RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester I

Subject Code	Subject Title	Credit
MJ01ZOO	Non-Chordates	03

UNIT I: Kingdom Protista

- General introduction and classification upto class
- Locomotion in Protista
- Reproduction and Nutrition in Protista

UNIT II: Phylum Porifera, Cnidaria, Ctenophora

- General characters and classification upto class
- Canal system in Porifera
- Coral and coral Reef formation.
- Alteration of Generation in cnidarian.
- Evolutionary significance of ctenophore

UNIT III: Helminthes

- General characters and classification of Platyhelminthes, Nemathelminthes and Aschelminthes upto class
- Life cycle of Fasciola hepatica

UNIT IV: Annelida

- Segmentation in Annelids
- Origin of coelom

UNIT V: Arthropoda

- General characters, Classification upto class
- vision in Arthropods, Appendages in Arthropods

UNIT VI: Mollusca

- General characteristic of Mollusca. Classification upto class
- Torsion and Detorsion in Mollusca

UNIT VII: Echinodermata

- General characters, classification upto class
- Water vascular system in Echinodermata

Reference Books:

- Barnes, R.D. (1982).Invertebrate Zoology, V Edition. Holt Saunders International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The
- Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington,E.J.W.(1979).InvertebrateStructureandFunctions.IIEdition, E.L.B.S. and Nelson
- Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of
- Students. Asia Publishing Home.
- Singh, S. Keshari S. and Abhishek, K.S. (2016). Medical Zoology and Parasitology, Jharkhand Jharokha, Classical Publishing Company.

Subject Code	Subject Title	Credit
MJL01ZOO	**Non-Chordates-Lab**	**01**

Practical:

1. Study of whole mount of Euglena, Amoeba and Paramecium; Binary fission and ConjugationinParamecium.Sycon(includingT.S.andL.S.),Obelia,Physalia,Aurelia,Gorgonia, Metridium, Pennatula, Aphrodite, Nereis, Heteronereis, Pheretima, Hirudinaria, Sacculina,Cancer,Pila,Unio, Asterias, Antedon

2. Study of adult *Fasciola hepatica,Taenia solium* and their life cycles(Slides/micro-photographs)

3. Study of adult *Ascaris lumbricoides* and their life stages (Slides/micro-photographs)

4. Mount of mouthparts and dissection of digestive system and nervous system of Periplaneta.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester II

Subject Code	Subject Title	Credit
MJ02ZOO	Chordates	03

UNIT I: Chordata

- Introduction to chordates and its origin general characters and outline classification

UNIT II: Protochordates

- General characters of Hemichordates Urochordates and Cephalochordates.

UNIT III: Agnatha

- General characters and classification of cyclostomes.

UNIT IV: Pisces

- General classification of chondricthyes and Osteicthyes
- Parental care in fishes

UNIT V: Amphibia

- General Classes and classification of Amphibia
- Parental care in Amphibians.

UNIT VI: Reptilia

- Poison apparatus and Biting mechanism in snakes.

UNIT VII: Aves

- General characters of Aves
- Flight adaptations in birds
- Flightless Birds: a brief idea.

UNIT VIII: Mammalia

- General characters and classification up to classes
- Dentition in mammals

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Reference Books:

1. Young, J. Z.(2004).The Life of Vertebrates. III Edition. Oxford university press.
2. Pough H. Vertebrate life, VIII Edition, Pearson International

Subject Code	Subject Title	Credit
MJL02ZOO	**Chordates-Lab**	**01**

Practical:

1. Study of Museum specimen:
   Petromyzon, Myxine, Scoliodon, Heteropneustes, Labeo, Exocoetus, Hippocampus, Tetrodon, Bufo, Hyla, Alytes, Salamandra, Uromastix, Draco, Vipera, Naja, Hydrophis, Columba, Bat.
2. Types of beaks and claws
3. Types of Hoofs in animals.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ03ZOO	Fundamentals of Ecology	03

UNIT I: An Overview of Ecology

- Structure and function of an ecosystem
- Energy flow in an ecosystem: Lindeman's Law. trophic dynamic concept
- Laws of limiting factor: Shelfords law of tolerance
- Food chain and Food web
- Productivity and its management
- Biome: An introduction and its type.

UNIT II: Population Ecology:

- Population and its attributes, Survivorship curve.
- Exponential and logistic growth.
- Population Regulation–Density dependent and density independent factors

UNIT III: Community Ecology:

- Community Characters, Analytical and synthetic characters
- Community Diversity Indices
- Community Interactions–positive and Negative interactions
- Niche concept: Niche overlap. Gause's principle with laboratory and field examples.
- Community Dynamics-Succession and climax concept

UNIT IV: Environment Management:

- Natural resources-types
- Biogeochemical cycles–Water, Carbon, Nitrogen
- Biodiversity-Alpha, Beta, Gamma.
- Concept of Hotspots

Reference Books:

- Raziuddin, M.., Mishra P.K.2014, A Hand book of Environmental Studies, Akanaksha Publications Ranchi.
- Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
- Gleeson, B. and Low, N.(eds.) 1999. Global Ethics and Environment, London, Routledge.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJL03ZOO	Ecology-Lab	01

Practical:

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/ real data provided'

2. Determination of population density in a natural/hypothetical community by quadrat method and calculation on of Shannon – Weiner diversity index for the same community.

3. Study of an aquatic ecosystem: phytoplankton and zooplankton; Measurement of area, temperature, turbidity/penetration of light, determination of pH, Oxygen content Oxygen content (Winkler's method), Biological Oxygen Demand, Chemical Oxygen Demand andfreeCO2.

