COURSES OF STUDIES

FOR

MASTER DEGREE COURSE

IN

LIFE SCIENCE

Part – I Examination – 2016-17

Part – II Examination – 2017-18

GOVERNMENT AUTONOMOUS COLLEGE,
PHULBANI, KANDHAMAL

The course shall comprise of two parts. Each part will consist of 4 Theory Papers and two practical papers. Each theory paper will carry 75 marks. Each practical paper will carry 100 marks. The duration of examination for each theory paper shall be of 4 hours and for each practical paper 6 hours.

Each theory paper shall have five units. An alternative question will be set in each unit. Part I will be common for all the students. In part II a student will take either plant science or animal science along with any one special theory paper (paper X) its related special practical (paper XII).

M.SC. PART- 1

Paper-I	Biophysics & Biochemistry	75 Marks
Paper-II	Cell Biology, Genetics, Micro Biology and Immunology	75 Marks
Paper-III	Ecology, bio-statistics & Instrumental Techniques	75 Marks
Paper-IV	Molecular Biology, Biotechnology & Genetic Engineering	75 Marks
Paper-V	Practical related to theory Papers I and II	100 Marks
Paper-VI	Practical related to theory Papers III & IV and Field Study report	100 Marks

M. SC. PART - II

PLANT SCIENCE

Paper-VII	Plant Morphology	75 Marks
Paper-VIII	Plant Physiology	75 Marks
Paper-IX	Plant Anatomy, Embryology Evolution & Developmental Botany	75 Marks
Paper-X	Special paper (Environmental Biology/Cytogenetic	75 Marks
Paper-XI	Practicals related to theory papers, VII, VIII & IX of Plant Sciences	100 Marks
Paper-XII	Practicals related to special paper (X) and study tour report for Env. Biology Students.	100 Marks

ANIMAL SCIENCE

Paper-VII	Non-chordata, Ethology	75 Marks
Paper-VIII	Chordata and Embryology	75 Marks
Paper-IX	Animal Physiology, Evolution & Taxonomy	75 Marks
Paper-X	Special paper (Environmental Biology / Cytogenetics / Physiology / bio-Chemistry)	75 Marks
Paper-XI	Practicals related to theory papers, VII, VIII & IX of Animal Science	100 Marks
Paper-XII	Practicals related to the special Paper X and study tour report for Env. Biology students.	100 Marks

PART - I

PAPER – I : BIO - PHYSICS & BIO- CHEMISTRY

Term end Exam.- 75 Marks

UNIT - I: Biophysics - I

1. Intermolecular forces: -
   Dipoles, dielectric constants, dipole moment, induce dipole, charge dipole, lonic bonding, Hydrogen bonds Vander Waals' forces.
2. Basic organisation of biomolecules in biomembranes. Bilayer modes of lipid arrangement, protein asymmetry and mobility.
3. Membrane transport, diffusion, facilitated diffusion, active transport.
4. Gibbs Danann membrane equilibrium, membrane potential.
5. Electromagnetic radiation and its interaction with living matters with reference to UV & visible radiations.

UNIT - II: Biophysics- II

1. Structure and ionisation of water, acid and bases, Relationship of PK and PH in a buffer.
2. Oxidation reeducation equilibrium, equilibrium constant and rodex potential.
3. Principles of thermos dynamics in relation to living organisation.
4. Concept of steady state, enthalpy, entropy and energy changes.
5. Concept of statistical mechanics.
6. Kinetic orders of reaction. Theories of reaction rate and the energy of activation.

Unit- III: Structure of Biomolecules - I

1. Structure of amino acids.
2. Structure of proteins (primary, secondary, tertiary and quaternary structures) Domain structure of protein, Ramachandran plot.
3. Structure and classification of enzymes and coenzymes.
4. Mechanism of enzyme action. Regulation of enzyme activity: Constitutive and regulatory enzymes, allosteric Enzymes, Michaelis-Menten Equilibrium.

Unit- IV: Structure of Biomolecules - II

1. Structure of carbohydrates: Monosaccharides, Disaccharides and Polysaccharide.
2. A broad out line classification of lipids, structure of saturated and unsaturated fatty acids.
3. Structure and significance of glycolipids, glycoprotein, peptidoglycans, steroids, vitamins and prostaglandin.

Unit- V: Biochemical process

1. Gluconeogenesis, Hexose Monophosphate shunt, Glyoxylate cycle.
2. β -Oxidation, Fatty acid biosynthesis, General reactions of amino acid metabolism.
3. Election transport in mitochondria and chloroplast, Oxidative phosphorylation & Photophosphorylation, proton pump.
4. Photochemical process of bioluminescence.

PAPER – II : CELL BIOLOGY, GENETICS, MICROBIOLOGY AND IMMUNOLOGY

Term end Exam.- 75 Marks

Unit-I: Cell Biology - I

1. Ultra structures, chemistry and function of mitochondria.
2. Ultra structure, chemistry & function of chloroplast.
3. Molecular organisation, structure, behavior and involvement of ribosomes in protein synthesis.
4. Origin, structure and function of cytoplasmic filaments and microtubules.
5. Origin, structure and function of nucleolus.

