

**Jankidevi Bajaj College of Science, Wardha**  
**Semester Pattern Syllabus**  
**FOR B Sc. BOTANY**  
**Session 2018-19**

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**SEMESTER – I**  
**Plant Diversity & Applications of Microbes**  
**(60 Hours)**

**Unit I: Viruses and Bacteria** **(10)**

- 1.1 Virus: General Account of Viruses and structure of TMV and HIV
- 1.2 Mycoplasma : - Structure, Reproduction.
- 1.3 Bacteria:- Cell structure, Reproduction: (Binary fission, Conjugation)
- 1.4 Cyanobacteria: -General account, Ultra cell structure, reproduction (eg. *Nostoc*).
- 1.5 Role of microbes in Agriculture, Medicine and Industries.

**Unit II: Algae** **(10)**

- 2.1. Classification of Algae F. E. Fritsch
- 2.2 General characters of algae with reference to Habitat, Thallus Organization, Pigmentation, Reserve food and Reproduction
- 2.3 Life history of: - *Oedogonium*, *Vaucheria*, *Chara*, *Ectocarpus*.
- 2.4 Economic Importance of Algae with special reference to Food, Industries, Agriculture and Harmful aspects

**Unit III : Fungi and Lichens** **(10)**

- 3.1 General characteristics of Fungi,
- 3.2 Classification of Fungi( Alexopoulos 1996),
- 3.2 Life history of: - *Albugo*, *Puccinia* *Cercospora*,
- 3.4 Economic importance (Industries, Medicine, Food & Agriculture)
- 3.5 Lichens: - Types, Reproduction & Economic importance

**Unit IV: Plant pathology** **(10)**

- 4.1 Host, pathogen, symptoms
- 4.2 Viral diseases-TMV
- 4.3. Bacteria – Black arm of cotton
- 4.4 Causes and Control of: Leaf curl of Papaya, Citrus canker and Red rot of Sugarcane

**Unit V: Bryophyta****(10)**

5.1 Classification (Proskauer 1957)

5.2 General characters (Hepaticopsida, Anthocerotopsida and Bryopsida),

5.3 Alteration of generation in life cycles of *Marchantia* & *Funaria*

5.4 Economic importance

**Unit VI: Applications of Microbes****(10)****(a) Biofertilizers**

6.1 Concept, importance and types, Vermicomposting

6.2 Nitrogen fixing biofertilizers: Azotobacter, Rhizobium, Nostoc, Anabena

6.3 Phosphorus degrading &amp; Potash mobilizing bacteria, VAM

**(b) Mushroom Cultivation**

6.4 Introduction of nutritional &amp; medicinal value of edible mushrooms

6.5 Economic importance of mushrooms.

6.6 Cultivation practices of *Agaricus* (button), *Pleurostus* (Dhingari oyster mushroom) and *Volcariella* (Paddy straw mushroom)**List of Practicals :**

Study of Bacterial forms from permanent micropreparation.

Gram staining of Bacteria, Ultrasturcture of Bacteriophage from TEM photographs

Study of Cyanobacteria: *Nostoc*.Study of Algal genera: *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus*.Study of Fungal genera:- *Albugo*, *Mucor*, *Puccinia*, *Cercospora*

Study of Lichen: - Thallus structure, Types

Plant pathology: – Leaf curl of Papaya, Red rot of Sugarcane, Citrus canker

Study of Bryophytes :- *Marchantia* & *Funaria*

\*To study the bacteria present in root nodules of leguminous plant.

To study the liquid culture/broth culture of *Rhizobium*.To prepare the biofertilizers from broth culture of bacteria (*Rhizobium* / Cyanobacteria)

Identification of different types of mushroom.

Materials required for Cultivation of Mushrooms.

Demonstration of cultivation of Mushroom.

