2001-04

JAI PRAKASH UNIVERSITY,CHAPRA

AMENDMENT IN THE REGULATION FOR MASTER EXAMINATION IN ARTS, SCIENCE AND COMMERCE FOR IMPLEMENTATION OF SEMESTER SYSTEM EXAMINATION.

`` Not withstanding anything contrary to the provisions contained in Chapter V of the Regulations for the Master`s Examination in Arts, Science and Commerce the following provisions be made applicable from the Session 2012-2013 in supersesion of the earlier provisions incorporated in the same Chapter of the regulation.

Ist General Admistration of Semester System:-

1. That the courses leading to the award of M.A/M.Sc/M.Com. degrees shall be of two years duration consisting of four semesters having equally distributed of overall 80 credits with 1600 marks of sixteen papers.

2. That the duration of semester and distribution of credits and papers will be as follows :-

   Ist Semester :- July to December : 20 Credits : 4 papers

   IInd Semester :- January to June : 20 Credits : 4 papers

   IIIrd Semester :- July to December : 20 Credits : 4 papers

   IVth Semester :- January to June : 20 Credits : 4 papers

***Course Structure** :-

To be comprised of :

(a) Core Subjects : compulsory for all.
(b) Elective Subject : Specialization (optional) – Each student has to opt for only one elective from the list of the courses offered in each of the 3rd and 4th semester.

3. That the Academic Council of the University will take appropriate policy decisions regarding the functioning of semester system and will give instructions to the Examination department of the university time to time. All matters regarding the conduct of semester system shall be referred to the Academic Council for decision .

4. That any issue arising out of the implementation of the Semester system which are of specific nature relating to any to particular department shall be resolved by the concerned Departmental committee and reported to the Academic Council. A Departmental committee will be constituted led by the head of the department and all faculty members of the concerned department .

5. The Academic Council of the University shall consider suggestions received from heads, faculty, students and the Examination department and whenever the matter

pertains to the overall functioning of the Semester system, shall recommend new rules, modifications in the existing rules or clarifications thereof.

II. Admission in the M.A/M.Sc/M.Com. Semester system :-

1. That no candidate who had not passed the B.A/B.Sc/B.Com. examination with Honours in the three year degree course stream in the subject concerned and allied subjects shall be admitted to the M.A/M.Sc/M.Com. Semester system.

2. That the Academic Council of the University will decide the allied subjects.

3. That the M.A/M.Sc/M.Com. degree will be awarded to students who complete a total of 80 credits in a minimum of two years for completing on an average 20 credits per semester.

4. That a student may offer courses eqivalent to 25% credits during 3rd and 4th semesters from any other allied department than the one where s/he is registered In case a student wishes to take all courses from the parent department s/he can also to so,

5. That each credit will be equivalent to 26 periods each period of 50 minutes,

6. That the Departmental committee consisting of all teachers in the department
   (a) will nominate the Faculty for each course to be taught in the department;

   (b) will evolve the norms for evaluating oral examinations whenever necessary in relation to assignments/mid-tern examination etc;

   (c) will decide eligibility norms for students from other departments offering courses at the department;

   (d) will announce at the commencement of each semester which credits are available to students from other departments;

   (e) will revise the syllabus at least every five years according to the guidelines of the UGC;

7. That the regular students can also audit for extra credits if the departmental committee agrees. Such audited credits will be mentioned *separately in the marks sheet. However, the grades of the extra credits shall NOT be counted for arriving at GPA&CGPA.*

III. Examination Rules :-

1 . That each course will have overall sixteen papers of 100 marks each.Each paper will consist of 70 marks of end term examination and 30 marks of internal evaluation.

2. Paperwise distribution of credits and marks may be seen at Annexure 1 .

3. (a) That in the subject having no practical courses. the candidate shall be examined in for theory papers each of 100 marks including 30 marks for internal evaluation at each semester . The duration of theory Examination shall be of 3 hrs.

(b) In the subjects having practical coures. viz. Physics, Chemistry ,Botany, Zoology, Statistics, Elactronics, Geography, Home science ,Psychology and other subjects having practical courses, the candidate shall be examined in three theory papers each of 100 marks including 30 marks for internal evaluation and one practical paper of 100 marks at each semester. The duration of theory and practical examination shall be of three hours and 6 hours, respectively.