4. Report on a visit to National Park/ Biodiversity Park/ Wildlife sanctuary

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester III

Subject Code	Subject Title	Credit
MJ04ZOO	**Insecta**	**03**

UNIT I: Introduction

- General features of insects
- Distribution and success of Insect on earth

UNIT II: Insect Taxonomy

- Basics of insects' classification: Classification of insects up to orders (Orthroptera, Coleoptera, Dictyoptera, Lepidoptera)

UNIT III: General Morphology of Insects

- External features of a typical insect
- Structure & Type of antennae
- Structure & Types of Mouthparts w.r.t feeding habits Type of legs adapted to diverse habitat

UNIT IV: Physiology of Insects

- Reproductive system
- Endocrine system
- Nervous system
- Sensory receptors – vision and sound receptors

UNIT V: Insect Animal Interaction

- Social economic insects (honey bees and termites) – Social organization & Social behaviour.
- Insects as a vector – Mechanical and biological vectors (*Musca domestica*, Anopheles & Culex)

UNIT VI: Insect Plant Interaction

- Role of allochemicals & pheromones in host plant mediation.
- Host plant selection by phytophagous insects
- Insect as plant pests & concept integrated pest management (IPM)

UNIT VII: Developmental Biology of Insects

- Developmental biology of Insects – oogenesis &spermatogenesis.
- Structure of egg and sperm
- Fertilization, Growth, types of Metamorphosis and its hormonal regualtion

Reference Books:

- A general textbook of entomology. Imms. A. D. Chapman & Hall, UK
- The insects: Structure and functions. Chapman. R.F. Cambridge University Press, U
- Principles of insect morphology. Snodgrass. R.F. Cornell University Press, USA.Introduction
- to the study of insects. Norro. D.J. Triplehorn. C.A. and Johanson. N.F. Saunders.College Publication, USA.
- Developmental Biology. Gilbert. Sinauer Associates, Inc., Publishers. Sunderland, Massachusetts U. S. A

Subject Code	Subject Title	Credit
MJL04ZOO	**Insecta-Lab**	**01**

Practical:

1. Study of one specimen from each insect order
3. Study of different kinds of antennae, legs and mouth parts of insects
4. Study of head and sclerites of any one insect
5. Study of insect wings and their venation.
6. Study of insect spiracles
7. Methodology of collection, preservation and identification of insects.
8. Morphological studies of various castes of Apis, Camponotus and Odontotermes
9. Study of any three insect pests and their damages
10. Study of any three beneficial insects and their products

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ05ZOO	Fish & Fisheries	03

UNIT I: Introduction and Classification:

- General description of fish; Account of systematic classification of fishes (upto class)
- Classification based on feeding habit, habitat and manner of reproduction.

Unit II: Morphology and Physiology:

- Types of fins and their modifications; Locomotion in fishes;
- Hydrodynamics; Types of Scales, Use of scales in classification and determination of age of fish;
- Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy;
- Osmoregulation in Elasmobranchs;
- Reproductive strategies (Special reference to Indian fishes);
- Electric organs; Bioluminiscince; Mechanoreceptors;
- Schooling; Parental care; Migration

Unit III: Fisheries:

- Inland Fisheries; Marine Fisheries;
- Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal;
- Fishing crafts and Gears;
- Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

Unit IV: Aquaculture:

- Sustainable Aquaculture; Extensive, semi- intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture;
- Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish;
- Role of water quality in aquaculture;
- Fish diseases: Bacterial, viral and parasitic;
- Preservation and processing of harvested fish, Fishery by- products

Unit V: Fish in Research:

- Transgenic fish
- Zebrafish as a model organism in research

Reference books:

1. Q Bone and R Moore, Biology of fishes, Talyour and Francis Group, CRC Press, U.K.

2. D.H. Evans and J.D. Claiborne, The Physiology of fishes, Taylor and Francis Group, CRC Press,

3. UK von der Emde, R.J. Mogdans and B.G. Kappor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands

4. C.B.L. Srivastava, Fish Biology, Narendra Publishing House • J.R. Norman, A history of Fishes, Hill and Wang Publishers

4. S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House

Subject Code	Subject Title	Credit
MJL04ZOO	**Fish & Fisheries-Lab**	**01**

1. Morphometric and meristic characters of fishes
2. Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus,
3. Hippocampus, Gambusia, Labeo, Hateropneustes, Anabas.
2. Study of different types of scales (through permanent slides/photographs).
3. Study of crafts and gears used in Fisheries
4. Water quality criteria for Aquaculture; Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias.
6. Demonstration of induced breeding in Fishes (video
7. Demonstration of parental care in fishes(video)
8. Project Report on a visit to any fish farm/pisciculture unit/Zebrafish rearing Lab

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester IV

Subject Code	Subject Title	Credit
MJ06ZOO	Developmental Biology	03

UNIT I: Basic concept of Development

- Basic concept of Development- Potency, Commitment, Specification, Induction, Competence.
- Phase of Development: Embryo genesis, Organo genesis, Blasto genesis in sea urchin & chick.
- Period of Development: Embroynic period, Post embryonic period.
- History of Embryology: Baer's law, theory of preformation, theory of epigenesist, mosaic theory.
- Pattern &axes formation in amphibian.
- Differential gene expression: cytoplasmic determinants and asymmetric cell division.

UNIT II: Early Embryonic Development

- Gametes: sperm or male gametes: types of sperms, Eggs or Female gametes: types of eggs
- Gametogenesis: Spermato genesis, Oogenesis.
- Egg membranes.
- Fertilization (External seaurchin and Internal Chick) & its mechanism.
- Planes and patterns of cleavage.
- Types of Blastula.
- Fate Maps
- Early development of frog and chick up to gastrulation.

UNIT III: Late Embryonic Development

- Extra embryonic membranes in birds.
- Implantation of embryo in humans.
- Placenta: Structure, types and functions of placenta.

UNIT IV: Post embryonic Development Metamorphosis:

- Types of Metamorphosis. Metamorphosis in amphibians Hormonal control of metamorphosis in
- amphibians
- Regeneration: Types of Regeneration
- Epimorphosis
- Morphallaxis
- Compensatory regeneration
- Ageing: Concepts and Theories

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

UNIT V: Implications of Developmental Biology

- Teratogensis: Teratogenic agents and their effect on embryonic development.
- In vitro: fertilization (IVF)
- Embryonic stem cells (Esc)
- Amniocentesis.

Reference Books:

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers,
- Sunderl and, Massachusetts,USA. Balinsky B.I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
- Kalthoff (2008). Analysis of Biological Development ,II Edition, McGraw - Hill Publishers. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

Subject Code	Subject Title	Credit
MJL06ZOO	Developmental Biology-Lab	01

Practical:

Study of whole mounts and sections of developmental stages of frog through permanent slides:

Cleavage stages, blastula, gastrula, morrula, tail-bud stage, tadpole (external and internal gill stages).