Botanical Excursions (One short/Long excursion is compulsory)

## Suggested Readings:

- Tortora, G. E. B. R. Funke, C. L Case U (1997): Microbiology, An Introduction, 6<sup>th</sup> Ed (Addison NesleyLogman ,Inc.)
- Smith, K. M. : Plant Viruses [1992] 6th Ed luniversity Book Stall ,New Delhi) Dubey, RC. DK Maheshwari [1999] : Text Book of Microbiology (S. Chand & Co) Sharma, P.D. [1993] : Microbiology and plant pathology ( Rastogi& Co) Sullia, S. B. [1998] : General Microbiology (Oxford &IBH) Prescott et al [1999]: Microbiology 3<sup>rd</sup>ed (Wm C Brown Pub)
- Bold, H.C. C. J Alexopoulos and T Delevoryas [1980] : Morphology of Plants and Fungi (Harper and Row Publishers, N.Y.)
- Ganguly, Kar [] : College Botany, Vol II (New Central Book Agency, Calcutta) Bierhorst, D. W. (1971) : Morphology of Vascular Plants (Macmillon& Co. N.Y.)
- Bold, H. C. and M. J. Wynne [1978] :Introduction of Algae: Structure and Reproduction (Prentice Hall Of India, Pvt. Ltd)
- Kumar, H. D. and HN Singh (1982) : A text Book of Algae (AffiliateEast - West Press, Pvt. Ltd, New Delhi)
- Sharma, O.P.1992): Text . Book OfThallophytes (McGraw Hill Publishing Co.) Smith, G. M. [1971] :Cryptogamic Botany, Vol. I Atgae and Fungi(TMh) Vasishtha, B. R. [1990] : Algae (S. Chand & Co. New Delhi)
- Alexopoulos, C. J. and G. W. Min & M. Blackwell, Indroductory Mycology, CBS distributors & publishers, Delhi.
- Dube, H. C. [1990] introduction to Fungi (Vikas Publishing House Pvt. Ltd, Delhi)
- Sharma, P. D. [1991] : The Fungi (Rastogi&Co.Meerut)
- Vasishtha, B. R.[1990] : Fungi (S. Chand and Co. New Delhi)
- Mehrotra, R. S. and Aneja, K. R. 1990 An Introduction to mycology (Wiley Estern Ltd.) Prempuri [1980] :Bryophyta (Atma Ram & Sons Delhi)
- Ram Udar [1970] : An Introduction to Bryophyta (ShashidharMalviyaPrakashan, Lucknow) Smith, G. M. [1971] :Cryptogamic Botany, vol. I I, Bryophytes and Pteridiphytes (THM)
- Chopra, G. Land D I Yadav [1980] : A text Book of Bryophyta (Arihant Press)
- Vashishtha, B. R. [1992] :Bryophyta (S. Chand & Co. New Delhi)

Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.  
 Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.  
 John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.  
 4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.  
 Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.  
 Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad  
 Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.  
 Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.  
 Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

**Semester - I**  
**Botany Practical Examination**  
**Question Paper**

**Time: 5 hrs**

**Marks: 30**

- Q. 1) Gram Stain given Bacterial strain / Stain the **Cyanobacterial** material [A], & Identify **04**
- Q. 2) Identify & give characters of the given **Algal** material [B]and make a temporary Mount **04**
- Q. 3) Identify & give characters of the given **Fungal** material[C] and make a temporary Mount **04**
- Q. 4) Identify & give characters of the given **Bryophytic** material[D] and make a temporary Mount **04**
- Q. 5) Spotting : **08**
- |                                |                       |                    |           |
|--------------------------------|-----------------------|--------------------|-----------|
| E-Virus/Bacteria/Cyanobacteria | F- Algae              |                    |           |
| G- Fungi                       | H-Bryophyte           | I- Plant pathology | J- Lichen |
| K- Biofertilizer               | L-MushroomCultivation |                    |           |
- Q. 9) Viva-voce **03**

Q.10) Practical Record & Excursion Report 03

**Semester – II**

**Pteridophyta, Paleobotany, Gymnosperms, Morphology of Angiosperms &  
Scientific Report writing  
(60 Hours)**

**Unit I Pteridophyta (10)**

1.1 Classification (Smith, 1952)

1.2 General characters (Psilopsida, Lycopsidea, Sphenopsida and Pteropsida),

1.3 **Life history of** *Selaginella* (Heterospory and seed Habit), *Equisetum*

1.4 Apogamy, Apospory and Stellar system in Pteridophytes

**Unit II Palaeobotany (10)**

2.1 Introduction to Paleobotany, Geological time scale

2.2 Fossilization: Replacement theory, Infiltration theory

2.3 Types of fossils: Impression, Compression, Petrification

2.4 Fossil plants: Gymnosperms: *Glossopteris* (Leaf, Scutum), *Cycadeoidea*  
(morphology, anatomy of Stem and flower)

**UNIT III: Gymnosperms (10)**

3.1 Classification (Stewart 1982)

3.2 General characters

3.3 Life cycles of *Pinus* and *Gnetum*

3.4 Affinities of gymnosperms with Pteridophytes and Angiosperms

3.5 Economic importance

**Unit IV: Morphology of Angiosperms I**

4.1 Diversity in Plants habits – Annual, biannual, perennials

4.2 Root: Tap, Adventitious & Modifications (Storage, Respiration & Reproduction.

4.3 Stem: Shape, surface, texture, nature, Branching (Monopodial, Sympodial),  
modifications (Runner, Rhizome, Tuber, Bulb, cladode).

