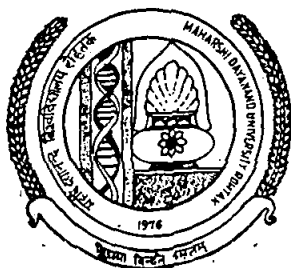


Maharshi Dayanand University Rohtak



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Ordinances, Syllabus and Courses of Reading for M.Sc. (Final) Botany/Zoology Env. Bio- Chem./Bio-Tech. Examination

Session—1999-2000

Available from :

Deputy Registrar (Publication)
Maharshi Dayanand University
Rohtak-124 001 (Haryana)

Price :

At the Counter : Rs. 50/-
By Regd. Parcel : Rs. 75/-
By Ordinary Post : Rs. 60/-

ORDINANCE - 'MASTER OF SCIENCE EXAMINATION'

1. The Master of Science Examination shall be held in two parts. Part-I Examination shall be held at the end of the first year and Part-II Examination at the end of the second year.

2. The Examination in Part-I and Part-II shall be held once a year ordinarily in the month of April on such dates as may be fixed by the Vice-Chancellor.

A supplementary examination in Part-II of M.Sc. will be held in December for those candidates who have passed all the papers of Part-I examination but have got 'reappear' or have failed or want to improve their score in paper(s) of part-II examination. However, total number of chances will not exceed as given in the Ordinance.

3. The last date for the receipt of admission form and fee without late fee as fixed by the Vice-Chancellor shall be notified to the Heads of the University Teaching Departments and the Colleges concerned.

4. A candidate's admission form and fee may be accepted after the last date on payment of Rs. 105/- up to the date notified by the University.

No late fee shall be charged if the admission form and fee are received within three working days of grace after the last date for the receipt of the same without late fee.

5. No one shall be eligible to join the first year (Part-I) class of M.Sc. Course unless he has passed one of the following examination:-

a) B.Sc. (Hons.) examination of this University with atleast 45% marks in the aggregate in the subject offered for the M.Sc. Course.

b) B.Sc. (Pass) examination with atleast 50% marks in the aggregate.

c) An examination of any other university recognised by the University as equivalent to (a) or (b) above.

Provided that:

i) to be eligible to join M.Sc. Course in Physics, a candidate must have passed B.Sc. Examination with Physics and Mathematics as two of the main subjects:

- ii) to be eligible to join M.Sc. Chemistry, a candidate must have passed B.Sc. Examination with Chemistry as one of the main subject.

Note: A Minimum of 25% of the total seats shall be filled in by the students who have passed the B.Sc. Examination with Chemistry, Physics and Mathematics. Any seat remaining unfilled out of this quota may be offered to other-eligible candidates.

- iii) to be eligible to join M.Sc. course in Bio-Science, a candidate must have passed B.Sc. Examination with Botany, Zoology, Bio-Sciences and any one of the subjects viz. Chemistry, Bio-Chemistry, Micro-Biology Fisheries and Geology.

Note: The candidates will be required to opt for Animal Sciences or Plant Sciences or Environmental Biology in M.Sc. final course which will be allowed after taking into consideration the performance of the candidate in M.Sc. previous examination. However, an indication to this effect will be required to be given by the candidate at the time of his admission.

- iv) conditions for admission to M.Sc. Course in Mathematics shall be same as prescribed for admission viz. M.A. Course in this subject.
- v) To be eligible to join M.Sc. Course in Geology, a candidate must have passed B.Sc. Examination with atleast 50% marks in the aggregate with Geology and any of two of the subjects viz. Physics, Mathematics, Chemistry Botany, Zoology, Bio-Science and Geography.
- vi) to be eligible to join M.Sc. Course in Mathematical Statistics and Operations Research a candidate must have passed B.A./B.Sc. (Pass) Examination with atleast 50% marks in the aggregate with Mathematics or Statistics as one of the subjects or have passed B.A./B.Sc. (Hons.) Examination in Mathematics or Statistics with atleast 45% marks in Mathematics/Statistics.

There shall be a Project Report in M.Sc. Mathematical Statistics (Final) and that the project report shall be evaluated by the external examiner on five point grading. The last date for submission of Project Report will be two months after the theory papers which can be extended further by two months

with the permission of the Vice-Chancellor.

Note : *A candidate who is placed under compartment in the qualifying Examination shall not be allowed to join M.Sc. Course. He/She will be eligible only after clearing the qualifying Examination.*

6.1 A candidate who has failed in one or more papers or fails to appear in the examination shall be allowed two additional subsequent chances only to pass the examination.

6.2 A candidate who fails to pass the M.Sc. examination within a period of four years of his admission to the course shall be deemed to be unfit for postgraduate studies in the subject concerned.

6.3 A person who has passed the M.Sc. (Previous) examination in the subject concerned from this University shall be eligible to join the M.Sc. final class. This is subject to Clause-6.2 above. However, the candidates who have passed atleast two theory papers out of four or five theory papers or atleast three theory papers out of six or seven theory papers of part-I examination of this University will be promoted to Part-II Class, provisionally.

7. M.Sc. Examination in Part-I/Part-II shall be open to a student who:-

- a) has passed the requisite qualifying Examination or is covered under Clause-6 and
- b) has his name submitted to the Controller of Examinations by the Head of the University Department/Principal of the College, he has most recently attended and produces the following certificates signed by him:-
 - i) of possessing good character.
 - ii) of having remained on the rolls of the Department/College, during the year preceding the Examination.
 - iii) of having attended not less than 65% of full course of lectures and tutorial separately and 75% of practicals in each part (the course to be counted upto the last day when the classes break up for the preparatory holidays).

8. A candidate whether a regular student or an ex-student shall submit his admission application to the Registrar/Controller of Examinations duly signed by the Principal of the College/Head

of the University Department he has last attended.

9. Every candidate shall be examined according to the Scheme of examination and syllabus as approved by the Academic Council from time to time.
10. The amount of Examination fee to be paid by a candidate for each part shall be as follows:-

Regular student	Ex-student
Rs. 100/-	Rs. 110/-

Note:- *Plus Rs. 20/- per practical subject.*

A candidate who re-appears in one or more theory or practical papers for the purpose of passing the examination or a candidate who appears in one or more theory papers for the purpose of improvement of score of marks/result shall pay fee as for the whole examination.

11. The medium of instructions and examination shall be English.
- 12.1. The minimum number of marks required to pass the examination shall be as under:-
 - i) 33% in each paper (written and practical) separately;
 - ii) 40% in dissertation/Viva-voce where prescribed;
 - iii) 40% in the aggregate.
- 12.2. A candidate who has completed the prescribed course of instructions in a College/University Teaching Department for Previous/Final examination but has not appeared in it or have appeared fails may be allowed on the recommendation of the Principal of the College/Head of University Teaching Department concerned to appear in the subsequent years in the examination paper(s) as the cases may be without attending a fresh course of instructions while re-appearing in the examination, the candidate shall be exempted from re-appearing in the paper(s) and/or practical(s) in which he has obtained atleast 40% marks.
13. As soon as possible, after the termination of the examination the Registrar/Controller of Examinations shall publish the result of the Candidates and issue Detailed Marks Card.
14. The result of candidates who have passed M.Sc. examination shall be classified into divisions, as under and the division obtained by the candidate will be stated in his degree.

inform the Controller of Examinations for the declaration of his result.

Provided further that the candidate will take the examination according to the syllabus in force for the regular students for that examination. Provided that the syllabus for the candidates for the special examination to be held in September/October shall be the same as was in force for the regular student in the last annual examination.

18. Notwithstanding the integrated nature of this course which is spread over more than one academic year, the Ordinance in force at the time a student joins the course shall held good only for the examination held during or at the end of the academic year and nothing in this ordinance shall be deemed to debar the University from amending the Ordinance and the amended Ordinance, if any, shall apply to all students whether old or new.

19. Candidate admitted to M.Sc. Course in 1990-91 or earlier shall be governed by the old rules. The new rules shall be applicable w.e.f. the admission of academic Session 1991-92.

SCHEME OF EXAMINATIONS OF M.Sc. (FINAL) BOTANY

There will be five theory papers of 70 marks each and there will be two practicals papers of 75 marks each.

Paper No.	Title of paper	Max. Marks	Time of Exam.
Theory			
VIII	Angiosperm Morphology and Anatomy	70	3 Hours
IX	Crop Improvement	70	3 Hours
X	Developmental Botany & Palynology	70	3 Hours
XI	Plant Physiology	70	3 Hours
XII	Plant Diversity	70	3 Hours
Practical			
XIII	Angiosperm Morphology, Taxonomy, Crop Improvement & Development Botany	75	6 Hours
XIV	Plant Physiology & Plant Diversity	75	6 Hours
Total Marks		500	

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**Paper-VIII ANGIOSPERM MORPHOLOGY,
TAXONOMY AND ANATOMY**

Max. Marks :70
Time : 3 Hours

Note : In all ten questions will be set two from each Unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

Angiosperm Morphology

- 1 General concept of the morphology, origin and evolution of flower vis-a-vis pollinators.
- 2 Origin and evolution of polypetal, Sympetal, apetal, monocy and dioecy.
- 3 Stamen origin and evolution from foliar to reduced condition extension of connective beyond anthers, mono, di-and poly adelphy.
- 4 Carpels : evolution conduplicate, involute and other types, validity of the concept of foliar origin of carpel, alternative concepts and approaches, superior, semi-inferior and inferior ovary, evolution of types of placentations.
- 5 Role of floral anatomy in taxonomy.

Unit-II

Taxonomy

- 1 **Botanical Nomenclature** : History, ICBN, principles, articles, recommendations and amendments of code. Botanical Survey of India (BSI), its organization and role.
- 2 **Classification of Angiosperms** : Historical account, principles of Taxonomy, systems of classification-Bentham and Hooker Engler and Prantl, Hutchinson, Takhtajana, Cronquist & Dallgren and Thorne.
- 3 **Origin and evolution of Angiosperms** : Origin, evolution and interrelationship, dicots and monocots.

Unit-III

- 1 Tools for taxonomic data: Morphological, Physiological Embryological, Anatomical, Cytological, Phytochemical and Numerical Taxonomy.
- 2 Salient features of the following families : Monocots, Crchidacedl, Musaceal, Zingiberabcene, Cannacea, Amarylliaceae, Palmae Cyeraceae, Cramineae (poaceac).

Unit-IV

Salient features of the following dicot families-Ranunculaceac, Magnoliaceae, Nympheaceae, Cruciferac, Papaveraceae, Capparideaceae, Caryophylaceae, Malvaceae, Tiliaceae, Sterculiaceae, Rutaceae, Meliaceae, Anancarediaceae, Fabaceae, Sterculiaceae, Rosaceae, Myrtaceae, Cucurbitacea, Cactaceae, Umbelliferae, Rubiaceae, Composieac, Scrophurlarioaceae, Apooynameae, Chenopodiaceae, Acanthaceae, Labiatae, Verbenaceae, Nyctaginaceae, Amaranthaceae.

Unit-V

Anatomy

1. Meristems: Apical, lateral and intercalary, organisation of root and shoot-apices, organogenesis and differentiation.
2. Ontogeny, Phylogeny, evolution, ultra structure and functions of primary and secondary xylem, wood anatomy.
3. Ontogeny, Phylogeny, evolution, ultra structure and function of primary and secondary phloem.
4. Vasoular oambium & cork cambium origin, structure and activity.
5. Nodal anatomy-nodal types, phylogenetic and evolutionary considerations.
6. Normal and anolamous secondary growth in dicots and monocots (root and stem).
7. Structural variability in leaves, development and ultra structure of trichomes and stomata, Leaf Architecture.

Paper-IX CROP IMPROVEMENT

Max. Marks : 70

Time : 3 Hrs.