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)

2. Study of different types of placenta (photomicrograph/ slides)

3. Project report on chick embryo development.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ07ZOO	Comparative Anatomy	03

UNIT I: Integumentary System

- Structure Function and Derivatives of integument

UNIT II: Skeletal System

- An Overview of Axial and Appendicular Skeleton, Jaw suspensorium

UNIT III: Digestive System

- Alimentary Canal and associated gland, Dentition

UNIT IV: Respiratory System

- Skin, Gills, Lungs, Air Sacs and accessory respiratory organs

UNIT V: Circulatory System

- Evolution of Heart and Aortic arches, General plan of Circulation

UNIT VI: Urinogenital System

- Succession of Kidney, Evolution of Urinogenital duct

UNIT VII: Nervous system

- Comparative account of brain, Autonomic Nervous System, Spinal Cord, Cranial Nerves in Mammals

UNIT VIII: Sense Organ

- Brief account of Visual and Auditory receptor

Reference Books:

- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw –Hill Companies.
- Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills
- Hilderbrand and, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJL07ZOO	Comparative Anatomy-Lab	01

PRACTICALS:

1. Study of placoid, cycloid and ctenoid scales through permanent slides/ photographs.
2. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit.
3. Carapace and plastron of turtle/ tortoise.
4. Mammalian skulls: One herbivorous and one carnivorous animal.
5. Dissection of ratto study arterial and urino genital system (subject to permission

digital mode)

6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video Recording (may be included if dissection not permitted).

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ08ZOO	Animal Physiology	03

UNIT I: Tissue

- Structure and classification, Bone and Cartilage

UNIT II: Digestive System

- Gastrointestinal tract and its associated glands; Mechanical and Chemical digestion of food; Absorption of Carbohydrate, Protein and Lipid

UNIT III: Respiratory System

- Histology of trachea and Lungs, Respiratory volumes, Respiratory Pigments, Diffusion of respiratory gases and Transport of O2 and CO2

UNIT IV: Circulatory System

- Structure and Working of Mammalian Heart Blood groups, Rh factor Blood and its components, Blood clotting Mechanism Cardiac cycle

UNIT V: Skeletal system

- Ultra-structure of Skeletal Muscle, chemical basis of muscle contraction.

UNIT VI: Excretory System

- Kidney: structure and function, Mechanism of urine formation, Counter – Current theory, Ornithine – Arginine cycle

UNIT VII: Reproductive System

- Histology of male and female reproductive organs, physiology of reproduction in male and female, Accessory Reproductive organs, Methods of Contraception, Reproductive Hormone.

UNIT VIII: Endocrine system

- Basics of Endocrine glands (Pituitary, Pineal, Thyroid, Pancreas Adrenal, Thymus, and Gonads). Classification of hormone Mode of hormone action. (TSH/Adrenaline)

UNIT IX: Nervous System

Ultrastructure of Neuron, Physiology of nerve conduction, Reflex Action.

Reference Books:

- Guyton, A.C. & Hall, J.E. (2006). Text book of Medical Physiology. XI Edition. Her court Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S.(2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.
- Victor P. Eroschenko. (2008). Di Fiore's Atlas of Histology with Functional correlations. XII Edition.
- Lippincott W. &Wilkins. Arey, L.B.(1974). Human Histology. IV Edition.
- W.B. Saunders. De Fiore Atlas of Human histology. Physiology Vandor

Subject Code	Subject Title	Credit
MJL08ZOO	**Animal Physiology-Lab**	**01**

PRACTICALS:

1. Recording of simple muscle twitch with electrical stimulation (or virtual).

2. Demonstration of the unconditioned reflex action (Deep tend on reflex such as knee jerk reflex).

3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells.

4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.

5. Microtome: Preparation of permanent slide of mammalian tissues.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester V

Subject Code	Subject Title	Credit
MJ09ZOO	Biochemistry	03

UNIT I: Biomolecules:

- A brief account of Carbohydrates, protein and lipids.

UNIT II: Carbohydrates:

- Structure and classification.
- Metabolism of carbohydrates. Glycohysis, Kreb's cycle, ETS and ATP synthesis. Glycogenesis, Gluconeosis. Glycogenesis HMP shunt.

UNIT III: Lipids

- Structure and classification.
- Steroids keto genesis and synthesis of Palmitic Acid.

UNIT IV: Proteins

- Composition, structure and biological significance.
- Amino acids: structure and classification.
- Catabolism of Amino acid: Transamination & Deamination.

UNIT V: Enzymes

- Nomenclature and classification.
- Enzyme kinetics. Regulation of Enzyme Action Coenzymes and Iso enzymes.
- Enzyme inhibition and Km Equation Organic reactions and their mechanism: Addition, Elimination and Substitution reactions

Reference Books:

- Cox, M. M and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, V Edition,W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co.,New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009,). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition,The McGraw – Hill Companies Inc.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJL09ZOO	Biochemistry-Lab	01

PRACTICALS:

1. Quantitative test of functional groups in carbohydrates, proteins and lipids.
2. Paper chromatography of amino acids.
3. Action of salivary amylase under optimum conditions.
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.
5. Demonstration of proteins separation by SDS-PAGE.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ10ZOO	Evolution	03

UNIT I: Introduction to Evolutionary Theories

- Historical review of evolutionary concept:
- Lamarckism, Darwinism, Modern synthetic theory

UNIT II: Evidence of Evolution

- Geological time and scale
- Fossil record (types of fossils, transitional forms,)
- Adaptive Radiation, Homology and analogy
- Evolution of horse.

UNIT III: Process of Evolutionary change: Sources of Variations:

- Heritable variations and their role in evolution.
- Concept of coevolution, parallel evolution.

UNIT IV: Principles of Population genetics

- Hardy Weinberg law (statement and derivation of equation, application of law to human population)
- Evolutionary forces upsetting H-W equilibrium.
- Natural selection
- Genetic Drift

UNIT V: Species concept

- Product of Evolution:
- Micro evolutionary changes (Inter population variations, clines, races)
- Species concept
- Isolating mechanism
- Modes of speciation-allopatric, sympatric.
- Macro evolution (Adaptive Radiation)

UNIT VI: Extinctions

- Background and Mass extinctions (causes and effects)
- Detailed example of K-Extinctions

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

UNIT VII: Origin and Evolution of Man

- Unique homin in characteristics contrasted with primate characteristics.
- Primate phylogeny from Dryopithecus leading to *Homo sapiens.*

UNIT VIII: Phylogenetic trees Multiple sequence alignment

- Construction and Interpretation Of Phylogenetic trees.