4.4 Leaf: Typical Leaf, Types (Simple, Compound), Phyllotaxy, Venation, Stipule  
and modifications of leaf (Tendrils, Phyllode)

**Unit V: Morphology of Angiosperms II (10)**

5.1 Inflorescence -Simple (Racemose, Cymose and special types).

5.2 Flower: Flower as modified shoot, Insertion of floral whorls,

5.3 Structure of Calyx, Corolla, Androecium and Gynoecium.

5.4 Placentation; Seed structure; Types of seeds

5.5 Fruit: Classification of fruits, Simple, Aggregate, Composite fruit.

## Unit VI Scientific Report writing

10

### (a) Data collection, Documentation and Photography

6.1 Maintaining a laboratory record; Tabulation and generation of graphs.

6.2 Imaging of tissue specimens and application of scale bars.

6.3 The art of field photography.

### (b) The art of scientific writing and its presentation

6.4 Numbers, units, abbreviations and nomenclature used in scientific writing.

6.5 Writing references. Power Point presentation. Poster presentation.

6.6 Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

## List of Practicals

Study of Pteridophytes : *Rhynia*, *Selaginella*, *Equisetum*.

Study of Gymnosperm: *Pinus*, *Gnetum*, *Cycadeoidea*, *Glossopteris*.

Study of Root: Types, Modifications.

Study of Stem: shape, surface, texture, nature Branching, Modifications (Ex. *Hibiscus*, *Ocimum*, any grass).

Study of Leaf: Stipules, base, kind, shape, surface, margin, Apex, texture, Phyllotaxy, Venation & Modifications.

Inflorescence: Types.

Flower: Parts, Thalamus, Calyx, Corolla, Androecium, Gynoecium.

Fruits: Types.

\* To understand and prepare reference list (e.g. Research papers, Reference books, websites, Ph.D./M. Sc. Thesis & research reports)

To write and understand units, abbreviations and nomenclature used in scientific writing and prepare presentations in poster and power point template.

To prepare scientific paper.

## Suggested Readings:

Rashid, A. [1989] : An Introduction to Pteridophyta Vikas Publishing House, Pvt. Ltd. New Delhi

Sharma, O. P. [1990] : Text Book of Pteridophyta (McMillan India Ltd.)

Bhatnagar, S. P. and Moitra A. 1996 Gymnosperms. New Age International Limited ,

New Delhi Davis, P. H. and Heywood V. H. 1963. Principals of Angiosperm Taxonomy. Oliver and Boyd London.

Sporne, K. R. 1965. The Morphology of Gymnosperms. Hutchinson University Library Press, London.

Stewart, W. N. and G. W. Rothwell 1993 : Paleobotany and the Evolution of Plants, 2<sup>nd</sup> Edn. Cambridge University Press.

Bierhorst, D. W. [1971] : Morphology of Vascular Plants. Macmillon & Co. N.

R. Vashishtha, B. R. [1992] : Gymnosperm (S. Chand & Co. New Delhi)

Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.

Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

**Semester II  
Practical Examination  
Question Paper**

**Time: 5 hrs**

**Marks : 30**

Q.1) Identify & give characters of the given **Pteridophytic** material **[A]** and make temporary Mount. 04

Q.2) Identify & give characters of the given **Gymnospermic** **[B]** material and make temporary mount. 04

Q.3) Describe the given **leaf** material **[C]** 04

Q.4) Describe (Calyx, Corolla, Androecium & Gynoecium) of given **Flower** **[D]**. 04

Q. 5) Spotting : 08

E. Pteridophyte                      F. Fossil      G. Gymnosperm      H. Vegetative morphology  
I. Inflorescence/flower      J. Fruit      K. Data collection      L. Scientific writing

Q.6) Viva-voce 03

Q.7) Practical Record & Excursion Report 03

## Semester – III

### Angiosperms Taxonomy, Cell Biology, Plant Breeding and Plant Microtechnique

(60 Hours)