Note :In all ten questions will be set two from each unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

- 1.1 Introduction to plant breeding-objectives of plant breeding, genetic variability and its role in plant breeding, centre of origin of crop plants.
- 1.2 Method of reproduction and breeding : breeding methods in self pollinated and cross pollinated plants, methods of breeding in vegetatively propagated and apomictic plants.
- 1.3 Heterosis and in-breeding depression-genetic basis of in-breeding depression, genetic, physiology and biochemical basis of heterosis, exploitation of hybrid vigour, production of hybrids, composites and synthetics.

Unit-II

- 2.1 Role of mutation in crop improvement, methods for maximization of mutation frequency, semidwarf mutants in wheat, rice & barley, photosynthetic mutants, disease resistant mutants, stress tolerant mutants.
- 2.2 Genetic of seed storage protein: Structure, organisation and expression of storage protein genes, modification of storage protein genes for improvement in nutritional quality.

Unit-III

- 3.1 Genetic of disease and insect resistance, horizontal resistance, vertical resistance, multiline concept, strategies of breeding for disease and insect resistance.
- 3.2 Genetics of stress tolerance : in vivo and in vitro responses to stress, selection for stress tolerance, strategies for transfer of stress tolerance genes.

Unit-IV

- 4.1 Genetics of Nitrogen fixation, symbiotic & non-symbiotic nitrogen fixation, organization & genetic analysis of 'nif' genes in Klebsiella, genetics of host genes, 'hup' genes, genetic regulation of nitrogen fixation.

- 4.2 Genetics of photo synthesis : genetic determinants of photo synthetic apparatus, characterization & mapping of photo synthetic genes, regulation of photosynthetic genes, recent developments.

Unit-V

- 5.1 Role of tissue culture in crop improvement, isolation & characterization of variants, somaclonal variation & their role in crop improvement.
- 5.2 Transgenic plants : production of transgenic plants for virus, herbicide, insect/pest tolerance through recombinant DNA techniques.

Paper-X DEVELOPMENTAL BOTANY AND PALYNOLOGY

Max. Marks : 70

Time : 3 hrs.

Note :In all ten questions will be set, two from each unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

- 1.1 **Microsporangium** :Structure and functions of wall layers, ultrastructural, changes in tapetum and meiocytes during microsporogenesis, role of tapetum.
- 1.2 Pollen wall morphogenesis, microspore/pollen mitosis, division of generative cell, heterogeneity in sperms, pollen fertility and sterility, pollen storage, viability and germination.
- 1.3 Another culture and haploids.
- 1.4 Ovule-ontogeny, types and evolution.
- 1.5 Megasporogenesis-subcellular profiles of archesporial and megaspore mother cell, megaspore tetrad, dyad and coenomegaspore determination of functional megaspore/dyad.
- 1.6 Embryosac types, ultrastructure of components, synergids and antipodal haustoria, nutrition of embryosac.

Unit-II

- 2.1 Ovule and ovary culture.

- 2.2 Pollination : structure and function of stigma & style, self and interacific incompatibility, significance pollen-pestil interaction, role of pollen wall proteins.
- 2.3 Barriers of fertilization, methods of overcoming incompatibilities.
- 2.4 Intra-ovarian pollination, in vitro pollination.
- 2.5 Fertilization : hetero spermy, differential behaviour of male gametes, discharge and movement of sperms, syngamy and triple fusion.
- 2.6 Parasexual hybridization.

Unit-III

- 3.1 **Endosperms:** Types, ultrastructure, endosperm haustoria, function, storage of metabolites.
- 3.2 Endosperm culture.
- 3.3 **Embryo:** Embryonic types, histo-and organogenesis of mono-and-dicotyledon, embryos, role of suspensor.
- 3.4 Embryo culture, rescue of hybrid embryos.
- 3.5 **Polyembryony :** Types, Gynogenesis, androgenesis, somatic embryogenesis. Agri-horticulture importance.
- 3.6 **Apomixis :** Diplospory, apospory, Parthenogenetic development of embryo, importance.
- 3.7 Parthenocarpy.

Unit-IV

- 4.1 Cell heterogeneity in plants, unequal divisions in embryo development and cell differentiation.
- 4.2 **Polarity.**
- 4.3 **Symmetry.**
- 4.4 **Cell Recognition :** Somatic & gametic communicators.
- 4.5 **Cell interaction :** Transfer of macro molecules & micro molecules between cells.
- 4.6 Apical meristem self organizing properties & stability.

Unit-V

- 5.1 Morphogenesis.

- 5.2 Biochemical interaction between the nucleus & cytoplasm during morphogenesis.
- 5.3 Classical concepts of development.
- 5.4 molecular explanations for development.
- 5.5 How genes are controlled in development.

Paper-XI PLANT PHYSIOLOGY

Max. Marks : 70

Time : 3 hrs.

Note : In all ten questions will be set, two from each, unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

- 1.1 Development of nodules in leguminous plants.
- 1.2 Physiology and biochemistry of reduction of nitrogen to ammonia with special reference to regulation of nitrogenase activity.
- 1.3 Significance of symbiotic nitrogen fixation in plant productivity.
- 1.4 Inorganic nitrogenous forms available to the plants.
- 1.5 Uptake and absorption of nitrate and ammonium.
- 1.6 Reduction of nitrate to nitrite and nitrite to ammonia.
- 1.7 Nit Isomorphous forms. Ammonia assimilation and primary amination reactions.
- 1.8 Factors affecting inorganic nitrogen assimilation.
- 1.9 Sulfur metabolism in plants.
- 1.10 Energetics of nitrogen fixation.

Unit-II

- 2.1 Current attitudes in photosynthesis.
- 2.2 Physical aspects of light in relation to photosynthesis.
- 2.3 Physical aspects of light harvesting centres.

- 2.4 Electron transport systems.
- 2.5 Oxygen production and role of magniseum.
- 2.6 Electron transport inhibition mechanism.
- 2.7 The oxidizing and reducing site of photosystem I and photosystem II.
- 2.8 Photophosorylation of electron transport. Various theories/mechanisms on photophosorylation.
- 2.9 Photorespiration.

Unit-III

- 3.1 Auxin-Biosynthesis, metabolism, transport physiological effects, mechanism of action.
- 3.2 Gibberellins occurance and distribution, chemical structure metabolism, action of gibberellins.
- 3.3 Cytokinins-Nature and distribution, identification and measurement, physiology, mechanism of action.
- 3.4 Abscisic acid : Structure, Biochemistry and function mode of action.
- 3.5 Ethylene-Ethylene production, plant response to ethylene mode of action.

Unit-IV

- 4.1 Concept on aging and senescence.
- 4.2 Changes in structure and function of chloroplast during aging.
- 4.3 Changes in pigment composition during natural aging and stress induced aging.
- 4.4 Changes in memberane stability during aging.
- 4.5 Changes in cytoplasmic active protein during aging.
- 4.6 Concept on occurance of Rhythms in lower and higher plants.
- 4.7 Terminology, endogenous and exogenous contact of rhythms.
- 4.8 Rhythms of CO₂ metabolism, control of phase effect of physical factors, role of membrane, biological significance.
- 4.9 Ionic relation-Basic aspect of membrance structure, active ion transport, passive ion transport.

Unit-V

- 5.1 Concept of phytochrome.
- 5.2 Mechanism, photochemistry of phytochrome, regulation.
- 5.3 Photomorphogenesis.
- 5.4 Juvenility, photoperiodism and vernalization.
- 5.5 Germination and dormancy.
- 5.6 Plant nutrition, role of nutrients and their deficiency symptoms.
- 5.7 Beneficial and toxic elements.
- 5.8 Physiology of marine plants. Physiological adaptation, reaction to environmental factors, peculiarities of algal metabolism.
- 5.9 Physiology of plant distribution and communities.
- 5.10 Physiological factors in plant distribution.

Paper-XII PLANT DIVERSITY

(Algae, Fungi, Bryophytes, Pteridophytes & Gymnosperms)

M.M. 70

Time : 3 hrs.

Unit-I

- 1.1 Classification of Algae.
- 1.2 Central characteristic of the phyla Englenophyta, Dinophyta chrysophyta and Cryptophyta.
- 1.3 Role of algae in soil fertility, Algae as indicators of pollution Algae blooms, fossils algae, Marine adaptation in algae.
- 1.4 Economic importance of Algae in Bio-technology.

Unit-II

Fungi

- 2.1 Classification of Fungi (Alexopolous Mins)
- 2.2 Life cycle patterns in Fungi, fungal Nutrition and Fungal hormones.
- 2.3 Economic importance of Fungi, Mushroom cultivation nycorrhizal application in agriculture and plant growth.
- 2.4 Role of Fungi in Industry.

Unit-III**Bryophytes**

- 3.1 Classification and Origin of Bryophytes, & evolutionary lines.
- 3.2 Bryophytes as pollution indicators and their role in monitoring economic importance.
- 3.3 Fossil Bryophytes.

Unit-IV**Pteridophytes**

- 4.1 Classification and origin of Pteridophytes
- 4.2 Comparative accounts of structure and reproduction of : Psilophytales, Psilotales, Lyceediales, Bepidodenuroles Osmuncales Filicales Marsileases Saloiniales.
- 4.3 Soral evolution Telecom Theory, Prothallial evolution

Unit-V**Gymnosperms**

- 5.1 Classification of gymnosperms
- 5.2 Histochemical and structural aspects of development in gymnosperm. Evolution of archogonium
- 5.3 Fossil Gymnosperms
- 5.4 Economic importance of Gymnosperms.

Books Suggested :

- 1 Cryptogamic Botany-by Smith Vol. I,II.
- 2 Algae-by Morris
- 3 Biology of Algae by round.
- 4 Fungi by Alexopolous.
- 5 Introduction to Fungy by Webster.
- 6 Fungi by H.C Dube.
- 7 Structure and Life History of Bryophytes by J.D. Waston.
- 8 Interrelationship of Bryophytes by C. Vers
- 9 Morphology of Pteridophytes-by K.K.Sperne.
- 10 Aspects of Plant Science Vol. 36 by S.S. Bir.

- 11 An introduction to Pteridophytes by Rashid.
- 12 Bryophytes by P.Puri.
- 13 Gymnosperm : by Structure & Evolution by Chambslin, C.J.
- 14 Gymnosperm by P.C. Vashistha
- 15 Morphology of Gymnosperms-by Coulter and Chamberlin
- 16 Studies in Paleobotany by A.N. Andrews
- 17 An introduction of Paleobotany by C.A.Arnold.

Note :The examiner shall set ten questions and the students shall be required to attempt five questions, one question from each unit.

**SCHEME OF EXAMINATIONS OF M.SC. (FINAL)
ZOOLOGY**

There will be five theory papers of 70 marks each and there will be two practicals papers of 75 marks each.

Paper No	Title of paper	Max. Marks	Exam. Time
Theory			
VIII	Entomology, Parasitology & Fisheries	70	3 hrs.
IX	Population Biology, Social Biology & Wild life	70	3 hrs.
X	Developmental Zoology	70	3 hrs.
XI	Animal Physiology	70	3 hrs.
XII	Animal Diversity	70	3 hrs.
Practical			
XIII	Entomology, Parasitology & Fisheries, Wild Life & Development Zoology	75	6 hrs.
XIV	Animal Physiology and Animal Diversity	75	6 hrs.
Total Marks		500	

Paper-VIII ENTOMOLOGY, PARASITOLOGY & FISHERIES

Max. Marks : 70

Time : 3 hrs.

Note :In all ten questions will be set two from each unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

- 1.1 Pests and their control- Biological control of insect pests.
- 1.2 Chemical control of insect pests.
- 1.3 Newer methods of insect control including genetic methods.
- 1.4 Integrated pest management-Its philosophy, strategies and tools.
- 1.5 Relevance of integrated pest management in pest control operations.
- 1.6 Insects of commercial importance and their culture : Honey bee, silk worm and Lac insect.