Reference Books:

1. Ridley, M.(2004). Evolution. III Edition. Blackwell Publishing
2. Barton, N.H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring Harbour Laboratory Press.
3. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
4. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. Wiley Blackwell

Subject Code	Subject Title	Credit
MJL10ZOO	**Evolution-Lab**	**01**

PRACTICALS:

- Study of fossil evidences from plaster cast models and pictures.
- Study of homology and analogy from suitable specimens/ pictures.
- Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ11ZOO	Cell Biology & Biostatistics	03

UNIT I: A general concept of prokaryotic and eukaryotic cells

- General structure of different cell organelles including Mitochondria, Golgi complex,

UNIT II:

- Endoplasmic reticulum, Nucleus. Ribosome, Lysosome

UNIT III: Cytoskeleton

- Composition and function. Micro tubules and micro filaments GERL system

UNIT IV: Cell membrane structure:

- Chemical composition of Plasma membrane of Erythrocyte, Active and Passive transport, (Diffusion and osmosis) ATPase Pump and Exchange.

UNIT V:

- Cell Adhesion Molecules and ECM

UNIT VI:

- Cell cycle, cell signaling, and cell culture.:
- A brief introduction to cell cycle, its various phases
- Mitosis and Meiosis, Cell division, Check points and its regulation.
- Apoptosis and Cancer
- Cell signaling, Regulation of signaling pathways. (GPCR and RTR)
- Cell communication

UNIT VII Biostatistics:

- Types of culture media: Sterilization method Somatic cell hybridization. Types of data: Primary and secondary data
- Mean, Median, Mode, Standard Deviation, Standard error
- Chi-square test, t-test, f test, ANOVA, Correlation, Regression Analysis.
- Basics of statistics software – SPSS, XLSTAT etc.

Reference Books:

- Karp, G.(2010).Cell and Molecular Biology: Concepts and Experiments.VI Edition John Wiley and Sons.Inc.
- DeRobertis, E.D.P. and DeRobertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

- Cooper, G.M. and Hausman, R.E. (2009).The Cell: A Molecular Approach. V Edition.
- Zar, J.H.(2013) Biostatistical Analysis (5th edition) Pearson.

Subject Code	Subject Title	Credit
MJL11ZOO	**Cell Biology & Biostatistics -Lab**	**01**

PRACTICALS:

- Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
- Study various stages of meiosis from permanent slides.
- Preparation of permanents lide to show the presence of Barr body in human female blood cells/ cheek cells.
- Preparation of permanent slide to demonstrate: a. DNA by Feulgen reaction b. DNA and RNA by MGP c. Mucopolysaccharides by PAS reaction d. Proteins by Mercurobromophenol blue/ Fast Green.
- Calculation of mean, standard deviation and standard error.
- Calculation of correlation coefficient values and finding out the probability
- Student's t–test dependent and independent, hand calculation and calculation using MS-Excel.
- ANOVA- hand calculation and calculation using MS-Excel.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester VI

Subject Code	Subject Title	Credit
MJ12ZOO	Endocrinology	03

UNIT I:

Introduction to Endocrinology

- Definition and Classification of hormones.
- Endocrine, paracrine and merocrine modes of hormone delivery
- Feedback mechanisms

UNIT II: Epiphysis, Hypothalamo- hypophysial Axis.

- Structure of the pineal gland, secretions and their function in biological rhythms and reproduction.\
- Structure of hypothalamus, hypothalamic nuclei and their functions, Regulatoin of neuroendocrine glands.
- Structure of pituitary gland, hormones of pituitary gland and their functions.
- Hypothalamo- hypophysial portal system.
- Hypothalamic control of adenohypophysis

UNIT III: Structure and functions of endocrine glands in Mammals.

- Structure, hormones, functions and regulation of endocrine glands: Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, pancreas, Testis, Ovary, Local endocrine gland

UNIT IV: Mechanism of Hormone Action

- General mechanism of hormone action
- Regulation of Hormone action: Hormone action at cellular level, Hormone receptors
- Transduction and regulation of hormone action at molecular level, molecular mediators, genetic control of hormone action

UNIT V: Hormonal dysfunction and diseases

1. Dwarfism and acromegaly
2. Goiter
3. Addison’s disease
4. Diabetes mellitus

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Reference Books :

1. General Endocrinology C. Donnell Turner Pub- Saunders Toppan.
2. Endocrinology: An integrated Approach; Stephen Nussey and Saffron Whitehead.
3. Oxford: BIOS Scientific Publishers; 2001
4. Hadley, M.E. and Levine J.E.2007. Endocrinology, 6th Edition Pearson Prentice- Hall, Pearson Education Inc., New Jersey.
5. Vertebrate Endocrinology by David O. Norris

Subject Code	Subject Title	Credit
MJL12ZOO	Endocrinology-lab	01

PRACTICALS:

1. Handling, sexing, numbering and maintenance of rat.
2. Dissection and demonstration of endocrine glands in laboratory bred rat.
3. Study of vaginal smear preparation of rat.
4. Demonstration of following surgical operations in laboratory bred rat:

a. Orchidectomy b. Ovariectomy C. Tubectomy

5. Study of permanent histological slides of following endocrine glands in rat: Pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary.
6. Estimation of plasma level of any hormone using ELISA.
7. Compensatory ovarian hypertrophy in vivo bioassay in laboratory bred rat.
8. Group discussion and seminar presentation on related topics.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ13ZOO	Genetics	03

UNIT I:

Genetics Pre- Mendelian genetics, Mendel's life, Symbols, and terminologies, Laws of dominance, segregation & independent assortment, Back cross & test cross, Multiple alleles, and Incomplete Dominance.

UNIT II:

Linkage: Coupling & repulsion hypothesis, Morgan's view of linkage, kinds of linkage, Chromosomal theory of linkage, Human chromosomal maps.

UNIT III:

Crossing over or Gene recombination: Somatic & germinal crossing over, kinds of crossing over, Theories of the mechanism of crossing over.

UNIT IV:

Eukaryotic Chromosomes: Structure & chemical composition of chromosomes. Karyotype, Lamp brush chromosome

UNIT V:

Sex determination: Genic balance theory, Chromosomal theory &, Types of sex determination, Environmental sex determination, Role of SRY gene in sex determination, and developing gonads. Ideogram, Human karyotype,

UNIT VI:

Sex-linked inheritance: Sex chromosomes, X-linked genes (colour blindness & haemophilia inheritance, Sex – limited & Sex influenced traits.

