B.Sc. ZOOLOGY SYLLABUS UNDER CBCS

(With effect from 2016-2017)

I - SEMESTER

DSC-1A (Theory)

Animal Diversity – Invertebrates

Max. Marks: 80

UNIT – I

1.1 Kingdom Animalia, Brief history of Invertebrates.
1.2 Protozoa General characters and Classification up to classes with examples.
1.3 Type study of *Elphidium*, Life cycle of *Plasmodium.* Locomotion, Reproduction and Diseases of protozoans.
1.4 Porifera General characters, Classification of up to classes with examples.
1.5 Type study of *Sycon;* Canal system in sponges and Spicules.

UNIT – II

2.1 General characters and Classification of Cnidaria up to classes with examples.
2.2 Type study of *Obelia*, Polymorphism in hydrozoa; Corals and coral reef formation.
2.3 General characters and Classification of Platyhelminthes up to classes with examples.
2.4 Type study- *Schistosoma;* Parasitic Adaptations in Helminthes.
2.5 Nemathelminthes General characters, Classification of Nemathelminthes up to classes with examples; Type study of *Dracunculus.*

UNIT – III

3.1 Annelida General characters and Classification up to classes with examples.
3.2 Type study of *Hirudinaria granulosa.*
3.3 Evolutionary significance of Coelome and Coelomoducts and metamerism.
3.4 Arthropoda General characters and Classification of Arthropoda up to classes with examples.
3.5 Type study of Prawn; Mouth parts of Insects; Insect metamorphosis; *Peripatus* - Structure and affinities.

UNIT – IV

4.1 Mollusca General characters and Classification up to classes with examples.
4.2 Type study – *Pila*; Pearl formation; Torsion and detorsion in gastropods.
4.3 Echinodermata General characters and Classification of Echinodermata up to classes with examples.
4.4 Water vascular system in star fish; Echinoderm larvae and their significance.
4.5 Hemichordata General characters and Classification up to classes with examples; *Balanoglossus* - Structure and affinities.

Suggested Readings

1. L.H. Hyman '*The Invertebrates' Vol I, II and V*. – M.C. Graw Hill Company Ltd.

2. Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.

3. E.L. Jordan and P.S. Verma '*Invertebrate Zoology'* S. Chand and Company.

4. R.D. Barnes '*Invertebrate Zoology'* by: W.B. Saunders CO., 1986.

5. Barrington. E.J.W., '*Invertebrate structure and Function'* by ELBS.

6 P.S. Dhami and J.K. Dhami. Invertebrate Zoology. S. Chand and Co. New Delhi.

7. Parker, T.J. and Haswell '*A text book of Zoology'* by, W.A., Mac Millan Co. London.

8. **Barnes, R.D. (1982).** *Invertebrate Zoology*, V Edition"

ZOOLOGY PRACTICAL SYLLABUS FOR I SEMESTER
ZOOLOGY - PAPER - I
ANIMAL DIVERSITY - INVERTEBRATES

Max. Marks: 50

1. **Study of museum slides / specimens / models (Classification of animals up to orders)**

   i. **Protozoa:** Amoeba*, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax*

   ii. **Porifera**: *Sycon, Spongilla, Euspongia, Sycon* - T.S & L.S, Spicules, Gemmule

   iii. **Coelenterata:** *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula*

   iv. **Platyhelminthes:** *Planaria, Fasciola hepatica, Fasciola* larval forms – Miracidium, Redia, Cercaria, *Echinococcus granulosus, Taenia solium, Schistosoma haematobium*

   v. **Nemathelminthes:** *Ascaris(Male & Female), Drancunculus, Ancylostoma, Wuchereria*

   vi. **Annelida:** *Nereis, Aphrodite, Chaetopteurs, Hirudinaria,* Trochophore larva

   vii. **Arthropoda:** Cancer, Palaemon**,** Scorpion, *Scolopendra, Sacculina, Limulus, Peripatus,* Larvae - Nauplius, Mysis, Zoea, Mouth parts of male *&* female *Anopheles* and *Culex,* Mouthparts of Housefly and Butterfly.

   viii. **Mollusca:** *Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus,* Glochidium larva

   ix. **Echinodermata:** *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon,* Bipinnaria larva

   x. **Hemichordata:** *Balanoglossus,* Tornaria larva

2. **Dissections:**

   Prawn: Appendages, Digestive system, Nervous system, Mounting of Statocyst
   Insect Mouth Parts

3. **Laboratory Record work shall be submitted at the time of practical examination**

4. An **"Animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

5. **Computer aided techniques should be adopted – show virtual dissections**

Suggested manuals:

1. Practical Zoology- Invertebrates S.S. Lal
2. Practical Zoology - Invertebrates P.S. Verma
3. Practical Zoology - Invertebrates K.P. Kurl

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – I

ANIMAL DIVERSITY - INVERTEBRATES (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

1. Study of museum slides / specimens/models (Classification of animals up to orders)

i) **Protozoa:***Amoeba, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoebahistolytica, Plasmodium vivax*

ii) **Porifera**:*Sycon, Spongilla,Euspongia, Sycon*- T.S &L.S, Spicules, Gemmule

iii) **Coelenterata:** *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula*

iv) **Platyhelminthes:***Planaria, Fasciolahepatica, Fasciola*larval forms – Miracidium, Redia, Cercaria, *Echinococcusgranulosus, Taeniasolium, Schistosomahaematobium*

v) **Nemathelminthes:***Ascaris(Male & Female), Drancunculus, Ancylostoma,Wuchereria*

vi) **Annelida:** *Nereis, Aphrodite, Chaetopteurs, Hirudinaria,* Trochophore larva

vii) **Arthropoda:** *Cancer, Palaemon,* Scorpion, *Scolopendra, Sacculina, Limulus, Peripatus,* Larvae -Nauplius, Mysis,Zoea,Mouth parts of male & female *Anopheles* and *Culex,* Mouthparts of Housefly and Butterfly.

viii) **Mollusca:** *Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus,* Glochidium larva

ix) **Echinodermata:** *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria,Antedon,* Bipinnaria larva

2. Demonstration of dissection / dissected / virtual dissection:
Prawn: Appendages, Digestive system, Nervous system, Mounting of Statocyst

3. Laboratory Record work shall be submitted at the time of practical examination

4. An **"Animal album"** containing photographs, cut outs, with appropriate write up about the abovementioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

5. Computer aided techniques should be adopted as per UGC guide lines.

Suggested manuals:

1. Practical Zoology- Invertebrates by S.S.Lal
2. Practical Zoology – Invertebrates by P.S.Verma
3. Practical Zoology –Invertebrates by K.P.Kurl

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HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

B.Sc. ZOOLOGY SYLLABUS UNDER CBCS

(With effect from 2016-2017)

II - SEMESTER

DSC-1B (Theory)

Ecology, Zoogeography and Animal Behavior

Max. Marks: 80

UNIT – I

1.1 Ecosystem structure and functions.
1.2 Types of Ecosystems –Aquatic and Terrestrial.
1.3 Biogeochemical cycles - Nitrogen, Carbon, Phosphorus and Water.
1.4 Energy flow in ecosystem; Food chain, food web and ecological pyramids.
1.5 Animal Associations - Mutualism, commensalism, parasitism, competition, predation.

UNIT – II

2.1 Concept of Species, Population dynamics and Growth curves.
2.2 Community Structure and dynamics; Ecological Succession.
2.3 Ecological Adaptations.
2.4 Environmental Pollution – Sources, Effect and Control measures of Air, Water, Soil and Noise pollution.
2.5 Wildlife conservation - National parks and Sanctuaries of India, Endangered species. Biodiversity and hotspots of Biodiversity in India.

UNIT – III

3.1 Zoogeographical regions – Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions - their Climatic and faunal peculiarities.
3.2 Wallace line
3.3 Discontinuous distribution.
3.4 Continental Drift

UNIT – IV

4.1 Types of Behaviour- Innate and Acquired, Instinctive and Motivated behavior.
4.2 Taxes, Reflexes, Tropisms.
4.3 Physiology and phylogeny of learning, trial and error learning, Imprinting, habituation, Classical conditioning, Instrumental conditioning.
4.4 Social behavior, Communication, Pheromones.
4.5 Biological rhythms, Biological clocks, Circadian rhythms.

Suggested Readings

M.P.Arora, '*Ecology*' Himalaya Publishing company.
P.D.Sharma, *Environmental Biology'*.
P.R.Trivedi and Gurdeep Raj. '*Environmental Ecology'*
Buddhadev Sarma and Tej Kumar, *Indian Wildlife Threats and Preservation*
Chapman J.L. and Reiss M.J, *Ecology Principles and Applications*, Second Ed., Cambridge University Press, London.
Benny Joseph, *Environmental Studies*, TATA MGraw Hill Com., New Delhi.
Eugene P. Odum, *Fundamentals of Ecology* Third Ed., NataraJ Publishers, Dehradun.
Veer Bala Rastogi, "Ecology and Animal Distribution"
P.K. Gupta, "Text Book of Ecology and Environment"
Bhatnagar and Bansal, "Ecology and Wildlife biology
Dasmann, "Wild life Biology"
Reena Mathur, "Animal Behaviour"
Alocock, "Animal Behaviour- an Evolutionalry Approach

B.Sc. PRACTICAL SYLLABUS FOR II SEMESTER
ZOOLOGY - Core Paper – II
Ecology, Zoogeography and Animal Behavior

Max. Marks: 50

1. Determination of pH of Soil and Water
2. Estimation of salinity (chlorides) of water in given samples.
3. Estimation of Carbonates and bicarbonates in the given water samples.
4. Estimation of dissolved oxygen of pond water, sewage water and effluents.
5. Identification of Zooplankton from a nearby water body.
6. Study of Pond Ecosystem / local polluted site - Report submission
7. Study of at least 3 endangered or threatened wild animals of India through photographs / specimens / models
8. Field visit to Zoo Park to study the management, behavior and enumeration of wild animals.
9. Identification of Zoogeographical realms from the Map and identify specific fauna of respective regions.
10. Observe the response of invertebrates in different lightening conditions

Computer aided techniques should be adopted as per UGC guide lines.