Unit-II

- 2.1 Introduction, origin and evolution of parasitism. Parasitic adaptation and host specificity.
- 2.2 Morphology, life cycle, Pathogenicity and profilaxis of **Fasciolopsis, Clonorchis, Microcellium, Paragonimus, Schistosoma, Gastrodiscocoides.**
- 2.3 Morphology, life cycle, pathogenicity and profileaxis of **Trichinella, Enterobius, Strongylodes, Necator, Ancylostoma Wucheria.**
- 2.4 Morphology and life cycle of **Macracanthorhynchus.**

Unit-III

- 3.1 Planning and management of a freshwater fish farm-survey, layout, soil and water requirement, preparation of nursery, rearing and stocking ponds, control of predatory and weed fishes, liming and manuring, stocking ratios for composite culture, artificial feeds and supplementary feeding, harvesting.

- 3.2 Integrated fish culture-paddy cum fish culture, fish cum duck, fish-cum- pig culture.
- 3.3 Induced breeding of major carps through hypophysation. Principle, technique and advantages.
- 3.4 Control of sex through sex hormones.
- 3.5 Chromosome set manipulation and polyloidy.
- 3.6 Selective breeding and hybridization.

Unit-IV

- 4.1 Fish preservation-Handling and cleaning, chilling, freezing, quick-freezing, use of chemicals and antibiotics, irradiation, salting, drying, smoking, canning and pickling.
- 4.2 Fish Pathology-symptoms, aetiology, prophylaxis and treatment of common diseases in cultivable fish.
- 4.3 Aquaria, setting up of and maintenance of an aquarium ornamental fishes.
- 4.4 Prawn culture.
- 4.5 Fish products and by products.
- 4.6 Biochemical composition and nutritive value.

Unit-V

- 5.1 Immune reaction to try phosomes and their evading mechanisms.
- 5.2 Abiastins and antigenic variations.
- 5.3 Molecular basis of antigenic variation in parasites.
- 5.4 Probe technology for parasitic diagnosis.
- 5.5 Imunity to malaria.
- 5.6 Immunity to Leishmaniasis and Trypanosomiasis.
- 5.7 Immunity to Filariasis.

Paper-IX POPULATION BIOLOGY, SOCIAL BIOLOGY AND WILD LIFE

Max. Marks :70

Time : 3 hrs.

Note :In all ten questions will be set two from each unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

- 1.1 Population structure : Sex structure and ratio, age structure, age classes and age pyramids.
- 1.2 Genetic structure genetic patterns in animals.
- 1.3 Ecological, trophic and phenological characteristics of population.
- 1.4 Size of natural population, factors affecting population size, range of population.
- 1.5 Population as Unit of evolution, geographical and ecological races.
- 1.6 Semispecies and incipient species.

Unit-II

- 2.1 Biogeography, its field and function.
- 2.2 Evolution and temporal distribution of life, factors influencing geographic distribution.
- 2.3 Zoogeographical realms and the pattern and causes of faunal distribution.
- 2.4 Geographical and other barriers limiting migrations and dispersal of animal on earth.
- 2.5 Life on isolated and remote island.
- 2.6 Role of man in animal distribution and misuse of environment.
- 2.7 Recent trends and conservation movement for the future distribution and survival of animal species.

Unit-III

- 3.1 Origin and analysis of sociality in animals.
- 3.2 Social integration by signals.
- 3.3 Honey bee dance and dance in spiders.
- 3.4 Appeasement behaviour.
- 3.5 Social insects.
- 3.6 Schooling in fishes, its evolution and survival value.

- 3.7 Flocking behaviour and hierarchy in birds.
- 3.8 Territory and social hierarchy in mammals.

Unit-IV

- 4.1 Distribution of wild life in India, wild life habitat.
- 4.2 Wild life territory and moments.
- 4.3 Characteristics of wild life.
- 4.4 Dynamics of Wildlife.
- 4.5 Regulation of wild life population.
- 4.6 Wildlife and land use.
- 4.7 Methods of studying wild life census of wild life, bird-ringing.
- 4.8 Wild life conservation, Red-data books, organisation management of Wild life, sanctuaries and parks.

Unit-V

- 5.1 Project Tiger.
- 5.2 Gir Lion Sanctuary project.
- 5.3 Crocodile breeding project.
- 5.4 Project Hangul.
- 5.5 Ecology and conservation of the Himalayan Musk Deer.
- 5.6 Manipur brow-antlered deer

Paper-X DEVELOPMENTAL ZOOLOGY

Max. Marks : 70
Time : 3 hrs.

Note : In all ten questions will be set, two from each unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

- 1.1 Development and differentiation of spermatozoa, Types of sperms; viability of sperms, capacitation.
- 1.2 Differentiation and growth of oocytes;

- 1.3 Vitellogenesis.
- 1.4 Fertilization; Acrosomal reaction and activation of egg.
- 1.5 Parthenogenesis-Natural and artificial; significance;
- 1.6 Culture of eggs & embryos *in vitro*.

Unit-II

- 2.1 Cleavage and its pattern.
- 2.2 Biochemical changes during cleavage.
- 2.3 Gastrulation and morphogenetic movements.
- 2.4 Concept of organizer and Induction.
- 2.5 Concept of growth at cellular, sub-cellular and organ level.

Unit-III

- 3.1 Cell division and cyto differentiation.
- 3.2 Stability of differentiated state of cells.
- 3.3 Differentiation; modulation; metaplasia and transdifferentiation.
- 3.4 Differentiation gene out of control.
- 3.5 Genomic alteration in Lymphocyte differentiation.

Unit-IV

- 4.1 Metamorphosis in insect and frogs.
- 4.2 Regeneration of tail in amphib and reptiles.
- 4.3 Senescence-Cellular and genetic basis of ageing;
- 4.4 Nuclear and cytoplasmic interaction.
- 4.5 Molecular basis of early embryonic development.

Unit-V

- 5.1 Control of gene activity during development at transcriptional level.
- 5.2 Control at mRNA processing.
- 5.3 Control at translational level.
- 5.4 Epigenetic modification of proteins.
- 5.5 Cell, tissue and organ culture.

Paper-XI ANIMAL PHYSIOLOGY

Max. Marks : 70

Time : 3 hrs.

Note : In all ten questions will be set, two from each unit. Students are required to attempt five questions, selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I**Physiology of respiration**

- 1.1 Exchange of respiratory gases at the pulmonary surface.
- 1.2 Transport of respiratory gases by blood.
- 1.3 Factors effecting combination of oxygen with haemoglobin.
- 1.4 Neural and hormonal control of breathing.
- 1.5 Distribution and brief chemistry of respiratory pigments.
- 1.6 Respiratory acidosis and alkalosis.
- 1.7 The concept of alkali reserve and regulation of blood PH.

Unit-II**Physiology of excretion and Thermoregulation**

- 2.1 Formation of urine. Roles of ultrafiltration, reabsorptions and secretion as transport mechanism in the formation of urine.
- 2.2 Control of urinary concentrations of sugar, urea, sodium, potassium and hydrogen ions.
- 2.3 Significance of loop of Henle in formation of hyperosmotic urine.
- 2.4 Function of aldosterone, antidiuretic hormone and reninangiotensin in system in renal Physiology.
- 2.5 Role of kidney in acid-base balance and body water regulation.
- 2.6 Temperature and Metabolism; Mechanism of thermoregulation in poikilotherms, homeotherms and heterotherms.
- 2.7 Aestivations and hibernation.

Unit-III**Physiology of heart and blood vascular system**

- 3.1 Characteristics of vertebrate cardiac muscle.

- 3.2 Initiation, conduction and regulation of heart beat.
- 3.3 Cardiac cycle and cardiac output.
- 3.4 Blood pressure and its regulation.
- 3.5 Neural, humoral and pharmacological regulation of cardiac amplitude and frequency.
- 3.6 The cascade of biochemical reactions involved in coagulation of blood.

Unit-IV

Neuromuscular Physiology

- 4.1 Ionic basis of resting and action potentials, axon hillock, significance of myelinated nerve fibers and velocity of conduction.
- 4.2 Mechanism of synaptic transmission, types of transmitters.
- 4.3 Reflexes and types of reflexes.
- 4.4 Functional differentiation of brain and hierarchy of control.
- 4.5 Structural proteins of muscle cells, actin-myosin complex and source of energy for contraction.
- 4.6 Sliding filament theory of muscle contraction.
- 4.7 Excitation-contraction coupling.

Unit-V

Endocrine and Reproductive Physiology

- 5.1 Cellular mechanism of hormone action in target tissues.
- 5.2 Hypothalamic control of pituitary activity and phenomenon of neurosecretion.
- 5.3 Genesis and general functions of hypophysis and adrenal hormones.
- 5.4 Genesis and general functions of thyroid and parathyroid hormones.
- 5.5 Endocrinological control of testicular, ovarian and uterine functions.
- 5.6 Capacitation, physiological aspects of implantation and parturition.

Paper XII : ANIMAL DIVERSITY**(Invertebrates and Vertibrates)**M.M.: 70
Time : 3 Hrs.**Unit-I**

- 1.1 Principles of taxonomy applied to the systematics of Animal Kingdom.
- 1.2 Type study of invertebrates amongst major classes : paramoecium, Sycon, x Hydra, Taenia, Ascaris, Pheretima, Palaeomon, Pila, Asterias, Balanoglossus.

Unit-II

- 2.1 Type study of vertebrates amongst: Fishes, Amphibians, Reptiles, Aves & Mammals: Scoliodon, Frog, Uromastix Pigeon, Rat.

Unit-III**Behavioural Diversity in Animals.**

- 3.1 Instinctive Behaviour
- 3.2 Earnings Behaviour
- 3.3 Feeding Behaviour
- 3.4 Courtship and mating
- 3.5 Parental Care
- 3.6 Migration and homing
- 3.7 Colouration and Mimicry

Unit-IV**Adaptation in Animals.**

- 4.1. Adaptation in relation to flight in insects, fishes, reptiles, birds & Mammals.
- 4.2. Aquatic adaptations in animals inhabiting deep sea and fresh water.
- 4.3. Arthorial adaptations in various groups.
- 4.4 Adaptation to endoparasitic environment.
- 4.5 Adaptation to environmental stress.
- 4.6 Characteristic adaptations of desert living animals.
- 4.7 Cursorial and fossorial adaptations.

Unit-V

Origin and Evolution

- 5.1 Evolutionary inter-relationship between invertebrates.
- 5.2 Evolutionary inter-relationship between vertebrates.
- 5.3 Origin and evolution of Amphibians.
- 5.4 Origin and evolution of fishes.
- 5.5 Origin and evolution of Reptiles.
- 5.6 Origin and evolution of Birds.
- 5.7 Origin and evolution of Mammals.

Books Suggested :

- 1 Invertebrates structure and function by Barrington, E.J.M.
- 2 Biology of invertebrates by J.M. Wilath.
- 3 The invertebrates by L.H. Hymen, Vol. I-VI
- 4 Biology of lower invertebrates by Russol and Hunter.
- 5 Biology of Higher Invertebrates by W.D. Russol and Hunter.
- 6 The life of Vertibrates by L.Z. Young.
- 7 Structure and Development of Vertebrates Vol.I,II by Goodrich.
- 8 Chordate Morphology by Jollie.
- 9 Morphology of Invertebrates by L.W. Torry.
- 10 Principles of Systematic Zoology by E. Mayer.
- 11 Evolution of Living Organisms by B.D. Crassy.
- 12 Animal Behaviour by J. Alock.
- 13 Animal behaviour by M.K. Chandrashekharan.
- 14 Analysis in behavioural ecology by Brown, Down & Hower.
- 15 Animal behaviour by D. Macfarlnd.

Note :The examiner shall set ten questions and the students shall be required to attempt five questions, one question from each unit.

