विश्वविद्यालय अनुदान आयोग के निर्देशानुसार
एवं पाठ्यचर्या के आधार पर तैयार किया गया पाठ्यक्रम
Syllabus for B.Sc. & M.Sc. Zoology
revised as according to U.G.C. model curriculum.
(Ch. Charan Singh University, Meerut)

The meetings of Board of Studies in Zoology were held on 28th, April 2003, 9th & 10th July 2003 and 12th & 13th July 2003 in the C.C.S. University, Meerut to review the syllabus of B.Sc. & M.Sc. courses in Zoology for the affiliated colleges, to update the syllabus in the light of U.G.C. model curriculum.

In order to give proper justification to the latest development in the curriculum the number of paper should be changed from existing two theory papers to three theory papers in each of the three classes of B.Sc. I, B.Sc. II and B.Sc. III. This decision was taken in order to bring uniformity with other universities of the state. The detailed courses outlined for B.Sc. I, II, & III are mentioned in the syllabus.

The committee members discussed the current course contents of M.Sc. I and M.Sc. II being offered in the colleges. It was unanimously felt that there was a justified need for bringing about major changes in the syllabus so as to make them compatible with the U.G.C. model curriculum. The list of the courses as well as the detailed course contents are mentioned in the syllabus.

Dr. R.C. Sharma
Convener Board of Studies
C.C.S. UNIVERSITY, MEERUT
Syllabus for B.Sc. I, II & III
(Based on model curriculum of U.G.C.)

ZOOLOGY

The courses of B.Sc. Zoology Shall consist of Nine Theory papers and three practical courses. The theory and practical courses shall be spread in three years as follows:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Name of Title</th>
<th>Code No.</th>
<th>Max Marks</th>
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</thead>
<tbody>
<tr>
<td>B.Sc. Part-I (w.e.f. July 2003 &amp; onwards)</td>
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<tr>
<td>Course-I</td>
<td>Non Chordata</td>
<td>B-121</td>
<td>33</td>
</tr>
<tr>
<td>Course-II</td>
<td>Cell Biology &amp; Genetics</td>
<td>B-122</td>
<td>33</td>
</tr>
<tr>
<td>Course-III</td>
<td>Ecology &amp; Wildlife Biology</td>
<td>B-123</td>
<td>34</td>
</tr>
<tr>
<td>Course</td>
<td>PRACTICAL</td>
<td>B-421 (P)</td>
<td>50</td>
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<tr>
<td>B.Sc. Part-II (w.e.f. July 2004 &amp; onwards)</td>
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<tr>
<td>Course-IV</td>
<td>Chordata</td>
<td>B-221</td>
<td>33</td>
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<tr>
<td>Course-V</td>
<td>Developmental Biology</td>
<td>B-222</td>
<td>33</td>
</tr>
<tr>
<td>Course-VI</td>
<td>Molecular Biology &amp; Tools &amp; Techniques</td>
<td>B-223</td>
<td>34</td>
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<tr>
<td>Course</td>
<td>PRACTICAL</td>
<td>B-521 (P)</td>
<td>50</td>
</tr>
<tr>
<td>B.Sc. Part-III (w.e.f. July 2005 &amp; onwards)</td>
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<td></td>
<td></td>
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<tr>
<td>Course-VII</td>
<td>Evolution and Animal behaviour</td>
<td>B-321</td>
<td>33</td>
</tr>
<tr>
<td>Course-VIII</td>
<td>Biochemistry &amp; Physiology</td>
<td>B-522</td>
<td>33</td>
</tr>
<tr>
<td>Course-IX</td>
<td>Biotechnology</td>
<td>B-323</td>
<td>33</td>
</tr>
<tr>
<td>Course</td>
<td>PRACTICAL</td>
<td>B-521 (P)</td>
<td>50</td>
</tr>
</tbody>
</table>

- There shall be six hours for theory courses and four hours for practicals course each week at each level.
- Each theory paper will be of 3 hours duration. Five questions are to be attempted by the candidates in the examination.
- There shall be internal or external or both types of choices.
- The practical course shall be of 4 hours duration conducted in one session and comprising 50 marks at the end of each year.
C.C.S. UNIVERSITY, MEERUT
Syllabus of B.Sc. Part I (Zoology) (w.e.f. July 2003 and onwards)
(Based on model curriculum of U.G.C.)