4. There shall be continuous internal evaluation of the student`s learning and performance by the teachers. Internal evaluation will include assignment, class tests, take-home tests, presentation,seminar,library consultation,essay papers,group discussion,fieldwork,dissertation,attendence etc.Internal evaluation may also include mid- semester test and final semester examination.

5. Evaluation pattern adopted for each course/paper of theory intensiv as well as practical intensive programmes will have point distribution as ;continuous internal evaluation 30 marks and end tern examination 70 marks.

6. End semester theory question paper may comprise of long, short and objective type questions covering whole syllabus which will be decided by the concerned department of the subject. The pattern of examination will be made known to students at the beginning of each semester.

7. Generally each cruces will be taught by one teacher who shall keep all the records related to attendance, teaching and evaluation in a systematic manner. In case, the faculty has been assisted in teaching by other teacher the teacher in charge shall be responsible for cordinating teaching and evaluation including award of final grade.The departmental committee of the concerned department shall organize teaching of courses the Board of Examination of the university will form a Board of Examiners for the end semester examination .

8. The Board of Examiners shall consist of two external and one internal examiner, at least two of whom (one internal and one external) must be present to conduct the evaluation and finalize the assesment and submit it to the examinaton department who will declare the results.

1st Semester

Paper I – Biosystematics , Taxonomy , Biostatistics , Bioinformatics

Paper II – Tools & Techniques.

Paper III – Non chordates & Chordates

Paper IV – Practical.

IInd Semester

Paper V – Biochemistry & Histochemistry

Paper VI – Cell & Molecular Biology

Paper VII – Immunology

Paper VIII – Practical

III rd Semester

Paper IX – Animal Physiology & Endocrinology

Paper X – Reproductive Biology (Gamete Biology & development)

Paper XI – Elective (Special) Paper

Paper XII – Practical

IVth Semester

Paper XIII – Genetics, Genetic Engineering & Evolution

Paper XIV – Animal Behavior & Environmental Biology

Paper XV – Elective (Special) Paper

Paper XVI – Practical (Special) Paper

SEMESTER-I **Full Marks - 70**

Paper Ist **Credit -5**

Biosystematics, Taxonomy , Biostatistics & Bioinformatics

Definition and basic concept of biosystematics
Importance and application of biosystematics
Dimensions of speciation
Species concept
Different species categories
Concept of superspecies, subspecies, infra species and other categories
Phylogenetic groups : Monophyly, polyphyly & paraphyly
Cladistics.
Phenetics
Theories of biological classification.
Hierarchy of categories of taxa
Taxonomic characters.
Primitive of advance characters.
Polymorphic characters & missing data
Characters of special consideration.
Characters related to strong selection pressure
Molecular sequence characters
Microcharacters , cryptic and internal characters.
Behavioural characters.
Environmental effects.
Procedures in taxonomy
Taxonomic collection and Preservation
Curetting
Process of identification
Taxonomic keys : different types of taxonomic keys & their merits and demerits
Process of typification and different zoological types.
Evaluation of Biodiversity Indices
Shanon- Weinner index
Dominance index
Similarity & dissimilarity index
Association index.

Quantitative Biology (Biostatistics)

- ✓ Probability distribution and their pattern
- ✓ Sampling theory statistical inference and estimation
- ✓ Hypothesis testing
- ✓ Analysis of variance and experimental design
- ✓ Tests of significance – Students – t test,Chi- square test,F - test
- ✓ Frequency distribution
- ✓ Correlation & Regression
- ✓ Dispersion.

Bioinformatics

Introduction to bioinformatics
Protein structure, folding and function (CADD , Docking, Synchrotron)

Biolocal Data base

- ✓ Primary , secondary & composite data base
- ✓ Nucleotide sequence database
- ✓ Protein sequence database
- ✓ Structural database

Sequence Analyses

- ✓ Type of sequence alignment
- ✓ Methods of sequence alignment
- ✓ Scoring schemes
- ✓ Gap & gaps Penalties.