Suggested manuals

1**. Robert Desharnais,Jeffrey Bell,** 'Ecology Student Lab Manual, Biology Labs'
2. **Darrell S Vodopich,** 'Ecology Lab Manual'

B.Sc. ZOOLOGY SYLLABUS UNDER CBCS

(With effect from 2016-2017)

III - SEMESTER

DSC-1C (Theory)

Animal Diversity- Vertebrates and Developmental Biology

Max. Marks: 80

UNIT – I

1.1 Salient features of Urochordata; Retrogressive metamorphosis and its significance in Urochordata.
1.2 Salient features and affinities of Cephalochordata.
1.3 General characters of Cyclostomata; Comparision of the *Petromyzon* and *Myxine.*
1.4 General characters and classification of Chordata upto orders with examples.
1.5 General characters and Classification of Fishes up to order level with examples; *Scoliodon* – Respiratory, Circulatory and Nervous system; Types of Scales and types of Fins.

UNIT – II

2.1 Amphibia General characters and Classification up to orders with examples.
2.2 Rana tigrina - Respiratory, Circulatory and Nervous system; Parental care in amphibia, Neotony.
2.3 General characters and Classification of Reptilia up to orders with examples; *Calotes* – Respiratory system, Circulatory and Nervous system.
2.4 Temporal fosse in reptiles and its evolutionary importance.
2.5 Distinguished characters of Poisonous and Non-poisonous snakes; Rhynchocephalia.

UNIT – III

3.1 Aves General characters and Classification up to orders with examples.
3.2 *Columba livia* -Digestive system, Circulatory systems, Respiratory system and Nervous system.
3.3 Migration in Birds; Flight adaptation in Birds
3.4 Mammalia General characters and Classification up to orders with examples; Rabbit –Digestive, Respiratory, Circulatory and Nervous system.
3.5 Dentition in mammals; Aquatic adaptations in Mammals.

UNIT – IV

4.1 Gametogenesis (Spermatogenesis and Oogenesis); Fertilization.
4.2 Types of eggs; Types of cleavages.
4.3 Development of Frog up to formation of primary germ layers.
4.4 Formation of Foetal membrane in chick embryo and their functions.
4.5 Types and functions of Placenta in mammals; Regeneration in Turbellaria and Lizards.

Suggested Readings:

1. **E.L.Jordan and P.S. Verma** '*Chordate Zoology'* -. S. Chand Publications.
2. **Mohan P.Arora**. '*Chordata – I*, Himalaya Publishing House Pvt.Ltd.
3. **Marshal, Parker and Haswell** '*Text book of Vertebrates*'. ELBS and McMillan, England.
4. **Alfred Sherwood Romer**. Thomas S. Pearson '*The Vertebrate Body*, Sixth edition, CBS college Publishing, Saunders College Publishing
5. **George C. Kent, Robert K. Carr**. *Comparative Anatomy of the Vertebrates*, 9th ed. McGraw Hill.
6. **Kenneth Kardong** *Vertebrates: Comparative Anatomy, Function and Evolution*, 4th ed, 'McGraw Hill.
7. **J.W. Young**, *The Life of Vertebrates*, 3rd ed, Oxford University press.
8. **Harvey Pough F, Christine M. Janis, B. Heiser,** *Vertebrate Life,* Pearson, 6th ed, Pearson Education Inc.2002.

ZOOLOGY PRACTICAL SYLLABUS
III SEMESTER - ZOOLOGY
Animal Diversity- Vertebrates and Developmental Biology

Max. Marks: 50

Study of museum slides / specimens / models (Classification of animals up to orders)

1. **Protochordata:** *Amphioxus, Amphioxus* T.S. through pharynx

2. **Cyclostomata:** *Petromyzon, Myxine, Ammocoetus larva*

3. **Pisces:** Sphyrna *Pristis, Torpedo, Channa, Pleuronectes,Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus,* Scales: Placoid, Cycloid, Ctenoid

4. **Amphibia:** *Ichthyophis, Amblystoma, Siren, Hyla, Rachophous,Bufo,Rana,* Axolotal larva

5. **Reptilia :** *Draco, Chemaeleon, Gecko, Uromastix, Vipera russeli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas.*

6. **Aves:** Archaeopteryx**,** *Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo,*Collection and study of different types of feathers: Quill, Contour, Filoplume, Down

7. **Mammalia:** *Ornithorthynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris,* Hedgehog;

Histology: T.S. of Liver, Pancreas, Kidney, Stomach, Intestine, Lungs Artery, Vein, Bone T.S., Spinal cord.

Osteology :

1. Rabbit – Axial skeleton system (bones of Skull and Vertebral Column)
2. Varanus, Pigeon and Rabbit – Appendicular skeleton system (bones of limbs and girdles)

Dissections of *Labeo/Tilapia*:

1. Digestive system.
2. Brain, Weberian ossicles
3. V, VII, IX, X cranial nerves

Embryology

1. Study of T.S. of Testis and Ovary of a mammal
2. Study of different stages of cleavages (2, 4, 8, 16 cell stages); Morula, Blastula
3. Study of chick embryos of 18 hours, 24 hours, 33 hours and 48 hours of incubation

Laboratory Record work shall be submitted at the time of practical examination

An **"Animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Computer aided virtual dissections.

Suggested manuals

1. **S.S.Lal,** Practical Zoology – Vertebrata
2. **P.S.Verma,** A manual of Practical Zoology – Chordata
3. **Freeman & Bracegirdle,** An atlas of embryology

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – IV

CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Cell Biology

1.1.1 Ultra structure of Animal cell

1.1.2 Structure (Fluid mosaic model) and Functions of Plasma membrane

1.1.3 Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Mitochondria and Nucleus

1.1.4 Chromosomes - Structure, types, Cell Division- Mitosis, Meiosis, Cell Cycle and its regulation.

UNIT – II

2.1 Molecular Biology

2.1.1 DNA (Deoxyribo Nucleic Acid) –Structure-RNA (Ribo Nucleic Acid)-Structure, types, DNA Replication

2.1.2 Protein Synthesis – Transcription, Translation.

2.1.3 Gene Expression - Genetic Code, Operon concept.

2.1.4 Molecular Biology Techniques – Polymerase Chain Reaction (PCR), Electrophoresis.

UNIT – III

3.1 Genetics

3.1.1 Mendel's laws of Inheritance and Non-Mendelian Inheritance , Linkage and Crossing over.

3.1.2 .Sex determination and Sex-linked inheritance.

3.1.3 Chromosomal Mutations- Deletion, Duplication, Inversion, Translocation; Aneuploidy and Polyploidy; Gene mutations- Induced versus Spontaneous mutations

3.1.4 Inborn errors of metabolism.

UNIT – IV

4.1 Developmental Biology

4.1.1 Gametogenesis (Spermatogenesis and Oogenesis), Fertilization, Types of eggs, Types of cleavages

4.1.2 Development of Frog upto the formation of primary germ layers

4.1.3 Formation of Foetal membrane in chick embryo and their functions

4.1.4 Types and functions of Placenta in Mammals,Regeneration in Turbellarians and Lizards

HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

Suggested Readings:

1. **Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell** *'Molecular Cell Biology'* W.H. Free man and company New York.

2. **Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008).** *Principles of Genetics.* VIII Edition. Wiley India.

3 **Snustad, D.P., Simmons, M.J. (2009).** *Principles of Genetics.* V Edition. John Wiley and Sons Inc.

4 **Klug, W.S., Cummings, M.R., Spencer, C.A. (2012).** *Concepts of Genetics.* X Edition. Benjamin Cummings.

5. **Russell, P. J. (2009).** *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.

6. **Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.** *Introduction to Genetic Analysis.* IX Edition.W. H. Freeman and Co.

7. **Ridley, M. (2004).** *Evolution.* III Edition. Blackwell Publishing

8.**Campbell, N. A. and Reece J. B. (2011).** *Biology.* IX Edition, Pearson, Benjamin, Cummings.

9.**James D. Watson, Nancy H. Hopkins** *'Molecular Biology of the Gene'*

10. **Gupta P.K**., 'Genetics'

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HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S.)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture
KAKATIYA UNIVERSITY - WGL-506009

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – IV

CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

I. Cytology

1. Preparation and Identification of slides of Mitotic divisions with onion root tips
2. Preparation and Identification of different stages of Meiosis in Grasshopper Testes
3. Identification and study of the following slides

i). Different stages of Mitosis and Meiosis

ii) Lamp brush and polytene chromosomes

II. Genetics

1. Problems on Genetics - Mendelian inheritance, Linkage and Crossing over, Sex linked inheritance

III. Embryology

1. Study of T.S. of Testis and Ovary of a mammal
2. Study of different stages of cleavages (2, 4, 8, 16 cell stages); Morula, Blastula
3. Study of chick embryos of 18 hours, 24 hours, 33 hours and 48 hours of incubation

IV. Laboratory Record work shall be submitted at the time of practical examination

V. An **"Album"** containing photographs, cut outs, with appropriate write-up about Genetics and Embryology

- **Computer aided techniques should be adopted as per UGCguide lines.**

Suggested manuals:

1. Manual of laboratory experiments in Cell Biology by **Edward, G.**
2. Freeman and Bracegirdle – An Atlas of Embryology.

*****

HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S)

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Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY III Year

SEMESTER – V

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Basics of Immune system

1.1.1 Cells of the Immune system and the Lymphoid organs (Primary and Secondary)

1.1.2 First line of defences-physical and chemical barriers; second line of defences – inflammation and phagocytosis.

1.1.3 Types of Immunity- Inherent (Active and Passive) and Acquired Immunity (Active and Passive) Humoral and Cell mediated immunity.

1.1.4 Major Histocompatibility complex (MHC)- structure and function of class I and Class II proteins. Significance of MHC in organ transplantation; MHC restriction

UNIT – II

2.1 Antibodies and Antigens and Immune system diseases

2.1.1 Antibodies(Immunoglobulins) – Structure, functions and classification, antibody diversity, Monoclonal antibodies and applications

2.1.2 Antigens structure, antigenic determinants/epitopes, haptens, adjuvants and antigenicity.

2.1.3 Antigen-antibody reactions; Agglutination; Precipitation, Opsonization, Cytotoxicity

2.1.4 Hypersensitivity reactions.
Autoimmunity and Immunodeficiency diseases.

Unit – III

3.1 Animal Biotechnology and Genetically modified organisms

3.1.1 Concept and Scope of Animal Biotechnology

3.1.2 Recombinant DNA Technology and its applications.

3.1.3 Cloning Vectors- Plasmids, Cosmids and shuttle vectors, Cloning methods(Cell, Animal and Gene cloning); Restriction enzymes and Ligases

3.1.4 Transgenesis – Methods of Transgenesis
Production of Transgenic animals- Sheep and Fish

Unit – IV

4.1 Applications of Biotechnology

4.1.1 In vitro fertilization and embryo transfer

4.1.2 Hybridoma technology – concepts and applications

4.1.3 Stem cells- Types and their applications

4.1.4 Recombinant insulin and human growth hormone; Polymerase Chain Reaction (PCR)
Animal Bioreactors- Concepts and Applications.

HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

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Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

Suggested Readings:

1. Text Book of Immunology – Ivan Riott
2. Text Book of Immunology – C.V.Rao
3. Text Book of Immunology – Nandinin Shetty
4. Text Book of Immunology – Kubey
5. Culture of Animal Cells – R. Ian Freshney, Wiley Liss
6. Biotechnology – S. Mitra
7. Animal Cell Culture - Practical Approach – Ed. John. RW. Masters, Oxford
8. Biotechnology – B.D.Singh
9. Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNAAnalysis*. II Edition, Academic Press, California, USA.
10. Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
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Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY III Year

SEMESTER – V

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

I. Immunology

1. Identification of Blood grouping (Demonstration of Agglutination) using kit.
2. Demonstration of Precipitation (VDRL/RPR) using kit.
3. Histological study of Lymphoid organs -Spleen, Thymus, Lymph node, Bone marrow (through prepared slides).
4. Enumeration of Total RBC from a given blood sample.
5. Enumeration of Total WBC from a given blood sample.
6. Enumeration of Differential count of WBC from a given blood sample.

II. Animal Biotechnology

1. Study the following techniques through Photographs / Virtual Lab

a) Identification of Vectors
b) Identification of Transgenic animals
c) DNA sequencing (Sanger's method)
d) DNA finger printing
e) Southern blotting
f) Western blotting

2. PCR (demonstration) on site or of site demonstration.

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

Suggested manuals:

1. A Hand Book of Practical Immunology – **Ivan Riott**
2. Animal Biotechnology – **P.K. Gupta.**
3. Immunology, VI Edition. W.H. Freeman and Company **Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006).**
4. Immunology, VII Edition, Mosby, Elsevier Publication **David, M., Jonathan, B., David, R. B. and Ivan R. (2006).**
5. Cellular and Molecular Immunology. V Edition. Saunders Publication, **Abbas, K. Abul and Lechtman H. Andrew (2003.)**

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University College
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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY III Year

SEMESTER – VI

ECOLOGY, ZOOGEOGRAPHY AND EVOLUTION

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Ecology- I

1.1.1 Ecosystem Structure and Functions; Types of Ecosystems – Aquatic and Terrestrial
1.1.2 Bio-geo chemical nutrient cycles - Nitrogen, Carbon, Phosphorus and Water
1.1.3 Energy flow in ecosystem
1.1.4 Food chain, food web and ecological pyramids
1.1.5 Animal Associations-Mutualism; Commensalism;Parasitism; Competition, Predation

UNIT – II

2.1 Ecology – II

2.1.1 Concept of Species, Population dynamics and Growth curves
2.1.2 Community Structure and dynamics and Ecological Succession
2.1.3 Ecological Adaptations
2.1.4 Environmental Pollution- Sources, Effect and Control measures of Air, Water, Soiland Noise Pollution
2.1.5 Wildlife conservation - National Parks and Sanctuaries of India, Endangered species; Biodiversity and Hotspots of Biodiversity in India.

UNIT – III

3.1 Zoogeography

3.1.1 Zoogeographical regions
3.1.2 Climatic and faunal peculiarities of Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions
3.1.3 Wallace line, Discontinuous distribution
3.1.4 Continental Drift

Unit – IV

4.1. Evolution

4.1.1 Theories of Evolution – Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, Modern synthetic theory, Evidences of Evolution.
4.1.2 Forces of Evolution–Natural Selection, Genetic drift, Gene flow, Genetic load, Organic variations,Hardy Weinberg Equilibrium.
4.1.3. Isolation –Premating and post mating isolating mechanisms.
4.1.4 Speciation: Methods of Speciation - Allopatric and Sympatric; Causes and Role of Extinction in Evolution.

HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

Suggested Readings:

1. Ecology – Himalaya Publising company – M.P Arora
2. Environmental Biology – P.D. Sharma
3. Environmental Ecology – P.R. Trivedi and Gurdeep Raj
4. Indian Wildlife Threats and Prervation – Buddhadev Sharma and Te Kumar
5. Ecology-Principles and Application II Edn. Cambridge Univ Press, London, Champan. JL and Re.iss MJ.
6. Environmental Studies, TATA McGraw Hill Com. New Delhi, Benny Joseph.
7. Fundamentals of Ecology Third Edn., Nataraj Publishers, Dehradun, Eugene.P. Odum.
8. Ecology and Animal Distribution, Veea Bala Rastogi.
9. Text Book of Ecology and Environment, P.K. Gupta.
10. Ecology and Wildlife Biology, Bhatnagar and Bansal.
11. Evolution 3rd Edn. Blackwell Publishing, Ridley, M (2004).
12. Evolutionary Biology, Addison –Wesley; Minkoff,E(1983).
13. *Evolution*. Cold Spring, Harbour Laboratory Press Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).
14. *Evolution*. IV Edition. Jones and Bartlett Publishers; Hall, B. K. and Hallgrimsson, B. (2008).
15. *Evolution*, 2nd Edn, Oxford and IBH Publishing Co., New Delhi, Jan M. Savage.

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HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY
Under Graduate Courses (Under CBCS 2019 - 2022)
B.Sc. ZOOLOGY III Year
SEMESTER – VI

ECOLOGY, ZOOGEOGRAPHY AND EVOLUTION PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

Ecology

1. Determination of pH of Soil and Water.
2. Estimation of Salinity (Chlorides) of water in given samples.
3. Estimation of Carbonates and Bicarbonates in the given water samples.
4. Estimation of dissolved Oxygen of Pond water, sewage, effluents.
5. Identification of Zooplankton from different water bodies.
6. Study of Pond Ecosystem / Local polluted site – Report submission.

Zoogeography

1. Study of at least 3 endangered or threatened wild animals of India through photographs/specimens/models
2. Field visit to Zoo Park to study the management, behavior and enumeration of wild animals.
3. Identification of Zoogeographical realms from the Map and identify specific fauna of respective regions.

Evolution

1. Museum Study of fossil animals: **Peripatus; Coelacanth fish, Dipnoi fishes; Sphenodon; Archaeopteryx.**
2. Study of homology and analogy from suitable specimens and pictures
3. Problems on Hardy-Weinberg Law
4. Macroevolution using Darwin finches (pictures)

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

Suggested manuals:

1. Ecology Student Lab Manual, Biology Labs – Robert Desharnais, JeffreyBell.
2. Ecology Lab manual – Darrell S Vodopich.

HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – IV

CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Cell Biology

1.1.1 Ultra structure of Animal cell

1.1.2 Structure (Fluid mosaic model) and Functions of Plasma membrane

1.1.3 Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Mitochondria and Nucleus

1.1.4 Chromosomes - Structure, types, Cell Division- Mitosis, Meiosis, Cell Cycle and its regulation.

UNIT – II

2.1 Molecular Biology

2.1.1 DNA (Deoxyribo Nucleic Acid) –Structure-RNA (Ribo Nucleic Acid)-Structure, types, DNA Replication

2.1.2 Protein Synthesis – Transcription, Translation.

2.1.3 Gene Expression - Genetic Code, Operon concept.

2.1.4 Molecular Biology Techniques – Polymerase Chain Reaction (PCR), Electrophoresis.

UNIT – III

3.1 Genetics

3.1.1 Mendel's laws of Inheritance and Non-Mendelian Inheritance , Linkage and Crossing over.

3.1.2 .Sex determination and Sex-linked inheritance.

3.1.3 Chromosomal Mutations- Deletion, Duplication, Inversion, Translocation; Aneuploidy and Polyploidy; Gene mutations- Induced versus Spontaneous mutations

3.1.4 Inborn errors of metabolism.

UNIT – IV

4.1 Developmental Biology

4.1.1 Gametogenesis (Spermatogenesis and Oogenesis), Fertilization, Types of eggs, Types of cleavages

4.1.2 Development of Frog upto the formation of primary germ layers

4.1.3 Formation of Foetal membrane in chick embryo and their functions

4.1.4 Types and functions of Placenta in Mammals,Regeneration in Turbellarians and Lizards

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Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

Suggested Readings:

1. **Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell** *'Molecular Cell Biology'* W.H. Free man and company New York.

2. **Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008).** *Principles of Genetics.* VIII Edition. Wiley India.

3 **Snustad, D.P., Simmons, M.J. (2009).** *Principles of Genetics.* V Edition. John Wiley and Sons Inc.

4 **Klug, W.S., Cummings, M.R., Spencer, C.A. (2012).** *Concepts of Genetics.* X Edition. Benjamin Cummings.

5. **Russell, P. J. (2009).** *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.

6. **Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.** *Introduction to Genetic Analysis.* IX Edition.W. H. Freeman and Co.

7. **Ridley, M. (2004).** *Evolution.* III Edition. Blackwell Publishing

8.**Campbell, N. A. and Reece J. B. (2011).** *Biology.* IX Edition, Pearson, Benjamin, Cummings.

9.**James D. Watson, Nancy H. Hopkins** *'Molecular Biology of the Gene'*

10. **Gupta P.K**., 'Genetics'

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HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S.)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture
KAKATIYA UNIVERSITY - WGL-506009

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – IV

CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

I. Cytology

1. Preparation and Identification of slides of Mitotic divisions with onion root tips
2. Preparation and Identification of different stages of Meiosis in Grasshopper Testes
3. Identification and study of the following slides

i). Different stages of Mitosis and Meiosis

ii) Lamp brush and polytene chromosomes

II. Genetics

1. Problems on Genetics - Mendelian inheritance, Linkage and Crossing over, Sex linked inheritance

III. Embryology

1. Study of T.S. of Testis and Ovary of a mammal
2. Study of different stages of cleavages (2, 4, 8, 16 cell stages); Morula, Blastula
3. Study of chick embryos of 18 hours, 24 hours, 33 hours and 48 hours of incubation

IV. Laboratory Record work shall be submitted at the time of practical examination

V. An **"Album"** containing photographs, cut outs, with appropriate write-up about Genetics and Embryology

- **Computer aided techniques should be adopted as per UGCguide lines.**

Suggested manuals:

1. Manual of laboratory experiments in Cell Biology by **Edward, G.**
2. Freeman and Bracegirdle – An Atlas of Embryology.

