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

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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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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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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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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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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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)					