Course I
B-121
M.M. : 33

NON-CHORDATA

1. Distinguishing characters and classification upto orders of each group listed below with suitable examples.
2. Detailed study should be made of the types listed under each group (except otherwise mentioned) comprising morphology, bionomics, life history and economic importance if any. Elementary knowledge of topics listed under each group should also be made.

Unit-I
1. Protozoa: Trypanosoma (morphology & life history), Paramecium
2. Porifera: Sycon

Unit-II
1. Cnidaria: Obelia
2. Platyhelminthes: Fasciola (morphology, life history, parasitic adaptations)
   Taenia (only life history).

Unit-III
1. Nemat-helminthes: Ancyclostoma (only life history)
2. Minor phyla: General characters with examples of Rotifera,
   Sipunculoidea, Echiuridae, Bryozoa, Brachiopoda.

Unit-IV
2. Mollusca: Pila, Lamelellidens (external features and nervous system only)

Unit-V
1. Ophiophora: Peripatus (only general characters and affinities).
2. Echinodermata: Asterias (general characters, water vascular system only).
3. Hemichordata: Balanoglossus (morphology, tornaria larva and affinities).

List of books:
1. Barnes, R.D. Invertebrate Zoology (W.B. Saunders Co.)
4. Nigam, Biology of Non-Chordata (S. Nagin Chand)
5. E. Iyer: A manual of Zoology Part I Invertebrate (S. Vithanathan)
Course II  CELL BIOLOGY AND GENETICS  Hours : 60
B - 122  M.M. : 33

Unit-I
1. Diversity of cell size and shape; Cell theory.
2. Structure of prokaryotic and eukaryotic cells.

Unit-II
1. Membrane structure – Unit membrane concept and Fluid mosaic model.
   Membrane transport of small molecules and the ionic basis of membrane excitability.
2. Cell functions, cell adhesion

Unit-III
2. Vesicular traffic in the secretary and endocytic pathways.
3. Structure of Nuclear pore, and Nucleolus.
4. Chromosomes – morphology, structure, types. Study of special chromosome structure such as Polytene and Lampbrush chromosomes.
5. Cell cycle – Mechanics of cell division

Unit-IV
1. Mendelian inheritance patterns and laws of heredity
2. Co-dominance and incomplete dominance
3. Linkage & linkage maps
5. Sex-chromosome systems and sex-linkage.

Unit-V
1. Non-chromosomal inheritance (Cytoplasmic inheritance)
2. Mutations and chromosomal alterations, meiotic consequences.
3. Human genetics – Chromosomal and single gene disorders; genetic counselling.

List of Books:
1. Lodish et al: Molecular cell Biology (Scientific American Books)
2. De Robertis and De Robertis, Cell and Molecular Biology (Saunders college Publ.).
3. Achets et al. Molecular Biology of cell (Garland Publishing, USA)
5. Verma, P.S. and V.K. Agarwal, Genetics, S. Chand & Co. N. Delhi
Unit-I
1. Aims and scope of Ecology.
2. Organisms – Principles of adaptation to external factors (e.g: temperature, rainfall etc.).
3. Precipitation/rainfall patterns, vegetation, soil types – causes and consequences.

Unit-II
4. Commensalism & mutualism.

Unit-III
1. Communities and Ecosystems – concepts, ecosystem energetics.
2. Biogeochemical cycles.
3. Community development – ecological succession, major biomes.

Unit-IV
1. Wildlife management, conservation of renewable resources, National parks, Sanctuaries, Hotspots of Biodiversity, Biosphere reserves.
2. Environmental pollution – Air and water pollutants, pollution control strategies.

Unit-V
1. Zoogeography – principle concepts of parallelism, endemism etc., Factors influencing animal distribution.

List of Books
3. Odum. Ecology (Amerind)
1. Major dissections
   General anatomy and nervous system of *Palaemon*, *Laemelidiens* and *Pila*.

2. Minor dissection
   Hastate plate of Prawn: Statocyst of Prawn; Radula of *Pila*; Appendages of Prawn. Exposition of one or two ganglia of *Laemelidiens in situ*.