Genomics & Proteomics

- ✓ Structural functional genomics
- ✓ Comparative genomics
- ✓ Classification of Proteomics
- ✓ Data mining in Proteomics
- ✓ Significance of Proteomics

SEMESTER -I **Full Marks - 70**

Paper IInd **Credit -5**

Tools, Techniques & Instrumentation

Working Principles of

Colorimetric and Spectrophotometric analysis : Fluorescence, UV, IR & Atomic absorption

Radioactive methods : Radiation dosimetry & equipments
: Radioisotopes
: Tracer Technique.
: Scintillation counting.

Flowcytometry and FACS

Molecular Separation Techniques

Chromatography : TLC, GLC
: Ion Exchange & Affinity Chromatography
: SDS- PAGE
: HPLC

Electrophoresis
Various types : paper, agarose , PAGE, Submerged DNA & Pulse chase
Isoelectric focusing
Various media of electrophoresis

Microscopy
Fluorescence microscopy.
Confocal microscopy .
SEM & TEM .

Cell/Tissue culture techniques.
Design & functioning of tissue culture labs
Media preparation & sterilization.
Inoculation & growth monitoring.

Cryotechnique.
Cryopreservation of cell , tissue & organs

Cryotechniques for microscopy .(Freeze fracturing)

Histology & Histochemistry
Fixation , microtomy, Staining – Principles & Process.
Histochemical demonstration of
Carbohydrate : by PAS & Alcian blue methods
Lipids : Sudan black B, Sudan black III & IV methods
Protein : Phenol blue & Ninhydrin test.
Nucleic Acid (Fuelgen & methylgreen)
Acid & Alkaline Phosphatases.
Dehydrogenase (lactate & succinate)

Radioimmunoassay.

ELISA.

SEMESTER -I Full Marks - 70
Paper IIIrd Credit -5

Non-Chordata

Group A

1. Non chordate body rorms
1.1 Non chordate body forms and adaptive significance
1.2 Synopsis of diversity of non chordate phyla
2. Feeding and Digestion
2.1 patterns of feeding and digestion in Lowe metazoans.
2.2 Filter feeding in Crustacea and Mollusca- Functional mechanism
3. Exeretion
3.1 Organs of Excretion in Nonchordate animals
3.2 Excretory structures and function in Helminthes
3.3 Osmoregulation
4. Respiration
4.1 Organs of Respiration; Gills, Lungs and Trachea.
4.2 Respiratiory pigments
4.3 Mechanism of Respiration
5. Reproduction
5.1 Reproductive mechanisms in nonchordates- Asexual, Sexual. Parthenogenesis, hermaphroditism,
6. Growth & Development
6.1 Metamorphosis & Diapause in insects & hormonal control
6.2 Moulting crustacea

Group B.

Chordata

Origin, evolution & features of Agnatha : Ostracoderms, cyclostomes and Placoderms.
Adaptive radiation in bony fishes .
Adaptive radiation in amphibia .
Origin & evolution of reptiles : account of Seymouria & Cotylosauria
Temporal vacuities in reptiles.
General account of Dinosaurs & their extinction.
Brief account of chelonia and crocodilia and their evolutionary account.
Origin of flight in birds.
Aerodynamics of flight in birds
General account of palate , beak & feet in birds
Adaptive radiation in metatherian mammals
Adaptive radiation in eutherian mammals
Origin & evolution of primates.
Origin , evolution and adaptive radiation of teeth in mammals
Jaw suspensorium in Chordates : functional & evolutionary significance
Correlation of structure and function of respiratory organs in chordate

Adaptive radiation in structure of gut as their food types in chordate
Circulation in foetal and neonatal mammals
Origin of olfaction & taste in vertebrates in evolutionary perspective
Functions of balancing in vertebrates in evolutionary perspective
Functional organization of brain
Evolutionary changes in cerebrum & its association with information processing
Evolution of urino-genital system in chordates
Juxtaglomerular apparatus.
Heart and circulation in foetal and neonatal mammal.