**SCHEME OF EXAMINATIONS OF M.SC. (FINAL)
ENVIRONMENTAL SCIENCE**

Course No.	Paper	Max. Marks	Examination Time
VIII	General Concept of Environmental Science	70	3 hrs.
IX	Environmental Chemistry, Environmental Bio-Chemistry and Molecular Toxicology	70	3 hrs.
X	Concepts of Energy and Resources	70	3 hrs.
XI	Environmental Hazards and Environmental Impact Assessment	70	3 hrs.
XII	Environment Conservation, Waste Management and Recycling	70	3 hrs.
XIII	Practical-I Based on theory papers VIII to XII	90	6 hrs.
XIV	Practical-II	50	6 hrs.
	Dissertation Viva voce on dissertation	10	
Total Marks		500	

M.Sc. (Final) ENVIRONMENTAL SCIENCE
Paper-VIII GENERAL CONCEPTS OF ENVIRONMENTAL SCIENCE

Max. Marks : 70

Time : 3 hrs.

NOTE :In all ten questions will be set two from each unit. Students are required to attempt five questions selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

Climatology

- 1.1 Elements of Climate; Climatic controls; Earth and sun relations.
- 1.2 Spatial and Temporal patterns of climatic parameters in India.
- 1.3 Indian Monsoon, Jet streams; General circulation.
- 1.4 Climates with special reference of India.
- 1.5 Agroclimatology; Global Warming; Ozone hole; Sea level rise.

Unit-II

Oceanography

- 2.1 Overview of oceanic environment-history and development of marine sciences.
- 2.2 Physical properties and marine waters. Density, Temperature Optics.
- 2.3 Waves generation, Thermo-haline, Turbidity currents (gravity).
- 2.4 Chemical properties of marine water; chemical behaviour of water with salts dissolved in it, Salinity-its determination & distribution, causes of salinity variations.
- 2.5 Ocean waters as biological environment; distribution and population of plants and animals in ocean.
- 2.6 Effect of pollution of marine life.

Unit-III

- 3.1 Meteorological fundamentals-Pressure, Temperature; Wind Humidity,Radiation.
- 3.2 Atmospheric stability, Adiabitic diagram; Turbulence & Diffusion.
- 3.3 Applications of micrometeorology to vegetated surfaces, urban areas, human beings, animal.
- 3.4 Applications of meteorological principle to transport and diffusion of pollutants.
- 3.5 Effects of meteorological parameters of pollutants and vice versa.
- 3.6 Topographic effects.

Unit-IV

- 4.1 Pure and applied aspects of Hydrology : Hydrologic-cycle Inventory of earth and water.
- 4.2 Various forms of precipitation; Interpretation of precipitation data; Transportation.
- 4.3 Infiltration capacity of soil; Factors influencing infiltration capacity.
- 4.4 Run off-duration of runoff; Flow rating curves-their determination; catchment characteristics and their effects on runoff.
- 4.5 Occurence of ground, water; influencing factor; Ground water flow.

Unit-V

- 5.1 Principle of remote sensing and its application in ecological studies.
- 5.2 Remote sensing application in ground water environment.
- 5.3 Remote sensing application in mining, Mineral and oil.
- 5.4 Remote sensing application in landslides, land subsidence and earthquake students.
- 5.5 Remote sensing application in waste land mapping.

**Paper-IX ENVIRONMENTAL CHEMISTRY,
ENVIRONMENTAL BIOCHEMISTRY
AND MOLECULAR TOXICOLOGY**

Max. Marks :70

Time : 3 hrs.

Note :In all ten questions will be set, two from each unit. Students are required to attempt five questions selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I

Environmental Chemistry

- 1.1 Chemical composition and chemical history of the earth, metals, minerals and fossil fuels.
- 1.2 Atmospheric chemistry; reaction in the lower and higher atmosphere.
- 1.3 Radioactivity in the atmosphere; air Pollution Chemistry.
- 1.4 Structure and properties of water and its environmental significance.
- 1.5 Fresh water and marine chemistry; role of water in the environment.
- 1.6 Some specific pollutants and their chemistry like surfactants, pesticides, sewage.

Unit-II

Soil Chemistry

- 2.1 Soil genesis : Weathering Processes & Soil formation. Soil profile development; chemical and mineralogical composition of soil.
- 2.2 Soil organic matter; Sources; composition; Microbial decomposition of organic matter; Humus formation; significance of C:N ratio.
- 2.3 Soil colloidal system; Cation and anion exchange phenomenon.
- 2.4 Soil reaction; Soil pH, Buffering capacity; soil acidity; alkalinity; soil nutrients.

- 2.5 Soil temperature; Absorption and loss of heat; thermal conductivity through soil profile.

Unit-III

- 3.1 Review of classical thermodynamics; State of a system.
3.2 Three laws of thermodynamics.
3.3 Gibb's energy; chemical potential Activity co-efficient.
3.4 Gibb's Donnan equilibrium; phase equilibrium; enzyme Kinetics;
3.5 Entropy change in irreversible processes; study of membranes; diffusion.

Unit-IV

- 4.1 Thrust on biochemical degradation of pollutants inside the cell as well as cellular interactions with the pollutants.
4.2 Pollutant interaction with biological system at different levels e.g. organism, organs and cell organelles.
4.3 Bio-conversion of pollutants: active vs inactive process; enzymatic degradation by monooxygenases.
4.4 Metal-biomacromolecule interaction, teratogenicity and carcinogenicity.
4.5 Cellular/Tissue injury: altered membrane permeability, free radical formation, lipid peroxidation, lysosomal degradation.

Unit-V

Molecular Toxicology

- 5.1 Cellular interaction with toxic elements/pollutant at the level of biomacromolecule and its reflection on an altered factor.
5.2 Cell behaviour and Cell signalling in response to environmental factors.
5.3 Chemical carcinogens: mutagen, environmental factors, chemicals as carcinogens.
5.4 Chemical carcinogenesis : altered gene expression and induction of tumor metastasis and angiogenesis.
5.5 Genetic basis carcinogenesis: as hereditary change; concept of protooncogene and oncogene; DNA transfection.

Paper-X CONCEPTS OF ENERGY AND RESOURCES

Max. Marks : 70

Time : 3 hrs.

Note :In all ten questions will be two from each unit. Students are required to attempt five questions selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I**Non-Biological Energy Resources and Conservation**

- 1.1 Sun as source of energy; Nature of its radiation.
- 1.2. Tidal, wind and geothermal energy; brief concept of solar heater; fuel cell, solar cell.
- 1.3 Concept on generation of nuclear energy and its utilization.
- 1.4 Management of nuclear reactor plant for prevention of radioactive wastes.
- 1.5 Natural energy resources : Coal, Crude Oil; Petrol; C.N.G. (Compressed Natural Gas); Oil Sand and Oil peats.

Unit-II**Biological Energy Resources and Conversion**

- 2.1 Biomass; nature of biomass; types of biomass and availability.
- 2.2 Biological conversion of biomass to make value added fuels and chemicals.
- 2.3 Biological gasification; Biological liquification.
- 2.4 Thermochemical gasification of biomass; direct liquification of biomass to liquid fuel; Biomass Pyrolysis.
- 2.5 Integrated biomass conversion technology.
- 2.6 Techno-economical feasibility.

Unit-III

- 3.1 Pattern of use of non-conventional energy in developed and developing countries.
- 3.2 Physico-chemical nature of conventional liquid fuels with reference to locomotive engine.

- 3.3 Physico-chemical nature of biofuel (Biogas, hydrogen) with special reference to locomotive engine.
- 3.4 Factors affecting the utilization of non-conventional energy.
- 3.5 Future strategies of non-conventional energy and its use.

Unit-IV

Water Resources:

- 4.1 Hydrological cycle and its balance; factors influencing the surface water and characteristics of stream flow; sub-surface water.
- 4.2. Elementary problems of confined, semi-confined and unconfined aquifer.
- 4.3 Stream flow and ground water levels.
- 4.4 Fluctuations due to evapotranspiration.
- 4.5 Fluctuations due to meteorological phenomenon urbanization. External loads, land subsidence.
- 4.6 Changes in chemical composition of water; estimates of flow storm drainage and highway drainage.

Unit-V

- 5.1 Definition of resources and reserves; abundance of elements and mineral resources.
- 5.2 Classification; Plate tectonics and mineral resources.
- 5.3 Geological setting for geographic distribution and reserves of important ferrous and non-ferrous metals.
- 5.4 Non-metallic and industrial minerals in India.
- 5.5 Mineral deposits through geological tides.

Paper-XI ENVIRONMENTAL HAZARDS AND ENVIRONMENTAL IMPACT ASSESSMENT

Max. Marks : 70

Time : 3 hrs.

Note : In all ten questions will be set two from each unit. Students are required to attempt five questions selecting one from each unit. The examiner should cover entire syllabus while setting question paper.

Unit-I**Natural Hazards**

- 1.1 River flooding : causes, nature and frequency of flooding nature and extent of flood hazard.
- 1.2 Urbanization and flooding; Environmental effects of flooding.
- 1.3 Landslides : causes human use and landslides prevention and correction.
- 1.4 Coastal hazards : tropical cyclones and tsunamis; coastal erosion; sea level changes and its impact on coastal areas.
- 1.5 Earthquakes; causes, intensity and magnitude.
- 1.6 Volcanism: Nature, extent and cause of volcanism; volcanism and climate.

Unit-II**Radiations and Environmental Hazard**

- 2.1 Units and definition of radioactivity; Radiation of cosmic origin.
- 2.2 Mechanism of radiation action on living system-stochastic and non-stochastic effects; delayed effects.
- 2.3 Fall out from nuclear explosions-ultraviolet radiations.
- 2.4 Atmospheric, aquatic and biological pathways and transport.
- 2.5 Pathways analysis and dose assessment.

Unit-III

Water, Soil and Air Pollution

- 3.1 Types, sources and consequence of water pollution, Domestic industrial and agricultural wastes- their effects on water bodies.
- 3.2 Ecological and biochemical aspect of water pollution.
- 3.3 Degradation of different pesticides, insecticides fungicides and weedicides in soil and their effects on soil components.
- 3.4 Industrial effluents and their interactions with soil components.
- 3.5 Natural and anthropogenic sources of atmospheric pollutants. Transport and dispersion of pollutants.
- 3.6 Effects of metrological and topographical factors; effects of pollutants.

Unit-IV

- 4.1 Noise Pollution Level (NPL); Sound Exposure Level (SEL) Traffic Noise Index (TNI) Day-night level.
- 4.2 Noise sources: Mechinary noise, pumps, compressors, building and construction equipment, domestic appliances, traffic-Vehicular, train, aircraft.
- 4.3 Hazards of noise pollution; physiological effect circulatory, respiratory and muscular.
- 4.4 Hearing loss and threshold shifts.
- 4.5 Noise standards; noise control.

Unit-V

Environmental Impace Assessmental

- 5.1 Nexus between development and environment; carrying capacity.
- 5.2 Origin and development of EIA; relationship of EIA to sustainable development.
- 5.3 EIA in project planning and implementation; EIA process.
- 5.4 EIL Methodology, role of GIS in EIA; Base line study.
- 5.5 Case studies; River Valley Projects; Thermal power plants, mining projects.
- 5.6 Oil refineries and petrochemicals; Tourism; Coastal Zone development.

Paper-XII ENVIRONMENT CONSERVATION, WASTE MANAGEMENT AND RECYCLING

Max. Marks : 70

Time : 3 hrs.

- *Note :In all ten questions will be set two from each unit. Students are required to attempt five questions selecting one from each unit. The examiner should cover entire syllabus while setting question paper.*

Unit-I**Environment Conservation**

- 1.1 Organisms-evolution and distribution in space and time; Elements of energy flow.
- 1.2 Conservation and preservation; Response of ecosystem to exploitation, Convergence and divergence in species.
- 1.3 Health and conservation; Diversity and the food chains sustainable exploitation and development.
- 1.4 Forest, water and mineral resources conservation; wildlife conservation.
- 1.5 Conservation-depletion rates, model using petroleum as example.

Unit-II**Resource Management**

- 2.1 Management of agricultural system; irrigation system; bio-fertilizers.
- 2.2 Management of rangelands and water sheds.
- 2.3. Eco-restoration of degraded lands.
- 2.4. Coastal erosion-causes and protection.
- 2.5. Rehabilitation of unbalanced soils; man groves; mined areas.

