

6. Bhatia, A.L. : Biochemistry and Endocrinology, Indus Valley Publication.
7. Bhatia, A.L. & N. Jain : Biotechnology, Indus Valley Publication.
8. Bhatia, A.L. & K.S. Kohli : Various Dimensions of Environmental Biology, Indus Valley Publication.
9. Voet, D. and Voet, J.G : Biochemistry John Wiley & Sons, New York.
10. Conn. Stumph R.K. Bruening and Doc : Outlines of Biochemistry (Wiley).
11. Davenport : An Outline of Animal Development (Addison-Werley).
12. De Robertis and DeRobertis : Cell and Molecular Biology (Saunders College)
13. Randall, D., Burggren, W., French, K. : Eckert Animal Physiology (W.H. Freeman).
14. Edward Gasque : Manual of Laboratory L.Ed. In Cell Biology (W.C. Brown Publishers)
15. Farnsworth : Genetics (Harper and Row) ,
16. Ganong : Review of Medical Physiology (Lange).
17. Glick : Molecular Biotechnology.
18. Grant : Biology of Developmental System.
19. Hyman, L.H. : The Invertebrates, Vol. I (McGraw Hill).
20. Hyman, L.H. : The Invertebrates, Vol. II (McGraw Hill).
21. Goldsby, R.A., Kindt, T.J., Osborne, B.A. : Kuby Immunology (W.H. Freeman).
22. Lodish, H. et al : Molecular Cell Biology W.H. Freeman and Company.
23. Monicly, A.R. : The Chordates (Cambridge University Press).
24. Moody : Introduction to Evolution (Indian Edition)
25. Odum : Ecology (Amerind).
26. Odum : Fundamentals of Ecology (Saunders).
27. Preseoff, DM : Reproduction in Eukaryotic Cells (Academic press)
28. Meyers, R.A. (Ed.): Molecular Biology and Biotechnology : (VCH Publishers)
29. Old, R.W. and Primrose, S.B. : Principles of gene manipulation: An introduction to Genetic Engineering.
30. Rao, K.V. : Developmental Biology : A modern synthesis (Oxford-IBH Publishers)

31. Ricklefs : Ecology (W.H. Freeman).
32. Roitt, L : Essential Immunology (ELBS).
33. Savage : Evolution (Holt, Reimhart and Winston.)
34. Strickberger : Genetics (MacMillan).
35. Stryer, L *et.al.* : Biochemistry (Freeman).
36. Subramanyan, T: Developmental Biology (Narosa Publishing House).
37. Waterman, A.J. : Chordata—Structure and Function (Macmillan Co.).
38. Watson, J.D. et al : Molecular Biology of the Gene (Benzamin/ Cummings)
39. Wilson, E.B. : Cell in Development and inheritance (Macmillan)
40. Young, J.Z.: Life of Vertebrates (Oxford University Press).

### PRACTICAL ZOOLOGY

#### B.Sc. Hons Part III

#### Ecology and Environmental Biology

##### Analysis of Environmental Components

- (i) Soil pH
- (ii) Water analysis – pH, alkalinity, acidity, dissolved O<sub>2</sub> and free CO<sub>2</sub> Salinity (Chlorides)
- (iii) Study of phyto and Zoo-planktons in a given water sample.
- (iv) Quantitative estimation of Zoo-planktons in given water sample.
- (v) Simple methods to measure population density.
- (vi) Field study of any one of the following habitats; freshwater; lake/pond, river, desert.

##### Developmental Biology

Study of Frog/toad development with the help of :

- (i) Preserved material available : egg, cleavage, blastula, gastrula, neurula, tail bud, mature tadpole larva, metamorphic stages, froglet/toadlet.
- (ii) Histological slides : cleavage, blastula, gastrula, neurula, tail bud.
- (iii) Study of living tadpole larva and its metamorphosis study.

##### Study of Chick Development :

- (i) Whole mounts : 18 hrs, 21 hrs, 24 hrs, 33 hrs, 48 hrs, 72 hrs and 96 hrs of incubation.
- (ii) If possible primitive streak stage in living embryos after removal of the blastoderm from the egg may be demonstrated.
- (iii) Study of the embryo at various stages of incubation in vivo by making a window in the egg shell may also be demonstrated.

**Syllabus : B.Sc. (Hons.) Part-III**

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- (iv) Study of various foetal envelopes in a 10-12 day old chick embryos (amnion, chorion, allantois and yolk sac)

**Evolution :**

Simple Neumericals based on population genetics.

**Applied Zoology XVII**

1. Preparation and use of culture media for microbes.
2. Study of microbes in food material (like curd etc.)
3. Preparation of Bacterial slides :
  - (i) Ordinary Gram-positive bacteria
  - (ii) Ordinary Gram-Negative bacteria
  - (iii) Gram-positive filamentous bacteria.
4. Study of Microscopic slides :
  - (i) *Entamoeba*
  - (ii) *Trypanosoma*
  - (iii) *Leishmania*
  - (iv) *Plasmodium*
  - (v) *Wuchereria*
  - (vi) *Dracunculus*

**Applied Zoology XVIII**

- (i) DNA finger printing.
- (ii) Genomic DNA isolation from Eukaryotic cells.
- (iii) Agarose gel electrophoresis of DNA
- (iv) Small scale preparation of Plasmid DNA
- (v) Restriction digestion of genomic and Plasmid DNA.