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HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – I

ANIMAL DIVERSITY – INVERTEBRATES

(Core Paper –I)

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Protozoa

1.1.1 General Characters and Classification of Protozoa up to Orders with examples
1.1.2 Type Study –***Elphidium***
1.1.3 Locomotion and Reproduction
1.1.4 Epidemiology of Protozoan diseases – Amoebiasis, Giardiasis, Leishmaniasis, Malaria

1.2 Porifera

1.2.1 General characters and Classification of Porifera up to Orders with examples
1.2.2 Type study - ***Sycon***
1.2.3 Canal system in Sponges
1.2.4 Types of Cells and Spicules in Porifera.

UNIT – II

2.1 Cnidaria

2.1.1General characters and Classification of Cnidaria up to classes with examples
2.1.2 Type study -***Obelia***
2.1.3 Polymorphism in Cnidarians with examples
2.1.4 Corals and Coral Reef formation

2.2 Helminthes

2.2.1 General characters and Classification of **Platyhelminthes** up to classes with examples
2.2.2 Type study -***Schistosoma***
2.2.3 General characters and Classification of **Nemathelminthes** up to classes with examples
2.2.4 Type study –***Dracanculus;*** Parasitic Adaptations in Helminthes

UNIT– III

3.1 Annelida

3.1.1 General characters and Classification of Annelida up to classes with examples
3.1.2 Type study – ***Hirudinaria granulosa***
3.1.3 Evolutionary significance of Coelome and Coelomoducts and Metamerism
3.1.4 Economic Importance of Annelida (Polychaeta, Oligochaeta and Hirudinea)

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University College
Kakatiya University.
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3.2Arthropoda

3.2.1 General characters; Classification of Arthropoda upto classes with examples
3.2.2Type study –***Palaemon***(Prawn)
3.2.3Crustacean Larvae; Insect metamorphosis; Useful and Harmful Insects
3.2.4***Peripatus***- Structure and affinities

UNIT – IV

4.1 Mollusca

4.1.1 General characters; Classification of Mollusca upto classes with examples
4.1.2Type study -***Pila*** (Snail)
4.1.3 Pearl formation; Torsion and Detorsion in Gastropods
4.1.4 Molluscs as Bio-indicators, Vectors and Pests; Economic importance

4.2 Echinodermata

4.2.1 General characters and Classification of Echinodermata upto classes with examples
4.2.2 Type study- ***Star Fish***
4.2.3Echinoderm larvae and their evolutionary significance
4.2.4 Autotomy, Regeneration and Symmetry of Echinoderms

Suggested Readings:

1. **L.H. Hyman** '*The Invertebrates' Vol I, II and V.* – M.C. Graw Hill Company Ltd.
2. **Kotpal, R.L. 1988 - 1992** Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
3. **E.L. Jordan and P.S.** Verma'*Invertebrate Zoology'* S. Chand and Company.
4. **R.D. Barnes** '*Invertebrate Zoology'* by: W.B. Saunders CO., 1986.
5. **Barrington. E.J.W.**, '*Invertebrate structure and Function'* by ELBS.
6. **P.S. Dhami and J.K. Dhami.**Invertebrate Zoology. S. Chand and Co. New Delhi.
7. **Parker, T.J. and Haswell**'*A text book of Zoology'* by, W.A., Mac Millan Co. London.
8. **Barnes, R.D. (1982).***Invertebrate Zoology*, V Edition"

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HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – I

ANIMAL DIVERSITY - INVERTEBRATES (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

1. Study of museum slides / specimens/models (Classification of animals up to orders)

i) **Protozoa:***Amoeba, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoebahistolytica, Plasmodium vivax*

ii) **Porifera**:*Sycon, Spongilla,Euspongia, Sycon*- T.S &L.S, Spicules, Gemmule

iii) **Coelenterata:** *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula*

iv) **Platyhelminthes:***Planaria, Fasciolahepatica, Fasciola*larval forms – Miracidium, Redia, Cercaria, *Echinococcusgranulosus, Taeniasolium, Schistosomahaematobium*

v) **Nemathelminthes:***Ascaris(Male & Female), Drancunculus, Ancylostoma,Wuchereria*

vi) **Annelida:** *Nereis, Aphrodite, Chaetopteurs, Hirudinaria,* Trochophore larva

vii) **Arthropoda:** *Cancer, Palaemon,* Scorpion, *Scolopendra, Sacculina, Limulus, Peripatus,* Larvae -Nauplius, Mysis,Zoea,Mouth parts of male & female *Anopheles* and *Culex,* Mouthparts of Housefly and Butterfly.

viii) **Mollusca:** *Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus,* Glochidium larva

ix) **Echinodermata:** *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria,Antedon,* Bipinnaria larva

2. Demonstration of dissection / dissected / virtual dissection:
Prawn: Appendages, Digestive system, Nervous system, Mounting of Statocyst

3. Laboratory Record work shall be submitted at the time of practical examination

4. An **"Animal album"** containing photographs, cut outs, with appropriate write up about the abovementioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

5. Computer aided techniques should be adopted as per UGC guide lines.

Suggested manuals:

1. Practical Zoology- Invertebrates by S.S.Lal
2. Practical Zoology – Invertebrates by P.S.Verma
3. Practical Zoology –Invertebrates by K.P.Kurl

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HEAD
Department Of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – III

ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR

Theory	**4 Hours/Week**	**4 Credit**	**Internal marks = 20**
Practical	**3 Hours/Week**	**1 Credit**	**External Marks = 80**

UNIT – I

1.1 Digestion

1.1.1 **Enzymes:** Definition, Classification, Inhibition, Regulation
1.1.2 Digestion of Carbohydrates, Proteins, Lipids and Cellulose
1.1.3Absorption and Assimilation of digested food
1.1.4 Role of Gastrointestinal hormones in digestion

1.2 Excretion, Homeostasis and Osmoregulation

1.2.1 Classification of Animals on the basis of excretory products: Ammonotelic, Ureotelic, and Uricotelic; Structure and function of Nephron
1.2.2Urine formation and Counter current mechanism
1.2.3 Concept and Mechanism of Homeostasis
a) Hormone regulation of Blood Glucose levels in Human being
b) Water and Ionic Regulation by Marine and Fresh water Animals
c) Thermo regulation in Human being
1.2.4. Osmoregulation in Marine, Fresh and Brackish water Animals

UNIT – II

2.1 Respiration

2.1.1Definition of Respiration, Respiration mechanism, External, Internal and Cellular Respiration.
2.1.2 Respiratory Pigments; Transport of Oxygen, Oxygen dissociation curves, and Bohr's Effect;
2.1.3 Transport of Carbon dioxide, Chloride shift
2.1.4 Regulation of Respiration; Nervous and Chemical Mechanism

2.2 Circulation

2.2.1 Types of Circulation Open and Closed; Structure of Mammalian Heart
2.2.2 Types of Hearts: Myogenic and Neurogenic
2.2.3 Heart functions - Conduction and Regulation of Heart beat, Regulation of Heart rate; ECG
2.2.4 Tachycardia and Bradycardia; Blood Clotting mechanism

UNIT– III

3.1 Muscle Contraction

3.1.1Types of Muscles
3.1.2 Ultra structure of skeletal muscle fibre
3.1.3 Mechanism and Chemical changes during Muscle Contraction (Sliding filament theory)
3.1.4 Twitch Tetanus summation and Treppe fatigue

3.2 Nerve Impulse

3.2.1 Structure of Neuron
3.2.2 Nerve impulse - Resting potential, Threshold potential and Action potential, Conduction of Nerve impulse
3.2.3 Transmission of Nerve impulse
3.2.4 Synapse and Synaptic transmission; Neurotransmitters-EPSP, IPSP

3.3 Endocrine System

3.3.1 Endocrine glands - Structure, secretions and functions of Pituitary gland
3.3.2 Thyroid, Parathyroid, Adrenal glands and Pancreas
3.3.3 Hormone action and Concept of Secondary messengers
3.3.4 Male and Female Hormones; Hormonal control of Menstrual cycle in human beings

UNIT – IV

4.1 Animal Behaviour

4.1.1 Types of Behaviour- Innate and Acquired; Instinctive and Motivated behaviour
4.1.2 Taxes, Reflexes, Tropisms

4.2 Learning and Memory

4.2.1 **Types of Learning**: Trial and Error Learning, Imprinting, Habituation
4.2.2 **Conditioning:** Classical Conditioning; Instrumental conditioning, Examples of Conditioning, Pavlov's Experiment

4.3 Social Behaviour and Communication

4.3.1 Social behaviour of insects (Dance language of honey bees)Colonial Existence of Bees and Termites; Pheromones

4.4 Biological Rhythms

4.4.1 Biological Clocks, Circadian Rhythms; solar and lunar Rhythms; Circannual Rhythms

Suggested Readings:

1. **Gerard J. Tortora and Sandra Reynolds Garbowski** *Principles of Anatomy and Physiology*, Tenth Ed., John Wiley & Sons
2. **Arthur C. Guyton MD**, *A Text Book of Medical Physiology*, Eleventh ed., JohnE. Hall, Harcourt Asia Ltd.
3. **William F. Ganong**, *A Review of Medical Physiology*, 22 ed, McGraw Hill, 2005
4. **Sherwood, Klandrof, Yanc, Animal** *Physiology*, Thompson Brooks/Coole, 2005.
5. **Sherwood, Klandrof, Yanc,** *Human Physiology*, Thompson Brooks/Coole, 2005.
6. **Knut Scmidt-Nielson,** *Animal Physiology***,** 5th edition, Cambridge Low Price Edition.
7. **Roger Eckert and Randal,** *Animal Physiology***,** 4th ed, Freeman Co, New York**.**
8. **Singh. H.R,** Text Book of Animal Physiology and Biochemistry
9. **Nagabhushanam**, Comparative Animal Physiology
10. **Veer Bal Rastogi,** Text Book of Animal Physiology
11. **Dasmann**, "Wild Life Biology"
12. **ReenaMathur,** "Animal Behaviour"
13. **Alocock,** "Animal Behaviour- an Evolutionary Approach

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – III

ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

1. Qualitative tests for identification of carbohydrates, proteins and fats
2. Qualitative tests for identification of ammonia, urea and uric acid (Nitrogenous excretory products)
3. Zonation of gut in Cockroaches
4. Study on effect of pH and Temperature on salivary amylase activity
5. Study of permanent histological sections of mammalian endocrinal glands: Pituitary, Thyroid, Pancreas, Adrenal gland
6. Estimation of Haemoglobin by Sahli's method
7. Estimation of Blood Clotting time
8. Estimation of total protein by Biuret's method
9. Estimation of unit metabolism of fish

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

Suggested manuals:

Tortora, G.J. and Derrickson, B.H. (2009).*Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
Guyton, A.C. and Hall, J.E. (2011). T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).*Biochemistry*.VI Edition. W.H Freeman and Co.
Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009).*Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper'sIllustrated Biochemistry*. XXVIII Edition.Lange Medical Books/Mc Graw3Hill.