Unit-III**Solid Waste Management**

- 3.1 Sources and generation of solid waste.
- 3.2 Nature and chemical composition of solid wastes.

- 3.3 Characterization and classification of solid wastes.
- 3.4 Different methods of dispersal and management of solid wastes.
- 3.5 Recycling of solid wastes.

Unit-IV

Waste Water Management

- 4.1 Types sources and characteristics of waste water.
- 4.2 Chemical and bacteriological sampling and analysis.
- 4.3 Water quality parameters; criteria and standards.
- 4.4 Sewage and waste water treatment.
- 4.5 Waste water pollution control; case studies.
- 4.6 Recycling of waste waters.

Unit-V

Recycling of Wastes

- 5.1 Recycling of Agro-wastes, biodegradation of pesticides.
- 5.2 Recycling of upgradation of industrial wastes/effluents.
- 5.3 Recycling of animal, sewage and municipal wastes.
- 5.4 Disposal and management of hazardous wastes.
- 5.5 Microbial leaching of metals.
- 5.6 Overall prospects and limitation of Bio-Wastes Processing.

Paper-XIII PRACTICAL-I

Max. Marks : 90

Time : 6 hrs.

(i) List of laboratory Practicals.

- 1 Study of sediments and soils by Centrifugation Laser size analyser
- 2 Water quality testing
 - pH conductivity, alkalinity
 - hardness, cation concentration
 - inorganics by AAS and spectrophotometry
 - Organics by Spectrophotometry.
 - Alkali metals by flame photometry
 - B.O.D., C.O.D. etc.

- 3 Measurement and evaluation of surface meteorological data.
 - a) Measurement of Dry bulb and Wet bulb temperatures and evaluation of Relative Humidity, Recording of wind speed and direction and setting maximum and minimum thermometers.
 - b) With the given data preparation of wind roses.
- 4 Interpretation of satellite imagery data.
- 5 Application of digital image processing in environmental studies.
- 6 Purification of biomolecules from a mixture by column chromatography.
- 7 Cell organelles separation by differential centrifugation.
- 8 Effect of radiation of living matter (Radiation measurements)
- 9 Selection of bacterial mutants.
- 10 Distal/total suspended particulates estimation.
- 11 Sulphation Rate detection-Lead candle method.
- 12 Flow rate measurements.
- 13 SO₂, NO₂ analysis by wet chemistry method.
- 14 Organics like hydrocarbons estimation.
- 15 Demonstration of Ouchtelony detection of antibody.
- 16 Immudetection of a protein by its antibody (Westernblot analysis)
- 17 EISA determination of a protein by its antibody.
- 18 isolation and purification of protein by column chromatography.
- 19 Protein purity by PAGE molecular determination sybmit.
- 20 Determination of proteins by SDS-PAGE analysis.
- 21 Purification of plasmid DNA and analysis electrophoresis.
- 22 Comparative study of aminoacids in xerophytes mesophytes, hydrophytes.
- 23 Relative water content of xerophyte/mesophyte/halophyte.
- 24 Physico-chemical characterization of semiarid zones.

- 25 Soil metabolic activity in semi arid soils.
- 26 Restoration of some useful soil characteristics of saline soils following amendments.
- 27 Thermal acclimation in fish and influence of temprature on rate of oxygen uptake.
- 28 Adaptation of acidity and akalinity in aquatic organisms.
- 29 Demonstration of acute toxicity-Behavioural effects Convulsions and other observations.
- 30 Determination of LD₅₀ to different agents.
- 31 Effect of organochlorine organophoshate pesticide...on haemoglobin, lymphocytes and tyerythrocytes.
- 32 Blood lymphocyte culture-effect on cell cycle and Mitotic index.
- 33 Histopathological changes in liver, kidney, lung, spleen etc. in rats induced by pollutants.
- 34 Physiochemical characterization of sugar factory effluent/soft drink plant.
- 35 Survey of occupational health hazards in nut-bolt/screws factory/cement factory workers.

**SCHEME OF EXAMINATIONS OF M.Sc. IN
BIO-CHEMISTRY (FINAL)
(As a stream in Bio-Science Deptt.)**

Paper No.	Nomenclature of paper	Time	Max. Marks
Theory			
VIII	Plant Biochemistry	3 Hours	70
IX	Medical Biochemistry & Immunology	3 Hours	70
X	Basic & Applied Enzymology	3 Hours	70
XI	Metabolism	3 Hours	70
XII	Vitamins, Minerals & Hormones	3 Hours	70
Practicals			
	Practical, I, VIII & XI	6 Hours	90
	Practical-II/Dissertation	6 Hours	60
Total Marks			500

Paper-VIII PLANT BIO-CHEMISTRY

Max. Marks : 70

Time : 3 Hrs.

Note :In all ten questions will be set, two from each unit. Each question should be divided into sub-parts. Students are required to attempt five questions in all, selecting one from each unit. The examiner should cover entire syllabus while setting the question paper.

Unit-I

- 1.1 Introduction to photosynthesis, structure of the chloroplast membrane, Biosynthesis of chlorophyll and carotenoid.
- 1.2 Photosynthetic electron transport and generation of NADPH and ATP.
- 1.3 Carbon reduction in C₃, C₄, and CAM plants; Recent advances and regulation of the pathways.
- 1.4 Sucrose and starch synthesis, storage and utilization.
- 1.5 Biochemistry of photorespiration.

Unit-II

- 2.1 Ammonium and nitrate as nitrogen sources, uptake and accumulation of nitrogen in the plant tissue.
- 2.2 Nitrite assimilation and regulation of the process.
- 2.3 Nitrite and ammonia assimilation, Entry port of inorganic nitrogen to the organic cycle.
- 2.4 Biological nitrogen fixation, nodule development and biochemistry of nitrogen fixation.
- 2.5 Regulatory aspects of N₂ fixation.

Unit-III

- 3.1 Protein biosynthesis in plants.
- 3.2 Protein degradation in germinating seeds & leaves.
- 3.3 Cereal storage protein : classification structure & role in Agriculture.
- 3.4 Stress proteins and Ca²⁺ binding proteins.

3.5 Plants lipids : Biosynthesis and catabolism.

Unit-IV

4.1 Sulphur metabolism in plants.

4.2 Assimilation of sulphate, sulfite formation.

4.3 Thiosulfate formation and reduction.

4.4 Biosynthesis and utilization of sulfur containing amino acids and small peptides.

4.5 Role of sulfur compounds in plant stress.

Unit-V

Structure metabolism and mechanism of action of plant growth Regulators.

5.1 Auxine.

5.2 Gibberline.

5.3 Cytokinin.

5.4 Ethylene, and abscisic-acid.

5.5 Phytochrome; structure, Physiochemical properties and mechanism of action; Recent advances.

5.6 Polyamines as a growth regulator.

5.7 Biochemistry of senescence.

Suggested Books

1. Plant Biochemistry by Bonner and Varner, Academic Press., N.Y.
2. An introduction to plant Biochemistry by T.W. Goodwin and E.I.
3. Phytochemistry Vol. III Ed.L. Miller Van Nostrand Reinhold London.
4. Biochemistry of Plants Vol. 1-8. Eds. M.D. Hatch and N.K. Boardman. Academic Press New York.

Paper-IX MEDICAL BIO-CHEMISTRY & IMMUNOLOGY

Max. Marks : 70

Time : 3 Hrs.

Note : In all ten questions will be set two from each unit. Each question should be divided into sub-parts. Students are required to attempt five questions in all, selecting one from each unit. The examiner should cover entire syllabus while setting the question paper.

Unit-I

Disease of Cardiovascular system : (Biochemical aspect)

Rheumatic fever, Ischaemic heart disease, congenital heart disease, atherosclerosis, hypertension.

Diseases of the respiratory system : T.B., Pneumonia & Bried idea of allergic diseases. Diseases of the alimentary system & Pancreas : Acid peptic disease, pancreatitis, malabsorption syndromes.

Unit-II

Disease of the Liver: Jaundice, Hepatitis Gall bladder & bileduct diseases. Gall stones, cholecystitis. Diseases of the Kidney & genitourinary system: Glomerulonephritis, renal calculi, Congenital abnormalities, clinical & Biochemical aspects of AIDS. Enzymes in clinical diagnosis.

Unit-III

Endocrine & metabolic diseases: Hyper & Hypothyroidism, Hypo & Hyper parathyroidism, diabetes mellitus, hyper lipidemias. Diseases of musculo skeletal system : Arthritis Allied rheumatic disorders. Diseases of the nervous system : Epilepsy, cerebrospinal diseases.

Unit-IV

Introduction to the cells & organs of Immunity : Memory, specificity diversity Self vs. non-self discrimination. Structure of primary & secondary lymphoid. organs, cell mediated Vs. humoral immunity T and B lymphocytes.

The nature of antigen and antibody: Antigen Structure of antibody (i) constant & Variable regions Fab & Fc; (ii) Isotype, allotype & Idiotype. Functions of antibody Molecules. Measurement of antigen-antibody interactions: Direct binding assays. Agglutination and precipitation, Radio immunoassay and Elisa Fluorescence analysis.

Unit-V

Generation of diversity in the immune system ; clonal selection theory concept of antigen specific receptors. The gene encoding antigen specific receptors on T & B lymphocytes-genetic rearrangement, Major Histocompatibility complex & its significance : Polymorphism of MHC genes & its products, Hyper sensitivity : Types I,II,III & IV response.

Suggested Readings

- 1 Clinical Biochemistry (1981) Ed. H.E. Spiegel. Acad. Press New York.
- 2 Biochemical aspects of human diseases (1983) R.L. Elkeles & A.S. Tavill, Blackwell Scientific Pub. Oxford.
- 3 Essential Immunology (5th edition) Roitt. Blackwell Scientific Publishing London.
- 4 Basic Immunology : A synthesis E. Golule. Sinaver Associates Sunderland.

Paper-X BASIC & APPLIED ENZYMOLOGY

Max. Marks : 70

Time : 3 hrs.

Note : In all ten questions will be set two from each Unit. Each Question should be divided into sub-parts. Students are required to attempt five questions in all, selecting one from each unit. The examiner should cover entire syllabus while setting the question paper.

Unit-I

Historical perspectives, nomenclature, IUB classification and importance of enzyme, Enzyme characteristics : Chemical nature as catalysts, terminologies used in enzymology like specific activity, activity units, turnover number, enzyme specificity, active centres, holoenzyme, apoenzyme, cofactors and prosthetic groups, metalloenzymes. Vitamins as co-enzymes : Mechanisms of biochemical reactions involving co-enzyme A, TPP, Pyridoxal phosphate, NADP⁺/NAD⁺/FMN/FAD and lipoic acid. Enzyme assay and units. Isolation and purification of enzymes and criteria of

homogeneity. Effect of pH, temperature, enzyme concentration and substrate concentration on enzyme activity and stability, Arrhenious plot significance of activation energy.

Unit-II

Kinetics of single substrate enzymatics reactions : Michaelis Menten equation derivation and applicability, determination and significance of V_{max} and K_m . Lineweaver-Bruke plot and other modes of plotting (S) and V. Enzyme inhibition: types of reversible inhibitors (competitive, non-competitive, uncompetitive) derivation of equations for different types of inhibitors, determination of K_i , irreversible inhibition-Mechanism of enzyme action : General mechanistic principles, factor associated with catalytic efficiency-proximity, orientation, distortion and strain, induced fit hypothesis, acid-base catalysis, and nucleophilic catalysis.

Unit-III

Two substrate reactions: random, ordered and ping-pong mechanisms, determination of K_m and V_{max} for the substrates, methods of determining Kinetic mechanism. chemical modification of enzymes: Active site directed irreversible inhibitors (affinity labels) and enzyme-activated irreversible inhibitors (suicide inhibitors). Detailed mechanism of enzyme action for ribonuclease, lysozyme, Chymotrypsin and carboxipeptidase. A Multifunctional and multienzyme systems and their significance.