**ZOOLOGY PRACTICALS**

**Scheme of Examination :**

**Max. Marks : 100**

**Min. Pass Mark : 40**

**Total Duration : 8 hours (In two days, hr. each day)**

**Distribution of Marks :**

1. Exercise in ecology and environmental biology	10
2. Developmental biology	10
3. Evolution	6
4. Applied Zoology-I (Microbiology)	10
5. Applied Zoology-II	10
6. Identification and comment upon spots (1 to 8).	24
7. Viva-voce	10
8. Class-record	10
9. Seminar/project report	10
<b>Total</b>	<b>100</b>

## 4. BOTANY (HONS.)

*Scheme :*

<i>Four Theory Papers</i>	<i>Duration</i>	<i>Max. Marks</i>	<i>Min. Marks</i>	<i>Pass Marks</i>
Paper-IX Biochemistry and Molecular Biology	3 hrs.	75		
Paper-X Systematics of Angiosperms and Environmental Biology	3 hrs.	75	120	
Paper-XI Biotechnology	3 hrs.	75		
Paper-XII Seed Science	3 hrs.	75		
Practicals 2 days (50 marks each)		100		
Practical-I Paper IX, X				
Practical-II Paper XI, XII				

**Scheme of Examination****Common for all Papers****Scheme of Examination****Time : 3 hrs****Max. Marks : 75**

- Two types of question papers for each theory paper will be applicable to total duration of 3 hours. One question paper will comprise the objective type of questions and other will be of descriptive long answer type question.
- Descriptive type of question paper (to be given during the first two hours of the examination) will have 6 questions out of which a student is supposed to attempt any 3. This portion of the paper will carry maximum 45 marks.
- The objective type question paper will be given after 2 hours of descriptive type paper and will have 35 questions of the objective types. This portion of the papers will carry 30 marks. The objective types of questions will be of the following types :
  - Multiples choice types questions—20 of 1/2 marks each.
  - Fill in the blanks/one word/true of false type question 10 of 1/2 marks each.
  - Very short answer types questions—5 of 1 mark each.

**Paper-IX : Biochemistry and Molecular Biology****Unit-I**

Nucleic Acids : Compositions of nucleic acids and synthesis

**Syllabus : B.Sc. (Hons.) Part-III**

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of nucleotides : DNA structure : A, B and Z form of DNA, denaturation and renaturation of DNA : chromatin structure : DNA replication and recombination : DNA polymerases : different forms of RNA and their role.

Amino acid and protein metabolism : Structure, characteristics and classification of amino acids; protein and non-protein amino acids; amino acid biosynthesis; GS/GOGA cycle; Transamination : peptide bond and polypeptide chain; primary, secondary, tertiary and quaternary structure of proteins; protein biosynthesis, and its regulation; post-translational Modification of proteins; protein targeting; protein degradation.

**Unit-II**

Carbohydrate metabolism : Classification; structure of some representative examples of monosaccharides, disaccharides, polysaccharides; stereoisomers, enantiomers and epimer; biosynthesis and degradation of sucrose and starch.

Lipid metabolism : Saturated and unsaturated fatty acids; fatty acid biosynthesis; oxidation of fatty acids; storage and mobilization of fatty acids lipids.

**Unit-III**

Gene structure, expression and regulation : Gene organization in prokaryotes and eukaryotes; operon concept; gene regulation in prokaryotes and eukaryotes; inducible, repressible, positive and negative gene regulation; interrupted genes in eukaryotes; RNA splicing; mRNA stability.

Recombinant DNA technology : Restriction endonucleases prokaryotic and eukaryotic cloning vectors; genomic and cDNA libraries; Southern and northern analysis; various techniques of gene mapping and DNA fingerprinting (RFLP, RAPD, AFLP); chromosome walking, polymerase chain reaction; DNA sequencing.

**Suggested Readings**

Alberts, B., Bray, O.Lewis; J. Raff., M. Roberts. K and Watson, J.D., 1990. Molecular biology of cell.

Garland Publishing Co., Inc., New York, USA.

Bhojwani. S.S., 1990. Plant Tissue Culture : Applications and limitations. Elsevier Science Publishers, New York, USA.

Buchanan, B.B.: Grulsem, W.; and Jones. R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists. Maryland, USA.

- Collins, H.A.; and Edwards, S. 1998. Plant Cell, Culture. Bios Scientific Publishers, Oxford, UK.
- Delnis, D.T.; Turpin, D.H., Lefebvre, D.O. and Layzell, D.B. (eds) 19-t. Plant Metabolism (~Edition) Longman, Essex, England.
- Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology (2nd Edition), John Wiley and Sons, Chichester, England.
- Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J. 2000. Molecular Cell Biology (4th Edition). W.H. Freeman and Co., New York, USA.
- Old, R.W. and Prinrose, S.B. 1989. Principles of Gene Manipulation: Blackwell Scientific Publications, Oxford, UK.
- Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York, USA.
- Vasil, IX and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherland.

***Suggested Laboratory Exercises***

1. Chemical tests to demonstrate the presence of starch, sugar, fat and protein in plant material.
2. To identify the amino acids in a mixture by resolving through paper chromatography or TLC.
3. To prepare the standard curve for protein and determine the protein content in unknown samples by Biuret method.
4. Colorimetric estimation of RNA using orcinol.
5. Colorimetric estimation of DNA using diphenyl amine.
6. Isolation of plant genomic DNA and its pooling.
7. Isolation of total RNA from plant tissue and its colorimetric estimation.
8. Preparation of tissue culture media, sterilization and inoculation of plant material.
9. Demonstration of techniques of invitro culture of various explants.
10. Isolation of plant protoplasts (e.g. tobacco, Petunia) using enzymes available commercially and estimation of their yield.

**Note :** In the practical classes emphasis should be given on basic principles of spectrophotometry, chromatography, electrophoresis and rDNA technology and related fundamentals.

***Suggested Readings (for laboratory exercises)***

- Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur. India.