#### Unit I Origin, Systematics and Biodiversity

(10)

- 1.1 Origin of Angiosperms (Benettitalean theory) & Phylogeny
- 1.2 Angiosperm Floras, Herbaria, keys (Indented and Bracketed), Valid publication
- 1.3 Modern tools in Taxonomy in relation to Morphology, Anatomy and Cytology
- 1.4 Concept and significance of Biodiversity

#### Unit II Classification and Study of Families

(10)

- 2.1 Classification of Angiosperms: Natural, Artificial and Phylogenetic systems.
- 2.2 Systems: Bentham & Hooker and Engler & Prantl (with merits and demerits),
- 2.3 Dicotyledons : Malvaceae, Fabaceae (Papilionoideae, Caesalpinioideae, Mimosoideae) Asteraceae, Asclepiadaceae, Euphorbiaceae
- 2.4 Monocotyledons : Liliaceae, Poaceae

#### Unit III Cell Biology I

(10)

- 3.1 Typical plant cell - Prokaryotic and Eukaryotic
- 3.2 Ultrastructure & functions of: Cell wall & Cell Membrane (Fluid mosaic model)
- 3.3 Ultrastructure & functions of: Nucleus & Endoplasmic reticulum (RER and SER)
- 3.4 Ultrastructure & functions of: Golgi complex, Ribosomes, lysosomes, Peroxisomes, Mitochondria & Chloroplasts

#### Unit IV Cell Biology II

(10)

- 4.1 Chromosome structure: Morphology (chromatid, chromomere, centromere, telomere, secondary constriction, satellite, karyotype)
- 4.2 Sex Chromosomes in plants: XY type in *Melandrium*
- 4.3 Cell division in plants: Mitosis, Meiosis and its significance.

#### Unit V Plant Breeding

(10)

- 5.1 Plant Breeding- Definition and objectives
- 5.2 Hybridization (emasculation, bagging, crossing, labelling)
- 5.3 Colonial selection, Heterosis (Definition and scope)



5.4 Biostatistics - Mean, Mode, Median, Standard deviation, Standard error, Students t-test

## **Unit VI Plant Micro-techniques**

**(10)**

### **(a) Staining Plant Materials**

6.1 Staining procedures, classification and chemistry of stains. Staining equipment.

6.2 Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags).

6.3 Cytogenetic techniques with squashed and smeared plant materials.

### **(b) Methods to study plant cell / Tissue Structure**

6.4 Whole mounts, peel mounts, clearing, maceration and sectioning;

6.5 Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, no coagulant fixatives; tissue dehydration using graded solvent series;

6.6 Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

### **List of Practicals**

Study of Families covered in the theory portion.

Study of fossil Angiosperms micropreparation and specimens: *Sahianthus*, *Enigmocarpon*

Study of Cell organelles with the help of photographs/ Slides

Study of mitosis in plant material

Study of meiosis in plant material

Study of hybridization (Emasculation, bagging crossing & labeling)

To calculate Mean, Mode, Median, standard error from the given data (At least 10 problems to be solved)

To calculate the study of t-value from the given data (At least 10 problems to be solved)

\* To prepare different laboratory stains.

To study different staining equipments.

To study procedure for staining different plant materials.

To study methods of fixation preservation and clearing.

To study the methods of paraffin and plastic infiltration.

To study maceration and sectioning of infiltrated materials.

Botanical Excursions (Two short or One long out of the state is compulsory).

### **Suggested Readings:**

Bhojwani, S. S. and Bhatnagar, S. P. 2000. The Embryology of Angiosperms. Vikas Publishing House, Delhi.

Hartman, H. T. and Kestler D.E. 1976. Plant Propagation :Principles and Practices, 3rd Edn. Prentice- Hall of India Pvt. Ltd. New Delhi.

Proctor, M. and Yeo, P. 1973. The Pollination of Flowers. William Collins Son, London.

Jeffrey, C. 1983. An Introduction of plant Taxonomy. Cambridge University Press, Cambridge, London.

Radford, A.E. 1986 Fundamentals of plant systematic. Harper And Row, New York.

Ugemuge, N. R. 1986. Flora of Nagpur District. Shree Prakashan, Nagpur.

Dutta, S. C. 1989. Systematic Botany. Wiley Eastern Co. Naik, V. N.- Taxonomy of Angiosperm.

Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

**Semester III  
Practical Examination  
Question Paper**

**Time : 5 hrs**

**Marks : 30**

- Q. 1) Describe in technical language the given Angiospermic material [A]. Classify & Identify the Family giving reason **06**
- Q. 2) Write floral formula and Draw Floral Diagram of the given flower [B] **03**
- Q. 3) Prepare semi-permanent squash /smear of given material [C] & Identify the stage of cell division **05**
- Q. 4) To solve the given problem of biostatistics **04**
- 5) Spotting: **06**
- D. Fossil angiosperm      E. Cytology      F. Cell organelles (photocopy)
- G. Taxonomy              H. Plant Microtechnique      I. Plant Cell/Tissue structure
- Q. 6) Viva-voce **03**
- Q. 7) Practical Record & Excursion Report **03**

**Semester – IV**  
**Anatomy, Embryology, Genetics, Molecular Biology & Plant Analytical techniques**  
**(60 Hours)**

**Unit I Anatomy** **(10)**

- 1.1 Meristems: Types, Apical cell , tunica-carpus & Newman theory
- 1.2 Primary structure of stem and root in dicot (Sunflower) & monocot (*Maize*)
- 1.3 Types of vascular bundles in dicots and monocots;
- 1.4 Secondary growth (Sunflower stem) & anomalous growth in *Bignonia* and *Dracena* stem.
- 1.5 Anatomy of leaf: Dicot (*Nerium*), monocot (*Maize*).

**Unit II Embryology** **(10)**

- 2.1 Pollination: Types and adaptation, significance
- 2.2 Microsporogenesis, male gametophyte,
- 2.3 Megasporogenesis :Types of ovules, female gametophyte (*Polygonum* type)
- 2.4 Double fertilization and triple fusion, endosperms and its types,
- 2.5 Structure of dicot (*Onagrad*) and monocot embryo.

**Unit- III Genetics I** **(10)**

- 3.1 Interaction of genes: Incomplete dominance (1:2:1 ratio in *Mirabilis jalapa*); Complementry (9:7 ratio) and Dominant epistasis (12:3:1 ratio)
- 3.2 Linkage: Definition, Theory of linkage (Coupling and Repulsion theory), types (complete and incomplete), significance
- 3.3 Extra-nuclear Genome- Mitochondrial DNA and Chloroplast DNA

**Unit- IV Genetics II** **(10)**

- 4.1 Crossing over: Definition, theories (Breakage and reunion), significance
- 4.2 Variation in chromosome number: Polyploidy (auto- and allo-), aneuploidy (nullisomics, monosomics, trisomics and tetrasomics), significance.
- 4.3 Structural changes in chromosome: deficiency, duplication, inversion translocation & their significance.
- 4.4 Concept of gene; Structure of eukaryotic gene, overlapping gene

**Unit- V Molecular Biology** **(10)**

5.1 DNAPackaging – Nucleosome ; DNA damage and repair: Photoreactivation, excision

repair. Satellite and repetitive DNA,

5.2 Gene expression in prokaryotes: Transcription and translation; Regulation of gene expression (Lac operon model).

5.3 Mutation: Types, Mutagens, Applications of induced mutations in crop improvement.

5.4 Transposable element in plants (AC-DS system)

## **Unit VI: Plant Analytical techniques**

**(10)**

### **(a) Analytical Pharmacognosy**

6.1 Drug adulteration - types, methods of drug evaluation

6.2 Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

### **(b) Herbal Cosmetics & Medicines**

6.3 Methods of Herbal extraction:- Maceration, digestion, Decoction, extracts and tinctures

6.4 Herbal Preparations: Churna, Asava, Arishta Products & uses of Aloe, Amla, Adathoda, Neem, Rose, Turmeric & Ginger.

### **List of Practicals-**

Study of simple tissue, complex tissue and secretory tissue from permanent slides

Study of types of vascular bundles

Study of internal structure of dicot and monocot root using hand section and prepare temporary mounts -Sunflower, Maize

Study of internal structure of dicot and monocot stem using hand section and prepare temporary mounts -Sunflower, Maize.

Study the growth ring in woods-Teak wood

Study of internal structure of secondary growth and anomalous secondary growth using hand section and prepare permanent micropreparations - *Bignonia* stem and *Dracena* stem.