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – II

ANIMAL DIVERSITY – VERTEBRATES

(Core Paper – II)

Theory	**4 Hours/Week**	**4 Credit**	**Internal marks = 20**
Practical	**3 Hours/Week**	**1 Credit**	**External Marks = 80**

UNIT – I

1.1 Hemichordata

1.1.1 General characters and Classification of Hemichordates upto classes with examples
1.1.2*Balanoglossus*- Structure and affinities
1.1.3. Larval Significance (Tornaria)

1.2. Protochordata

1.2.1 General Characters and Classification of Chordates up to orders with examples
1.2.2 Salient features of Urochordata; Retrogressive metamorphosis in Urochordata
1.2.3 Salient features and affinities of Cephalochordata
1.2.4 General Characters of Cyclostomata; Comparison of *Petromyzon*and *Myxine*

UNIT – II

2.1 Pisces

2.1.1 General characters of and Classification of Pisces up to orders with examples
2.1.3*Scoliodon*- Digestive,Respiratory, Circulatory and Nervous system
2.1.4 Types of Scales, Types of Fins
2.1.5 Migration in Fishes

2.2 Amphibia

2.2.1 General characters and Classification of Amphibians up to orders with examples.
2.2.2***Rana tigrina***- Respiratory, Circulatory and Nervous systems
2.2.3 Parental care in Amphibians; Neoteny and Paedogenesis
2.2.4 Metamorphosis in Amphibians and its hormonal control

Unit – III

3.1 Reptilia

3.1.1 General characters and Classification of Reptilia up to orders with examples
3.1.2***Calotes***–Digestive,Respiratory, Circulatory and Nervous systems
3.1.3 Temporal fossa in Reptiles and its evolutionary importance
3.1.4 Distinguished characters of Poisonous and Non-poisonous snakes

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

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3.2 Aves

3.2.1 General characters and Classification of Aves upto orders with examples.
3.2.2***Columba livia***- Digestive, Respiratory,Circulatory and Nervous systems
3.2.3 Migration in Birds
3.2.4 Flight adaptation in Birds

Unit – IV

4.1 Mammalia

4.1.1 General characters and Classification of Mammalia upto orders with examples
4.1.2***Rabbit***- Digestive, Respiratory,Circulatory and Nervous systems
4.1.3Dentition in Mammals
4.1.4 Aquatic adaptations in Mammals

Suggested Readings:

1. **E.L.Jordan and P.S. Verma**'*Chordate Zoology*' -. S. Chand Publications.

2. **Mohan P.Arora**. '*Chordata – I*, Himalaya Publishing House Pvt.Ltd.

3. **Marshal, Parker and Haswell**'*Text book of Vertebrates*'. ELBS and McMillan, England.

4. **Alfred Sherwood Romer**. Thomas S. Pearson '*The Vertebrate Body*, Sixth edition, CBS CollegePublishing, Saunders College Publishing

5. **George C. Kent, Robert K. Carr**. *Comparative Anatomy of the Vertebrates*, 9th ed. McGrawHill.

6. **Kenneth Kardong***Vertebrates: Comparative Anatomy, Function and Evolution*, 4th ed,'McGraw Hill.

7. **J.W. Young**, *The Life of Vertebrates*, 3rd ed, Oxford University press.

8. **Harvey Pough F, Christine M. Janis, B. Heiser,** *Vertebrate Life,* Pearson, 6th ed, Pearson Education Inc.2002.

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HEAD
Department Of Zoology
University College
Kakatiya University.
WARANGAL.-506009(T.S

Dr. G. SHAMITHA
Chairperson
Board of Studies
Department of Zoology & Sericulture Unit
KAKATIYA UNIVERSITY - WGL-506009 (T.S)

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – II

ANIMAL DIVERSITY - VERTEBRATES (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

I. Study of museum slides / specimens / models (Classification of animals up to orders)

1. **Hemichordata:** *Balanoglossus, Tornmaria larva*
2. **Protochordata:** *Amphioxus, Amphioxus* T.S. through pharynx
3. **Cyclostomata:** *Petromyzon, Myxine, Ammocoetus larva*
4. **Pisces:** *Sphyrna, Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus,* Scales: Placoid, Cycloid, Ctenoid
5. **Amphibia:** *Ichthyophis, Amblystoma, Siren,Hyla, Rachophous,Bufo, Rana,* Axolotal larva
6. **Reptilia :** *Draco, Chemaeleon, Gecko, Uromastix, Vipera russeli, Naja, Bungarus, Enhydrina, Typhlops, Ptyas, Testudo, Trionyx, Crocodilus*
7. **Aves:** Archaeopteryx, *Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo* ,Collection and study of different types of feathers: Quill, Contour, Filoplume, Down
8. **Mammalia:** *Ornithorthynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris,* Hedgehog;
9. **Histology:**T.S. of Liver, Pancreas, Kidney, Stomach, Intestine, Lung, Artery, Vein, Bone T.S, Spinal Cord. T.S.

II. Osteology:
Rabbit – Axial Skeleton (Bones of Skull and Vertebral Column),
Varanus, Pigeon and Rabbit - Appendicular skeleton (Bones of Limbs and Girdles

III. Demonstration of dissection / dissected / virtual dissection: Labeo / Tilapia
1. Digestive system 2. Brain, Weberian Oscicles3. V, VII, IX, X cranial nerves

IV. Laboratory Record work shall be submitted at the time of practical examination

V. An **"Animal album"** containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

VI. Computer aided techniques should be adopted as per UGC guide lines.

Suggested manuals:

1. **S.S.Lal,** Practical Zoology – Vertebrata
2. **P.S.Verma,** A manual of Practical Zoology– Chordata

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ZOOLOGY
SYLLABUS FOR B.Sc.

CHOICE BASED CREDIT SYSTEM (CBCS)

To be commenced from the Academic year 2025-26

KAKATIYA UNIVERSITY
WARANGAL-506009
TELANGANA STATE

KAKATIYA UNIVERSITY

CREDIT DISTRIBUTION FOR THE COURSE

Annexure-I (Credits)

Proposed CBCS Structure from 2025-2026 for Undergraduate Course

Courses		Papers	Total Credits	Credits for each paper/ Semester					
				B.Sc					
				I	II	III	IV	V	VI
Core Courses (DSC)	Major-1	6	30	5	5	5	5	5	5
	Major-2	6	30	5	5	5	5	5	5
	Minor-1	4	20	5	5	5	5	---	----
MIL/AEC (First language)	English	4	20	5	5	5	5	---	----
Second Language (Telugu, Hindi, Urdu etc.,)		4	20	5	5	5	5	---	----
Multi Disciplinary Course	MDC-1	1	4	---	----	---	----	4	----
SEC 1,2		2	4	---	----	---	----	2	2
SEC 3,4		2	4	---	----	---	----	2	2
Value added course (VAC)	VAC 1,2	2	6	---	----	---	----	3	3
Internships	Internship/Project	1	4	---	----	---	----	---	4
Total Credits in each semester		----	142	25	25	25	25	21	21
Total Credits in UG		---	142						

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

KAKATIYA UNIVERSITY

CREDIT DISTRIBUTION FOR THE COURSE

CURRICULUM FOR ZOOLOGY FOR B.Sc. (UG) 2025-26

Code	Semester	Course Title (Theory and Practical)	HPW	Number of Credits	Total Credits	Max. Marks		
						I.A	End Exam	Total
1st Year	I Sem	Paper-1: Animal Diversity – Invertebrates & Vertebrates(Theory)	4	4	5	20	80	100
		Animal Diversity – Invertebrates & Vertebrates (Practical)	2	1		-	25	25
	II Sem	Paper-II: Comparative Anatomy of Vertebrates and Developmental Biology (Theory)	4	4	5	20	80	100
		Comparative Anatomy of Vertebrates and Developmental Biology (Practical)	2	1		-	25	25
2nd Year	III Sem	Paper-III: Animal Physiology and Animal Behaviour (Theory)	4	4	5	20	80	100
		Animal Physiology and Animal Behaviour (Practical)	2	1		-	25	25
	IV Sem	Paper-IV: Cell and Molecular Biology & Genetics (Theory)	4	4	5	20	80	100
		Cell and Molecular Biology & Genetics (Practical)	2	1		-	25	25
3rd Year	V Sem	Paper-V: Immunology and Animal Biotechnology (Theory)	4	4	5	20	80	100
		Immunology and Animal Biotechnology (Practical)	2	1			25	25
		MDC-1	4	4	4	20	80	100
		SEC-1	2	2	2	10	40	50
		SEC-2	2	2	2	10	40	50
		VAC-1	3	3	3	15	60	75
	VI Sem	Paper-VI: Physiological Chemistry & Endocrinology (Theory)	4	4	5	20	80	100
		Physiological Chemistry & Endocrinology (Practical)	2	1		-	25	25
		SEC-3	2	2	2	10	40	50
		SEC-4	2	2	2	10	40	50
		VAC-2	3	3	3	15	60	75
		Internship / Project	4	4	4	20	80	100
		TOTAL	**58**	**52**	**52**	**230**	**1070**	**1300**

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HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

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Sl.No	Paper	Credits
1	Major - 1	30
2	Major -2	30
3	Minor - 1	20
4	AEC (Ability Enhancement Course) - English	20
5	Second Language	20
6	MDC (Multi-Disciplinary Course) - 1	4
7	SEC (Skill Enhancement Course) – 1,2,3,4	8
8	VAC (Value Added Course) -1,2	6
9	Project	4
	TOTAL	**142**

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University College
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WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

B. Sc. ZOOLOGY - I YEAR - SEMESTER – I
KAKATIYA UNIVERSITY – WARANGAL - TELANGANA
Under Graduate Courses (Under CBCS 2025-26 onwards)

PAPER-I: ANIMAL DIVERSITY – INVERTEBRATES & VERTEBRATES

UNIT I: INVERTEBRATES - PROTOZOA TO PLATYHELMINTHES

1.1 Concepts of: Multicellularity; Diploblastic and triploblastic organization; Symmetries; Body cavities.

1.2 Protozoa: General characteristics and classification up to classes; Locomotory organelles and locomotion in Protozoa.

1.3 Porifera: General characteristics and classification up to classes; Canal system in sponges and spicules; Evolutionary significance of sponges as early metazoans.

1.4 Cnidaria: General characteristics and classification up to classes; Polymorphism in Hydrozoa and Siphonophora; Coral reef formation and ecological significance.