**Syllabus : B.Sc. (Hons.) Part-III**

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- Dixon, R.A. (Ed.) 1987. *Plant Cell Culture : A practical Approach*, IRL Press, Oxford.
- Dryer, R.I. and Lata, G.F. 1989. *Experimental Biochemistry*, Oxford University Press, New York.
- Glick, B.R. and Tompson, J.E. 1993. *Methods in Plant Molecular Biology and Biotechnology*, CRC Press, BocaRaton, Florida.
- Hackett, P.B., Fuchs, J.A. and Messing, J.W. 1988. *AI? Introduction to Recombinant DNA Techniques : Basic Experiments in Gene Manipulation*. The Benjamin Cummings Publishing Co., Inc., Menlo Park, California R.D. (Ed.) 1999, *Plant Cell Culture Protocols*. Humana Press Inc., New Jersey, USA.
- Ninfa, A.J. and Ballou, D.P. 1998. *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*. Fitzgerald Science Press, Inc., Maryland, USA Scott, R.P.W. 1995. *Techniques and Practice of Chromatography*. Marcel Dekker, Inc., New York.
- Wilson, K. and Goulding, K.H. (Eds.) 1986. *A Biologists Guide to Principles and Techniques of Practical Biochemistry*, Edward Arnold, London, UK.

**Paper-X : Systematics of Angiosperms and Environmental Biology**

**Unit-I**

Introduction: Aims and components of systematics; introduction to identification, nomenclature, phylogeny and classification.

Systematics in practice: Importance of herbarium specimens and their preparation; role of herbaria and botanical gardens; documentation (floras, monographs, manuals, journals, abstracts, indices and dictionaries); keys for identification of plants-single access and multiaccess; value of computers and databases for identification.

Taxonomic hierarchy : Taxonomic category; taxonomic groups; concepts of species, genus and family.

Botanical nomenclature : Principles and rules; ranks and names; type method; principle of priority and its limitations; names hybrids and cultivars; concept of biocode.

Phylogeny of angiosperms: A general account of the origin and evolution of angiosperms (special reference to Bennettitalean Gnetalean, Caytonialean and herbaceous origin theories); primitive

living angiosperms; co-evolution of angiosperms and animals. Systems of classification: Bentham and Hooker's system, Engler and Prantl's system, and Takhtajan's system.

#### Unit-II

Modern taxonomy : Supporting evidences/inputs for taxonomy; taxonomy in relation to anatomy, embryology, palynology, ecology, cytology (cytotaxonomy), secondary metabolites in plants (chemotaxonomy).

Numerical taxonomy : Concepts, characters and attributes; OTU's; coding; cluster analysis: cladistics.

#### Environmental Biology

Introduction : Inter-relationships between the living world and the environment; the components and dynamism; homeostasis; relevance to man.

Earth as a system : The biosphere, the hydrosphere, the atmosphere and the lithosphere; components within biosphere, (biomes); parameters delimiting individual biomes.

The environment : Soil-general account and adaptations; the living world-biotic component of environment; types of biotic interactions; fire as an ecological factor.

Organismal ecology/biotic components : Individuals species, populations, communities and their characteristics.

Ecosystems : Concepts of ecosystem; homeostasis; structure of ecosystem; functions of ecosystem; transfer of energy and minerals via grazing and detritus chains and role of microorganisms; cycles (hydrologic, gaseous); role of humans in maintaining biogeochemical cycles.

Diversity of ecosystem : Aquatic (fresh water); terrestrial (forest/grassland); man-made ecosystems.

#### Unit-III

Phytogeography : Introduction; endemism, static and dynamic plant geography; a short account of vegetation of India.

Human ecology and ecological management : The human population; renewable and non renewable natural resources and their management; conservation of biodiversity; endangered species; conventional and non-conventional energy sources.

Impact of human activities : Pollution of air, water and soil; a brief account of environmental toxicology; incidence of noise; thermal and radioactive pollution; prevention and control of pollution; global warming, desertification and ozone depletion. Role of national and International organizations in environmental management; formulation of optimal models.

Bio-indicators.

Environmental impact assessment : A brief account.

***Suggested Readings***

***Angiosperm Systematics***

Davis, P.H. and Heywood, V.H. 1960. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.

Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.

Jons, S.B., Jr. and Luchsinger, A.E. 1986. Plant Systematics (edition). McGraw-Hill Book Co., New York.

Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. MacMillan, New York.

Naik, V.N. 1984. Taxonomy of Angiosperms. TataMcGraw Hill, New Delhi.

Radford, A.E., 1986. Fundamentals of Plant Systematics. Harper and Row, New York.

Singh, G. 1999. Plant Systematics : Theory and Practice. Oxford and IBH Pvt. Ltd. New Delhi.

Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge, London.

Stace, C.A. 1989. Plant Taxonomy and Biosystematics, 2nd edition. Edward Arnold, London.

Woodland, D.W. 1991. Contemporary Plant Systematics Prentice Hall, New Jersey.

Nordenstam, B., El-Gazaly, G. and Kassas, M. 2000. Plant Systematics for 21 Century. Portland Press Ltd., London.

***Environmental Biology***

Ambasht, R.S. 1988. A Text Book of Plant Ecology. Students Friends Co., Varanasi.

- Botkin, D.B. and Keller, E.A. 2000. Environmental Planet (edition) John Wiley & Sons Inc., New York.
- Chapman, J. Land-Reiss, M.J. 1995. Ecology : Principles and Applications. Cambridge University Press.
- Cunningham, W.P. and Saign, S.W. 1977. Environmental Science : A Global Concern. WCB, McGraw Hill.
- Dash, M.C. 1993. Fundamentals of Ecology : Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Caubenmire, R.F. 1974. Plants and Environment A Text Book of Plant Ecology (3rd edition). John Wiley & Sons, New York.
- Kendeigh, S.C. 1980. Ecology with Special Reference to Animals and Man. Prentice Hall of India Pvt. Ltd., New Delhi.
- Kumar, H.D. 1996. Modern Concepts of Ecology (4th edition). Vikas Publishing House Pvt. Ltd., Delhi.
- Kumar, H.D. 1997. General Ecology, Vikas Publishing House Pvt. Ltd., Delhi.
- Koimondy, E.J. 1996. Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
- Miller, W.R. and Donahue, R.L. 1992. Soils An Introduction to Soil and Plant Growth (6th edition). Prentice Hall of India Pvt. Ltd., New Delhi.
- Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehradun.
- Pickering, K.T. and Owen, L.A. 1997. An introduction to Global Environmental Issues (~edition). Butter and Tanner Ltd., Great Britain.
- Smith, L.R. 1996. Ecology and Field Biology (6th Edition). Harper Collins College Publishers, USA.
- Smith, L.A. and Smith, T.M. 199B. Elements of Ecology (4th Edition) An Imprint of Addison Wesley, Longman Ink., California.
- Tyler, M.G. Jr. 1997. Environmental Science : Working with Earth (6th Edition). Wadsworth Publishing Co.
- Weaver, J.E. and Clements, S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd., Bombay.

