Publication, Jodhpur |
| 6. S.S. Purohit and R.R. Ranjan | Air Environment and Pollution | Agro Bios (India), Jodhpur |
| 7. S.S. Purohit | Diversity in Plant Speciation | Agro Bios (India), Jodhpur |
| 8. Grant | Plant Ecology | Columbia University Press |
| 9. Kocher P.L. | Ecology | Rattan Prakashan, Mandir, Delhi Gate, Agra |
| 10. Paul Kollinvaux | Pollution and Biomonitoring | John Wiley Sons, New York |
| 11. Rana B C | Elements of Ecology | Tata McGraw Hill, Pub. Co. Ltd New Delhi. |
| 12. Sharma P A | Propagation of Horticultural Plants | Rastogi Publication, Meerut |
| 13. Adrianc and Brison | Plant propagation, Principals | Tata McGraw Hill, Pub. Co. Ltd. New Delhi |
| 14. Hartman H.T. | | Prarnice Hall India Pvt. Ltd. |

- | | | | |
|-----|---|---|------------------------------|
| | D E Kaster | and practices | |
| 15. | Rana R S
R K Saxena
S Saxena
V Mittal | Conservation and
management of plant genetic
resources | NBPGR, PUSA, New Delhi |
| 16. | Rana R.S
Bhag Sing
M N Koppal
Mathura Rai
S kochar &
S S Dahoor | Plant Genetic Resources
Exploration Evaluation
Maintenance | NBPGR, PUSA, New Delhi |
| 17. | Rana R S and
Other | Plant Genetic Resources
<i>Ex. Situ</i> conservation | NBPGR, PUSA, New Delhi |
| 18. | O P Sharma
(2001) | Experiment and Techniques
in Microbiology, Ecology
and Soil Science, pollution,
Bio-Chemistry, Plant
Physiology | Pragati Prakashan, Meerut |
| 19. | S C Santra (1999)
T P Chatterji
A P Das | College Botany, Practical
Vol. I | Central Book Agency, Kolkata |
| 20. | P D Sharma | Environmental Biology | Rastogi Publication, Meerut |
| 21. | R S Shukla &
Chandel | Plant Ecology & Soil Science | S. Chand & Co., New Delhi |
| 22. | P D Sharma | Ecology & Environment | Rastogi Publication, Meerut |
| 23. | For giving minor project assignments, the booklet written by C.D. Patil on “ <i>parisara chatuvatikegalu</i> ” Published by Belgaum Association of Science Education, Belgaum may also be referred. | | |

Model Question Paper Pattern for practical Examination

Time : 03 hrs.

Max. Marks: 40

- | | |
|--|----|
| 1. Identify and assign the plant to respective ecological group with neat labeled
Diagrams giving reasons. ‘A’ (Morphological and anatomical) | 10 |
| 2. Analysis comment on sample of water/soil/air for its biological contamination ‘B’ | 10 |
| 3. Identify endangered & endemic sps. (photographs) | 05 |
| 4. Identify and comment the gives slides/Materials/Instrument | 10 |
| ‘D’ Ecological slides | |
| ‘E’ Ecological slides | |
| ‘F’ Ecological Instrument | |
| ‘G’ Ecological Instrument | |
| 5. Records and Submission | 05 |

Total- 40
Internal Assessment - 10

Scheme of Evaluation

- | | | |
|-----|------------------------------------|----------|
| I. | Identification | 01 Mark |
| | Morphological adaptations & Sketch | 04 Marks |
| | Anatomical peculiarities & Sketch | 05 Marks |
| II. | Analysis | 04 Marks |

	Procedure	02 Marks
	Results	02 Marks
III.	Plant – Preparation	03 Marks
	Advantages	02 Marks
IV.	Each Specimen	02.5 Marks