UNIT - II: Cell Biology - II

1. Structure of chromosome: Euchromatin and heterochromation, nucleosome concept and higher levels of organisation.
2. Structural changes in chromosomes: Deletion, duplication, inversion and translocation.
3. Numerical changes in chromosomes: Euploidy and aneuploidy.
4. Molecular basis of cell cycle.
5. Cytological and biochemical abnormalities of cancer cell.

UNIT - III: Genetics

1. Mendelism and Deviations from Mendelian principles.
2. Linkage, crossing over (molecular mechanism) and gene mapping.
3. Bacterial recombination: Transformation, transduction and conjugation.
4. Population genetics, Hardy-Weinberg principles.
5. Inheritance of Quantitative characters.

UNIT - IV: Microbiology

1. Virus-General properties and Classification, Molecular Architecture of a bacteriophages. Reproduction in Virus with special reference to lysogeny and lytic cycle. Virus as a tool in genetic engineering.
2. Bacteria- Molecular organisation, growth, nitration and reproduction in bacteria, Elementary idea of antibiotics.
3. Other Microbes- A brief outline survey of other Microbes: Protozoa, Mycoplasma, Slime mould, Actinomycetes, Yeasts and Cyanobacteria and their use in industry (fermentation, alcohol, antibiotics, vitamins, organic acids, enzymes, food preservation) and agricultural use.

UNIT - V: Immunology

1. Types of Immunity: Innate, acquired, passive, active, Humoral and Cell- Mediated immunity, Specificity and Memory.
2. Lymphocytes: Lymphoid organs, origin, development and differentiation of Lymphocytes, its sub population, surface markers and their Functions.
3. Antigens: Hapten, Antigen Antibody recognition.
4. Immunoglobulins: Structure, distribution and function.
5. Major Histocompatibility Complexes, HLA- Role in antigen Presentation.
6. Introduction to auto - immune disorders, Human immune deficiency disease.

PAPER –III : ECOLOGY AND BIOSTATISTICS

Term end Exam.- 75 Marks

UNIT - I: Ecology - I

1. Concept of Ecosystem (Emergent Properties, Biological levels of Organisation, Structure, Classification of Ecosystems, Ecological Energetics, Gaja hypothesis and Cybernetics).
2. Leibig's Law of Minimum and concept of limiting factors, Law of Tolerance.
3. Population Ecology (structure and dynamics).
4. Community Structure.
5. Community dynamics (Succession), Niche segregation & species diversity.

UNIT - II: Ecology - II

1. Air pollution.
2. Water pollution.
3. Soil pollution.
4. Noise pollution.
5. Radioactive pollution.

UNIT - III: Ecology - III

1. Systems ecology - Ecomodeling.
2. Human population and problems.

3. Biodiversity and its conservation.
4. Waste management & Bioremediation.
5. Environmental management, auditing, education and awareness.
6. Types of forests and their distribution in India.

UNIT - IV: Bio Statistics

1. Probability distribution (Normal, Binomial & Poisson).
2. Students't' tests.
3. Analysis of variance.
4. Correlation and Regression, Analysis.
5. Goodness of fit and association analysis by chi-square test.

UNIT - V: Instrumental Techniques

1. Microscopy - (Principles of Phase contrast Microscopy, Electron & Scanning Electron Microscopy).
2. Chromatography - Principles, Paper, Thinayer and Gas Chromatography.
3. Centrifugation - General Principles, types of centrifugation.
4. Spectrophotometry - Laws of light absorption, Colorimeters, Electrophoresis - Spectrophotometers (UV, Visible, Infrared).
5. Electrophoresis - Principles and types (Paper, SDS PAGE Rocket immuno electrophoresis).

PAPER – IV : MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Term end Exam.- 75 Marks

Unit- I: Molecular Biology

1. Structure of Nucleic acids, Components of DNA & RNA, double helical structure of DNA, Other forms of DNA, Types of RNA.
2. Replication of Double Stranded DNA.
3. Eukaryotic gene concept: Split gene, transposable elements and over lapping gene concepts.
4. Molecular basis of gene mutation.
5. Regulation of gene expression, Operon concept, negative & positive regulations, gene regulation in eukaryotes.

UNIT - II: Molecular Biology - II

1. Constitution of Eukaryotic genome, C-Value paradox, sequance components (repetitive and non repetitive DNA sequence).
2. Methods of DNA hybridization and its application.
3. Sequencing of nucleic acids and proteins.
4. Molecular biology of cancer.

UNIT - III: Gene Expression

1. Genetic code.
2. Central dogma.
3. Process of transcription.
4. Post- transcriptional modification: (RNA splicing, capping and Polyadenylation).
5. Process of translation.
6. Post - translational modification of proteins.