SEMESTER-I

Paper-IV Practical

Full Marks – 100

1. Preparation of taxonomic key	5
2. Museum specimens of non chordates & chordates slides , bones .	20
3. Dissection of General anatomy/ Nervous System of Prawn/Unio/Sepia Weberian ossicles, swimbladder of carp Cranial and spinal nerves of Lizard Urinogenital system in mice	15
4. Demonstration of instruments UV- VIS – spectrophotometer Ultracentrifugation , microscopy	10
5. Statistical software and data analysis	10
6. Database and search tool for bioinformatics	5
7. Record and collection	10
8. Viva	25

Semester –II **Full Marks - 70**
Paper – V **Credit - 5**
Biochemistry and Histochemistry

A.- Biochemistry

Protein:-

- Metabolism of amino acid
- Detoxification of amino acid
- Synthesis of urea

Enzyme

- Classification & preferability as drug targets
- Allosteric modulation
- Michaelis – Menten & Hill's equation
- Non – genetic regulation of enzyme action
- Ribozyme

Carbohydrate

- Glycogenolysis, Gluconeogenesis and their regulation
- Interrelationship between different carbohydrate metabolism

Lipid : -

- Terpenes & Alkaloids
- Prostaglandins – Types & synthesis
- Cholesterol – Biosynthesis & metabolism

Bioenergetics

- High energy compounds
- ATP as energy currency
- Generation of ATP
- Redox potential
- Experimental proof for chemiosmotic coupling
- Coupling of ETS to oxidative & photophosophorylation

Xenobiotics

- Types & metabolism
- Degradation

B. Histochemistry

General Principles of Fixative
General Principles of staining
Histochemical demonstration of
Carbohydrates (PAS and Alcian Blue Methods)
Lipids (Sudan Black B, Sudan III & IV Method.)
Protein (Phenol Blue and Ninhydrin method.)
Nucleic Acids (Fuelgen and Methyl-Green test)
Phosphates – Acid and Alkaline.
Dehydrogenases – Lactate and succinate.

Semester –II **Full Marks - 70**
Paper -VI **Credit -5**

Cell & Molecular Biology

Cell Membrane
- Principles of Membrane assembly
- Biosynthesis of cellular membranes
- Molecular structure of specialized cell junctions
- Lateral mobility of lipid & protein molecules in membrane
- Energy transducing membranes

Membrane transport
- Permeability of membrane
- Ion channels, ionophores and ion pumps
- Diffusion kinetics
- Active transport, symports and antiports
- Membrane potential

Structural organization of organelles
- Structure - functional dynamism of GERL Complex
- Mitochondrial DNA , Mitoribosome
- Localization of mitochondrial proteins

Intracellular protein trafficking –
- Basic principles of sorting and processing of protein / post translational modification
- Transport of protein across mitochondrial membranes.
- Transport of protein across Nuclear pore-complex
- Uptake in E.R.

Cytoskeletal material
- Structure and dynamics of microtubules
- Structure and dynamics of microfilaments
- Intermediate filaments

Cell cycle
- Genetic regulation of cell cycle
- Cyclins & CDKs
- Oncogenic transformation
- Molecular basis of neoplasia

Biology of cancer Cell –
- Types of tumors
- Features of cancer cell & etiology
- Biology of aging & cell death
- Stem cell disorders
- Stem cell therapy

Semester – II **Full Marks -70**
Paper – VII **Credit - 5**

Immunology

Phylogeny of immunity, evolution of immune system
Concept of immunity and development of immune system
Nature of antigens and super antigens
- Antigenicity and immunogenicity
- Factors influencing immunogenicity
- Epitopes, Haptens & adjuvant

Antibodies structure & function.
- Molecular structure of antibodies
- Antibodies mediated effector function

Antigen presentation
- APCs
- Dendrite cells
- MHC
- T- cell

Antigen recognition
- T &B cell Receptor
- Antigen receptor diversity
- Clonal selection & expansion

Cell mediated immunity
- Peptide recognition, adhesion & co-stimulation
- Cell (T_H& Tc) mediated immune response
- T_{H1} & T_{H2} response (Specially in allergy)

Humoral Immunity
- Class switching mechanism
- B- Cell maturation - function
- Monoclonal & polyclonal antibodies and its application
- Immunological memory & vaccination

Hypersensitivity
Recognition & entry process of pathogens like viruses & bacteria into animal cell
Immune response to infective agents especially, intracellular parasites
Alteration of host cell behavior by pathogens
- Virus induced transformation of cell
- Cell- cell fusion in both normal & abnormal cells

Organisation & expression of Ig Genes

- Models of Ig Gene Structure
- Multiple organization Ig genes
- Geneation of antibody diversity