Unit-IV

Regulation of enzyme activity: Product inhibition, feedback control, enzyme induction and repression, covalent modification, allosteric concept, protein ligand binding, cooperativity (Positive and negative) and mechanisms of allosteric interactions and cooperativity (concerted, sequential) quantitative analysis of cooperativity (Hill equation, scatchard plot). Isozymes. Zymogens.

Unit-V

Immobilized enzymes: Methods of immobilization-covalent coupling, adsorption, entrapment, microencapsulation, etc. Immobilized enzymes-relative practical and economic advantages for industrial use, effect of partition on kinetics and performance with particular emphasis on charge (including pH) and hydrophobicity. Immobilized multienzyme systems; Analytic and clinical applications of immobilized enzymes.

Suggested Books

- 1 The Enzymes by Dixon M. & E.C. Webb, Longman Group Ltd. London.
- 2 The Enzymes Vols. I & II P.D. Boyer (Ed) Academic Press, London.
- 3 Fundamentals of Enzymology by Price and Stevens Oxford Univ. Press.
- 4 The Nature of Enzymology by R.L. Foster.
- 5 The Handbook of Enzyme Biotechnology by Wiesman.
- 6 Enzymes in Industry and Medicine by G.F. Bickerstaff Edward Arnold Publishers, London.
- 7 Biochemistry by A.L. Lehinger.
- 8 Biochemistry by L. Stryer.
- 9 Enzyme Kinetics: Behaviour and Analysis of Rapid Equilibrium & Steady State Enzyme System by I.H. Segal.
- 10 Enzymatic reaction Mechanism, by C.J. Gray.

Paper-XI METABOLISM

Max. Marks : 70

Time : 3 hrs.

Note :In all ten questions will be set two from each unit. Each question should be divided into sub-parts. Students are required to attempt five questions in all, selecting one from each unit. The examiner should cover entire syllabus while setting the question paper.

Unit-I

Amino acid metabolism: deamination of amino acids-transamination, oxidative deamination, Formation and disposal of ammonia: The urea cycle, formation of uric acid. Metabolic breakdown of individual amino acids, biosynthesis : of physiologically active amine hione and phosphocreatine. Genetic defects related to abnormal amino acid metabolism.

Unit-II

Nucleotide metabolism : biosynthesis and degradation of purine and pyrimidine nucleotides, regulation of nucleotides, metabolism. Purine salvage; pathway. Disorders related to abnormal nucleotide metabolism. Biosynthesis of nucleotide coenzymes.

Unit-III

Techniques and strategies used in the study of Intermediary Metabolism: Use of intact organism, bacterial mutants, organ perfusion, tissue slices homogenates, cellfree systems, stable and radioactive isotopes in the investigation of metabolic pathways (isotope dilution, pulse labelling techniques and autoradiography).

Carbohydrates Metabolism: historical perspectives, detailed study and regulation of alcoholic fermentation, glycolysis, TCA cycle, gluconeogenesis, hexose monophosphate shunt, and glyoxalate cycle. Biosynthesis and degradation of oligosaccharides and polysaccharides (starch and glycogen), control of carbohydrate metabolism, metabolism, metabolism of glycoproteins.

Unit-IV

Lipid Metabolism: Detailed account of beta-oxidation pathway of fatty acid catabolism, role of carnitine, oxidation of odd chain and unsaturated fatty acids, *denovo* fatty acids bio-synthesis and elongation of fatty acid chain including regulation, biosynthesis of unsaturated fatty acid, metabolism of ketone bodies. Biosynthesis and degradation of triacylglycerols phosphoglycerides and sphingolipids. Biosynthesis and regulation of cholesterol.

Unit-V

Bioenergetics high energy compounds, TP as the universal energy currency and its structural suitability as a high energy phosphate group transfer phosphagen. NADH, NADPH, Coenzyme Q FADH and cytochromes as a major electron carriers. Nature, order and organization of carriers of electron transport chain, oxidative phosphorylation, Mitchell's chemiosmotic hypothesis, inhibitors of electron transport chain and uncouplers of oxidative phosphorylation, P/O ratio, respiratory control of oxidative phosphorylation.

Suggested Books

- 1 Biochemistry by J.D. Rawn.
- 2 Biochemistry by G. Zubay
- 3 Biochemistry by Stryer

- 4 Biochemistry by A.L. Lehinger 1975 edition.
- 5 Harper's Biochemistry Ed. Murray, Mayes et al
- 6 Principles of Biochemistry by Smith, Hill, Lehman, Lefkowitz Handler and white.

Paper XII VITAMINS, MINERALS AND HORMONES

Max. Marks : 70

Time : 3 Hrs.

Note : In all ten questions will be set, two from each unit. Each question should be divided into sub-parts. Students are required to attempt five questions in all, selecting one from each unit. The examiner should cover entire syllabus while setting the question paper.

Unit-I

Historic development of vitamins. Biosynthesis of vitamins and their bound forms, metabolism and function of water soluble and fat soluble vitamins relative stabilities of vitamins towards various physical and chemical agents.

Unit-II

General classification of hormones and their structure synthesis, secretion, transport, metabolism and mechanism of action of hormones of thyroid, hypothalamus, pituitary, pancreas, adrenals, sex hormones, postaglandins. Cell membrane and intracellular receptors of hormones hormonal interrelationship.

Unit-III

Major and trace minerals-their bound forms and functions inorganic elements: bulk and trace elements-their importance Chelation and chelating agents-fundamentals and applied aspects in biochemistry, deficiency and toxicity of trace elements, metabolism of Fe, Ca, Cu, & I. Biological role of Zn, Mn, Co, Mo, Cu, Mg, Se and F. Biochemistry of muscle contraction: Structure of skeletal muscle, contractile proteins, mechanism of muscle contraction, energy source for muscle contraction.

Unit-IV

Neurotransmission: neuronal, K^+ and Na^+ channels, nerve impulse Propagation, neurotransmitters with particular reference to acetylcholine. Acetylcholine, receptor, acetylcholine analogs and inhibitors of acetylcholinesterase; inhibitors of

acetylcholine receptors. Biochemistry of vision; rhodopsin visual cycle hyperpolarization of rod cells, role of transducin and cyclin G.M.P. in visual excitation.

Water and electrolyte balance: body water-distribution, daily water turnover and water balance, water depletion, composition of body fluids-total body water, composition of FCF and ICF, permeability of cell membrane to proteins, Na^+ and K^+ as electrolytes. Acid-base equilibrium, disorders of acid-base balance.

Suggested Books

1. Handbook of vitamins-Nutritional, biochemical and clinical aspects. Ed. L.J. Machlin. M. Dekkar, N.Y.
2. Vitamins by W.H. Sebrell and R.S. Harris. AP,N.Y.
3. Handbook of vitamins, minerals and hormones by R.J. Kutsky, Van Nostrand, Reinhold, N.Y.
4. Principles of Biochemistry by Smith, Hill, Lehman, Lefkowitz Handlev & White, A. Mc. Graw Hill, N.Y.
5. Biochemistry by L.Stryer.
6. Biochemistry by L.S. Zubey.
7. Biochemistry and mode of action of hormones.
8. Hormones by A.W. Norman & Litwack. AP, N.Y.

Scheme of Examination M.Sc.(Final) Biotechnology**(As a stream in Bio-science Dept.)**

Theory	Max. Marks	Time
VIII Recobminant Technology	DNA 70	3 hrs.
IX Immuno-Technology	70	3 hrs.
X Cell Tissue and Organ Culture Technology	70	3 hrs.
XI Biomass Processing & Microbial Technology	70	3 hrs.
XII Waste Recycling & upgradation Technology	70	
Parctical-I		
XIII Laboratory Practicals covering all five theory papers	90	6 hrs.
Practical-II		
XIV Practical-II Dissertation	50	6 hrs.
Viva-voce Examination	10	

	Total Marks	500

Paper-VIII RECOMBINANT-DNA TECHNOLOGY

Max. Marks : 70

Time : 3 Hrs.

Note :In all ten questions will be set two from each unit. Students are required to attempt five questions in all, one from each unit.

Unit-I

- 1.1 Introduction to recombinant DNA technology, safety guidelines.
- 1.2 Enzymes used in recombinant DNA technology, restriction enzymes, DNA\RNA modifying enzymes.
- 1.3 Restriction and modification systems in Bacteria
- 1.4 Ligation strategies, Linker technology.
- 1.5 Bacterial Chromosomes, plasmids and episomes.
- 1.6 Expression vectors in Prokaryotes.

Unit-II

- 2.1 Plasmids as cloning vectors.
- 2.2 Bacteriophage as cloning vectors.
- 2.3 Cosmids and phage vectors.
- 2.4 Cloning hosts-bacteria, yeasts, streptomycetes.
- 2.5 Genomic and DNA Libraries.
- 2.6 Screening strategies.
- 2.7 Identification of recombinant.

Unit-III

Principle of Agarose gel electrophoresis, density gradient centrifugation, Nick translation, Southern, Northern and Western blots, Dot-blot technique, Colony hybridisation, Sequencing of DNA polymerase chain reaction (PCR), Restriction fragment length polymorphism (RFLP), RAPD (Random amplified polymorphic DNA) technique. DNA foot printing.

Unit-IV

Genetic engineering in plant and animal systems: Gene transfer via microinjection, particle gun, electroporation, PEG and liposome gene transfer via vectors. transformation and expression. Use of

Agrobacterium (Ti and Ri) plasmids, Cauliflower mosaic and Gemini viruses, viral vectors for gene transfer and expression in mammalian Cells.

Unit-V

Application of DNA techniques in the diagnosis of genetic diseases inherited diseases and gene/therapy. Transgenic animals chimeras formation. Strategies for production of transgenic plants for abiotic stresses, herbicides, viruses and insect resistance. Sitedirected mutagenesis.

Paper-IX IMMUNO TECHNOLOGY

Max. Marks :70

Time :3 hrs.

Note : In all, ten questions will be set two from each unit. Students are required to attempt five questions in all, one from each unit.

Unit-I

- 1.1 Principles of immunology, Biological basis of immunity, humoral immunity, cell mediated immunity, immunoglobulins, antigens antibody reactions, Lymphoid Organs, cells of Lymphoreticular system, lymphokines and monokines.
- 1.2 Tumor immunology.
- 1.3 Structure and function of CD₄, and CD₈ molecules.
- 1.4 Role of MHC II and MHC I molecules in cell co-operation.

Unit-II

- 2.1 Immunogenetics-immunoglobulin genes. T cell receptor, MHC genes, Ig gene superfamily.
- 2.2 Hypersensitivity : Anaphylactic sensitivity, Antibody dependent cytotoxic hypersensitivity, complex mediated hypersensitivity, complex mediated hypersensitivity, Delayed hypersensitivity, Stimulatory hypersensitivity.
- 2.3 Immunoblot ELISA and RIA.
- 2.4 Immunoelectrophoresis & Immunodiffusion, Immunofluorescence.

Unit-III

- 3.1 Vaccinology-Bacterial vaccines, viral vaccines, Protozon & Helminth vaccines, strategies for developing vaccines against important tropical diseases-Schistosomiasis, Typhoid, Cholera, Leprosy, Tuberculosis, Shigellosis.

Unit-IV

- 4.1 Autoimmune diseases.
- 4.1.1 Theories of autoimmunity.
- 4.1.2 Immunopathology of Rheumatoid arthritis.
- 4.1.3 SLE
- 4.1.4 Autoimmune Thyroiditis.
- 4.2 Immunological tolerance.
- 4.3 Immunodeficiency disorders.
- 4.3.1 Primary immunodeficiency diseases.
- 4.3.2 T.Cell immunodeficiency diseases.
- 4.3.3 D.Cell immunodeficiency diseases.
- 4.3.4 Severe Combined immunodeficiency
- 4.4. Acquired immunodeficiency Syndrom AIDS.