UNIT VII:

Pedigree analysis: Penetrance & expressivity, Symbols, Pedigree analysis of dominance inheritance (polydactyly in man), Recessive inheritance (cystic fibrosis), and sex-linked inheritance (colour blindness). in humans), Y-linked

UNIT VIII:

Mutation: Historical background, Mutagens, Chromosomal mutation & gene mutation, Chromosomal aberrations in humans, Euploidy & aneuploidy

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Reference Books:

Strick berger's Genetics, Printice Hall of India (PHI), Delhi

Principles of Genetics: Snustad & Simmons, John Wiley & Sons, USA

Modern Genetics Analysis: Integrating Genes and Genomes, Griffith et al. W.H. Freeman & Company, USA

Subject Code	Subject Title	Credit
MJL13ZOO	Genetics-lab	01

PRACTICALS:

- To study the Mendelian laws and gene interactions
- Chi- square analyses using seeds/ beads/ Drosophila. Linkage maps based on data from conjugation, transformation and transduction.
- Linkage maps based on don data from drosophila crosses.
- Study of human karyotype (normal and abnormal).
- Pedigree analysis of some human inherited traits.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ14ZOO	Molecular Biology	03

UNIT I:

DNA- Chemistry of nucleic acids (DNA & RNA): N-bases, Pentose sugar, Nucleosides & Nucleotides, Watson - model of DNA, Types of DNA (A, B & Z), Base pairing, Major & minor grooves of DNA, uninterrupted genes.

UNIT II:

DNA synthesis in E. coli: Semi-conservative DNA replication, Replication fork, DNA polymerases, Phases- initiation, elongation and termination. Errors in DNA and their repair (base excision repair & nucleotide excision pair)

UNIT III:

Transcription in E. coli: Consensus sequences, Promoter (-35 & -10 elements), RNA polymerase, Phases elongation and termination. RNA processing of mRNA.

UNIT IV:

RNA: initiation, Chemistry of RNA, types of RNA (mRNA, rRNA, tRNA, snoRNA), Structure of mRNA & tRNA (clover-leaf model), Basics of RNA edit, RNAi.

UNIT V:

Genetic codes: History of genetic codes, Features of genetic codes, Wobble hypothesis. Central dogma.

UNIT VI:

Translation in E. coli: Translation factors, charging of tRNAs, Phases- initiation, elongation and termination.

UNIT VII:

Gene recombination : Homologous recombination.

UNIT VIII:

Operon concept: Operon and its types, Lac operon – inducible, constitutive & non-inducible.

UNIT IX:

Basics of the genetics of cancer: Proto-oncogenes, Gene regulation of the cell cycle. Gene therapy, Stem cell therapy, BLAST

Reference Books:

Lenhinger Principles of biochemistry: Cox &Nelson, MacMillan & Freeman, USA

Molecular biology of Gene: Watson et al., Pearson Publication, USA

Strickberger's Genetics, Prinitis Hall of India (PHI), Delhi

Principles of Genetics: Snustad & Simmons, John Wiley & Sons, USA

Modern Genetics Analysis: Integrating Genes and Genomes, Griffith et al., W. H. Freeman & Company, USA

Genetics: Russell & Benjamin, Cummings Publishing Company, USA.

Genetics: PK Gupta, Rastogi Publication, NewDelhi.

Subject Code	Subject Title	Credit
MJL14ZOO	Molecular Biology-lab	01

PRACTICALS:

1. Study of polytene chromosomes from Chironomus / drosophilalarvae.

2. Preparation of liquid culture medium (LB) and raise culture of E.coli.

3. Estimation of the growth kinetics of E. coli by turbidity method.

4. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking.

5. Demonstration of antibiotic sensitivity/ resistance of E.coli to antibiotic pressure and interpretation of results.

6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter (Diphenylaminere agent) or spectrophotometer (A260 measurement).

7. Quantitative estimation of RNA using Orcinol reaction.

8. Study and interpretation of electron micrographs/ photo graph showing

i. DNA replication

ii. Transcription

iii. Split genes

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ15ZOO	Biophysics & Bioinformatics	03

Unit I:

Structure of proteins – primary, secondary, tertiary and quaternary. X-ray crystallography Physical methods for determining size and shape of macromolecules – diffusion to sedimentation, reverse osmosis, ultracentrifugation, Ramachandran Plot Analysis.

Unit II:

Energetics of a living body, sources of heat limits to temperature (qualitative treatment), heat dissipation to conservation, laws of thermodynamics. Nature of chemical bonds, intra and intermolecular interaction in biological systems.

Unit III:

Bioinformatics and its relation with molecular biology Examples of related tools, databases and software, Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

Unit IV:

Biological Database and its Types, Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases, Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: Structure databases.

Unit V:

Gene Expression and Representation of patterns and relationship, General introduction to Gene expression in prokaryotes and eukaryotes, transcription factors binding sites. SNP, EST, STS. Introduction to Regular Expression, Hierarchies, and Graphical models (including Marcov chain and Bayes notes). Genetic variability and connections to clinical data.

Reference Books:

1. Silberschatz A, Korth HF, Sudarshan S (2002) Database system concepts (4th Edition). McGraw-Hill Education.
2. Holtje HD, Sippl D, Rognan, Folkers G (2008) Molecular modelling basic Principles and applications (3rd Edition). Wiley-VCH
3. Hughes W. (1979), Aspects of Biophysics, John willey and sons.
4. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

5. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999 Old editions

Subject Code	Subject Title	Credit
MJL15ZOO	**Biophysics & Bioinformatics-Lab**	**01**

Practical:

- Preparation of buffers (acetate, phosphate, citrate, borate buffers). Preparation of Normal, molar and standard solutions, serial dilutions
- To plot absorption spectrum of DNA and protein (BSA/Egg Albumin) and find λmax
- To learn a) use of microscope b) principles of fixation and staining; To familarize with bright field, phase contrast, fluorescence & polarizing microscopes. and micrometry.
- Familiarity with use of Internet, Search engines, Web sites, Surfing, Browsing websites such as NCBI, EMBL, DBT, DDBJ.3d modelling of protein prediction.
- Separation of amino acids and sugars using paper and Thin layer chromatography. Estimate their Rf value
- Fractionation of mixture of amino acids and sugars using Paper & TLC

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester VII

Subject Code	Subject Title	Credit
MJ16ZOO	Animal Biotechnology	03

UNIT I

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus &Genetransfer.