Semester – II
PRACTICAL
Paper – VIII

Full Marks – 100

1. Chromosome preparation (Any one) 15

   Polytene chromosome
   Lampbrush chromosome
   Karyotyping

2. Determination of glucose in different patho-physiological condition 15

   Estimation of protein from tissue of animals
   DNA isolation & agarose gel electrophoresis) .
   Thin layer chromatography

3. Spectrophotometric analysis 15

   Determination of Km of enzymes
   Quantification of cell by trypan blue exclusion dye
   Characterization of blood cells
   Blood Grouping
   Antigen – antibody interaction

4. Identification of histological slides of lymphoid tissue 20

5. Records 10

6. Viva Voce 25

SEMESTER-III **Full Marks - 70**
Paper –IX **Credit - 5**
Animal Physiology & Endocrinology

Animal Physiology
Principles of animal physiology.
Homeostasis in different forms
Size & scale of organisms,
Metabolic scaling, relationship between BMR & Body mass
Metabolic rate as a function of animal locomotor system in
Butterfly & louse
Rainbow trout
Cheetah
Thermal regulation
Heat transfer between animal & environment
Poikilothermy & homoeothermy
Thermal adaptation to extreme environmental temp.
Sensory Physiology
Photoreception : Lateral inhibition in vertebrate eye
Photo transduction
Phonoreception
Chemoreception (taste and olfaction)

Excretion
Counter current mechanism in urine formation
Control & regulation of excretion
Renal regulation of acid –base balance.

Digestive physiology
Control and regulation of digestion & absorption
Respiration
Porphyrines & hemoglobin
Control & regulation of breathing
Respiratory adaptation in animals living in O_2 deficient conditions
High altitude & deep sea respiratory physiology
Communication physiology
Pheromones
Bioluminescence
Biochemical & biophysical aspect of muscle contraction
Physiology of Neuronal impulse generation and induction
Synaptic transmission
Neurotransmitter & Neurohormones

Neuronal Disorders :

Stokes , exicotoxicity and NMDA receptors
Epilepsy
Alzheimer's diseases ,
Parkinsonism

Endocrinology

Chemical nature and structure of hormones of Hypothalamus , Pineal ,Pituitary, Thyroid, Parathyroid ,Adrenal, Pancreas, and Gonads.

Gastrointestinal Hormones .

Nature and types of hormone receptors.

Concept of second messengers, G-proteins

Neuroendocrine feedback response to various stimuli

Production of hormones by DNA technology

Hormonal regulation through differential gene expression

Genetic analysis & clinical management of hormonal disorders

Biosynthesis of steroid hormones , peptide hormones and amino acid derived hormones (T4)

Phylogeny of ADH and oxytocin

SEMESTER-III **Full Marks - 70**
Paper - X **Credit -5**
Reproductive Biology

Gr.A . **Gamete Biology**

Puberty and Menopause
Cycles : Estrous cycle,Menstrual cycle
Menstruation
Human Sexual response cycle
In Vitro Fertilization
Embryo sexing
Infertility in male & female -Assesment
(a)Causes
(b)Treatment
Assisted Reproductive Techniques (ART)
- ICSI
- GIFT
- ZIFT

Semen Composition and Assesment of sperm function
Leydig cells
- Morphology
- Functions and its regulation

Contraception
- Natural Contraception (rhythm Methods)
- Barrier Methods
- IUD
- Hormonal Method
- Emergency contraception
- Surgical Methods

Intersex in human
- Male intersex
- Female intersex
- Management of intersex

Gr.B Developmental Biology

Role of hormones in Amphibian metamorphosis
Role of hormones in insect metamorphosis
Structure of corpus luteum and role of hormones in its formation
Mammary gland differentiation
Stem cells
Blood cell formation
Bone marrow and its transplants
Gene therapy
Apoptosis