Unit-V

- 5.1 Hybridoma technique
- 5.1.1. Concept of somatic Cell hybridization.
- 5.1.2 The need to develop monoclonal antibodies.
- 5.1.3. Hybridoma technique and HAT selection and cloning.
- 5.1.4 Mouse as Cites and purification of monoclonal antibodies.
- 5.1.5 Application in basic and clinical sciences.
- 5.1.6 Radioimaging and immunotargeting.
- 5.2 Human monoclonal antibodies.
- 5.3 Hybrid antibody molecules.
- 5.4 Chiemeric antibody molecules.
- 5.5 Isotype switch selection.
- 5.6 T X T hybridomas.

Paper-X CELL, TISSUE AND ORGAN CULTURE TECHNOLOGY

Max. Marks : 70

Time : 3 Hours.

Note : In all, ten questions will be set two from each unit. Students are required to attempt five questions in all, one from each unit.

Unit-I

Cell tissue and organ culture technology, Historical background. Media preparation aseptic manipulations, Single cell culture : batch and continuous cultures, cell growth kinetics and viability of cultured cells. Cryogenic preservation and maintenance of cell and tissues. Animal Cell Culture, Clonal propagation of plants.

Unit-II

Meristem, shoot tip and bud culture; introduction of differentiation; Regulation of genes in differentiation; Organogenesis, somatic embryogenesis; Artificial seed production and other applications of somatic embryo cloning.

Unit-III

In vitro production of haploids and triploids : Anther and Pollen Culture, In vitro gynogenesis, Endosperm culture. Cytogenetics of plant cell culture In vitro pollination, Wide hybridisation and embryo rescue technique, In vitro fertilization. Embryo culture.

Unit-IV

Somatic hybridisation and cybridisation: Isolation, culture and fusion of protoplasts. Selection of fusion products, Electroporation, Assessment of somatic hybrid plants, Production of cybrids, Practical applications of somatic hybridisation and cybridisation. In vitro selection and characterisation of variant cell lines for biotic and abiotic stresses. Somaclonal and geneoclonal variations, molecular basis of variations and their application in plant breeding. Various techniques of genetic transformation of plants.

Unit-V

Production of useful secondary metabolites through plant and animal cell culture. Techniques for selecting cell lines for high yield of secondary compounds, factor affecting yield, mass cultivation of

plant cells, Bio-reactor and immobilised plant cell culture. Biotransformation, Elicitor-induced accumulation of products. Recent advances and limitations.

Books Recommended :

1. Plant Tissue Culture-Theory and Practice by Bhojwani, S.S. and Razdan M.K. Elsevier Pub.
2. Plant tissue culture-applications and Limitations ed. Bhojwani, S.S. Elsevier Pub.
3. Biotechnology in Agriculture and Forestry, Vol. 1 to 14 ed. Bajaj Y.P.D. Springer Verlego.

Paper-XI BIOMASS PROCESSING & MICROBIAL TECHNOLOGY

Max. Marks : 70

Time : 3 Hours.

Note : In all, ten questions will be set two from each unit. Students are required to attempt five questions in all, one from each unit.

Unit-I

- 1.1 Biomass conversion technology.
- 1.2 Basic concept on biomass processing technology.
- 1.3 Types of fermentation technology.
- 1.4 Biotechnology of biomass gasification.
- 1.5 Biotechnology of biomass liquification.

Unit-II

- 2.1 Biomass processing in organic acid producing industry.
- 2.2 Isolation, preservation and improvement of industrial microbes.
- 2.3 organisms, manufacturing of acetic acid, butyric acid.
- 2.4 propionic acid, formic acid. and amino acids.
- 2.5 production of antibodies, single cell protein, Role of Microbes in diary products, Immobilisation of whole cells & their role in production of industrially important chemicals.

Unit-III

- 3.1 Biomass processing in brewing Industries.
- 3.2 History : Microbes associated with brewing.
- 3.3 Raw material and preparation of medium.
- 3.4 Large Scale Germentation.
- 3.5 Cold storage maturation carbonation.

Unit-IV

- 4.1 Biomass processing is enzymes industry.
- 4.2 A brief note on some commercially important enzymes.
- 4.3 Large scale enzyme production technology.
- 4.4 Nature of reactors.
- 4.5 Processing technology.
- 4.6 Enzyme stabilisation.

Unit-V

- 5.1 Microbial biomass production technology.
- 5.2 Large scale production of yeast.
- 5.3 Mass scale production of algal biomass.
- 5.4 Mushroom production of technology.
- 5.5 Biotechnology market and the problems of the Indian Bioindustry.

Paper-XII WASTE RECYCLING & UPGRADATION TECHNOLOGY

Max. Marks : 70

Time : 3 hrs.

Note : In all, ten questions will be set two from each unit. Students are required to attempt five questions in all, one from each unit.

Unit-I

- 1.1 Conceptual strategies to wastes.
- 1.2 Genesis of waste and its classification.
- 1.3 Factor; Waste generation and accumulation.
- 1.4 Social, political, environmental, Economical management.
- 1.5 Laws & Regulations for Waste Prevention and control.

Unit-II

Management of highly solid wastes.

- 2.1 Highly solid agrowastes.
- 2.2 Genesis and classification, physiochemical nature.
- 2.3 Conversion of soild waste to value added chemicals and biofuels.
- 2.4 Municipal soild waste (MSW)

Physiochemical nature, microbial conversion of MSW to value added Chemicals and fuels. Microbial decomposition to obtain biofertilizer.

Unit-III

3 Management-Soft Organic Waste (MOW)

- 3.1 Market organic waste : Physicochemical nature microbial gasification of MOW to obtain biogas. Microbial decomposition on to obtain fertilizer.
- 3.2 Human Excreta (HE) or Night Soil.
Microbial management and production of biogas and biofertilizer.
- 3.3 Waste from cheese manufacturing factories Chemical Nature of whey
Microbial gasification of whey.
- 3.4 Animal Paunch manure
Physicochemical nature. Microbial gasification.
- 3.5 Cattle manure, poultry and swan manure chemical nature
Microbial gasification & production of biogas and biofertilizer.

Unit-IV

Agrochemical Industry Wastes Management

4.1 Types

- Pulp and paper mill waste: Pulping process Physicochemical nature of waste compounds formed during pulping, pulping chemicals anaerobic treatment of waste and sludge. Anaerobic versus aerobic upgradation of waste, pulping mud to plastics.
- 4.2. Sugar mill Waste : Nature of chemical used in sugarcane processing, waste generating during molasses fermentation
Biological upgradation of distillary effluent for obtaining biogas.
Bioethanol production from sugar mill waste water.
- 4.3 Vanaspati Wastes: Nature of raw materials processing of raw materials, microbial upgradation and recycling.

Unit-V

Waste Water Management

5.1 Industrial waste water :

Coal processing industry, nature of waste water, Microbial detoxification.

5.2 Waste water from pesticides industry :

Types of pesticides industry Processing technology microbial detoxification of waste water.

5.3 Sewage Waste and sludge.

Physicochemical nature of waste water. Biological treatment of sewage water sewage sludge upgradation.

SCHEME OF EXAMINATION OF M.Sc. (FINAL) GENETICS**(As a stream in Bioscience Deptt.)****FIRST YEAR : (Common as for M.Sc. Previous Bioscience)**

Papers	Nomenclature of paper	Max.Marks	Time
Theory			
I	Genetics and Evolutionary Biology	70	3 hrs
II	Biochemistry	70	3 hrs
III	Cell and Molecular Biology	70	3 hrs
IV	Microbiology and Biotechnology	70	3 hrs
V	Environmental Biology	70	3 hrs
Practicals			
VI	Based on paper I and II	60	6 hrs
VII	Based on paper III,IV and V	90	6 hrs
		500	

SECOND YEAR**Theory**

VIII	Principles of Genetics	70	3 hrs
IX	Immuno Genetics	70	3 hrs
X	Medical Genetics	70	3 hrs
XI	Molecular Genetics	70	3 hrs
XII	Microbial Genetics and Gene Technology	70	3 hrs

Practicals

XIII	Based on Theory Papers	90	6 hrs
XIV	Dissertation	60	-
		500	

Paper VIII Principles of Genetics Max. Marks 70

Time : 3 hrs

Unit-I :Eukaryotic Genome:

- 1.1 Early concept of inheritance, discussion on Mendal's paper, proof that genetic information is stored in DNA, organisation of DNA in chromosomes. Genetic code and protein synthesis; Extrachromosomal inheritance, Transposons.
- 1.2 Repeated DNA and sequence organization, DNA renaturation kinetics, moderately repetitive sequences, satellite DNA, highly repetitive sequences, Telomere structure, Heterochromatin, Euchromatin and gene amplification.
- 1.3 Repeated sequences in Human Genome: Long interspersed and short interspersed nuclear elements (LINE and SINE), Exons, Introns, Assembly of genes during development, Human antibody chains.
- 1.4 Regulation of inducible gene expression in eukaryotes: Induction by temperature, Heat shock genes, Induction by Hormones.

Unit-II

- 2.1 Basic features of mutation; spontaneous, induced mutation, phenotypic effects of mutation-Human globin genes and Blocks in metabolic pathways, Genetic analysis of mitochondrial mutation.
- 2.2 Molecular mechanism of mutation, tautomeric shifts, transitions, transversions and frameshift mutations, Repair and suppression, mutation rates; mutation induced by chemicals, by radiations, by transposable genetic elements.
- 2.3 Screening chemicals for mutagenicity (AMES test) mutagenicity and carcinogenicity, Mutation rates and evolution, Mutation randomness, genes adaptation and evolution, practical applications of mutations.

Unit-III

- 3.1 Genetic analysis of Development in Drosophila. Imaginal discs, correlation of genetic and cytological maps of Drosophila, Fate map of Drosophila blastoderm, Sex determination in Drosophila, Genetic mosaics, Homeotic

- 3.2 Genetic analysis of Development in vertebrates; vertebrate homologs of invertebrate gene, Insertional mutagenesis, Maternal effects on development, Early embryogenesis of the mouse, Transgenics and knock down mutation in mouse.
- 3.3 Genetics of Drosophila Rhythms, per genes and Biological Rhythms, Maternal effect in Drosophila. Maternal effect in shell coiling.

Unit-IV Quantitative and population Genetics

- 4.1 Analysis of quantitative traits: Frequency distribution, the mean, mode class variance; standard deviation, correlation coefficients and regression.
- 4.2 Quantitative Traits, Genetic variation, additive and dominance effects. Hybrid vigour, heritability.
- 4.3 Theories of population genetics; Random mating and Hardy Weinberg Principle of genetic equilibrium. Forces influencing gene frequencies selection, mutation migration, population size, applications of H.W. principle.
- 4.4 Genetic variation and evolution, Electrophoretic variants of proteins in the study of population genetics. Concept and measurement of Inbreeding and heterozygosity.

Unit-V Molecular Evolution

- 5.1 Origin of genomes, acquisition of new genes (by gene duplication, from other species).
- 5.2 Non coding DNA and genome evolution, Transposable elements and genome evolution, Origin of introns. Comments of Human Genome.
- 5.3 Molecular phylogenetics. Tree construction, applications of molecular phylogenetics.

Paper IX IMMUNO GENETICS

Max. Marks:70

Time:3 Hrs.

Unit-I

- 1.1 Immunological specificity, Memory and diversity. Innate and Acquired immunity, Immunological apparatus; Structure and functions of primary and secondary lymphoid organs, Types and functions of immunocompetent cells.

- 1.2 Specialized proteins providing Immunological specificity Specific features of antigens, Haptens, antigenic determinants; Structure of antibodies. Isotypes, Allotypes and Idiotypes, Immunoglobulin Classes.
- 1.3 Cellular interactions, Cellular immune response (T cell mediated), Humoral immune response (antibody mediated), clonal selection.