**Systematics of Angiosperms**

1. Description of the locally available species of the following families & genera.
2. Ranunculaceae : *Ranunculus*, *Delphinium*.
3. Brassicaceae : *Brassica*, *Alyssum*, *Iberis*, *Coronopus*
4. Capparidaceae : *Capparis*, *Cleome*
5. Caryophyllaceae : *Dianthus*, *Stellaria*, *Spergula*.
6. Rutaceae : *Citrus*, *Murraya*.
7. Tiliaceae : *Corchorus*, *Grewia*.
8. Fabaceae : Faboideae : *Lathyrus*, *Clitoria*, *Melilotus*,  
*Cajanus*; Caesalpinioideae : *Cassia*, *Caesalpinia*;  
Mimosoideae : *Prosopis*, *Mimosa*, *Acacia*.
9. Myrtaceae : *Callistemon*, *Eucalyptus*.
10. Cucurbitaceae : *Luffa*, *Coccinia*.
11. Apiaceae: *Coriandrum*, *Anethum*.
12. Rubiaceae : *Hamelia*, *Mussaenda*.
13. Asteraceae : *Tridax*, *Helianthus*, *Calendula*, *Ageratum*,  
*Vernonia*, *Sonchus*, *Launaea*.
14. Apocyanaceae : *Vinca*, *Thevetia*, *Nerium*, *Tabernaemontana*.
15. Asclepiadaceae : *Calotropis*, *Asclepias*.
16. Solanaceae: *Solanum*, *Withania*.
17. Acanthaceae : *Adhatoda*, *Peristrophe*.
18. Lamiaceae : *Ocimum*, *Salvia*.
19. Chenopodiaceae : *Chenopodium*, *Beta*.
20. Euphorbiaceae : *Euphorbia*, *Phyllanthus*, *Jatropha*.
21. Moraceae : *Morus*, *Ficus*.
22. Cannaceae : *Canna*.
23. Liliaceae : *Asphodelus*, *Asparagus*.
24. Commelinaceae : *Tradescantia*, *Commelina*.
25. Poaceae : *Avena*, *Triticum*, *Hordeum*, *Poa*.

**Environmental Biology**

1. Mechanical analysis of soils by sieve method.
2. Determination of soil porosity and density (sand and pit method)

3. Determination of water holding capacity and field capacity of soil.
4. Determination of permeability (capillarity and percolation) of different types of soils.
5. Titrimetric estimation of total carbonates of soil samples.
6. Quantitative determination of soil organic matter by Walkley and Black's rapid titration method.
7. Determination of species area curve by minimal quadrat size.
8. Analysis of the herbaceous vegetation for frequency, density and abundance.
9. Study the height spectrum of herbaceous vegetation by line transect method.
10. Effect of tree canopy on the distribution of herbaceous vegetation.
11. Estimation of biomass of aerial parts of herbaceous plants (fresh weight and dry weight).
12. Analysis of different water samples for pH, oxygen, carbon-dioxide (titrimetric estimation), turbidity and temperature.
13. Demonstration of desert and aquatic ecosystems with the help of models.
14. Field visit : students should be taken for field visits to places of ecological/environmental interest. They should submit detailed report of the visit in the form of project report in the final practical examination for evaluation. The report shall carry marks.

*Suggested Readings (for Environmental Biology laboratory exercises)*

- Ambasht, R.S. 1990. Environment and Pollution Student Friend and Co. Varanasi, India.
- Kapur, P. and Govil, S.R. 2000. Experimental Plant Ecology. S.K. Jain for CBS Publisher and Distributors, New Delhi.
- Misra, R. 1968. Ecology Work Book, Oxford and IBH, New Delhi.
- Moore, P.W. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publication.

- Piper, C.S. 1950. Soil and Plant Analysis, University of Adelaide, Australia.
- Smith, R.L. 1966. Ecology and Field Biology. Harper Collins, New York.
- Smith, R.L. 1990 (4th Edition). Ecology and Field Biology. Harper Collins, New York.

**Note to Teachers :**

The students are to be familiarized with the families listed above in the practical classes with representative species or any other that may be available locally. However, questions pertaining to these may be asked in the theory examinations.

The teachers should prevent the students from collecting plants and submitting them for the practical examinations. Instead, the students should be asked to prepare field reports.

**Paper-XI : Biotechnology**

***Unit-I***

1. Introduction, historical developments, scope, terminology and perspectives.
2. Genetic manipulation through tissue culture techniques, concept of differentiation, dedifferentiation, re-differentiation, Media : composition, preparation, sterilization, Callus growth patterns, organogenesis and plant regeneration. Cell culture techniques, screening of cell lines, selection for nutritional quality, disease resistance, salt and drought tolerance ; anther culture and production of haploids, uses of haploids.

***Unit-II***

3. Gene manipulation through protoplast culture : isolation of protoplasts, fusion of isolated protoplast, culture of protoplasts, somatic hybrid; direct DNA uptake by protoplast, Agrobacterium-mediated gene transfer and electroporation.