UNIT - IV: Bio-technology and Genetic Engineering - I

1. Basic Principles:
   Restriction enzymes, Isolation and Purification of target DNA, Blotting technique (Southern, Northern and Western) Dot and Slot blots.
2. Gene Cloning in prokaryotic cells.
   Cloning vectors, types and reconstruction of vectors, Generation of Sticky ends, blunt ends. Ligation, Model cloning experiments.
3. cDNA and its synthesis, construction of gene library, general concept of Vermitechnology and Bio-fertilisers.

4. Industrial Biotechnology: Application of enzymes in pharmaceutical and food processing Industries.

UNIT - V: Biotechnology & Genetic Engineering - II

1. Application of genetic engineering:
   Hydridoma technology, genetic manipulation of nitrogen fixation with reference to NIF gene transfer
2. Gene transfer technology and production of transgenic plants with reference to Agriculture.
3. Gene transfer technology and production of transgenic animals with reference to Animal husbandry & Pharmaceuticals.
4. DNA finger printing.
5. Protoplast fusion and somatic hybridisation.

PAPER – V : PRACTICAL

Lab Exercise relating to papers 1 & 2 - 6 hours, 100 Marks

PAPER – VI : PRACTICAL

Lab Exercise relating to papers 3 & 4 6 hours, 100 Marks

PART -II
(PLANT SCIENCE)

PAPER –VII : PLANT DIVERSITY

Term end Exam.- 75 Marks

UNIT - I: Algae

An outline classification of cryptogams up to order. Algae-Range of thallus structure and reproduction in Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.

UNIT - II: Fungi

Organisation of thallus structure and reproduction. Economic importance of phycomycetes, Ascomycetes and Basidiomycetes.

UNIT - III: Bryophytes and Pteridophytes

Bryophytes - Evolution of gametophyte and sporophyte in Marchantiales, Evolution of sex organs in Bryophyte. Mosses as the most advanced bryophytes. Pteridophytes- Origin of land plants, evolution of vascular tissues, Origin of heterospory and its significance. Fillicates as most advanced groups of pteridophytes.

UNIT - IV: Gymnosperms

Gymnosperms - Origin and outline classification upto order. Characteristics features in the structure and reproduction of important orders. Cycadofillicales as Intermediate group between bryophytes and pteridophytes, cycadales as relic of ancient gymnosperms, phylogenetic position of Ginkgoales, wood anatomy and embryogeny of coniferales, angiospermic character of Gnetales, Palaecobotany-Geological or, process of fossilisation. Fossil gymnosperms.

UNIT - V: Angiosperms

Origin and evolution of angiosperms. Different systems of classification up to order. International code of Botanical Nomenclature (ICBN), Range of floral structure, affinities and phylogeny of monocot land dicots with special reference to Glumiflorae, Liliflorae Scitaminae, Microspermae, Ranales, Malvales, Tubiflorae and Umbelliflorae.

(PLANT SCIENCE)
PAPER – VIII : PLANT PHYSIOLOGY

Term end Exam.- 75 Marks

UNIT - I: Water Relation

Water relation in plants-Concepts of water potential, principles of absorpition of water, ascent of sap, transpiration, stomatal mechanism and transpiration ratio.

UNIT - II: Mineral Nutrition

Mineral nutrition-Essential elements, hydroponics, absorption of elements, passive and active transport, role of essential elements land deficiency symptoms, translocation of organic materials in phloem.

UNIT - III: Nitrogen Metabolism

Nitrogen metabolism-Bio-chemical mechanism of Nitrogen fixation in free living and symbiotic organisms, Nitrogen cycle.

UNIT - IV: Respiration

Respiration-Aerobic and anaerobic respiration, respiratory quotient, energetics of respiration, electron transport system, action uncouplers, cyanide resistant respiraction. HMP pathway,- Oxidation of fatty acids.

UNIT - V: Photosynthesis

Photosynthesis-Principles of light absorption in chloroplast, Organisation of light absorbing systems, mechanism of electron flow, C3, C4 and CAM pathway for carbon reduction, Photorespiration.

(PLANT SCIENCE)
PAPER- IX : ANATOMY, EVOLUTION, EMBRYOLOGY, DEVELOPMENT BOTANY

Term end Exam.- 75 Marks

UNIT - I: Plant Anatomy

Secondary growth in plants, anomalous secondary growth and principles of arrangement of mechanical tissues.

UNIT - II: Evolution

Concept of Organic evolution, geological ora, age of Earth, origin of life, dating of rock, processes of fossilisation, geographical distribution of plants, isolation and isolating mechanisms, sympatric and allopatric populations.

UNIT - III: Embryology

Microsporogenesis, megasporogenesis, Embryosac, types of Endosperms, apomixis, development of dicot and monocot embryos.

UNIT - IV: Tissues culture

Concept of totipotency in plants, culture methods, preparation of culture media, somaclonal variations, protoplast culture, somatic hybridization, significance of production and use of haploids.