UNIT II

Introduction to transgenesis.Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT III

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems& ethics.

UNIT V

Stem cell therapies: Generation of induced pluripotent cells, and molecular Mechanism of iPSCs reprogramming. Direct differentiation. Stem cell technologies, Gene editing technologies-TALEN, CRISPR-Cas 9.

Reference Books:

- Lanza R, Gaerhart J,Hogan B, Melton R, Thomas D, Thomas J, and Wilmut S. Essentials of Stem Cell Biology. Elsevier!Inc.
- Stillman B, Stewart D and Grodzicker T, Control and Regulation of Stem Cells.
- Tursen Kursad, Stem Cell Biology and Regenerative Medicine, Humana Press

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJL16ZOO	Animal Biotechnology-Lab	01

Practical:

- Extraction of DNA and RNA.
- Polyacrylamide gel electrophoresis (PAGE). Agarose gel electrophoresis.
- Restriction endonuclease analysis of DNA.
- Isolation and purification of plasmid.
- Polymerase chain reaction. Cloning of gene. Expression of cloned gene.
- Purification of recombinant protein.
- Blotting. RFLP. RAPD

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ17ZOO	General Microbiology	03

Unit 1: Introduction, history and scope of Microbiology

Contribution of Antony Van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Ivanowsky, Waksman, Subba Rao, Sambhunath De; Position of microorganisms in the living world. 5 kingdom classification of Whittaker and 3 kingdom classification, comparison of the 3 domain of microorganisms- bacteria, archaea, eukarya; Bergey's manual and introduction to classification of bacteria.

Unit 2: Bacterial morphology

Ultrastructure of bacterial cell, cell wall, plasma membrane, capsule, flagella, nucleoid, and reserve material. Differences between archaebacterial and eubacterial cell. General features of Rickettsia, Chlamydia, Mollicutes, Actinomycetes and Cynobacteria.

Unit 3: Techniques in microbiology I

Principles of microscopy, construction and application of Compound Microscope (monocular and binocular), Bright field Microscopy, Dark field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Electron Microscopy- TEM and SEM

Unit 4: Techniques in microbiology II

Principles, construction and application of centrifuge; bacteriological Incubator Shaker; Laminar flow; Colourimeter & Spectrophotometer (UV-vis)

Unit 5: Sterilization techniques and control of microorganisms

Definitions of terms- sterilization and disinfection; Sterilization by Physical methods- Use of moist heat- heat under pressure, autoclave, boiling, pasteurization, fractional sterilization, tyndallization; Use of dry heat- hot air oven, incineration; Filtration- Seitz filter, membrane filter, HEPA filter.

Unit 6: Isolation, cultivation and preservation of microorganisms

Culture media and its types: Methods of isolation enumeration of microorganism using several plating techniques

Unit 7: Stains and staining techniques

Staining techniques, principles, methods and applications of several techniques: simple and negative staining; Differential staining: Gram and Acid fast staining.

Reference Books:

- Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.

- Atlas R.M., Microbiology- Fundamentals and applications, Macmillan Publishing Company, New York.
- Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York.
- Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw-Hill, Newyork.

Subject Code	Subject Title	Credit
MJL17ZOO	General Microbiology-Lab	01

Practical:

- Good labroratory practice in Microbiology and safety measures.
- Cleaning and sterilization of glassware and equipments.
- Study of o aseptic technique- preparation of Credit cotton plug, wrapping of glassware, transfer of media and Inoculum. Study of instruments- Microscope, autoclave, hot air oven, laminar airflow, inoculation loop and needle, incubator, B.O.D incubator, centrifuge machine, pH meter, colony counter, seitz filter, membrane filter, colourimeter, spectro photometer.
- Preparation of different culture media- nutrient agar/nutrient broth for bacterial culture, PDA for fungal culture.
- Staining of bacteria- 1. Simple staining- methylene blue 2. Gram's staining 3. Acid fast staining 4. Ziehl Neelsen staining 5. Giemsa staining 6. Structural staining- capsule, endospore. 7. Staining of fungi using lactophenol and cotton blue.
- Enumeration of bacteria using spread plate and pour plate techniques
- Isolation of bacteria by pour plate, spread plate and streak plate method

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ18ZOO	Water Relations, Growth and Development	03

Unit 1:

Water relations of plants: Unique physio-chemical properties of water, chemical potential , water potential. Apparent free space, bulk movement of water, soil plant atmosphere, contuum (SPAC), stomatal regulation of transpiration, hormonal and energy dependent hypothesis; Inorganic nutrition, physicochemical aspects of solute transport, diffusion and facilitated diffusion, passive and active transport; Nernst equation and Donnan's potential. Role of ATPase as a carrier, co-transport (symport) and counter transport (antiport). Ion channels, role of calmodulin. Importance of foliar nutrition and use of chelates.

Unit 2:

Photosynthesis: Energy pathway in photosynthesis, chloroplast as an energy transducing organelle; Composition and characterization of photo systems, I and II , electron flow through cyclic, non cyclic and pseudo cyclic photophosphorylation. Pathways of CO2 fixation. Differences between C3 and C4 fixation and different kinds of C4 pathways.

Unit 3:

CAM pathway: Occurrence, biological events and adaptive advantage; Photorespiration : Mechanism and regulation of photorespiration; Introductory studies on water stress and its tolerance mechanisms.

Unit 4:

Enzymes: Classification, mode of enzymes action, allosteric enzymes. Km value; Industrial application, immobilized enzyme application; Enzyme regulation : Competitive and noncompetitive Inhibition. Enzyme kinetics.

Unit-5

Chemical control of growth and morphogenesis; Hormonal effects on growth and development; Bioassay of plant growth regulators and mode of action with reference to auxins; Gibberellins, cytokinins, abscisic acid and ethylene; Phytochrome: Chemistry and photo morphogenetic effects and role in flowering; Genetic study of secondary metabolites such as alkaloids (only types of wide occurrence.) Dormancy: Seed and bud dormancy; hormonal regulation.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJL18ZOO	Water Relations, Growth and Development -Lab	01

Practical:

1. Study of physical and chemical characteristics of soil by rapid field test.

2. Determination of pH of water.

3. Determination of dissolved oxygen in water

4. Extraction of amylase and determination of its activity

5. Preparation of cleared whole mounts of floral parts of polypetalae, sympetalae and monocots for vasculature.

6. With the help hand section and dissection prepare longitudinal and transverse sections of flower. Examination of: a. Transmitting tissue/ canal in stigma and style.Use of paraffin method of microtechnique .