3. Permanent Mountings
   Gemmule and Spicules of sponge; *Rasifera*; *Obelia* or any other coelenterate; *Fasciola* and *Taenia*; Section of ospharadium of *Pila*, Radula of *Pila*, Gill, *Laemelidiens*; *Daphnia*.

4. Prepared Slides
   **Protozoa**
   - Euglena, Polystomella, Paramecium, Nyctotherus, Balanidium, Opalina, Noctiluca, Trypanosoma, Monocystis.

   **Porifera**
   - T.S. Sycon, L.S. Sycon, Gemmule of sponge.

   **Cnidaria**
   - Obelia entire; Medusa of Obelia.

   **Platyhelminthes**
   - Taenia scolex, Mature and gravid proglottid of Taenia. Fasciola, Miracidium larva, Redia larva, Cercaria larva, Bladder worm. T.S. Fasciola through different regions, T.S. Taenia through different regions, Planaria entire.

   **Annelida**
   - T.S. of Hirudinaria passing through different parts of body.

   **Arthropoda**
   - Daphnia, Cyclops, Zoea, Megalopa and Nautilus.

   **Mollusca**
   - Glochidia, T.S. shell, T.S. lamina of *Laemelidiens*.

   **Echinodermata**
   - Tube feet of Starfish, Pedicillaria.

   **Hemichordata**
   - T.S. Balanoglossus passing through Proboscis, Collar and Branchiogenital regions, Tornaria larva.

5. Museum specimens
   **Porifera**
   - Euporiphia, Euplectella, Hylanema.

   **Cnidaria**
   - Aurelia, Adamsia, Gorgonia, Physalia, Peirnula, Tubipora, Fungia.

   **Platyhelminthes**
   - Fasciola, Taenia.

   **Minor Phyla**
   - Lingula.

   **Ctenophora**
   - Beroe, Cestum.

   **Annelida**
   - Hirudinaria, Nereis, Aphrodite, Chastopterus.

   **Arthropoda**
   - Limulus, Crab, Hemit crab, Lepas, Balanus, Sacculina on crab, Centipede, Millipede, Apis, Grasshopper.

   **Mollusca**
   - Chiton, Nautilus shell, Sepia, Octopus, Solen, Pearl oyster.
Echinodermata  Ophiderma, Brittle star, Holothuria, Antedon, Echinus, Sea urchin.
Onychophora  Peripatus.
Hemichoradata  Balanoglossus.

6. Cytology Exercises
(a) Cell organelles (specified in theory) – permanent slides or electron micrographs.
(b) Study of different stages of mitosis and meiosis from permanent slides.
(c) Preparation and study of slides for mitosis using squash technique (root tip).
(d) Microscope and their parts.

7. Genetics exercises
(a) Genetics problems on sex-linked inheritance.
(b) Preparation of familial pedigree.

8. Ecological exercise
(a) Measurement of dissolved oxygen contents by Winkler's method.
(b) Measurement of hardness of water by EDTA method.

9. Viva-Voce
Pertaining to the courses specified in theory papers I, II & III and the practicals.

10. Sessional Records
(a) Practical record books must be maintained by each student and submitted at the practical examination along with the charts and models prepared.
(b) Regular tests (at least 2 in a session) are to be conducted and record of the same is to be maintained.
(c) One or two field excursions for collection/study be arranged.

Scheme of Practical Examination of B.Sc. Part I

The practical shall be of 4 hours duration conducted in one day.

1. Major dissection  10
2. Minor dissection  4
3. Mounting  4
4. Spotting (including cytology)  10
5. Cytology exercise  4
6. Genetics Exercise  4
7. Ecology Exercise  4
8. Viva-Voce  5
9. Sessional Records  5

Total 50
C.C.S. UNIVERSITY, MEERUT
Syllabus of B.Sc. Part- II (Zoology) (w.e.f. July 2004 and onwards)
(Based on model curriculum of U.G.C.)

Course IV
B – 221

CHORDATA

| Hours : 60 |
| M.M. : 33 |

1. Distinguishing characters and classification upto orders of each group listed below with suitable examples.
2. Detailed study should be made of the types listed under. Each group (except otherwise mentioned) comprising morphology, bionomics, life history and economic importance if any. Elementary knowledge of the topics listed under each group should also be made.