UNIT - V: Plant Development

Germination, physiology of flowering photoperiodism, senescence, Regulation of plant growth and development phytohormones, molecular mechanism of responses of plants to Auxins, Gibberellins, Cytokinins, ABA and Ethyiene

Books Suggested:

1. Physiology and Bio-Chemistry of Plant Hormones: T.C. Moore, Academic press.
2. Biochemistry: Trehan, K. New Age International Calcutta.

3. Environmental Law: A.K. Panigrahi, Sadagranath Mandir, Berhampur.
4. Plant Physiology, F.B. Sabsbury and C.W. Rass. 4th Edition, Wordsworth Publishing Company Belmont, USA-1992.
5. Environmental Science Panigrahi A.K. Mc. Mollan, India Ltd. Calcutta.
6. Biotechnology P.K. Gupta (1995) Rastogi and Company, Meerut.
7. Water Pollution : Gad, P.K. New Age, International, Calcutta.
8. Glossry of useful plants and economically important plants, Panigrahi, A.K. & Alaka Sahu New Central Book Agency, Calcutta.

PART - II
(ANIMAL SCIENCE)

PAPER – VII : NONCHORDATA AND ETHOLOGY

Term end Exam. - 75 Marks

Unit- I: Nonchordata - I

1. Locomotion in protozoa.
2. Reproduction in protozoa.
3. Parasitism in protozoa.
4. Origin of Metazoa and Coelom.
5. Reproduction in Porifera.
6. Polymorphism in Coelenterata.
7. Structure and affinities of Ctenophora

UNIT - II: Non-chordata - II

1. Structure and affinities of Archiannelida.
2. Helminth parasites with special reference to man.
3. Metamerism in Annelida.
4. Vision in Insects.
5. Larval forms in Crustacea.
6. Respiration in Arthropoda.

UNIT - III: Non-chordata - III

1. Structure and affinities of peripatus.
2. Respiration in Mollusca.
3. Larval forms in Echinodermata.
4. Water-vascular system in Echindermata.
5. Structure and affinities of Hemichordata.

UNIT - IV: Ethology - I

1. Structure and affinities of Lophorotes.
2. Structure and affinities of Brochiopods.
3. Structure and affinities of Gastrotricha.
4. Economic Zoology: Apiculture, Sericulture, Lac culture, pearl culture.

UNIT - V: Ethology- II

1. Instinct, Learning, types of learning, Neural mechanism of learning and learning in Vertebrates.
2. Biochemical approach to problem of memory.
3. Orientation and navigation in animals.
4. Migration behaviour in fishes and birds.
5. Reproductive behaviour in vertibrates (courtship and mating)
6. Biological clocks.
7. Social behaviour in insects and primates.

(ANIMAL SCIENCE)

PAPER – VIII : CHORDATA AND EMBRYOLOGY

Term end Exam.- 75 Marks

UNIT - I: Chordata-I

1. Origin of Chordata.
2. Inter-relationship of Cephalochordata and Urochordata.
3. Structure and affinities of Cyclostomata.
4. Distribution, structure and affinity of Dipnoi.
5. Air bladder in fish.
6. Accessory respiratory organs in fish.

UNIT - II: Chordata- II

1. Origin of Tetrapoda .
2. Structure and general account of Gymnophiana.
3. Parental care in fishes and Amphibia.
4. Structure and affinies of sphenodon.
5. Mammal like reptiles.
6. Flight adaptations and perching mechanism in birds.

UNIT - III: Chordata - III

1. General account of Prototheria and Metatheria.
2. Dentition in mammals.
3. Adaptive radiation in mammals.
4. Comparative anatomy of Integument, Jaw-suspensorium, skull, vertebral column and uinogenital system in vertebrates.

UNIT -IV: Embryology - I

1. Molecular events during fertilisation.
2. Cleavage.
3. Morphogenic movements and mechanism of gastrulation.
4. Differentiation and differential gene activity.
5. Concept of organiser and embryonic induction.
6. Totipotency and tissue culture in animals.
7. Regeneration.

UNIT - V: Embryology - II

1. Foetal membranes and their development.
2. Placentation.
3. Development of notochord and heart in chick.
4. Oestrous and Menstrual cycle.
5. Infertility and artificial insemination.
6. In vitro fertilisation.
7. Birth control.

(ANIMAL SCIENCE)

PAPER – IX : ANIMAL PHYSIOLOGY, EVOLUTION AND TAXONOMY

Term end Exam.- 75 Marks

UNIT - I: Animal Physiology - I

1. Digestion: Nutrition patterns in animals and digestive enzyme.
2. Principles and regulation of absorption of food.
3. Cardiac cycle and its regulation.
4. Haemoglobin: Constituents and role in respiration.
5. Breathing and gaseous exchange, transportation of gases, oxygen equilibrium curve, Bohr's effect, Haldane effect.