***Unit-III***

4. Recombinant DNA technology : isolation and purification of DNA from plant cells, DNA sequencing, gene isolation, cutting and joining DNA molecules, restriction endonucleases, ligases; cloning vehicles; plasmids and bacteriophages; cloning strategies- enzymatic synthesis of genes, selection of vehicle/vector,

attachment to the vehicle, transfer of recombinant DNA to the host, expression of the transferred plant genes in bacteria; genomic DNA libraries.

5. Application of biotechnology in agriculture and medicine.

**Practicals**

1. Callus induction, organogenesis and plant regeneration (Tobacco, Petunia or any other suitable material).
2. Protoplast isolation, fusion.
3. Isolation, purification of DNA from plant material.
4. Plant tumors—induction through *Agrobacterium*.

**Paper-XII Seed Science**

***Unit-I***

**Introduction** : Importance and History of Seed Technology, Development of seed testing in India.

**Seed Testing Procedures** : Aim, Sampling, types of samples, sampling equipment, method of testing physical purity, genetic purity (seedling and plant stages), moisture content, (oven method, moisture meter); Germination-3, STTC test, embryo excise methods; blotter methods, roll towel; sand or pot; seedling evaluation.

**Morphology and anatomy of Seed** : Development and structure in dicotyledons and monocotyledons (Leguminosae, Poaceae), exomonorphic feature, gross internal morphology, seed coat anatomy (basic types in contest's classification).

***Unit-II***

**Seed Storage** : Principles and methods of safe seed storage, types of storage structures, deterioration in storage and its control.

**Physiology of Seed** : Dormancy—Significance, types and release of dormancy : Longevity—Life span of seed, factors affecting longevity.

***Unit-III***

**Seed Health** : Kinds of seed borne inoculum; location of seed borne inoculum; effects of the inoculum. Methods of seed health testing (Dry seed examination, washing test, blotter method, Hiltner's methods).

**Seed Certification** : Concept, minimum certification standards, general and crop standards, Field inspection ISTA certificates.

The seeds Act of India, National Seeds Corporation, State seed corporation, Central Seed Testing Laboratory.

**Practicals** : Based on theory syllabus.

**MATHEMATICS**B.A./B.Sc. (Hons) Part III ~~2019~~

Teaching : 3 Hours per Week per Theory Paper.

Examination :

Min. Pass Marks

Max. Marks. 400

Science 160

	Duration	Max. Marks
Paper – IX Algebra	3 hrs.	100
Paper – X Complex Analysis	3 hrs.	100
Paper – XI Dynamics and Computer Programming inc	Theory : 2½ hrs. Practical : 2 hrs.	68 32
Paper – XII Any one of the following		
1. Statistics	3 hrs.	100
2. Spherical Triognometry and Astronomy	3 hrs.	100
3. Integral Equations and Calculus of Variations	3 hrs.	100
4. Calculus of Several Variables	3 hrs.	100

Note :

1. Papers IX, X and XII will be divided into FIVE Units. Two questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.
2. Paper XI is divided into FOUR Units. TWO questions will be set from each Unit. Candidates are Required to attempt FOUR questions in all taking ONE question from each Unit. All questions carry equal marks.
3. Common paper will be set for both the Faculties of Social Science and Science. However, the marks obtained by the candidate in the case of Faculty of Social Science will be converted according to the ratio of the Maximum marks of the papers in the two Faculties.
4. Each candidate is required to appear in the Practical examination to be conducted by internal and external examiners. External examiner will be appointed by the

University and internal examiner will be appointed by the Principal in consultation with Local Head/Head, Department of Mathematics in the college.

5. An Internal/external examiner can conduct practical Examination not more than 100 (Hundred) candidates (20 Candidates in one batch).
6. Each Candidate has to pass in Theory and Practical examinations separately.

**Paper – IX : Algebra**

**Teaching : 3 Hours per Week**

**Duration of Examination : 3 Hours**

**Max. Marks : 100**

**Note :** This Paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

- Unit 1 :** Definition and simple properties of Groups and Subgroups. Permutation group, Cyclic group. Cosets, Lagrange's theorem on the order of subgroups of a finite order group.
- Unit 2 :** Morphism of groups, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorems of Isomorphism.
- Unit 3 :** Definition and simple properties of Rings and Subrings. Morphism of rings. Embedding of a ring, Integral domain and field. Characteristics of a Ring and Field.
- Unit 4 :** Ideals and Quotient Ring. Maximal ideal and Prime ideal. Principal Ideal domain. Field of quotients of an integral domain. Prime fields. Definition, Examples and Simple properties of Vector spaces and Subspaces.
- Unit 5 :** Linear combination, linear dependence and Linear independence of vectors. Basis and Dimension. Generation of subspaces. Sum of subspaces. Direct sum and Complement of subspaces. Quotient space and its dimension.

**Paper – X : Complex Analysis**

**Teaching : 3 Hours per Week**

**Duration of Examination : 3 Hours**

**Max. Marks : 100**

**Note :** This paper is divided into FIVE Units. TWO questions will be

set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

**Unit 1:** Complex plane. Connected and Compact sets. Curves and Regions in complex plane. Jordan curve theorem (statement only). Extended complex plane. Stereographic projection. Complex valued function – Limits, Continuity and Differentiability. Analytic functions, Cauchy-Riemann equations (Cartesian and polar form). Harmonic functions, Construction of an analytic function.

**Unit 2 :**Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function, Morera's theorem, Poisson integral formula, Liouville' theorem.

**Unit 3 :**Taylor's theorem. Laurent's theorem. Maximum modulus theorem.

**Power series** – Absolute convergence, Abel's theorem, Cauchy-Hadamard theorem, Circle and Radius of convergence, Analyticity of the sum function of a power series.