Study of internal structure of leaves- *Nerium*, Maize

Study of types of ovules, stamens anther structure, pollen grains, adaptations for pollination,

To calculate the percent pollen germination in the given specimen

To prove the Mendel's law of segregation with the help of coloured beads.

To prove the Mendel's law of independent assortment with the help of coloured beads.

From the given data workout the type of gene interaction in the given cross.

\*To study different methods of identification of drug adulteration.

To study the methods of biological testing of herbal drugs.

To study the screening tests for secondary metabolites.

Identification of useful herbal plants.

To study different methods of herbal extractions.

To prepare different products. (Churna, Asava, Arishta)  
Botanical Excursions (One short tour is compulsory).

### **Suggested Readings:**

- Cutter, E. G. 1971. Plant Anatomy Experiment and Interpretation. Part II. Organs. Edward Arnold, London.
- Esau, K. 1979 Anatomy of seed Plants, 2nd Edn. John Wiley and Sons New York
- Fahn, A. Plant Anatomy, 2nd Edn. Pergamon Press, Oxford.
- Alberts, B. D. Bray, J Lewis, M. Raff K, Roberts, and J. D. Watson [1999] Molecular Biology of the Cell ( Garland Publishing Co. Inc. N.Y.)
- Gardner, E. J., M. J Simmond, and D. P. Snustadt(1991) :Principles of Genetics, 8'h ed (John Wiley and Sons, Inc N. Y.)
- Gupta, P.K.[ 1999] : A Text Book of cell and Molecular Biology (Rastogi Publications, Meerut India)
- Hawms, J. D. [1991] : Gene Structure and Expression 2nd ed (Cambridge University Press Cambridge U.K.)
- Kleinsmith, L. J and V. M. Kish [ 1995] : Principles of cell and Molecular Biology, 2"d ed. Harper Collins college pubs.
- Snustad, D. P. and M. J. Simmons [ 2000] : Principles of Genetics ( John Wiley and sons, USA)
- Freifelder, D [1990] : Essentials of Molecular Biology ( Narosa Publishing House, New Delhi, Madras)
- Watson, J. D. Hopkins, Roberts, Steitz, Weiner [ 1987] Molecular Biology of Gene. Benjamin Cummings Pub. Co. Sherman)
- Cooper, G. M. [1997] : The Cell" A Molecular Approach (Oxford Univ. Press)
- Kumar, H. D. [1991] : A text book of Cytology, Genetics and Evolution [1991] : A Text Book Cytology, Genetics and Evolution (Kalyani Publisher, New Delhi)
- Lewin, G. [2000] : Gene VII (John Wiley and Sons, N. Y.)
- Lodish, H. A. Berk, S. L. Zipursky, P Matudaira , D. Baltimore and Jm Damell [ 2000] :Molecular cell Biology ( W. H. Freeman and Co. N. Y. )
- Russel, P. J. [1998] : Genetics ( The Benjamin/ Cummings publishing Con. Inc. USA)
- Kumar, H. D. [1991] : A text book of Cytology, Genetics and Evolution [1991] : A Text Book Cytology, Genetics and Evolution (Kalyani Publisher, New Delhi)
- Karp, G [1961]: Cell and Molecular Biology- Concepts and Experiments ( John Wiley and Sons Inc.)
- Gupta PK (2007) Genetics: Classical to Modern. Rastogi Publications, Meerut
- Vyas SP and Mehta A (2011) Cell and Molecular Biology. CBS Publ. and Dist. Pvt. Ltd., New Delhi

Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.

The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.

Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.

Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.

Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.

Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

**Semester IV**  
**Practical Examination**  
**Question Paper**  
**Time : 5 hrs**  
**Marks : 30**

- Q. 1) Prepare temporary mount of the given material [A](Root/Leaf)& Identify giving diagnostic character **03**
- Q. 2) Prepare double stained permanent mounts of the given material [Stem] [B] & Identify giving diagnostic character **06**
- Q. 3) Calculate percent germination in the given pollen grains [C] **02**
- Q. 4) To prove Mendel's Law of Inheritance through coloured beads [D] **04**
- Q. 5) To work out the type of gene interaction in the given cross from the given data. **03**
- Q. 6) Spotting: **06**  
E- Tissue                      F- Root anatomy  
G-Stem anatomy              H-Embryology  
I. Analytical pharmacognosy J. Herbal cosmetics & Medicines
- Q. 7) Viva-voce **03**
- Q. 8) Practical record and excursion report **03**