Unit-I
1. Urochordata  Herdmania (excluding development).
2. Cephalochordata  Amphioxus (excluding development).
3. Cyclostomata  External features of Petromyzon & Myxine.

Unit-II
1. Pisces  Scoliodon (excluding endoskeleton and development);
   Economic importance of fishes.

Unit-III
1. Reptilia  Uromastix or any lizard (excluding endoskeleton and development);
   Poison apparatus, Identification of Poisonous & non-poisonous snakes, Biting mechanism, venom, antivenom.

Unit-IV
1. Aves  Columba (excluding development), Migration of birds; Flight muscles; Flight adaptations in birds; types, structure and development of feathers, Perching mechanism.

Unit-V
1. Mammalia  Distribution, salient features and affinities of Protophtheria, Metatheria; and Eutheria, Dentition in Mammals.

List of Books:
Course V
B-222

DEVELOPMENTAL BIOLOGY

Hours: 60
M.M.: 33

Unit-I
1. Gametogenesis: Spermatogenesis and Oogenesis, vitellogenesis, egg membranes.
2. Fertilization: Sperm-egg interactions – biochemical events, post fertilization events.
3. Parthenogenesis

Unit-II
1. Types of animal eggs; patterns of cleavage; germ layers, gastrulation, fate maps and cell lineage.
2. Embryonic and post-embryonic development of sea urchin.
3. Details of developmental events in frog.

Unit-III
2. Organogenesis of heart, kidney, nervous system & sense-organs.

Unit-IV
1. Salient features of chick development.
2. Extra embryonic membranes of chick.
3. Types of placentae in mammals.

Unit-V
1. Regeneration in invertebrates, e.g., Hydra, Planaria, Echinoderms.
2. Regeneration in amphibian Limbs.
3. Metamorphosis in Frog.

List of Books

Course VI
MOLECULAR BIOLOGY, TOOLS & TECHNIQUES
Hours: 60
B - 223
M.M.: 34

Unit-I
1. Genes and chromosomes – nature of genetic material – central dogma
2. Organization of DNA - viral, bacterial and eukaryotic, palindromes, split genes, transposons.

Unit-II
1. DNA replication – general principles, enzymes and inhibitors
2. DNA repair.

Unit-III
1. Transcription – basic details of molecular mechanism.
2. Protein biosynthesis – basic details of molecular mechanism.

Unit-IV
1. Regulation of gene expression – general principles.
2. Regulation of gene expression in bacteria – Lactose operon, positive and negative control mechanism. Regulation at transcription and translation levels in prokaryotes.

Unit-V
2. Molecular separations by chromatography, electrophoresis, precipitation etc.
3. Organelle separation by centrifugation etc.

List of Books:
1. Brown, T.A. Genetics: a molecular Biology approach Van Nostrand
2. Alberts et al. Molecular Biology of the Cell (Garland Publishing Inc. USA)
8. Dabre, P.D. Introduction to Practical molecular biology (John Wiley & Sons)
1. **Major dissection**  
   *Scoliodon* - General anatomy, Afferent blood vessels, Efferent blood vessels, and Cranial nerves.

2. **Minor dissection**  
   Internal ear of *Scoliodon*; Accessory respiratory organs of any one local fish, *(Clarias or Heteropneustus or Channa).*

3. **Mounting:**  
   Ampullae of Lorenzine, Placoid scales, Striated and nonstriated muscles.

4. **Prepared Slides**  
   **Cephalochordata**  
   T.S. of *Amphioxus* passing through vestibule, pharynx, gonads, intestine, and caudal regions.  
   **Pisces**  
   V.S. Skin of Shark, T.S. body through trunk and tail regions of shark.  
   **Amphibia**  
   V.S. skin, T.S. of decalcified bone, T.S. of cartilage  
   **Reptilia**  
   V.S. skin,  
   **Aves**  
   V.S. Skin, Feathers of different types  
   **Mammalia**  