**Unit 4 :**Singularities of an analytic function, Branch point, Meromorphic and Entire functions, Riemann's theorem, Casorati-Weierstrass theorem.

Residue at a singularity. Cauchy's residue theorem. Argument principle. Rouché's theorem. Fundamental theorem of Algebra.

**Unit 5 :**Conformal mapping. Bilinear transformation and its properties.

Elementary mappings :  $w(z) = \frac{1}{2} \left( z + \frac{1}{z} \right)$ ,  $z^2$ ,  $e^z$ ,  $\sin z$ ,  $\cos z$ , and  $\log z$ .

Evaluation of a real definite integral by contour integration. Analytic continuation. Power series method of analytic continuation.

**Paper – XI : Dynamics and Computer Programming in C**

**Teaching : 3 Hours per Week**

**Duration of Examination : 2½ Hours**

**Max. Marks : 68**

**Note :** This paper is divided into FOUR Units. TWO questions will be set from each Unit. Candidates are required to attempt FOUR questions in all taking ONE question from each Unit. All questions carry equal marks.

**Unit 1 :** Velocity and acceleration – along radial and transverse directions, along tangential and normal directions. S.H.M., Hooke's law, motion along horizontal and vertical elastic strings.

**Unit 2 :** Motion in resisting medium – Resistance varies as velocity and square of velocity. Work and Energy. Motion on a smooth curve in a vertical plane. Motion on the inside and outside of a smooth vertical circle.

**Unit 3 :** Central orbits – p-r equations, Apses, Time in an orbit, Kepler's law of planetary motion. Moment of inertia – M.I. of rods, Circular rings, Circular disks, Solid and Hollow spheres, Rectangular lamina, Ellipse and Triangle. Theorem of parallel axis. Product of inertia.

**Unit 4:** Programming languages and problem solving on computers, Algorithm, Flow chart, Programming in C-Constants, Variables, Arithmetic and logical expressions, Input-Output, Conditional statements, Implementing loops in Programs, Defining and manipulating arrays and functions.

**Practical :**

**Teaching : 2 Hours per Week per Batch  
(20 Candidates in each Batch)**

**Examination : Duration : 2 Hours**

**Scheme**

Max. Marks 32  
Min. Pass Marks 13

**Distribution of Marks :**

**Two Practicals of**

10 Marks each	=	20 Marks
Practical Record	=	06 Marks
Viva-voce	=	06 Marks
<b>Total Marks</b>	<b>=</b>	<b>32 Marks</b>

The paper will contain TWO practicals. The candidates are required to attempt both practicals.

Programming in C and execution for the result of

1. Solution of linear algebraic equations by Gauss elimination method
2. Solution of algebraic and transcendental equations by Bisection, False position and Newton – Raphson Methods

3. Solution of ordinary differential equations by Euler's and Runge-Kutta 4th order method
4. Numerical integration by Trapezoidal and Simpson's one third rule

**Note :**

1. Each Candidate (Regular/non-Collegiate) has to prepare his/her practical record.
2. Each Candidate has to pass in Practical and Theory examinations separately.

**Paper – XII : Any One of the Following :**

**Paper – XII (I) : Statistics**

**Teaching : 3 Hours per Week**

**Duration of Examination : 3 Hours**

**Max. Marks : 100**

**Note :** This paper is divided into FIVE Units. TWO questions will be set from each Unit. The candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

**Unit 1 :** Frequency distributions and measures of location, Measures of dispersion, Skewness and Kurtosis, Moments of frequency distributions.

**Unit 2 :** Mathematical expectation, Moment generating and Cumulative functions. Discrete probability distributions (Binomial, poisson, Geometric and Hypergeometric).

**Unit 3 :** Continuous probability distributions (Rectangular and Normal distributions).

**Unit 4 :** Methods of least squares and curve fitting. Correlation and Regression, Multiple and partial correlation.

**Unit 5 :** Theory of probability.

**Paper – XII (II) : Spherical Trigonometry and Astronomy**

**Teaching : 3 Hours per week**

**Duration of Examination : 3 Hours**

**Max. Marks: 100**

**Note :** This paper is divided into FIVE Units. TWO questions will be set from each Unit. The candidates are required to attempt FIVE question in all taking ONE question from each Unit. All questions carry equal marks.

- Unit 1 : Spherical triangles. Relation between sides and angles. Right angled triangles.
- Unit 2 : Celestial sphere. Astronomical coordinate system, Diurnal motion, Twilight.
- Unit 3 : Atmospheric Refraction. Time.
- Unit 4 : Precession and Mutation.
- Unit 5 : Aberration Parallax and Eclipses.

**Paper – XII (III) : Integral equations and Calculus of Variations**  
**Teaching : 3 Hours per Week**

**Duration of Examination : 3 Hours**                      **Max. Marks : 100**

**Note :** This paper is divided into FIVE Unit. TWO question will be set from each Unit. The candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

- Unit 1 : Linear Integral Equations - Definition and classification, Conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions and their properties for symmetric kernels. Solution of homogeneous and general Fredholm integral equations of second kind with degenerate kernels.
- Unit 2 : Iterated kernels and their properties. Construction of resolvent kernel with the aid of iterated kernels. Solution of Fredholm and Volterra integral equations of second kind by using resolvent kernel method. Fredholm determinants. Solution of Fredholm integral equation of second kind by using Fredholm determinants.
- Unit 3 : Laplace transform - Definition and its properties. Rules of manipulation. Laplace transform of derivatives and integrals. Properties of inverse Laplace transform. Convolution theorem.
- Unit 4 : Abel's integral equation and its generalizations. Application of Laplace Transform to solve the Volterra integral equations with convolution type kernels.
- Calculus of Variations - Variations and its properties. Euler's equation. Functionals. Functionals dependent on Higher order derivatives and functions of several independent variables.