1.5 Helminthes: General characteristics and classification up to classes of Platyhelminthes and Nemathelminths; Parasitic adaptations in helminths; Regeneration in Turbellarians.

UNIT II: INVERTEBRATES – ANNELIDA TO HEMICHORDATA

2.1 Annelida: General characteristics and classification up to classes; Metamerism and its evolutionary significance; Coelom and coelomocytes.

2.2 Arthropoda: General characteristics and classification up to classes; Vision in arthropods and metamorphosis in insects; Economic importance of insects.

2.3 Mollusca: General characteristics and classification up to classes; Torsion and detorsion in gastropods; Pearl formation and economic importance of molluscs.

2.4 Echinodermata: General characteristics and classification up to classes; Water vascular system in starfish; Larval forms of echinoderms.

2.5 Hemichordata: General characteristics and affinities of Hemichordata.

UNIT III: VERTEBRATES - PROTOCHORDATES TO AMPHIBIANS

3.1 General characteristics of Urochordata and Cephalochordata; Retrogressive metamorphosis in Urochordata.

3.2 Cyclostomata: General characteristics and classification; Evolutionary status and affinities of cyclostomes.

3.3 Pisces: General characteristics and classification up to classes and major orders; Migration and osmoregulation in migratory fishes; Parental care in fishes.

3.4 Amphibia: General characteristics and classification up to orders; Parental care, neoteny, and paedogenesis in amphibians.

3.5 Evolutionary Trends in Early Vertebrates: Transition from water to land; Adaptive features in early tetrapod.

UNIT IV: VERTEBRATES - REPTILIA TO MAMMALIA

4.1 Reptilia: General characteristics and classification up to orders; Biting mechanism in snakes and temporal fossae in reptiles; Adaptive radiations in Mesozoic reptiles.

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HEAD
Department of Zoology
University College
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4.2 Aves: General characteristics and classification up to orders; Flight adaptations and migration in birds; Evolutionary significance of birds as theropod ancestors.

4.3 Mammalia: General characteristics and classification up to orders; Origin of mammals: Monotremes, marsupials, and placentals; Dentition and aquatic adaptations in mammals.

4.4 Evolutionary Trends in Vertebrates: Origin of amniotes and evolutionary significance of amniotic egg; Primate evolution and human ancestry.

4.5 Conservation of Vertebrate Diversity: Threats to vertebrate diversity; Conservation strategies for endangered species.

Suggested Readings:

1. Ruppert, E.E., Fox, R.S., Barnes, R.D. (2004). Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Cengage Learning, India
2. Barrington, E.J.W. (2012). Invertebrate Structure and Functions, II Edition, ELBS and Nelson.
3. Pechenik, J. A. (2015). Biology of the Invertebrates. VII Edition, McGraw-Hill Education
4. Hickman, C., Keen, S., Larson, A., Eisenhour, D. (2018). Animal Diversity, 9th Edition, McGraw-Hill.
5. Young, J.Z. (2004). The Life of Vertebrates, III Edition, Oxford University Press.
6. Kardong, K.V. (2009). Vertebrates: Comparative Anatomy, Function, Evolution, 4th Edition, McGraw-Hill.
7. Pough F.H., Janis, C.M., Heiser, J.B., Heiser, C.B. (2009). Vertebrate Life, VIII Edition, Benjamin Cummings.
8. L.H. Hyman 'The Invertebrates' Vol I, II and V. – M.C. Graw Hill Company Ltd.
9. Kotpal, R.L. Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
10. E.L. Jordan and P.S. Verma 'Invertebrate Zoology' S. Chand and Company.
11. R.D. Barnes 'Invertebrate Zoology' by: W.B. Saunders CO., 1986.
12. P.S. Dhami and J.K. Dhami. Invertebrate Zoology. S. Chand and Co. New Delhi.
13. Parker, T.J. and Haswell 'A text book of Zoology' by, W.A., Mac Millan Co. London.
14. Mohan P.Arora. 'Chordata – I, Himalaya Publishing House Pvt.Ltd.
15. Marshal, Parker and Haswell 'Text book of Vertebrates'. ELBS and McMillan, England.
16. J.W. Young, The Life of Vertebrates, 3rd ed, Oxford University press.
17. Harvey Pough F, Christine M. Janis, B. Heiser, Vertebrate Life, Pearson, 6th ed, Pearson Education Inc.2002.

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University College
Kakatiya University,
WARANGAL-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

B. Sc. ZOOLOGY - I YEAR - SEMESTER – I
KAKATIYA UNIVERSITY – WARANGAL - TELANGANA
Under Graduate Courses (Under CBCS 2025-26 onwards)
PAPER-I: ANIMAL DIVERSITY – INVERTEBRATES & VERTEBRATES

PRACTICAL SYLLABUS

1. Study of Museum Specimens/Slides/Models (with Classification of animals)
    1. Protozoa: *Amoeba*, *Paramecium*, *Plasmodium vivax*
    2. Porifera: *Sycon*, *Spongilla*
    3. Cnidaria: *Obelia*, *Aurelia*
    4. Platyhelminthes: *Fasciola*, *Taeniasolium*
    5. Nemathelminths: *Ascaris*, *Wuchereria*
    6. Annelida: *Nereis*, *Hirudinaria*
    7. Arthropoda: Prawn, *Periplaneta*
    8. Mollusca: *Pila*, *Sepia*
    9. Echinodermata: *Asterias*, *Echinus*
    10. Protochordates: *Balanoglossus*, *Amphioxus*
    11. Cyclostomata: *Petromyzon*, *Myxine*
    12. Pisces: *Scoliodon*, *Labeo*
    13. Amphibia: *Hoplobatrachus*, *Bufo*
    14. Reptilia: *Calotes*, *Naja*
    15. Aves: *Columba*, *Passer*
    16. Mammalia: *Pteropus*, *Oryctolagus*, *Funambulus*

2. Dissections
    Prawn: Appendages, digestive system, nervous system, mounting of statocyst.
    Insect: Mouthparts of Anopheles, Culex, housefly, and butterfly.
    Virtual dissection of Labeo/Tilapia: Digestive system, brain, and cranial nerves (demonstration only).

3. Key for identification of venomous and non-venomous snakes
4. First aid for snake bite mitigation
5. Animal Album: Mandatory submission of an "Animal album" containing photographs, cut-outs, and write-ups about the studied taxa.
6. Visit to Zoological Park or Natural History Museum
7. Computer-Aided Techniques : Use of virtual dissections and animations for better understanding of anatomical structures.

Suggested manuals:

1. Lal, S.S. Practical Zoology – Invertebrates, Rastogi Publications.
2. Verma, P.S. Practical Zoology – Invertebrates, S. Chand Publications.
3. Verma, P.S. A Manual of Practical Zoology – Chordata, S. Chand Publications.
4. S.S.Lal, Practical Zoology – Vertebrata
5. Freeman & Bracegirdle, An atlas of embryology

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

B. Sc. ZOOLOGY - I YEAR - SEMESTER – II
KAKATIYA UNIVERSITY – WARANGAL - TELANGANA
Under Graduate Courses (Under CBCS 2025-26 onwards)

PAPER-II: COMPARATIVE ANATOMY OF VERTEBRATES AND DEVELOPMENTAL BIOLOGY

UNIT – I: Integumentary, Skeletal, and Muscular Systems

1.1 Comparative study of structure and function of integument and its derivatives (glands, scales, feathers, and hair) from fishes to mammals.
1.2 Comparative study of axial skeleton in fishes to mammals (skull and vertebrae).
1.3 Comparative study of appendicular skeleton in fishes to mammals (pectoral and pelvic girdles; limbs).
1.4 Comparative anatomy of axial, appendicular, branchiomeric, and integumentary muscles.
1.5 Comparative study of adaptive modifications in vertebrate locomotion (swimming, walking, and flying).

UNIT – II: Digestive, Respiratory, Circulatory, and Excretory Systems

2.1 Evolution of the Digestive System – Structural and functional modifications of the alimentary canal and digestive glands from fishes to mammals.
2.2 Respiratory System Adaptations – Comparative study of respiratory structures (gills, swim bladders, lungs, and air sacs) and their evolutionary significance.
2.3 Circulatory System Variations – Morphological and functional diversity of the heart, aortic arches, and major blood vessels in vertebrates.
2.4 Excretory System and Osmoregulation – Evolution of kidneys, urinary bladders, and their ducts in different vertebrate groups with adaptations to aquatic and terrestrial environments.
2.5 Nephron and Kidney Evolution – Comparative anatomy of nephron structure, types of kidneys (pronephros, mesonephros, metanephros), and their evolutionary succession.

UNIT – III: Reproductive, Nervous, and Sensory Systems

3.1 Evolution of Reproductive Organs – Structural and functional modifications in male and female reproductive organs from fishes to mammals.
3.2 Modifications in Vertebrate Genital Structures – Evolutionary adaptations in gonads, accessory reproductive structures, and reproductive strategies across vertebrates.
3.3 Comparative Anatomy of the Nervous System – Structural variations in the vertebrate brain and cranial nerves from fishes to mammals.
3.4 Spinal Cord and Peripheral Nervous System – Comparative study of the spinal cord and spinal nerves, their structural and functional modifications in vertebrates.
3.5 Sensory Organs and Receptor Systems – Comparative study of sensory organs (vision, hearing, taste, smell, and touch) and sensory receptors (special somatic and special visceral receptors)from fishes to mammals.

UNIT – IV: Developmental Biology

4.1 Early Embryonic Development: Gametogenesis (spermatogenesis and oogenesis) in mammals; vitellogenesis in birds; Fertilization mechanisms, and blocks to polyspermy.

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Government College (A)

4.2 Cleavage and Gastrulation: Structure of the fertilized chick egg; Patterns of cleavage, presumptive areas, fate maps.
4.3 Late Embryonic Development: Implantation of the rabbit embryo; Extraembryonic membranes; Placenta and types.
4.4 Organogenesis: Morphogenetic movements; Neurulation and notogenesis in frogs.
4.5 Basic principles of Evolutionary Developmental Biology Hox genes, and their role in vertebrate development and evolution.