SEMESTER –VI

PAPER- 6.1: CELL BIOLOGY GENETICS, PLANT BREEDING AND PLANT PROPOGATION

Cell Biology	64 hrs
1. Introduction- Scope of cytology and molecular biology	02 h
2. Comparative study- Prokaryotic and Eukaryotic cell	01 h
3. Ultra structure and functions of Plant Cell and organelles	07 h
i) Cell wall, Plasmodesmata- ultra structure, (Chemical composition, Functions)	
ii) Cell Membrane (Models of Cell membranes)	
iii) Endoplasmic Reticulum	
iv) Nucleus & Nucleolus	
v) Golgi complex	
vi) Nucleic Acids:	05 h
a. DNA (Structure, Chemical composition, models and functions)	
b. RNA (Structure Chemical Composition and types)	
c. DNA Replication: Conservative, semi conservative and dispersive	
4. Chromosomes: Structure, types and function. Ultra structure of Chromosome Karyotype & ideogram	03 h
5. Giant Chromosomes: Salivary gland and Lamp brush chromosomes	02 h
6. Process of Mitosis & Meiosis and its significance	04 h
7. Chromosomal Aberrations:	06 h
i) Deletion	
ii) Duplication	
iii) Translocation	
iv) Inversion	
v) Numerical variations: Euploidy and Aneuploidy.	
Genetics	
1. Introduction: Mendel's laws of inheritance: Law of dominance, law of segregation, law of independent assortment	05 h
2. Test Cross and Back cross	01 h
3. Interaction of genes: Incomplete dominance, Complementary genes (flower color in sweet pea) Supplementary genes, (coat color in pearl millet) duplicate, Epistatic genes (fruit color in summer squash).	04 h
4. Polygenic inheritance : Ear size in maize	01 h
5. Multiples alleles – Ex. Coat Colour in Rabbit	01 h
6. Sex determination:	03 h
i) Chromosome theory of sex determination (XX-XY <i>Drosophila</i> and <i>Melandrium</i>)	
ii) Sex linked inheritance: Eye color in <i>Drosophila</i>	
7. Linkage and Crossing over: Example Maize (Coupling and repulsion)	02 h
8. Cytoplasmic inheritance: plastid inheritance in <i>Mirabilis</i>	01 h
9. Cytoplasmic male sterility in <i>maize</i>	01 h

- | | |
|--|------|
| 10. Mutations: Spontaneous and induced mutations and their significance. | 02 h |
| 11. Genetic Code: Meaning and properties | 02 h |
| 12. Protein synthesis | 03 h |

Plant Breeding 05 h

1. Introduction, Aims and objectives of plant breeding, Principles and methods of plant breeding.
2. Methods of hybridization: Intra specific, inter specific and inter generic.
3. Hybrid seed production.
4. Plant Breeding centres in India and their significant contributions.

Biostatistics: 03 h

- i. Mean, Mode and Median
- ii. Measures of Variation, Standard deviation, Standard error and Correlation Regression.
- iii. Chi-Square analysis.

PRACTICALS

Cell Biology

1. To conduct the microchemical test for Cellulose, lignin, Protein (Procedure), Cystoliths and Raphides
2. Study of dimorphic chloroplast in Euphorbia hirta/C4 plant(sugarcane)
3. Study of cell division: Mitosis in Onion root tips (Squash method)
4. Study of Cell division: Meiosis in Onion flower buds/Rheo discolor (Smear method)
5. Cytological technique of making permanent slides

Genetics

6. Genetics problems based on theory syllabus- Monohybrid, Di hybrid and Interaction of factors

Plant Breeding

7. Practice of hybridization technique in a self pollinated and cross pollinated plant-Maize

References:

- | | | | |
|----|---------------------------|---|-----------------------------------|
| 1. | P K Gupta | Genetics | Rastogi Publications, Meerut |
| 2. | S Sundarajan | College Botany Vol. IV | Himalaya Publishing House, Mumbai |
| 3. | P K Gupta | Cytogenetics | Rastogi Publications, Meerut |
| 4. | P K Gupta | Cytology, Genetics & Evolution | Rastogi Publications, Meerut |
| 5. | Singh & Tomeir | Cell Biology | Rastogi Publications, Meerut |
| 6. | P K Gupta | A text book of Cell & Molecular Biology | Rastogi Publications, Meerut |
| 7. | Satguru Prasad | Elements of Biostatistics | Rastogi Publications, Meerut |

Model Question Paper Pattern for practical Examination

Time: 03 hrs.