**Unit 5 :** Variational problems in parametric form. The moving boundary

value problem for a function of the form  $\int_{x_1}^{x_2} f(z,y,z) dx$ .

Euler's finite difference method. Ritz method for variational problem.

**Paper-XII (IV) : Calculus of Several Variables**

**Teaching : 3 Hours per Week**

**Duration of Examination : 3 Hours**

**Max. Marks : 100**

**Note :** This paper is divided into FIVE Units. TWO questions will be set from each Unit. The candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

**Unit 1 :** Normed vector space, Distance, Inner product. Open and Closed sets. Compactness, Connectedness. Sequence and series. Continuous functions.

**Unit 2 :** Calculus in vector space - Functions on n-space, Space of continuous functions, Differentiability and the chain rule, Properties of derivative. Partial derivatives, Jacobian, Differentiation under integral sign.

**Unit 3 :** Mean value theorem and its applications. Higher derivatives and Taylor's formula. Invertible and implicit functions. Continuously differentiable functions. Maxima and minima.

**Unit 4 :** Multiple integral on  $R^n$  Closed n-rectangle. Lower and upper Riemann sums. Lower and upper Riemann integrals. Riemann integral. Characteristic function. Admissible function. Admissible set. Criteria for admissibility. Repeated integral. Change of variables.

**Unit 5 :** Ordinary Differential Equations - Integral and Approximate solutions. Lipschitz's property. Comparison of two approximate solutions. Existence and Uniqueness theorem (statement only). Linear differential equation.

(45)

## 6. GEOGRAPHY (HONS.)

*Scheme :**Minimum Marks : 160 (40%)**Maximum Marks : 400*

<i>Four Papers</i>	<i>Maxi.Marks</i>
Paper-IX India : A Systematic Geography	80
Paper-X Evolution of Geographical Thought	80
Paper-XI Agricultural Geography : An Introductory Course	80
Paper-XII Applied Geography	80
Practical	80

160

**Notes :**

1. Students are permitted to use stencils, simple calculator and Log tables wherever needed in the examinations.
2. One question (Question No. 1) of 20% marks of the total. Question No. 1 will be compulsory and will cover the entire course contents of the paper. Question be set in two Parts :
  - (a) Question on Map (to be supplied) of 10% marks.
  - (b) Question on objective type (Multiple choice and very short answer) of 10% marks.
3. Nine questions will be set with three questions from each section.
4. The Candidate will attempt five questions selecting at least one from each section.
5. The students are required to pass both in theory and practical separately.
6. The theory paper will be of 3 hours duration.

**Paper-IX : India : A Systematic Geography*****Section A***

India in the context of Asia and the world.

Systematic Geography :

Land—Major terrain units of India and their characteristics.  
 Drainage systems and their functional significance to the country. The Indian monsoon-regional and seasonal variations in climate and climatic

division : soil types, their characteristics and distribution and the problems of soil conservation, vegetation cover-vegetation types and their distribution. Forest resources and their conservation.

Mineral and power resources—reserves, production and problems of conservation, Resource regions of India.

*Section B*

People—Numbers, distribution density and growth, with special reference to the post-independence period. Socio-economic implications of explosive growth of population literacy and education-spatial patterns, urbanisation-its relation with economy and ecology.

Economy—Changing nature, Indian economy and over-view.

Agriculture—Main characteristics and problems of Indian agriculture, spatial aspects of irrigation developments, technological developments in Indian agriculture, green revolution and its spatial dimension, regionalisation of agriculture in India, food production and population growth.

*Section C*

Industry—Industrial development and the Indian economy-an overview. Locational factors and spatial pattern of major industries in India-iron and steel, engineering goods, textiles, chemicals, cement, sugar, paper etc. industrial regions of India.

Transport and Trade—Development of transport network, different modes and their functional significance. Internal and international trade-composition and change (both in spatial and temporal terms).

*Recommended Books :*

1. Bose, A. (ed.)—Pattern of population change in India, 1951-61, Allied Publishers, Bombay, 1967.
2. Davis, K—Population of India and Pakistan, Princeton University Press, Princeton, 1951.
3. Farmer, B.H.—An Introduction to South Asia, Methuen, London, 1983.
4. Government of India—The Gazetteer of India, Publication, Division, Ministry of Information and Broadcasting, New Delhi, 1965.
5. Mitra, Ashok—Levels of Regional Development of India, Vol.I-Part I-A(i) and (ii) Census of India Publication, New Delhi, 1967.

6. NATMO (G.O.I.)—National Atlas of India, NATMO, Calcutta.
7. Puri, G.S.—Indian Forest Ecology, Volumes I & II Oxford Book and Stationary Co., New Delhi, 1960.
8. Sdasyuk, G. and Sengupta—Economic Regionalisation of India, Census of India Publication, New Delhi, 1968.
9. Sharma. T.R.—Location of Industries in India. Hind Kitab, Bombay, 1949.
10. Singh. R.L. (ed). India—Regional Studies, Published for the 21st International Geographical Congress held New Delhi. 1968.
11. Singh, R.L. (ed).—India A Regional Geography. National Geographical Society of India, Varanasi, 1971.
12. Spate, O.H.K. and Learmonth, A.T.A.—India and Pakistan, Land, People and Economy, Methuen & Co., London, 1967.
13. Srivastava, M.A. : Trade of India, S. Chand & Co., Delhi, 1967.
14. Wadia, D.N.—Geology of India, MacMillan & Co., London, 1967.
15. Wadia, Mehar and Wadia, D.N.—Minerals of India, National Book Trust, New Delhi, 1966.

**Paper-X : Evolution of Geographical Thought**

***Section A***

The nature of Geography is the early classical period with reference to the works of Horodotus, Eratosthenes, Strabo and Ptolemy. Early Medieval Geography.

***Section B***

The Revival of Geography from the 16th to the early 19th century.

The Works of Varenius. Humboldt and Ritter.