UNIT - II: Animal Physiology - II

1. Muscle contraction.
2. Mechanism of nerve impulse conduction & synaptic transmission.
3. Vision, hearing and olfaction in man.
4. Chemical nature of hormones.
5. Mechanism of hormone action.
6. Metamorphosis in insects and Amphibians.

UNIT - III: Animal Physiology- III

1. Physiology of excretion.
2. Acid base balance
3. Osmoregulation in animals.
4. Pheromones: Nature, classification, sources.
5. Senescence.
6. Physiology of reproduction in humans.

UNIT - IV: Evolution

1. Fossils, Follilisation and dating of fossils, some Indian fossils.
2. Patterns of evolution: Sequential evolution, Convergent and Divergent Evolution, Micro, Macro and Mega Evolution, Quantum Evolution.
3. Synthetic theory of evolution.
4. Natural selection, Hardy- Weinberg's Law.
5. Continental drift and animal distribution.
6. Animal distribution (Cosmopolitan, Discontinuous, Bipolar and isolated distribution), and factors effecting distribution.
7. Speciation.

UNIT - V: Taxonomy

1. History of Taxonomy.
2. Principles of classification and procedures in Taxonomy.
3. Species concept.
4. Concepts of chemotaxonomy, cytotaxonomy and numerical Taxonomy.
5. Preservation and identification of animals.
6. Ecology and physiology in taxonomy.
7. General classification on Animal Kingdom.

PAPER –X : ENVIRONMENTAL BIOLOGY (SPECIAL PAPER)

Term end Exam.- 75 Marks

UNIT -I: Habitat Ecology - I

1. Soil ecology
   a) Soil formation.
   b) Classification of soils, Types of soils and soils of Orissa.
2. Grassland Ecology
3. Crop land Ecology
4. Forest Ecology

UNIT - II: Habitat Ecology- II

1. Limnology
   a) Classification of Inland Water bodies.
   b) Origin of lakes.
2. Marine Ecology
   a) Stratification of Marine habitat.
   b) Planktonic adaptations.
3. Estuarine ecology.

UNIT - III: Stress Physiology

1. Basic concepts of stress, Strain, Resistance, Tolerance and Avoidance, Incipient lethal level, Acclimation and acclimatisation, Homeostasis.
2. Bioassays, Synergism and Antagonism.
3. Water deficit stress and adaptations of plants and animals to water deficit stress.
4. Ionising radiation, types and sources of ionising radiation in environment, effects and radiation standards.
5. Pollution-Oil, pollution, pollution due to agricultural activity and Eutrophication.
6. Pollution in Indian rivers.

UNIT - IV: Production and Conservation Ecology

1. Primary production and methods of measurement.
2. Secondary production and yield to man.
3. Ecological efficiencies and production in different regions of the world.
4. Natural habitat conservation in Orissa with special references to Chilika, Bhitar Kanika, Similipal and Mahendragiri
5. Afforestation and forest management.
6. Wild life conservation.
7. Soil conservation.

UNIT - V: Environment Management

1. Environmental monitoring and management.
2. Environment protection laws.
3. Environmental education and awareness.
4. Biological control of pests.
5. Sewage and solid waste management.
6. Treatment of effluents in distillaries and paper and pulp industries.

PAPER –X : SPECIAL PAPER CYTOGENETICS

Term end Exam.- 75 Marks

UNIT-I: Chromosome structure and variation

1. Fine structure of eukaryotic chromosomes:-
   a. Longitidinal differentiation of chromosomes.
   b. Heterochromatin & Euchromatin.
   c. Packing of chromatin fibres, Uninemy and polynemy models.
2. Structure and significance of: -
   a. Polytene chromoscme.
   b. Lampbrush chromosome.
3. Supernumerary chromosomes.
4. Chromosome aberrations: structural rearrangements and their genetic consequences.
5. Sex chromosome and Sex determination in animals.

UNIT -II: Chromosome movement and behaviour

1. Cell cycle kinetics, methods of synchronization of cell cycle.
2. Organisation and chemistry of spindle apparatus & kinetochore.
3. Synaptinemal complex and mechanism of chiasma formation.
4. Theories of chromosome movement.
5. Meiotic abnormalities (non-disjunction of chromosomes, misdivision of centromere).
6. Human genetics autosomal & sex chromosomal disorders, positive and negative eugenic measures.

UNIT -III: Population and molecular genetics

1. Multiple gene inheritance.
2. Mechanism of quantitative inheritance.

3. Genetic equilibrium & factors disrupting genetic equilibrium.
4. Structure and replication of single stranded and circular DNA (replication by chain, elongation single rolling circle).
5. Enzymatic apparatus for DNA replication.
6. Genetic counselling.

UNIT - IV: Molecular methodology

1. Gene mapping in prokaryotes and Human genome mapping.
2. RNA transcription in prokaryotes and eukaryotes, RNA polymerase.
3. RNA processing (cutting and trimming, mechanism of splicing, capying, polyadenilation and control of RNA processing).
4. DNA damage and repair.
5. Autoradiography.
6. Genetically modified food and technology.