7. Acquaintance with ultratomy: use of wood microtomy and common and anatomy and histochemical methods.

8. Learning techniques of making temporary and permanent microscopic preparation.

9. Knowledge and use of photomicrography in anatomical studies.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJ19ZOO	Fermentation and Bioprocess Technology	03

bbbb

Concept of Fermentation, Different types of fermentations-Batch, Fed-batch and continuous fermentation, An overview of submerged and solid state fermentations. Factors affecting fermentation; Bioreactor- structure and applications of a laboratory bioreactor; Different types of bioreactors like - Stirred tank reactor, air-lift, packed bed, fluidized and bubble column- their structure and applications; Multiphase bioreactor system

Unit 2:

Sterilization (medium and air) thermal death kinetics of microorganisms; aeration, agitation and heat transfer in bioprocess. Microbial substrates, Media formulation and optimization; Microbial growth and kinetics. Monitoring of Bioprocesses: On line and Techno-economic data biochemical analysis for measurement and control of data parameters, Computer based important physicochemical acquisition, feasibility of bioprocess.

Unit 3:

Isolation and characterization of industrially important Microorganisms; Generation of mutant strains for fermentation. Different approaches for strain improvement for fermentation. Concept of primary and secondary metabolites, Yield coefficient and efficiency. An overview of important products like antibiotic, biofuel, enzymes, An overview of recombinant proteins.

Unit 4:

Biological mixture-composition and separation of different components of biological mixture titration, separation, flocculation, liquid-liquid extraction, chromatographic techniques, reverse osmosis, ultra and micro filtration; Purification of wild and recombinant proteins, Product polishing-drying; crystallization; storage and packaging. Recent advances and applications in the field.

Reference Books:

1. Bioprocess Engineering: Basic Concepts (2017) 3rd ed. Shuler, ML, and Kargi, F. Pearson Prentice Hall, ISBN: 0137062702.

2. Principles of Fermentation Technology (2016) 3rd ed. Stanbury P, Allan Whitaker, Stephen Hall. Imprint (Butterworth-Heinemann), ISBN: 9780080999531.

3. Biochemical Engineering Fundamentals (2013) 5th reprint J. E. Bailey and Ollis, D. F. McGraw Hill Education (India) Pvt Ltd., ISBN: 0070701237.

4. Bioprocess Engineering Principles (2013) 2nd ed. Doran, P.M, Academic Press, ISBN: 978-0 12- 2208515. 5. Bioreactors Analysis and Design (2011) Panda T, Tata McGraw Hill, ISBN: 978-0-07 070424-4.

Subject Code	Subject Title	Credit
MJL19ZOO	Fermentation and Bioprocess Technology-Lab	01

Practical:

- To determine Volumetric Oxygen Transfer Coefficient (kLa) in fermentation system by dynamic method/sulphite method.
- Comparative studies on the kinetics of free and immobilized enzymes/cells.
- To study the production of biofuel/enzyme using lignocellulosic biomass
- Comparative study of batch, fed-batch and continuous fermentations
- To study the structure and functions of a stirred tank bioreactor.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Semester VIII

Subject Code	Subject Title	Credit
MJ20ZOO	Immunology	03

Unit 1: Overview of Immunology

History of immunology, Physical and physiological barriers, Innate and Acquired immunity, Organs and Cells of Immune system

Unit 2: Complement System

Complement System Proteins, Alternate and Lectin Pathway

Unit 3: Immunity; Antigen and Antibody

Humoral and Cell Mediated Immunity, Active and Passive Immunity; Antigens: Types, characteristics, Adjuvents, Immunogenicity, Cytokines: Details study about Antibodies, Antigen presentation, MHC classes.

Unit 4: Immune Response

Types of Hypersensitivity, Mechanism of hypersensitivities with examples; Antibody dependent Cell mediated Cytotoxicity,Phagocytosis, Inflammation

Unit 5: Applications

Applications of antibody in diagnosis Cytotoxicity, and therapy; Phagocytosis, In vitro Response Inflammation: Immunoglobulins in serological test; Ag-Ab Reaction; ELISA,RIA,CLIA etc.

Reference Books:

1. Kindt, Goldsby and Osborne. Kuby's Immunology. WH Freeman& Company

2. Roitt I,Brostoff, J and Male D.Immunology, 6th edition, 2001, Mosby, London.

3. Ramesh SR, Immunology. Mc Graw Hill Publications.

4. Madhavee LP, A Textbook of Immunology, S Chand Publisher.

5. Reddy R, Textbook of Immunology, 3rd edition, AITBS Publisher.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
MJL20ZOO	Immunology-Lab	01

Practical:

ABO blood group determination.

Differential Leukocyte Count. Total Leukocyte Count.

Widal Test.

Demonstration of lymphoid organs.

Histological study of spleen, thymus and lymph nodes through slides/ photographs

Preparation of stained blood film to study various types of blood cells.

Demonstration of - i. ELISA& ii. Immunoelectrophoreisis.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
AMJ01ZOO	NANOBIOTECHNOLOGY	03

Unit 1:

Introduction of Nanobiotechnology and its applications. Various types of nanomaterial utilized in agriculture

Unit 2:

Nanoparticles in agricultural and food diagnostics: Enzyme Biosensors and Diagnostics – DNA Based Biosensors and Diagnostics, Radiofrequency Identification.

Unit 3:

Nanotechnology in food production: Food and new ways of food production -Efficient fractionation of crops, Efficient product structuring -Optimizing Nutritional Values - Applications of Nanotechnology in Foods: Sensing, Engineering Food Ingredients to Improve Bioavailability Nanocrystalline Food Ingredients – Nano-emulsions – Nano Engineered Protein Fibrils as Ingredient Building Blocks.

Unit 4:

Sequence alignment and its evolutionary basis: Simple alignment and multiple sequence alignment - searching the database for sequence similarity – search programmes with special reference to FASTA, BLAST, CLUSTAL W. Application of bioinformatics in phylogenetic analysis.