The Nature of Geographical Thought in the second half of 19th century.

The dualism in Geography.

***Section C***

The Works of Peschel and W.M. Davis, Ratzel, Semple Richtnofen,

Hetter, Herbertson and Saur. Concepts of Areal differentiation and Region.

Natural Regions and Geographical Regions, Concept of Ecology.

**Recommended Books :**

1. Hartshorne, Richard : The Nature of Geography (Annals of American Geographers 1939-1947).
2. Hartshorne, Richard : Perspective on the Nature of Geography, John Murray, London.
3. Taylor, Griffith (Ed) : Geography in the Twentieth Century, New York, 1951.
4. James, Preston E.—American Geography : Inventory and Prospects, Syracuse, 1945.
5. Bowman, Isabiah : Geography in Relation to the Social Science New York, 1934.
6. Mackinder, Halford, J. : On the Scope and Method of Geography. Proceedings of the Royal Geographical Society, 1887.
7. Wooldridge, S.W. and W.G East : Spirit and Purpose of Geography.
8. Dickinson, R.E. : Makers of Modern Geography.

**Paper-XI : Agricultural Geography**  
**An Introductory Course**

**Section A**

Nature, Scope and significance of Agricultural Geography.

Approaches to the study of Agricultural Geography—commodity, environmental, systematic and regional.

Determinants of agricultural Land use—Physical, Social, Economic and cultural.

**Section B**

Whittlesey's agricultural types—their characteristics and distribution in the world.

A critical review of Whittlesey's agricultural classification.

*Section C*

Indian Agriculture—(a) Problems and prospects, (b) regions.

*Recommended Books :*

1. Alexander, J.W. : Economic Geography, Prentice Hall, Inc. Englewood Cliffs, N.J. Latest Edition.
2. Symons, L. : Agricultural Geography, G. Bell & Sons, London, 1964.
3. Husain, M. : Agricultural Geography, Inter-India Publications, New Delhi, 1979.
4. Singh, J. and Dhillon, S.S. : Agricultural Geography, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1984.
5. Grigg, D.B. : Agricultural Systems of the World and Evolutionary Approach, Cambridge University Press Cambridge, 1978.
6. Whittlesey, Darwent, S. : Major Agricultural Regions of the Earth. Annals of the Association of American Geographers. Vol. 26, 1936.
7. Tewari P.S. (ed) : Contribution to Agricultural Geography, Heritage, Delhi, 1986.

*Reference Books :*

1. Gregor, H.F. : Geography of Agriculture—Themes in Research, Prentice Hall Inc., London, 1970.
2. Morgan, W.B. and Mutton, R.J.C.—Agriculture Geography, Methuen, London, 1971.

Paper-XII Applied Geography

*Section A*

Nature, scope and content of applied geography; identification of problems of interdisciplinary nature (like environment resource base, resource-use, development and disparity).

Issues related to variations in physical environment. Variations

land quality affecting agricultural productivity; environmental degradation, environmental disaster and environmental management.

**Section B**

Issues related to human resource-quality vs numbers; social and demographic issues; diversity and disparity; carrying capacity of the earth; human resources use and manpower planning.

Issues related to economy; spatial organization of economic activities (like agriculture, industry, transport, trade, etc.) spatial inequalities-causes and consequences.

**Section C**

Environment and sustainable development with a focus on man environment relationship. Review of policies related to planning formulated for local, regional and national level with special reference of india.

**Recommended Books :**

1. Dohrs, F.E. and Sommers, L.W. (eds.): Introduction to Geography, Thomas Y. Crowell Co., New York, 1967.
2. Hartshorne Richard; Perspective on the nature of Geography Rand Mc Nally & Co. Chicago, 1959.
3. Harvey, David.: Explanation in Geography, Edward-Arnold, London, 1972.
4. Hold-Lensen, A : Geography Its History and Concepts, Longmans, 1980.
5. Husain Majid : Evolution of Geographica Thought, Rawat Publications, Jaipur, 1984.
6. James, P.E.: All possible Worlds: A History of Geographical Ideas, Sachin Publication, Jaipur, 1980 (Indian reprint).
7. Johnston, R.J. and Claval, P.(eds.) : Geography since the Second World War, Croom Helm, London/Bernes and Noble, Totowa, N.J., 1984.
8. Jones, P.A.: Fieldwork in Geography, Longmans.

9. Lownsburg, J.F. and Aldrich, F.T.: Introduction to Geographical Methods and Techniques, Charles Marrill, Columbus, 1979.
10. Minshull, R. : The Changing Nature of Geography, Hutchinson University Library, London, 1970.
11. Worldridge, S.W. : The Geographer as a Scientist, Thomas Nelson and Sons Ltd., London, 1956.
12. Misra, V.V., Ayyar, N.P. et.al. (editors) : Essay in Applied Geography University Printing Press, Saugar, 1976.

**Practicals : Map Projectionis & Surveying**

General Principles, classification, identification, transformation and choice of projections.

Construction, Properties, limitations and uses of the following projection :

Cylindrical : Simple, Equal Area and Mercator's

Conical : One standard, Two standard Boone's, Polyconic and international.

Zenithal : Gnomonic, Stereographic Orthographic, Equidistant and Equal Area (Polar Cases only).

Conventional : Sinusoidal and Mollwede's (normal Cases only).

Dumpy level : Survey and Contouring.

***Recommended Books :***

1. Kellaway, George, P.—Map Projections, Methuen & Co., London.
2. Steers : J.A.—Map Projections, University of London Press, London.
3. Singh, R.L.—Practical Geography, Kalyani Publishers, New Delhi.

***Reference Books :***

1. Gamett. William—Map Projections, George Philip & Sons., London.
2. Jameson, A.H. & Ormsby, M.T.M.—Mathematical Geography, Vol. I, Isaac Pitman & Sons., London.