Unit-II

- 2.1 Genetics of antibody formation. Genetics basis of antibody diversity, Genetics organisation of Ig, Two gene one polypeptide, Control of Ig gene expression.
- 2.2 Genomic rearrangement during B lymphocyte differentiation; Genetic control of human antibody lambda and Kappa Chains, Somatic recombination events, Somatic hypermutation.
- 2.3 Antibody class switching, Allelic exclusion, Hybridomas, monoclonal antibodies.

Unit-III

- 3.1 MHC complex; MHC genes and immune response, Genetic map of H₂ and HLA complexes; Class-I, Class-II and Class-III MHC molecules and the traits under their control, Role of CD₄, CD₈, MHC-I and MHC-II in cell cooperation and cytotoxicity.
- 3.2 MHC restriction: Ir genes and MHC link, MHC restriction, Thymic selection, Transgenic mice and Super antigens.
- 3.3 T cell receptor complex: Characterisation of TCR, TCR and Ig, TCR gene organisation and strategies.

Unit-IV

- 4.1 Antigen-antibody reactions; Antibody Affinity and Avidity, Methods to detect primary antigen antibody reactions- Fluorescent quenching RIA, ELISA. Secondary antigen antibody reactions-precipitation, Immunoelectrophoresis, Agglutinations, Haemagglutination.
- 4.2 Immunologic tolerance; Conditions influencing tolerance, clonal deletion, functional inactivation, regulated inhibition of antigen reactive T and B cells
- 4.3 Inherited defects of Immune system, Autoimmune diseases-IDD, SLE, Immunodeficiency diseases: SCID and AIDS HIV genome, Life cycle of HIV.

Unit-V

- 5.1 Transplantation Immunology-Different types of Transplantation laws, graft rejection-Ist set; IInd set, and chronic rejection, Transplantation groups.
- 5.2 MHC genes and graft rejection. Transplantation antigens, lymphocyte defined antigens (LD). Alloreactivity, Serologic tissue typing, Mixed tissue typing (MLA), Histo compatibility testing.
- 5.3 Tumour Immunology: Cancer and immunology, Oncogenes, Tumour specific and Tumour associated antigens (TSA and TAA), Cellular immunity and tumours, Immuno therapy.

Paper-X**Medical Genetics**

Max. Marks:70

Time:3 Hrs.

Unit-I

- 1.1 Mendelian Principles in Human Genetics: Pedigree and consanguinity, Gene transmission in families: autosomal recessive inheritance, X linked inheritance, Intermediate inheritance (co-dominance and incomplete dominance), Polygenic inheritance. Autosomal dominant inheritance.
- 1.2 Sex determination in Human beings; TDF and sex determining region (SRY), Testicular feminization syndrome; X chromosome inactivation in Mammals (Genetic mosaics). Human Karyotyping and Banding pattern in chromosomes.
- 1.3 Somatic Cell genetics: Somatic cell hybrids, Mapping, In situ hybridization, Production of hybrid cells-major pathways and salvage pathways HAT selection, Isolation of DMD gene, Revers genetics and Germ line transformation in Mammals (Trangenic mammals).

Unit-II

- 2.1 Structural chromosomal aberrations: Types of structural changes, Deletions, Duplications, Inversions, Translocation, Ring chromosomes, Isochromosomes; Genetic disorders caused by structural chromosomal changes. Achondroplasia, Galactosemia, Huntington's disease, Polydactyly.

- 2.2 Aberrations in chromosomal number; Abnormalities of autosomes, Abnormalities of sex chromosomes; Genetic disorders caused by chromosomal numerical anomalies: Down's syndrome, Kline filter's syndrome, Turner's syndrome.
- 2.3 Radiation genetics: characteristics, sources and types of irradiation exposure, carcinogenic effects of radiation. Cytogenetic aberrations and somatic effects caused by radiations.

Unit-III

- 3.1 Metabolic variation and disease: Inherited enzyme defects in Man (Metabolic blocks), Blocks in biosynthetic pathway (Albinism).
- 3.2 Disorders of amino acid metabolism: Blocks in degradative pathways Phenylketonuria (PKU) and Alkaptonuria.
- 3.3 Disorders of carbohydrate metabolism: Galactosemia, Glucose-6 phosphate dehydrogenase deficiency. Disorders of intermediary metabolism: cystinosis, Wilson's disease, Nephrogenic diabetes insipidus.

Unit-IV

- 4.1 Blood group polymorphism: ABO blood group system, MNS" blood group system, RH blood group system.
- 4.2 Theoretical and practical applications of blood groups: Understanding basic genetic principles, Management of blood transfusions, Management of maternal fetal incompatibilities, Anthropology, Medico legal problems.
- 4.3 Haemoglobinopathies: Normal Haemoglobin structure, Abnormal Haemoglobins, diseases of abnormal Haemoglobins: Sickle cell anaemia, Thalassemia

Unit-V Genetics and Clinical Practice.

- 5.1 Genetic Screening: Screening of parents, New born and prenatal screening DNA finger printing, Paternity test and Forensic application.
- 5.2 Genetic counselling, Assessment of genetic risks, problems of having affected children.

- 5.3 Diagnostic techniques: Genetic Engineering, Eugenics, Micro injection of DNA into fertilised egg, Human Gene therapy: Genetic modification of animals. Human Genome project.
- 5.4 Treatment of genetic disease: Genetic heterogeneity of disease, Disease resistance, Recognition of carrier states, Metabolic manipulation, somatic cell gene therapy Treatment of Human diseases.

Paper XI MOLECULAR GENETICS Max. Marks:70
Time:3 hrs.

Unit-I

- 1.1 Topology of nucleic acids.
1.1.1. DNA structure and alternate forms of DNA
1.1.2 DNA super coiling,
1.2.3 DNA topoisomerases.
- 1.2 Basic features of DNA replication in vivo
1.2.1 Semiconservative replication of DNA.
1.2.2 Replication forks and Replication bubble
1.2.3 Bi-directional replication,
1.2.4 Okazaki Fragments
1.2.5 Rolling circle replication.
- 1.3 DNA polymerases and in vitro DNA synthesis,
1.4 DNA ligases
1.5 RNA primers & DNA binding protein.

Unit-II Transcription and RNA Processing

- 2.1 Transcription in Prokaryotes
2.1.1 RNA Polymerase: A complex enzyme
2.1.2 Initiation of RNA chains
2.1.3 Elongation of RNA chains
2.1.4 Termination of RNA chains
2.1.5 Concurrent transcription, Translation and m RNA degradation
- 2.2 Transcription and RNA Processing in Eukaryotes:
2.2.1 Three RNA polymerase/Three sets of Genes.
2.2.2 Initiation of RNA chains
2.2.3 RNA Chain Elongation and the Addition of 3 poly(A) Tails.
2.2.4 RNA Editing. Altering the information content of m RNA molecules
- 2.3 Interrupt Genes in Eukaryotes: Exons and Introns
2.4 Removal of Intron sequences by RNA splicing

Unit-III

- 3.1 Regulation of gene expression in Prokaryotes.
 - 3.1.1 Control Point of Gene Expression
 - 3.1.2 Induction and Repression in Prokaryotes
 - 3.1.3 Lactose metabolism and the operon.
 - 3.1.3.1 Lactose as a carbon source
 - 3.1.3.2 Organisation of the lactose metabolic genes
 - 3.1.3.3 Experimental Evidence for the Regulation of the lac operon.
 - 3.1.3.4 The model for regulation of the lac operon
 - 3.1.3.5 Positive control of the Lac operon by the CAP and Cyclic AMP
 - 3.1.4 The Tryptophan Operon
 - 3.1.4.1 Tryptophan Biosynthesis
 - 3.1.4.2 Regulation of trp operon
 - 3.1.4.3 Attenuation
 - 3.1.5 Temporal sequences of Gene expression during phage infection.

Unit-IV

- 4.1 DNA Repair mechanism:
 - 4.1.1 Light dependent repair
 - 4.1.2 Excision repair
 - 4.1.3 Mismatch repair
 - 4.1.4 Post replication repair
- 4.2 DNA recombination mechanisms:
 - 4.2.1 Cleavage & rejoining of DNA molecules
 - 4.2.2 Gene conversion: DNA repair synthesis associated with recombination.
- 4.3 Transposable genetic elements:
 - 4.3.1 Is elements
 - 4.3.2 Composite transposons
 - 4.3.3 Tn 3 elements
 - 4.3.4 Retro transposons
 - 4.3.4.1 Retro virus like elements
 - 4.3.4.2 Retroposons

Unit-5 The Techniques of Molecular Genetics:

- 5.1 Basic Techniques used to clone gene:
 - 5.1.1 The Discovery of restriction Endonucleases.
 - 5.1.2 Production of recombinant DNA molecules in vitro
 - 5.1.3 Amplification of Recombinant DNA molecules in cloning vectors.
- 5.2 The Molecular Analysis of DNA, RNA and Protein.
 - 5.2.1 Analysis of DNAs by southern Blot Hybridisation
 - 5.2.2 Analysis of RNAs by Northern Blot Hybridisation
 - 5.2.3 Analysis of proteins by Western Blot Techniques.
- 5.3 The Molecular Analysis of Genes and Chromosomes:
 - 5.3.1 Amplification of DNA by the Polymerase Chain reaction.
 - 5.3.2 Physical maps of DNA molecules based on Restriction Enzymes Cleavage Sites.

**Paper XII Microbial Genetics and Gene Technology Max. Marks:70
Time:3 hrs.**

Unit-I

- 1.1 Genome Organisation in Bacteria
- 1.2 Recombination in Bacteria
- 1.3 Gene mapping in bacteria
- 1.4 Plasmid.
 - 1.4.1 Type of Plasmids
 - 1.4.2 Detection of Plasmids
 - 1.4.3 Transfer of Plasmid DNA
 - 1.4.4 In vitro plasmid transfer
 - 1.4.6 Properties of particular bacterial plasmids: F Plasmids, Drug resistance plasmids, Colicinogenic plasmids, Agrobacterium plasmid Ti, Broad Host range plasmid, other plasmids.

Unit-II

- 2.1 Structure, characteristic and Life cycle of bacteriophages
- 2.2 Organisation and expression of bacteriophage genes.
- 2.3 Genetics of phage T4:
 - 2.3.1 Genetics recombination in phages

- 2.3.2 Genetic mapping of Page T-4
- 2.3.3 T4 gene organisation
- 2.3.4 Feature of T4 life cycle

- 2.4 Genes in eukaryotic organelles
 - 2.4.1 Basic features
 - 2.4.2 Organisation of organelle genomes: chloroplast genes, mitochondrial genes.
 - 2.4.3. The evolution of extrachromosomal genes.

Unit-III

- 3.1 DNA manipulative enzymes: Nucleases, Ligases, Polymerases.
- 3.2 Recombinant DNA
- 3.3 Ligation-joining DNA molecules together
- 3.4 Restriction endonucleases
- 3.5 Vectors
 - 3.5.1 Cloning vectors based on E coli plasmids
 - 3.5.2 Cloning vectors based on M 13 bacteriophage
 - 3.5.3 Cloning vectors based on bacteriophage.
 - 3.5.4 Cloning vectors for Yeast and other fungi
 - 3.5.5 Cloning vectors for higher plants
 - 3.5.6 Cloning vectors for mammalian cells.

Unit-IV: Application of cloning in gene analysis

- 4.1 Strategies for obtaining clone
- 4.2 Identification of a clone from a gene library
- 4.3 Methods for clone identification
- 4.4 Study the location of cloned gene
- 4.5 DNA sequencing
- 4.6 Studying the transcript of a cloned gene
- 4.7 Studying the regulation of gene expression
- 4.8 Identifying and studying the translation product of a cloned gene.

Unit-V: Gene cloning in Research and Biotechnology

- 5.1 Production of protein from cloned genes
- 5.2 Production of pharmaceutical compounds

- 5.3 Production of recombinant vaccines
- 5.4 Screening for genetic diseases
- 5.5 Identification of the cystic fibrosis gene
- 5.6 Production of Herbicide and Pest resistance plants.
- 5.7 Manipulating gene expression using antisense RNA.