Reference Books:

1. Xiong, Essential Bioinformatics. Cambridge University Press.

2. Marketa J Zvelebil, Understanding Bioinformatics. Garland Science.

3. Shui Quing Ye, Bioinformatics: A practical Approach.

4. Anna Tramontano, Introduction to Bioinformatics

5. David W Mount, Bioinformatics. CBS

Subject Code	Subject Title	Credit
AMJL01ZOO	NANOBIOTECHNOLOGY-Lab	03

Practical:

- Search and Sequence retrieve from genbank database
- Alignment of sequence by using tools: Clustal X, Clustal W, Mega and Bioedit
- Phylogenetic tree analysis by using Mega software.
- Primer designing by using online tools.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
AMJ02ZOO	Industrial Microbiology	03

Unit 1:

Taxonomic diversity of industrially useful bacteria & fungi. Important characteristics of microbes used in Industrial Microbiology, Isolation techniques.

Unit 2:

Exploitation of microorganism and their products, Screening, Strain development strategies, Immobilization methods.

Unit 3:

Fermentation: Media, Raw material, Antifoaming agents, Buffers. Equipments, Fermenter design. Types of fermentation – Single, Batch, Continuous.

Unit 4:

Down-stream processing steps: Detection and assay of the product, Recovery & (intercellular and extracellular product). Purification (solvent extraction chromatography)

Unit 5:

Production of Alcohol (industrial alcohol, wine, beer, whiskey), Organic acid (Citric acid), Antibiotic (Penicillin)

Unit 6:

Production of Vitamin (B12), Enzyme (Amylase), Amino acid (Glutamic acid), Hormones (Insulin), Vaccine (Hepatitis B).

Unit 7:

Biofuel (Methane), Production of Biofertilizers & Biopesticides, Biotransformation of steroids.

Reference Books:

1. Industrial Microbiology (2000) by AH Patel, Macmillan Publishers India

2. Biology of Industrial microorganism (1981) by Arnold L. Domain, Bejamin/ cummings Pub. Co.

3. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.

4. Industrial Microbiology by Casida LE, New age International (P) Ltd.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
AMJL02ZOO	Industrial Microbiology-Lab	03

PRACTICALS:

- Study of Bioreactor & its essential parts
- Isolation and microscopic observation of industrially important microorganism
- Isolation and characterization of microorganism used in Dairy industry
- Isolation and characterization of Yeast used in Bakery/distillery/winery
- Isolation & identification of important microorganism of food microbiology
- Determination of the quality of milk by MBRT
- Bacteriological analysis of food products
- Bacterial examination of milk – Alcohol test
- Preservation methods

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
AMJ03ZOO	Sericulture	03

Unit-I

History of Sericulture.

Unit-II

Types of Silkworms, Distribution in India and other countries.

Unit-III

Production of mulberry and non-mulberry silk in India and other countries. Comp. Production efficiencies.

Unit-IV

Sericulture organization in India – Administrative set up – Research and training set up – Seed production – Cocoon production and Marketing of cocoon and silk – Reeling and Weaving sectors– Exports and imports –Tariff protection.

Unit- V

Sericulture Research in India and its impact and also research being carried out in the universities.

Subject Code	Subject Title	Credit
AMJL03ZOO	Sericulture-Lab	01

Practical:

- Estimation of Moisture Content of Mulberry Leaves for Chawki Rearing
- Determination of Mulberry Leaf Driage in the Rearing Bed
- Estimation of Silkworm Larval Density in the Rearing Bed and Silkworm Population
- Estimation of Larval Density and Shoot Quantity Required for Late Age Rearing (Shoot Feeding Method) for 100 dfls
- Estimation of Hatching and Brushing Percentage of Silkworm Eggs

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
RC01	Research Methodology	04

1. Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - Understanding the language of Research - Concept, Construct, Definition, Variable. Research Process.

2. Problem Identification & Formulation - Research Question - Investigation Question Measurement Issues - Hypothesis - Qualities of a good Hypothesis. Null Hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & Importance.

3. Research Design: Concept and Importance in Research - Features of a good research design Exploratory Research Design - concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

4. Qualitative and Quantitative Research: Qualitative research - Quantitative research - Concept of measurement, causality, generalization, replication. Merging the two approaches.

5. Measurement: Concept of measurement- what is measured? Problems in measurement in research- Validity and Reliability. Levels of measurement: Nominal, Ordinal, Interval, Ratio.

6. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample- Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample Practical considerations in sampling and sample size.

7. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis- Cross tabulations and Chi square test including testing hypothesis of association.

8. Interpretation of Data and Paper Writing- Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

9. Use of tools I techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/ Mendeley, Software for paper formatting like LaTeX/ MS Office, Software for detection of Plagiarism

Reference Books:

1. Research Methodology- C. R. Kothari
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
RC02	Research Proposal	04

Process of writing a research proposal.

Formulation of Research Proposal on a specific topic.

That includes the following points:

1. TITLE.
2. INTRODUCTION
3. REVIEW OF LITERATURE (BACKGROUND AND RATIONALE)
4. RESEARCH QUESTION(S).
5. AIMS & OBJECTIVES
6. RESEARCH METHODOLOGY.
7. PLAN OF WORK
8. REFERENCE/BIBLIOGRAPHY.

RKDF UNIVERSITY RANCHI

B.Sc. Zoology

Subject Code	Subject Title	Credit
RC03	Research Report	04

A research report is a reliable source to recount details about a conducted research. It is most often considered to be a true testimony of all the work done to garner specificities of research. Research reports present the results of formal investigations into the properties, behavior, structures, and principles of material and conceptual entities. Almost any physical phenomenon or concept may be investigated in a research framework.

The following are some key differences between formal research, and other less structured kinds of inquiry.

1. Problem definition: the rigorous reduction of the inquiry to a narrow question with a quantifiable answer. The most significant preliminary phase of research writing is that of effective problem definition. This process is one of identifying an interesting question and narrowing the research inquiry to a manageable size.

2. Research approach: the structuring of the research according to a methodology associated with a specialized field of inquiry. Specialized fields have research methodologies that are followed in investigating problems. These range from general methods of interviewing and literature researching to highly specialized procedures for using materials and mechanical devices to establish appropriate conditions for generating data. Adapting a sound research methodology to the investigation of your problem is a major milestone in the conduct of your inquiry.

3. Research report: the presentation of the research and its results in a rigorously formatted document that follows a conventional structure. In presenting your research, you pull all its elements together into a focused, coherent document. Research reports contain a standard set of elements that include.