5. **Museum Specimens**  
   **Urochordata**  
   *Hardmania, Cliona*  
   **Cephalochordata**  
   *Amphioxus*  
   **Cyclostomata**  
   *Myxine, Petromyzon*  
   **Pisces**  
   *Pristis, Torpedo, Echinus or Remora, Exocoetus,*  
   *Pleuronectes, Amia, Chimaera, any lung fish.*  
   **Amphibia**  
   *Urotyphlus, Axolotl, Hyla, Salamandra, Siren.*  
   **Reptilia**  
   *Hameleon, Draco, Hemidactylus, Varanus, Crocodile,*  
   Poisonous and non-poisonous snakes, Turtle.  
   **Aves**  
   *Bufo (owl), Psittacula (parrot), Pavo, Eudynamis*  
   **Mammalia**  
   *chidna, Manis, Bat, Hedgehog, Funambulus, Leo leo,*  
   Spiny ant eater or Duck-billed-platypus.
6. **Skeleton**
   Endoskeleton of *Varanus* (excluding loose bones of skull), Fowl (excluding loose bones of skull) and Rabbit.

7. **Embryological slides**
   Fish
   Embryo of *Scalidion*
   Frog
   Sperm of the frog & ovum of frog. Morula stage, early blastula stage, late blastula & early gastrula, late gastrula, whole mount of 5 mm and 7mm embryos of frog. L. S. of Tadpole through head and body regions.
   Chick
   Whole mount of chick embryo showing primitive streak, whole mount of 5, 10, 20, 35, 48 somites stage of embryo, V.S. of skin showing development of feathers.

8. (a) **Molecular biology** – Demonstration of DNA replication, protein synthesis and gene regulation through chart or model
   (b) **Chromatography** – Paper, gel

9. **Viva-Voce pertaining to course specified in theory course I, II & III and the practical**

10. **Sessional Record**
    (a) Practical record books must be maintained by each student and submitted at the practical examination along with charts and models prepared.
    (b) Regular tests (at least 2 in a session) are to be conducted and record of the same is to be maintained.
    (c) One or two field excursions for collection/study be arranged.

**Scheme of Practical Examination**

The practical examination shall be of 4 hours duration conducted in one day.

1. Major dissection  10
2. Minor dissection  5
3. Mounting  5
4. Experiment on chromatography / molecular biology  5
5. Spotting – (a) General spots 10 (b) Embryological spots (10+5)  15
6. Viva-Voce  5
7. Sessional Record  5

**Total**  50
C.C.S. UNIVERSITY, MEERUT
Syllabus of B.Sc. Part III (Zoology) (w.e.f. July 2005 and onwards)
(Based on model curriculum of U.G.C.)
Course VII
B – 321
EVOLUTION AND ANIMAL BEHAVIOUR
Hours : 60
M.M. : 33

Unit-I
1. Concept of Evolution.
3. Origin of prokaryotic and eukaryotic cells.

Unit-II
1. Variations, mutations as raw material for evolution, recombination, ploidy, isolation, Natural selection; Evolution in action.
2. Concept of species and speciation.

Unit-III
1. Polymorphism; Population genetics, Genetic drift.
2. Macro – and microevolution.

Unit-IV
1. Introduction to Ethology.
2. Patterns of behaviour, approaches to the study of behaviour.
3. Genetics of behaviour, natural selection and behaviour.
4. Reproductive behaviour patterns.

Unit-V
1. Social organization in animals, social interactions among individuals.
2. Comparative aspects of learning.
3. Human ethology, effect of hormones, and drugs on behaviour.

List of books.
1. Strickberger, M.W.: Evolution (CBS publishers Delhi)
2. Moody: Introduction to Evolution (Indian edition)
3. Dobzhansky et al. Evolution (W.H. Freeman)
Course VIII  Biochemistry and Physiology  Hours : 60  M.M. : 33  
B – 322

Unit-I
1. Amino acids and peptides – Properties & structure
2. Carbohydrates and lipids – Classification, structure and clinical significance.
3. Vitamins – Discovery, structure and functions

Unit-II
1. Proteins – Classification, structural properties
2. Nucleic acid and nucleotides – Structural properties and functions
3. Enzymes – Classification, purification and kinetic assays, immobilised enzymes & their uses.

Unit-III
1. Blood – Composition and function of blood, blood groups; Blood coagulation; Structure and function of haemoglobin.
2. Heart – Structure; Conduction and regulation of heart beat; Cardiac cycle and ECG.

Unit-IV
1. Respiration – Mechanism and control of breathing.
2. Digestion and absorption of dietary components.

Unit-V
1. Physiology of muscle function.
2. Physiology of neuronal function.
3. Endocrine glands and hormones.