SUGGESTED READINGS:

1. E.L.Jordan and P.S. Verma 'Chordate Zoology' -. S. Chand Publications.
2. Mohan P. Arora. 'Chordata – I, Himalaya Publishing House Pvt.Ltd.
3. Marshal, Parker and Haswell 'Text Book of Vertebrates'. ELBS and McMillan, England.
4. Alfred Sherwood Romer. Thomas S. Pearson 'The Vertebrate Body, Sixth edition, CBS College Publishing, Saunders College Publishing
5. George C. Kent, Robert K. Carr. Comparative Anatomy of the Vertebrates, 9th ed. McGraw Hill.
6. Kenneth Kardong Vertebrates: Comparative Anatomy, Function and Evolution, 4th ed, McGraw Hill.
7. J.W. Young, The Life of Vertebrates, 3rd ed, Oxford University Press.
8. Harvey Pough F, Christine M. Janis, B. Heiser, Vertebrate Life, Pearson, 6th ed, Pearson
9. Education Inc.2002.
10. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc.,
11. Publishers, Sunderland, Massachusetts, USA.
12. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
13. Carlson, R. F: Patten's Foundations of Embryology
14. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
15. Berril. N.J. and Karp: Developmental Biology. McGraw Hill, New York.

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Department of Zoology
Kakatiya University
WARANGAL - 506 009, T.S.

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

Dr. P. ROHINI
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Kakatiya Government College (A)
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B. Sc. ZOOLOGY - I YEAR - SEMESTER – II
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Under Graduate Courses (Under CBCS 2025-26 onwards)

PAPER-II: COMPARATIVE ANATOMY OF VERTEBRATES AND DEVELOPMENTAL BIOLOGY

PRACTICAL SYLLABUS

1. Comparative Study of Vertebrate Skeletons: Observation and identification of skeletal structures from different vertebrate groups (fishes, amphibians, reptiles, birds, mammals).
2. Histological Examination of Tissues: Microscopic study of integumentary, muscular, and glandular tissues in different vertebrates.
3. Virtual Dissection and Organ System Comparison: Dissection of representative vertebrates to study the digestive, respiratory, circulatory, nervous and urogenital systems.
4. Comparison of the anatomy of locomotory appendages in different groups of vertebrates .
5. Developmental Biology Experiments: Study of frog/chick embryology through prepared slides, observation of cleavage, gastrulation, and neurulation stages.

Suggested Manuals

1. Freeman & Bracegirdle, An atlas of embryology
2. George C. Kent, Robert K. Carr. Comparative Anatomy of the Vertebrates, 9th ed. McGraw Hill.
3. Kenneth Kardong Vertebrates: Comparative Anatomy, Function and Evolution, 4th ed, McGraw Hill.

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Kakatiya Government College (A)
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B. Sc. ZOOLOGY - II YEAR - SEMESTER – III
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Under Graduate Courses (Under CBCS 2025-26 onwards)

PAPER-III: ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR

UNIT – I: Digestion, Respiration, and Circulation

1.1 Digestion: Biological significance of nutrients (carbohydrates, proteins, lipids, vitamins, and minerals); digestion, absorption, and assimilation of macronutrients; Role of gastrointestinal hormones in digestion.
1.2 Respiration: Types of respiration (external, internal, and cellular); respiratory pigments, oxygen transport, oxygen dissociation curves, Bohr's effect; carbon dioxide transport and chloride shift.
1.3 Regulation of Respiration: Neural and chemical control of respiration.
1.4 Circulatory System: Types of circulation (open vs. closed); mammalian heart structure, conduction system, and regulation of heartbeat.
1.5 Cardiac Cycle: Regulation of heart rate, cardiac output, blood clotting mechanism, and conditions such as tachycardia and bradycardia.

UNIT – II: Homeostasis, Excretion, and Osmoregulation

2.1 Homeostasis: Concept and mechanism of homeostasis; thermoregulation in poikilotherms and homeotherms.
2.2 Excretion: Classification of animals based on nitrogenous waste products (ammoniotelic, uricotelic, ureotelic); structure and function of nephrons; urine formation, counter-current mechanism in urine formation.
2.3 Hormonal Control of Excretion: Role of ADH and RAAS in osmoregulation and urine concentration.
2.4 Osmoregulation: Water and ionic regulation in stenohaline and euryhaline animals; osmoregulatory strategies in freshwater, brackish water, and marine animals.

UNIT – III: Muscle Physiology, Nervous System, and Endocrine System

3.1 Muscle Contraction: Types of muscles; ultrastructure of skeletal muscle fibers; sliding filament theory, energetics of contraction.
3.2 Neural Function: Structure of neurons; resting potential, threshold potential, action potential, and conduction of nerve impulses.
3.3 Synaptic Transmission: Mechanisms of Synaptic Transmission; Neurotransmitters, Excitatory Postsynaptic Potential (EPSP), Inhibitory Postsynaptic Potential (IPSP), Reflex Action.
3.4 Sensory Organs: Vision, hearing, taste, smell, and touch in chordates.
3.5 Endocrine System: Structure and function of major endocrine glands (pituitary, thyroid, parathyroid, adrenal, pancreas); hormonal control of the menstrual cycle; mechanism of hormone action through secondary messengers.

UNIT – IV: Animal Behaviour and Biological Rhythms

4.1 Types of Behavior: Instinctive vs. acquired behaviour; behavioural responses (taxes, reflexes, tropisms).

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4.1 Learning and Memory: Types of learning (trial and error, imprinting, habituation, conditioning); Pavlov's experiment.
4.2 Social Behavior and Communication: Social organization in bees and termites; pheromonal communication.
4.3 Biological Rhythms: Biological clocks, circadian, circumlunar, and circannual rhythms; behavioural adaptations to environmental cycles.
4.4 Neuroethology: Neural basis of behaviour; interactions between nervous and endocrine systems in behavioural regulation.

Suggested readings

1. **Gerard J. Tortora and Sandra Reynolds Garbowski** *Principles of Anatomy and Physiology*, Tenth Ed., John Wiley & Sons
2. **Arthur C. Guyton MD**, *A Text Book of Medical Physiology,* Eleventh ed., JohnE. Hall, Harcourt Asia Ltd.
3. **William F. Ganong**, *A Review of Medical Physiology*, 22 ed, McGraw Hill, 2005
4. **Sherwood, Klandrof, Yanc,** *Animal Physiology*, Thompson Brooks/Coole, 2005.
5. **Sherwood, Klandrof, Yanc,** *Human Physiology*, Thompson Brooks/Coole, 2005.
6. **Knut Scmidt-Nielson,** *Animal Physiology***,** 5th ed, Cambridge Low Price Edition.
7. **Roger Eckert and Randal,** *Animal Physiology***,** 4th ed, Freeman Co, New York**.**
8. **Singh. H.R,** Text Book of Animal Physiology and Biochemistry
9. **Nagabhushanam**, Comparative Animal Physiology
10. **Veer Bal Rastogi,** Text Book of Animal Physiology

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Department of Zoology
Kakatiya University
WARANGAL - 506 009, T.S.

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

B. Sc. ZOOLOGY - II YEAR - SEMESTER – III
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PAPER-III: ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR

PRACTICAL SYLLABUS

1. Identification of carbohydrates, proteins, and lipids in biological samples.
2. Detection of ammonia, urea, and uric acid from excretory products.
3. Comparative study of digestive systems and gut zonation from fishes to mammals using models.
4. Effect of pH and temperature on salivary amylase activity.
5. Examination of permanent histological sections of endocrine glands (pituitary, thyroid, pancreas, adrenal glands).
6. Estimation of hemoglobin using Sahli's method; counting different types of blood cells using a hemocytometer.
7. Measurement of blood clotting time and factors affecting clot formation.
8. Estimation of unit oxygen consumption in fish with reference to body weight.
9. Study of permanent slides of neurons and glial cells.
10. Observational experiments on learning and memory in animals.

Note: Laboratory record work shall be submitted at the time of practical examinations. Computer-aided techniques shall be adopted as per UGC guidelines.

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Kakatiya University
WARANGAL - 506 009, T.S.

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

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PAPER-IV: CELL AND MOLECULAR BIOLOGY &GENETICS

UNIT – I: Cell Biology

1.1 Cell Structure and Organization: Prokaryotic vs. eukaryotic cells, organelles, and their functions.
1.2 Membrane Biology: Structure and functions of biological membranes, transport mechanisms, and cell signaling.
1.3 Cell Cycle and Cell Division: Phases of the cell cycle, mitosis, and meiosis, regulation, and significance.
1.4 Cytoskeleton and Cellular Motility: Microtubules, microfilaments, intermediate filaments, and their roles in intracellular transport.
1.5 Cellular Communication: Signal transduction pathways, receptors, and second messengers.

UNIT – II: Molecular Biology

2.1 DNA Structure and Function: Double helix model, types of DNA, organization of prokaryotic and eukaryotic genomes.
2.2 DNA Replication: Mechanism, enzymes involved, prokaryotic vs. eukaryotic replication.
2.3 Transcription and RNA Processing: Mechanism of transcription, types of RNA, post-transcriptional modifications.
2.4 Translation and Protein Synthesis: Genetic code, ribosomes, initiation, elongation, and termination of protein synthesis.
2.5 Gene Regulation: Operon concept, epigenetics, and post-transcriptional gene regulation.

UNIT – III: Genetic Engineering and Applications

3.1 Mutations and DNA Repair: Types of mutations, mutagens, mechanisms of DNA repair.
3.2 Recombinant DNA Technology: AI-Driven Innovations in Recombinant DNA Technology: Enhancing Gene Cloning, PCR Optimization, and Vector Design
3.3 Genetic Engineering in Biology: Gene therapy, transgenic animals, CRISPR technology.
3.4 Genomics and Proteomics: Human Genome Project, applications of genomics, and proteomics in biotechnology.
3.5 Applications of Molecular Biology: Forensic science, genetic testing, and synthetic biology.

UNIT – IV: Principles of Genetics

4.1 Mendelian Genetics: Laws of inheritance, monohybrid and dihybrid crosses, test cross, and back cross.
4.2 Non-Mendelian Genetics: Incomplete dominance, codominance, multiple alleles, and epistasis.
4.3 Chromosomal Basis of Inheritance: Chromosome theory, linkage, crossing over, and gene mapping.
4.4 Sex Determination and Sex-Linked Inheritance: Chromosomal and environmental sex determination, X-linked, Y-linked, and sex-limited traits.
4.5 Genetic Disorders and Pedigree Analysis: Autosomal and sex-linked genetic disorders, pedigree construction, and interpretation.

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

Suggested readings:

1. Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell 'Molecular Cell Biology' W.H. Free man and company New York.
2. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
3. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
4. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
5. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
6. Molecular Biology of the Cell – Alberts et al.
7. Molecular Biology of the Gene – James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick.
8. Lewin's Genes XII – Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick.
9. Molecular Cell Biology – Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, et al.
10. Molecular Biology – Robert Weaver.
11. Fundamental Molecular Biology – Lizabeth A. Allison.
12. The Cell: A Molecular Approach – Geoffrey M. Cooper, Robert E. Hausman.
13. Molecular Biology of RNA – David P. Clark.
14. Molecular Biology by Freifelder D. 2nd ed.
15. Molecular Biotechnology: Principles and Applications of Recombinant DNA – Bernard R. Glick, Cheryl L. Patten.
16. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
17. Gupta P.K., 'Genetics'.