SEMESTER: 3rd

PAPER: XI

ENTOMOLOGY

A. Taxonomy, Morphology, Flight, Origin and Evolution.

1. **Classification**

1.1. An outline classification of class insect

1.2. Salient features. Outline classification of:-

a.) Apterygotes

b.) Hemiptera

c.) Diptera

d.) Lepidoptera

2. Integument

2.1. Structure, Scelerotisation, Moulting

2.2. Modification and Functions.

3. Flight

3.1. Wings-Structure, Venation, Modification.

3.2. Flight muscles and mechanism of flight.

3.3. Migration.

4. Antennae-Structure, types and functions.

5. Behaviour

5.1. Orientation

6. Origin and Evolution of Insects

7. Sound Production

7.1. Organs involved

7.2. Mechanism

7.3. Significance of Sound production.

8. **Light Production.**

8.1. Light Production Organs.

8.2. Mechanism of Light Production.

8.3. Significance of Light Production.

B. Physiology, Development and Endocrinology

1. Digestion

1.1. Modification of alimentary canal in relation to food.

1.2. Physiology of digestion.

1.3. Microorganisms and their role in digestion of food.

2. Excretion

2.1. Excretion and organs of excretion.

2.2. Nitrogenous excretion.

2.3. Salt and water regulation.

3. Respiration

3.1. Terrestial.

3.2. Aquatic

3.3. Endoparasitic

4. Circulation

4.1. Haemolymph: Constituents and their functions.

Semester III
Paper – XI
Elective (Special Paper) **Full Marks - 70**
Cell Biology **Credit - 5**

Cell structure and function

Plasmamembrane

Evolution of membrane organization from prokaryote to eukaryote.
Specialized cell membranes , membrane of muscle cells, neurons and energy transduction membrane
Adhesion and other cell surface molecules like integrins , some important GPCRs and signalling (clinical correlation)
Dynamics and mobility of the membrane proteins and lipid molecules

Membrane biophysics

Basis of resting membrane potential Nernst potential, Donnan equilibrium, Na- k^+ Pump (Special referece to Chara,Nitella cell)
Potentials across plant and animal cell membrane
Measuring membrane potentials
Voltage clamp and patch clamp technique to asses the electrical properties of membrane like conductance, resistance

Transport process across membrane

GLUT-1 transport and its kinetics
Fick's law of Diffusion
Energy involvement in membrane transport
Transport with the help of ionophores
Role of different types of inhibitors in membrane transport
Transport across nuclear pore complex
Active transport : P-class, F- Class and V-class ion pumps
ATPase pumps
Uniport ,symport and antiport

Receptors

Membrane receptors : Enzyme linked & ion channel receptors, miscellaneous receptors (toll like receptors)

Chemical Characteristis

Nuclear envelope

Nuclear sap

Nucleolus Structure and organization

yolk nucleus, vitellogenesis

Cellular Movement .

- Amoeboid movement
- Cyclosis & cytoplasmic streaming
- Ciliary and flagellar movement
- Neuronal transport

Semester - III

ELECTIVE PAPER XI : FISH AND FISHERIES

Full Marks - 70

Credit - 5

I. Taxonomy, Anatomy, Embryology and Reproduction

- Classification of fishes
- Origin and Evolution of :
    - Bony fish
    - Cartilaginous fish
- Structure, Distribution and affinities of
    - Crossopterygii
    - Polypterini
    - Holocephali
- Integument
- Alimentary canal and its modification in relation to feeding habits
- Air bladder
- Weberian ossicles
- Pressure and buoyancy in fishes
- Reproduction in teleosts
- Development

II. Behaviours, Physiology and Endocrinology

- Electric organ
- Migration
- Sound Production
- Hill stream fishes
- Larvicidal fishes
- Respiration
- Excretion
- Osmoregulation
- Structure and function of following endocrine glands :
    - Pituitary
    - Thyroid
    - Adrenal
    - Stannius Corpuscles

Semester – III
Paper –XII (Practical) **Full Marks - 100**
Time – 6 Hours

Identification of embryological slides – blastula, gastrula- stages of mammals , different stages of chick embryos (somites, brain, eye , heart) 10

Or

Preparation of different stages of chick embryo.

Determination of activity of amylase from cockroach and mammals 10
Or

Determination of RBC count, WBC count

Or

Determination of pH, urea and uric acid content of urine & blood.