Max. Marks: 40

1. Make a squash preparation of specimen 'A'. identify, Sketch and label any two stages 10
and show the preparation to the examiner.
2. Make a smear preparation of specimen 'B'. Identify, Sketch and label two stages. 10
Show the preparation to the examiner
3. Conduct a microchemical test in specimen 'C' an identify the cell inclusions 03
(Cellulose, Lignin, Starch, Protein, Cystoliths/Raphides)
4. Make a cytological preparation of specimen 'D' to observe the dimorphic chloroplast 04
Sketch, label and show the preparation to the examiner
5. Solve the given genetic problems 'E' 04
6. Demonstrate the technique of hybridization in specimen 'F' 04
7. Records and Submission 05

Total- 40

Internal Assessment - 10

Scheme of Evaluation

I.	Mitosis - Preparation	05 Marks
	Identification Sketch & Label	05 Marks
II.	Mitosis - Preparation	05 Marks
	Identification Sketch & Label	05 Marks
III.	Test and Identification	03 Marks
IV.	Chloroplast – Preparation	02 Marks
	Sketch and label	02 Marks
V.	Genetic Problem	04 Marks
VI.	Demonstration of the Technique	04 Marks
VIII	Record and Submission	05 Marks

SEMESTER –VI

PAPER-6.2: PLANT PHYSIOLOGY AND BIOTECHNOLOGY

64 hrs

Plant Physiology

- 1. Introduction** to Plant physiology **01h**
- 2. Plant water relation** and importance of water to plant life **01h**
- 3. Physical processes** of water absorption: Imbibitions, diffusion, osmosis, plasmolysis, water potential, DPD, osmotic potential, pressure potential, TP and WP **02 h**
- 4. Absorption of water:** Mechanism of water absorption, Active absorption, Passive absorption, factor affecting water absorption **03 h**
- 5. Ascent of Sap:** Meaning, mechanism and theories; vital theory, pulsatory and Root pressure, physical theory, Transpiration pull theory. **03 h**
- 6. Transpiration:** Definition, types, structure of stomatal apparatus. Mechanism of opening and closing of stomata, theories, starch sugar inter conversion, Active proton or (K+) transport concept. Factors affecting the process of transpiration (external and internal). Significance of transpiration. anti transpirants Guttation: Definition, hydathods. **06 h**
- 7. Mineral nutrients:** Micro and macro nutrients, role of N₂, Ph, K, Su, Fe, Zn, Mn in plant metabolism **02h**
- 8. Mineral absorption:** **03 h**
 - i. Passive absorption, Donnan's equilibrium
 - ii. Active absorption: Carrier concept
- 9. Photosynthesis:** Introduction, structure of chloroplast, quantasomes, pigment system, mechanism of photosynthesis-light reaction, cyclic and non cyclic photophosorylation. Dark reaction: C₃, C₄ cycles CAM. Photorespiration. Factors affecting photosynthesis, law of limiting factors. **09h**
- 10. Respiration:** Definition, structure of mitochondria. Types of respiration: Aerobic and Anaerobic: Aerobic: mechanism, Glycolysis, Kreb's cycle and Terminal oxidation. Anaerobic: Alcoholic fermentation, factors affecting respiration. ATP formation mitochondrial hypothesis **09 h**
- 11. Translocation of organic solutes:** Munch's Mass flow hypothesis **02 h**
- 12. Growth Hormones:** Phytohormones definition and concept and role in growth: Auxins, Gibberellins, Cytokinins, ethylene, ABA. **06h**
- 13. Photoperiodism and vernalisation:** Introduction, types of plants (Short day, long day and day neutral plants). Importance of photoperiodism. Vernalisation: Introduction and mechanism **04h**

- 14. Stress Physiology:** Introduction brief account on Biotic stress in plants Salt stress and salt resistance in plants. **02 h**
- 15. Seed Dormancy:** Meaning, mechanism of breaking seed dormancy. **02h**
- 16. Physiology of fruits Ripening:** Physiological & Biochemical Changes. **01h**

Plant Biotechnology **08 h**

- a. Introduction and scope of Plant Biotechnology.
- b. Recombinant DNA technology
- c. Tools of Genetic Engineering
- d. Plasmids: PBR-322
- e. Transgenic plants: Ex, BT-Cotton, Golden Rice
- f. Plant Tissue culture