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Department of Zoology
Kakatiya University
WARANGAL - 506 009, T.S.

DEPARTMENT OF ZOOLOGY
University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

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PAPER-IV: CELL AND MOLECULAR BIOLOGY &GENETICS

PRACTICAL SYLLABUS

1. ABO blood grouping and Rh factor determination.
2. Study of Cell Organelles: Microscopic observation of cell structures using prepared slides.
3. Observation of dividing cells in onion root tips/grasshopper testis to study mitosis and meiosis.
4. Extraction of DNA from animal cells and quantification using spectrophotometry.
5. Separation and visualization of DNA fragments by Agarose Gel Electrophoresis.
6. Basic principles and demonstration of Polymerase Chain Reaction.
7. Quantification of proteins in biological samples using Biuret/Bradford Method.
8. Demonstration of thin-layer chromatography for amino acid separation.
9. Study of monohybrid and dihybrid crosses in *Drosophila*.
10. Identification of normal and abnormal karyo types (Down syndrome, Turner syndrome, Klinefelter syndrome).

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University College
Kakatiya University,
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HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

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PAPER-V: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

UNIT - I: Basics of Immune system

1.1 Cells of the immune system and the lymphoid organs(Primary and secondary).
1.2 First line of defense mechanism - Physical and chemical barriers; Second line of defense mechanism - Inflammation and phagocytosis; Cytokines/ Interleukins / Interferons.
1.3 Types of immunity-Inherent(Active and passive) and acquired immunity(Active and passive) Humoral and cell mediated immunity
1.4 Major histocompatibility complex (MHC) – definition, structure and function of Class I and Class II proteins.
1.5 Significance of MHC, Role in organ transplantation, Graft vs. rejection; MHC restriction.

UNIT - II: Antibodies and Antigens and Immune System Diseases

2.1 Antibodies/immunoglobulins - Structure, functions and classification; Monoclonal and Polyclonal antibodies and applications.
2.2 Antigens structure, antigenic determinants/epitopes, haptens, adjuvants and antigenicity.
2.3 Antigen-antibody reactions-agglutination, precipitation, opsonization, cytotoxicity.
2.4 Hypersensitivity reactions – their types and mechanisms.
2.5 Autoimmunity – Definition and examples (SLE, RA & HT), and Immunodeficiency diseases – Definition and examples (CVID, SCID & HIV).

UNIT – III: Animal Biotechnology and Genetically Modified Organisms

3.1 Concept and Scope of Animal Biotechnology.
3.2 Recombinant DNA technology and its applications.
3.3 Cloning vectors – Plasmids (PBR-322, POC18/19), Cosmids and Shuttle vectors, Yeasts (YEPS); Cloning methods (Gene, Cell, and Animal cloning).
3.4 Transgenesis – Methods of Transgenesis; Production of Transgenic animals - sheep and fish.
3.5 Vaccine Development – Recombinant and mRNA vaccines.

UNIT – IV: Applications of Biotechnology

4.1 In vitro fertilization and embryo transfer.
4.2 Hybridoma technology – concepts and applications.
4.3 Stem cells –types and their applications.
4.4 Biopesticides; *Bacillus thuringiensis* – mode of action of toxin.
4.5 Animal Bioreactors – concepts and applications.

Reference Books:

1. Text book of immunology-Ivan Riott
2. Text book of immunology-C.V.Rao
3. Text book of immunology-Nandini Shetty

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University,
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

4. Text book of immunology-Kubey
5. Culture of Animal cells. R. Ian Freshney, Wiley Liss.
6. Biotechnology – S. Mitra.
7. Animal Cell culture – Practical Approach – Ed. John R W Masters, Oxford.
8. Biotechnology – B. D. Singh

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Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL.-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

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PAPER-V: IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

PRACTICAL SYLLABUS

I. Immunology

1. Study agglutination of blood or ABO-blood grouping using kit.
2. Demonstration of Widal Test using kit.
3. Demonstration of precipitation(VDRL/RPR test) using kit.
4. Enumeration of WBC and Differential Count of Leucocytes using hemocytometer.
5. Histology of lymphoid organs - Spleen, Thymus, Lymph node, Bone marrow.

II. Animal Biotechnology

1. Study the following techniques through photographs / virtual lab
   a. Identification of Vectors
   b. Identification of Transgenic animals
   c. DNA sequencing (Sanger's method)
   d. DNA finger printing
   e. Southern blotting
   f. Western blotting

2. PCR demonstration /virtual lab

- Laboratory Record work shall be submitted at the time of practical examination
- Computer aided techniques should be adopted as per UGC guidelines.

Reference Books:

1. A hand book of practical immunology-Ivan Riott
2. Animal Biotechnology – PK Gupta

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

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PAPER-VI: PHYSIOLOGICAL CHEMISTRY AND ENDOCRINOLOGY

UNIT-I: Biomolecules of Importance

1.1 Types of biomolecules –Carbohydrates, Proteins, Lipids, Nucleic acids, Vitamins and their significance in biological systems.
1.2 Classification of protein; Function of proteins based on their chemical nature
1.3 Protein metabolism: Transamination, deamination, urea cycle; Synthesis and catabolism of Histidine and Proline.
1.4 Classification and function of carbohydrates
1.5 Carbohydrate metabolism: Glycolysis, Kreb's cycle, electron transport and oxidative phosphorylation.

UNIT-II: Lipids and Enzyme Classification

2.1 Lipids: nomenclature and classification of lipids
2.2 Fatty acid synthesis and beta-oxidation of lipids
2.3 Cholesterol synthesis and metabolism of steroidal hormones
2.4 Enzyme definition, nomenclature, classification and Enzyme kinetics, Lineweaver-Burk plot
2.5 Mechanism of enzymes: Action, enzyme inhibition, coenzymes

UNIT - III: Introduction to Endocrinology

3.1 Concept and scope of endocrinology; Hormones as chemical messengers.
3.2 Classification of hormones
3.3 Mechanism of action of aminoacid derivatives; Peptide hormones and steroid hormones.
3.4 Positive feedback mechanism and Negative feedback control
3.5 Hormonal regulation of protein, carbohydrate and lipid metabolism.

UNIT - IV: Endocrine Glands and their Hormones

4.1 Hypothalamus and its Hormones.
4.2 Structure, hormones and functions of Pituitary gland.
4.3 Structure, hormones and functions of Thyroid, Parathyroid, and Thymus glands.
4.4 Structure, hormones and functions of Adrenal, Pancreas, and Pineal glands.
4.5 Role of hormones in human reproduction.

REFERENCE BOOKS:

1. Text book of biochemistry
2. Text book of physiology and biochemistry
3. Comparative Endocrinology of Invertebrates by Highman and Hill.
4. Comparative Vertebrate Endocrinology by P. J. Bentley, Cambridge Univ. Press
5. Text Book of Endocrinology by Turner and Bangnara (W.B.Sanders)
6. Essential Endocrinology by JoenLaycock and Peter Loise Oxford Univ. Press.
7. Text Book of Endocrinology by R. H. Williams (W. B. Saunders).

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Department of Zoology
Kakatiya University
WARANGAL - 506 009, T.S.

DEPARTMENT OF ZOOLOGY
University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)

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PAPER-VI: PHYSIOLOGICAL CHEMISTRY AND ENDOCRINOLOGY

PRACTICAL SYLLABUS

1. Identification of carbohydrates –Molisch test, Benedict's/Fehling's test,Iodine test,Barfoed's test.
2. Identification of proteins-Biuret test, Sodium hydroxide test
3. Identification of amino acids-Xanthoproteic test, Nin-hydrin test, Millon's test.
4. Identification of lipids-Sudan-IV test.
5. Histology of endocrine glands - Pituitary, Thyroid, Parathyroid, Thymus, Adrenal Pancreas, Ovary & Testis, Uterus.
6. Effect of eye stalk ablation on blood glucose levels in crab.
7. Identification of gonadotrophin in human urine samples.
8. Effect of thyroxine and thiourea (antithyroid agent) on oxygen consumption in fish.

- Laboratory record work shall be submitted at the time of practical examinations
- Computer-aided techniques shall be adopted as per UGC guidelines

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University College
Kakatiya University,
WARANGAL.-506009(T.S)

HEAD
Department of Zoology
University College
Kakatiya University
WARANGAL-506009(T.S)

Dr. P. ROHINI
Asst. Professor of Zoology
Kakatiya Government College (A)
Hanumakonda, Telangana.

Annexure – I (Credits)
Proposed CBCS Structure from 2025-26 for Under Graduate Courses

Courses		Papers	Total Credits	Credits for each paper / Semester						Credits for each paper / Semester						Credits for each paper / Semester					
				BA						B.Com.						B.Sc.					
				I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Core Courses DSC	Major-1	6	30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Major -2	6	30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Minor-1	4	20	5	5	5	5	-	-	5	5	5	5	-	-	5	5	5	5	-	-
MIL/AEC (First Language)	English	4	20	5	5	5	5	-	-	5	5	5	5	-	-	5	5	5	5	-	-
Second Language (Telugu, Hindi, Urdu, etc.)		4	20	5	5	5	5	-	-	5	5	5	5	-	-	5	5	5	5	-	-
Multi-Disciplinary Course	MDC 1	1	4	-	-	-	-	4	-	-	-	-	-	4	-	-	-	-	-	4	-
Sec 1, 2		2	4					2	2					2	2					2	2
Sec 3, 4		2	4					2	2					2	2					2	2
Value added course (VAC)	VAC 1, 2	2	6	-	-	-	-	3	3	-	-	-	-	3	3	-	-	-	-	3	3
Internships	Internship / Project	1	4	-	-	-	-	-	4	-	-	-	-	-	4	-	-	-	-	-	4
Total Credits in each semester			142	25	25	25	25	21	21	25	25	25	25	21	21	25	25	25	25	21	21
Total Credits in UG				142						142						142					
Credits under Non-CGPA (Community engagement and service)		NSS /NCC /sports / Extra curricular	6	Upto 6 (2 in each year)						Upto 6 (2 in each year)						Upto 6 (2 in each year)					
		IKS	4	Upto 4 (2 in each, after I & II years)						Upto 4 (2 in each, after I & II years)						Upto 4 (2 in each, after I & II years)					