Dissection and Identification of Endocrine glands in rat 10

Identification of histological slides of endocrine glands 10

Microtomy , fixation & staining of endocrine tissue 10

Estimation of acetylcholinesterase 10

Identification of different stages of estrous cycle in rat 5

Records 10

Viva 25

SEMESTER- IV **Full Marks - 70**
Paper XIII **Credit - 5**
Genetics, Genetic Engineering & Evolution

Organization of chromosome

Karyotype, banding pattern & nomenclature
Organization of chromatin
Nucleosome
Molecular anatomy of eukaryotic chromosome
Structural organization & function of telomere, centromere and kinetochore
Polytene & lampbrush chromosome
Euchromatin, heterochromatin, constitutive & facultative heterchromatin
Sex determination and dosage compensation in *C.elegans* , *Drosophila* & Human
Chromosome mapping

Genetic imprinting

Imprinting of genes
Epigenetic regulation by DNA methylation

Somatic Cell hybridization

Cell fusion technology
Heterokaryon ,selecting hybrids from cell culture and chromosome segregation
Hybridoma technology
Radiation, hybrids ,Hybrid panel & gene mapping

Microbial Genetics

Bacterial conjugation, transformation, transduction (sex transduction)
Bacteriophage,Types , structure & morphology of T_4

Genome analysis

C- value paradox
Various models of genomes : viral , prokaryotic & eukaryotic genome

Human genetics

Human genome project
Cytogenetic & molecular approach - Human chromosome analysis

Population Genetics & evolution

Neutral theory of evolution & neutralist Selectionist Controversy

Hardy –Weinberg law of genetic equilibrium, analysis of gene frequency in natural population

Different types of selection.

Stabilizer selection, Disruptive selection, Balancing selection, frequency dependent selection , K-selection, r- selection etc.

Adaptation.

Mutation

Mutation Theory

Chromosomal Mutation

Gene (or point) mutation

Genetic drift

Gene migration

Meiotic drive

Genetics of speciation; allopathic, sympatric & parapatric speciation

Isolation ,patterns and mechanism

Geographic isolation

Reproductive isolation

Micro, Macro & Mega evolution

Semester- IV
Paper –XIV
Full Marks – 70
Credit- 5

ANIMAL BEHAVIOUR AND ENVIRONMENTAL BIOLOGY

Animal Behaviour

1. Innate and learned behavior
2. Neural control of behavior Hormonal control of behavior
3. Ecological aspect of behavior
   a. Aggression
   b. Homing
   c. Territoriality
   d. Dispersal
4. Social behavior
   Social organization in insects, termites and primates
5. Evolution of sex and Reproductive Strategies
   a. Mating behavior in Mammals.
   b. Courtship
   c. Parental Care in fishes
6. Biological rhythms
   a. Circadian and circunnual rhythms
7. Migration of fish and birds
8. Learning and memory
   a. Conditioning
   b. Habituation
   c. Insight Learning
   d. Association Learning
   e. Reasoning
   f. Cognitive Skills
9. Taxis & Kinesis

Environmental Biology

System Structure & Function

Ecological Processes in herbivore dominated ecosystem
Ecological Processes in wetland ecosystem
Measuring ecosystem Productivity , limits of primary production
Community organization
Nature of Communities
Analysis of community structure : gradient analysis.
Random nich model of species association
Species diversity in ecological gradient
Experimental and field test of diversity – stability hypothesis
Energy flow
Concept of energy
Laws of thermodynamics
Linderman's concept of trophic dynamics
Energy flow models.
Pollution ecology
Pollutant , their sources and classification
Effects of pollutants on organisms
Type of pollution : Air , water, soil , Noise, Radiation and thermal pollutions
Biomagnifications
Biodegradation and Bioremediation its environmental limitation
Bioindicators : definition : as index of pollution and their significance
Waste Management
Agricultural, Biomedical & domestic waste management
Effects and management for purification and recirculation
Stress Physiology
Basic concept of environmental stress
Stress resistance, stress avoidance & stress tolerance
Concept of steady-state homeostasis

Population Biology

Population growth & control
Population growth curves , carrying capacity
Control of population size and its evaluation, ; key factor analysis and the ideas on population control population regulation – extrinsic & intrinsic mechanism Life Table.
Met population
Basic concept, structure and dynamics Levin's model of met population
Capitation
Prey – Predator dynamics
Competition theory, modeling competitive exclusion and coexistence
Conservation Biology
Conservation of natural resources.
Resource type and degradation
Human impact on terrestrial and aquatic resources
Conservation of grassland forest : an overview
Intimations an CITES, IUCN , CBD
Conservation of wild life
Approaches and limitation
Concept of protected areas : National packs , sanctuaries, Biosphere reserves, cores and buffers , Nodes & corridors.