PRACTICALS

Plant Physiology

1. **Osmosis:** Endosmosis & Exmosis
2. **Plasmolysis** and Deplasmolysis (in Rheo Leaf)
3. **Absorption of Water:** To show passive absorption by showing relationship between absorpton and transpiration.
4. **Ascent of Sap:** i) Balsam plant experiment
ii) To show suction due to transpiration
5. **Transpiration:**
 - i) Experiment to show transpiration by polythe bag
 - ii) Ganaongs photometer
 - i) Four leaf and CoCl_2 methods
 - ii) Guttation to be observed
6. **Photosynthesis:**
 - i) Evolution of oxygen
 - ii) Efect of quality of light on photosynthesis
 - iii) Light is essential for photosynthesis
 - iv) Effect of CO_2 concentration on photosynthesis
 - iii) CO_2 is essential for photosynthesis
 - iv) Chromatography: Paper chromatography
 - v) Rate of Photo synthesis under varying HCO_3^- Contamination in an aquatic plant using bicarbonates & to find out the optimum & toxic concentration.
7. **Respiration:**
 - I) Aerobic Respiratiaon- Evolution of CO_2
 - II) Anerobic respiration: Kunhe's apparatus
 - III) Release of heat during respiration
 - IV) Measurement of RQ comparison
8. **Grwoth:** Arc Auxonometer
9. **Plant growth movements:**
 - i) Phototropism
 - ii) Geotropism
 - iii) Hydrotropism
 - iv) Thigmotropism

- v) Bolting experiment/Avena coleoptiles bioassay.

10. Biotechnology

1. Plant Tissue culture
2. DNA Isolation from Coconut endosperm

References:

- | | | | |
|----|---------------------|------------------------------------|------------------------------|
| 1. | P K Gupta | Elements of Biotechnology | Rastogi Publications, Meerut |
| 2. | V K Jain | Fundamental of Plant
Physiology | S. Chand & Co. New Delhi |
| 3. | P S Gill | Plant Physiology | S. Chand & Co. New Delhi |
| 4. | H Srivastava | Plant Physiology | S. Chand & Co. New Delhi |

Model Question Paper Pattern for practical Examination

Time : 03 hrs.

Max. Marks: 40

- | | | |
|----|--|-----------|
| 1. | Perform the Physiology expt. 'A' record your observation and show to examiner
(major expt.) | 08 |
| 2. | Perform the Physiology expt. 'B' record your observation and show to examiner
(major expt.) | 08 |
| 3. | Demonstrate the experiment and write protocol on C (Questions on Biotechnology) | 06 |
| 4. | Identify and comment on (Physiology) 'D', 'E', 'F' and 'G'
(Biotechnology) 'H' and 'I' | 08
04 |
| 5. | Submission of Records | 06 |
| | Total - | 40 |
| | Internal Assessment - | 10 |

Scheme of Evaluation

- | | | | |
|------|------------------------|------------------------------------|----------------|
| I. | Physiology | - Principle, Procedure and Diagram | 05 Marks |
| | | - Setting of the experiment | 03 Marks |
| II. | Physiology | - Principle, Procedure and Diagram | 05 Marks |
| | | - Setting of the experiment | 03 Marks |
| III. | Demonstration | | 03 Marks |
| | Procedure writing | | 03 Marks |
| IV. | Identification | | 01 Mark (Each) |
| | Comment | | 01 Mark |
| V. | Records and Submission | | 06 Marks |

Theory Question Paper Pattern

Time: 03 Hours

Max Marks : 80

Instructions to the Candidate:

1. Answer all questions.
2. Diagram will enhance the value of answers

I. Answer any TEN from the following in two or more sentences 10 x 2 = 20

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

II. Answer any FOUR of the following questions. 4 x 5 = 20

- 13.
- 14.
- 15.
- 16.
- 17.
- 18.

III. Answer any FOUR of the following questions. 4 x 10 = 40

- 19.
- 20.
- 21.
- 22.
- 23.
- 24.

Model Theory Question Paper

Question paper for Internal assessment

1) One mark questions	5 (Answer all questions)
2) Five mark questions	2 (Answer any one question)
3) Ten mark questions	2 (Answer any one question)
4) Total =	20 Marks

**Chairman, BOS (UG)
Botany**