UNIT -V: Plant and Animal Breeding

1. Plant breeding methods.
2. Genetic basis of inbreeding and heterosis.
3. Animal breeding.
4. Practical applications and breeding principles for high yielding crops.
5. Practical applications and breeding principles for farm animals.
6. Techniques and practical applications of transgenic plants and animals.

PAPER –XI : PRACTICAL

Laboratory work relating to Plant science or Animal science: **6 Hours** duration **100 marks.**

PAPER –XII : PRACTICAL

Laboratory work relating to Special papers: **6 Hours** duration **100 marks**.

Books Recommended:

FUNDAMENTALS OF BIOPHYSICS

1.	Epsteir	Elementary Biophysics	A Wisley
2.	Ackerman	Biophysical Science	P Hall
3.	Giese	Cell Physiology	Saunders
4.	Davson	A text Book of General physiology	Little Brown co.
5.	Milcheil	A text Book of General Physiology	Mc Graw Hill
6.	Dewben	General Physiology	Harper Row

FUNDAMENTALS OF BIOCHEMISTRY

1.	Mertz	Elemental Biochemistry -Vaklis Feffor and Simontout Ltd. (Bombay)	
2.	Harper	Review of Physiological Chemeistry	Lange Med Publ. Marcezen Asia end, Kothari Book Depot. Bombay.
3.	Mohlar and	Biological Chemistry	Harper Row Corded
4.	Mallette Althouse Calgett	Biochemistry of Plant and Animals	Willey Eastern
5.	West, Todd Text Baugen Meson & Van	Book at Biochemistry	Mc. Millan
6.	Lehringe	Biochemistry	
7.	White. Hander		

	& Srrith.	Principles of Biochemistry	Mc Graw Hill
8.	Watson	Molecular Biology of gene	W.Bengeamin
9.	Cohn & Stumt.	("Colines" RNA Synthesis protein Synthesis "Transfer RNS" losteriz regulation").	

FUNDAMENTALS OF BIOSTATISTICS AND BIO TECHNIQUE

1.	Simkpson Row & Lowton.	Quantitative Zoology	Hacouri Beane & World
2.	Bailey	The mathematical approach to Biology and Medicine	A.Willey
3.	Mather	Statistical analysis in Biology	Matheun
4.	Dixon and Massey	An introduction to Statistical analysis	Mc Graw Hill
5.	Sendecor and Cochran	Statistical Method	Lows stall College Press
6.	Dauben	Plants and Environment	Wiley
7.	Misra	Ecology work Book	
8.	Lieth and Whittakara	Primary Productivity of the Biosphere	Spring vering
9.	Misra & Misra	Introductory practical Biostatistics	Waya Prakash, Calcutta

CYTOGENETICS

1.	CellBiology	Saunder	
2.	Lowey &	Cell function	Half, Reinchart Sickeyits& Winston
3.	Longley	Cell function	Rein held
4.	Hoffmon	The life & Death of Cells	Delphin Books
5.	Bulter	Inside the living Cell	George Allen & Unwin
6.	Dupraw	Cell & Molecular Biology	AC Press
7.	Stern Nanney	The biology of Cell	Wiley
8.	Cooper	The Cell	
9.	Novikoff	Cell & Organells	Harper Row
10.	Altenber	Genetics	Oxford
11.	Winechester	Genetics A survey of the Principles of Heredity.	I.I.M.
12.	Sinnot Dunns & Dobzhansry	Principles of Genetics	Mc.Gaw Hill
13.	Bonner	Heredity	P.Hall
14.	Hartman and Geneaction	-do-	Suskind
15.	Stah	-do-	
16.	Levine	Gene	Holt Rein
17.	Fraser	Heredity, Genes & Chromosomes	Mc. Graw
18.	Fox	Origin of prebiological System	Ac. Press

PRINCIPLES OF MICROBIOLOGY & IMMUNOLOGY

1.	Sistrom	Microbial Life	Holt rein chart and Winster.
2.	Stanier	General Microbiology	
3.	Wellberg	Introduction to Microbiology	
4.	Stanier- Doudorff and Adelberg	The Microbial World	P.Holl
5.	Gacesales Stained	The bacteria (Five Volumes)	Ac.Press
6.	Luria	Virology	
7.	Wodberg	Microbes & You	ox.ind
8.	Barnet	Virus (Three Volumes)	Ac. Press
9.	Fvaenkel contrat	The chemistry and Biology of viruses	Ac. Press
10.	Brieger	Structure and ultra Structure of Microorganism	Ac. Press
11.	Davis	Principles of Microbiology and Ecology	Harper & Row

PLANT SCIENCE

Cryptogamic Botany:

1.	Fritsch	Structure and Reproduction in Algar.	(2 Vol.)
2.	Smith	Cryptogamic Botany	(2 Vol.)
3.	Vaughan	Structure & Reproduction in Fungi.	
4.	Verdoon	Mannual of Bryology	
5.	Verdoom	Mannual of pteriodolgy	
6.	Campbell	Mosses and Ferns	
7.	Bower	Primitive land plants	
8.	Arnold	An Introduction to palaeobotany	
9.	Andrews	Palaeobotany	
10.	Bowerson	Fillicales	
11.	Alexopahoss	Phycomycetes	

Phanerogamic Botany:

1.	Coulter and Chamberian	Morphology of Gymnosperms
2.	Chamberian	Gymnosperms
3.	Scott	Fostil Botany
4.	Randle	Classification of Angiosperms
5.	Lawrence	Plant Taxonomy
6.	Bonson	Plant classification
7.	Haines	Flora of Bihar and Orissa (3 Vols.)
8.	Hill	Economic Botany
9.	Esau	Plant Anatomy
10.	Eames	Morphology of Embryology of Angiosperms
12.	Steward	Growth & Organization of plants.

Plant physiology:

1.	Steward	Plant physiology
2.	Boneer & Vener	Plant Biochemistry
3.	Suteliff	Mineral Nutrition in plants
4.	Leopold	Plant Growth & Development
5.	Wilkins	Physiology of plant growth and Development
6.	Audus	Plant Growth substances
7.	Devlin	Plant Physiology
8.	Curtis & Clark	An Introduction to plant Physiology

ANIMAL SCIENCE

Invertebrate Zoology:

1.	Parker & Haswel	A Text Book of Zoology (Vol. 1)	Wc. Millian
2.	Borradaile & potts	The Invertebrates	Comb. U
3.	Human	The Invertebrates (7 volumes)	Mc. Graw Hill
4.	Rounos	Survey of Invertebrates	Van Nostrand
5.	Carte	A General Zoology of Invertebrates	Sidgerick and Jacksen

CHORDATE ZOOLOGY AND EMBRYOLOGY

1.	Parker and Haswell	A Text Book of Zoology Vol. II	Mc. Millan
2.	Welchet	Anatomy of Chordates	Mc. Graw Hill
3.	Romer	The vertebrate Body	Sounders
4.	Joile	Chordata Morphology	Van Nostrand
5.	Sedgwich	Text Book of Zoology	
6.	Goodrich	Structure & Development of Vertebrates	Life of Vertebrates
7.	Young	Life of Mammals	
8.	Colbert	Evolution of Vertebrate	

9.	Ravan	An outline of development Physiology	Pergamn
10.	Welss	Dynamics of Development	-do-
11.	Bodemer	Modern Embryology	Halt
12.	Bonney B	Molecular Biology of Development	Mc. Millan
13.	Child	Patterns & Problems of Development	Chicago U
14.	Locks	Major problems in Development Biology	Ac Press
15.	Locks	Control Mechanism in development process	Ac Press
16.	Sexem & Toiben	Primary Embryonic Industion	-do-
17.	Torry	Morphogenes of the W	Wiley
18.	Barth	Development Selected topics	A Wesley
19.	Eiller and Oppenhelmer	Foundation of Experimental Embryology	Ph Hall
20.	Bell	Molecular and cellular Aspects of Development	Harper Row

ANIMAL PHYSIOLOGY AND BEHAVIOUR

1.	Hoar	General & Comparative Animal Physiology	
2.	Florey	Introduction to General and Comparative Animal Physiology	
3.	Prosser and Brown	Comparative Animal Physiology	Saunder
4.	Best & Taylor	The Living Body	Methewn
5.	Schemidt	Animal Physiology	P. Hall
6.	Ctoudslay & Thompson	Rhythmic Activities in Animal Physiology and Behaviour	Ac. Press
7.	Scheer	Animal Physiology	Wiley
8.	Hind	Animal Behaviour	Mc. Graw Hill
9.	John	Mechanisms of Memory	Ac. Press
10.	Walass	Molecular Basis of some aspects of mental activity	-do-
11.	Marne and	Mechanisms and Animal behaviour	Hamilton A Weslay
12.	Manning	An introduction to Animal behaviour	A. Waslay
13.	Edusonetal	Biochemistry and Behaviour	-do-
14.	Dethle and Steller	Animal Behaviour	

EVOLUTION PALAENTOLOGY AND TAXONOMY

1.	Lauage	Evolution	Ox. Ind
2.	Simpson	The Meaning of Evolution	-do-
3.	Simpson	Temp & mode of Evolution	I. A. P. C.
4.	Solbrig	Evolution & Systematic	C. M. I.
5.	Hamilton	Process & pulton in Evolution	-do-
6.	Delay	Problem in Evolution	A. C. C.
7.	Moody	Introduction to Evolution	Harper Row
8.	Merrell	Evolution & Genetics the Modern Theory	Ox. Ind
9.	Mayr	Principles Systematic Zoology	Mc. Graw
10.	Sokaland Sneeth	Numerical Taxonomy	Freeman
11.	Hakesed	Chemo Taxonomy & Taxonomy	U. Press
12.	Simpson	Principles of Animal Secrotaxonomy	Columbia