List of Books
1. Stryer, L. Biochemistry (Freeman).
5. Hoar, W.S. General and Comparative Physiology. Prentice Hall of India
7. Rama Rao, A.V.S.S. Biochemistry
Course IX
B – 323

BIOTECHNOLOGY

Hours : 60
M.M. : 34

Unit-I
1. Definition and scope of biotechnology.
2. Basic concepts in genetic engineering.
3. Enzymology of genetic engineering – Restriction enzymes, DNA ligase, Polymerase etc.

Unit-II
1. Cloning vehicles – Plasmids, Cosmids, Lambda phage, Charon phage, Shuttle vectors, 2μ DNA plasmids, yeast plasmids.
2. Introduction of cloned genes into the host cells – Transformation, transfection, Particle gun, electroporation, liposome mediated cultivation, etc.

Unit-III
1. Analysis and expression of cloned genes in host cells – Restriction enzyme analysis, Southern blotting, Northern blotting, RFLP, DNA finger printing, polymerase chain reaction.
2. Gene libraries – mRNA isolation, cDNA synthesis, cloning and amplification of gene libraries, Genomic DNA libraries, YACs, BACs.

Unit-IV
1. Transferring genes into animal oocytes, eggs, embryos and specific animal tissues.
2. Application and impact of rDNA technology.
3. Ethical issues and biosafety regulations.

Unit-V
1. Cell culture techniques
2. Design and Functioning of tissue culture laboratory
3. Cell proliferation measurements, Cell viability testing
4. Culture media preparation and cell harvesting methods.

List of Books
2. R.A. Meyers (Ed.) Molecular Biology and Biotechnology. VCH Publishers
1. Physiology:
   The physiology will include two aspects: In the first aspect an experiment is to be performed and in the second, comments are to be made on set experiments.
   (a) Experiments to be done
   1. Test for amylase, invertase and pepsin.
   2. Determination of Hb% in blood.
   3. RBC count by haemocytometer in blood.
   4. Test for sugar, proteins and lipids.
   Note: Blood can be procured from blood bank.
   (b) Experiments for demonstration and comments
   1. Osmosis
   2. Muscle twitch by stimulating it with mechanical, chemical and thermal stimuli.
   3. Reflex action
   4. Respiration
   5. Blood pressure equipment.

2. Dissection of Endocrine Gland:
   Dissection and location of endocrine glands in Rat or any other vertebrate.

3. Mounting:
   Permanent mounting of the following: Striated and nonstriated muscle fibre of frog (or mammals), Feathers of birds.

4. Prepared Slides:
   (a) Histological slides of amphibia, reptilia, birds and mammals of followings organs:
       Stomach, intestine, liver, pancreas, kidney, testis, ovary, spinal cord, artery and vein.
   (b) Histological slides of endocrine glands.

5. (a) Experiments related to evolution and animal behaviour.
   i. Adaptive modification in feet of birds.
   ii. Adaptive modification in mouth parts of insects.
   iii. Embryological evidence for evolution.
   iv. Analogy and homology.
   v. Study of learning and feeding of dog
   vi. Study of territorial behaviour in birds.
5. (b) Experiments related to Biotechnology
   i. Cloning of Dolly.
   ii. Preparation of human insulin by bacteria.
   iii. DNA fingerprinting.
6. Viva-Voce:
   Pertaining to course specified in theory course I, II, III and the practical 3.
7. Sessional Record:
   (a) Practical record books must be maintained by each student and submitted at the practical examination along with charts and models prepared.
   (b) Regular tests (at least 2 in a session) are to be conducted and record of the same is to be maintained.
   (c) One or two field excursions for collection/study be arranged.

Scheme of Practical Examination of B.Sc. Part III

The practical examination shall be of 4 duration conducted in one day.

1. Physiology Experiments (2) 10
2. Dissection of Endocrine gland 5
3. Mounting 5
4. Spotting (5) 10
5. Evolution / Animal behaviour Exercise 5
6. Biotechnology Exercise 5
7. Viva-Voce 5
8. Sessional Record 5

Total 50

Chairman:
Dr. R.P. Singh
Vice-Chancellor

Convener:
Dr. R.C. Sharma
Meerut College, Meerut