ENVIRONMENTAL BIOLOGY

Quantitative Ecology Limnology:

1.	Boughey	Ecology of populations CMI	
2.	Dasmann	Environmental Conservation	Ac. Press
3.	Nan Dyne	The Ecosystem Conception Natural resource management	-do-
4.	Panigrahi & Panigrahi	Environment Sc.	Mc Millan, India Calcutta
5.	Mc Das	Fundamental of Ecology	Mc Graw Hill
6.	P.S.B. Rao and P.M. Rao	Environment Management and Audit	Deep and Publish, New Delhi
7.	Vollen weider	A Manual on Methods for Measuring primary production in acquite Environments IBP Hand Book No. 12.	-do-
8.	Retrusewles & Mate to adyeened	Productivity of terrestrial animals: principles and methods I & P hand book No. 3.	Block well Sc. Publ.
9.	Edmondson and Winberged	A Manual of Secondary productivity in fresh Water I & P hand Book No. 17	Block Well Sc. Publ
10.	Sobmn	Population Dynamics	Arnold Dep
11.	Mc. Arther	Biology of populations	
12.	Weld Ps	Limnological methods	Mc.Graw Hill
13.	Golterman HL	Method for analysis of Black well sed fresh waters.	Punl Hand Book No. 8
14.	Edmandson	Fresh water Biology	Willey and sons publ.
15.	Panigrahi & Sahu	Environmental Studies	Sadagranth Mandir
16.	Misra & Misra	Introduction practical Biostatistics	Naya prakes Calcutta
17.	Panigrahi, A. K.	Environmental Law	Sadagranth Mandir, Berhampur.

ENVIRONMENTAL PHYSIOLOGY & SOIL BIOLOGY

1.	Prosser and Brown	Comparative Animal physiology	Saunders
2.	Florkin	Molecular, approaches to Ecology	Ac press
3.	Flock	Introduction to Environmental Physiology	Lea & Febiger (Philedelhis)
4.	Bernsteine	Biochemical Responses Environmental stress	PPC
5.	Durgan	Biochemical Ecology of water Pollution	-do-
6.	Harbone	Physiology, Environmental and man	PPC
7.	Lee	Physiology Environmental and man	PPC
8.	Sharp	Ecology and Human Environment	
9.	Sulton	Mutagenic effects of Environmental contaminants	Ac. Press
10.	Varnberg	The Animal and the Environment	Harper Row
11.	Prosser (ed)	Molecular Mechanisms of Temperature Adaptation No. 84	AAAS. Publ.
12.	Levitt	Responses of plants to Environmental Stress	Ao. Press
13.	Bacq and Alexander	Fundamentals of Radio Biology	Academic Press
14.	Jakson	Soil Chemical Analysis	Prentice Hall
15.	Soil Survey Staff USA	Soil Survey Manual	Oxfod and IBA
16.	Jongeerins (ed)	Soil Micromorphology	Elsevie

17.	Edwards and softy	Biology of Earthworm	Edward Annold
18.	Phillipson(ed)	Quantitative Ecology	Well Sc.
19.	Southwood	Ecological	

CYTOGENETICS CYTOLOGICAL AND QUANTITATIVE

1.	Caspari	Genetic organisation(Volumes)	Ac.press
2.	Demerced	Advances in Genetics	-do-
3.	Purdon ed	Genetics effects of relations	-do-
4.	Ravin	The Evolution of genetic	Ac.press
5.	Serra	Modern Genetics (Three Vols)	-do-
6.	Gardner	Principles of Genetics	Willey Eastern
7.	Sutton	An introduction to Human Genetics	Harper Row
8.	Strickberger	Principles of Genetics	Mac Millan

MICROBIAL AND MOLECULAR GENETICS

1.	De Busk	Molecular Genetic	CVI
2.	Demerce ed	Advances in Genetics(Vols)	Ac press
3.	Nishimura	Coding	VPP
4.	Shugar	Genetics Elements Properties and function	Ac press
5.	Taylor	Molecular Genetics	Ac press
6.	Taylor	Selected papers on Molecular Genetics	
7.	Zubay	Papers in Biochemical Genetics	Harper Row
8.	Hayes	The Genetics of Bacteria and their viruses	Blackwel Sc Pub
9.	Wittman and Sehuster	Molecular Genetics	Springer Verlag
10.	Watson	Molecular Biology of the Gene	W. Benjamin
11.	Hartman and	Gene Action	P. Hall
12.	Finchan	Microbial and Molecular Modern Bill	Modern Bill Series
13.	Serra	Modern Genetics (3 Volumes)	A C Press
14.	Brester	Introduction to Molecular	

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