PAPER – XV

Full Marks – 70
Credit - 5

ENTOMOLOGY ELECTIVE (SPECIAL PAPER)

A. Agricultural, Entomology, Pest management.

1. Insect Control

1.1. Chemical Control

1.1.1. Chemic al nature preparations toxicity and mode of action of :

a.) Chlorinated hydrocarbons.

b.) Organophosphorus compounds.

c.) Carbamates.

d.) Insecticides of botanical origin.

1.2. Biological control

1.2. Parasites

1.2.1. Parasites

1.2.2. Parasitoids

1.2.3. Predators

1.3. Hormonal Control

2. Fumigants

2.1. Principles of fumigation and production in handling fumigants, chemical nature, toxicity and mode of action.

3. Attractants, Repellants and Antifeedants.

4. Insecticide Appliances.

B. Agricultural, Veterinary, Medical and Industrial Entomology.

1. Agricultural Entomology.

1.1. Major pests of the following crops and their life history and control-

a.) Paddy b.) Wheat c.) Maize d.) Sugarcane e.) Stored grains.

2. Veterinary entomology-paste of farm animal

3. Medical entomology

3.1. Paste of public health importance

3.2. insects born diseases: vector and their life cycle, pathogen & controlled

3.2.1. – Malaria,

2.2. – Filaria, Kalazar

3.3 .Bitotechnological application in vector control

4. Industrial entomology

4.1. Sericulture,

4.2 .Apiculture

4.3 .Lac culture

5. Insect as bioreactor

Semester IV
Paper XV **Full Marks- 70**
Elective (Special Paper) **Credit - 5**
Cell Biology

Signal Transduction
- G – protein mediated signaling
- Cytokine receptors – STAT mediated Signalling
- Tyrosine kinase (families) receptors Signalling
- with special reference to drug delivery (ERBB I and 2 , HER / new
- Second messenger pathways – iNOS
- Ras – Raf, MAPK – ERK, MEK pathways

Cell cycle :

Molecular basis of cell cycle regulation, Cyclin & CDKs & their regulation

Cellular differentiation and potency
- Cell senescence & death
- Cellular aging
- Necrosis
- Apoptosis
- Gene regulation of apoptosis

Biology of cancer cell
- Cytology and physiology of cancer cell
- Causes & processes of oncogenic transformation
- Viral gene hypothesis of carcinogenesis
- Chemical carcinogenesis, nutrition & cancer
- Radiation & cancer
- Multistep Process of neoplasia

Cell / tissue culture
- Media preparation for animal cells
- Monolayer culture
- Suspension culture
- Factors influencing cell growth in vitro
- In vitro transformation of cell

Stem cell
- Concept of stem cell
- Embryonic stem cell
- Hemopoietic stem cell
- Blood cell formation
- Bone marrow transplants

Semester - IV

ELECTIVE PAPER XV : FISH AND FISHERIES

Full Marks - 70

Credit - 5

I. Principles of fresh water fish culture maintenance.

- Pond Management
- Types of ponds
- Role of Physico – chemical factors
- Role of Biotic factors
- Composite fish farming
- Aquatic weeds and their control
- Induced Breeding
- Identification of eggs , spawn, fry and fingerling of culturable fishes
- Collection and Transport of fish seed
- Exotic fish
- Fish pathology , prophylaxis and therapy
    - Protozoan – Ichthyopthiriasis (white spot disease)
    - Helminth - Gyrodactylus
    - Crustacean – Ergasilus
    - Fungal - Saprolegniasis
    - Bacterial – Furunculosis
    - Viral – Pappilomatosis (cauliflower disease)
    - Nutritional – Avitaminoses , Intoxication

II. Fisheries and Fishing environment : -

- Pollutants and their effect on fish culture
- Methods of fishing craft and gear
- Fish preservation
- Fish byproducts
- Fecundity, growth and age determination
- Status of Aquaculture in India
- Cold water fisheries
- Sewage fed fisheries
- Marine & estuarine fisheries
- Prawn fisheries
- Shell Fisheries

PRACTICAL SPECIAL PAPER

PAPER : XVI

ENTOMOLOGY

Time: 6 hours.

Full Marks = 100

1st Sitting

1. Dissection, digestive, nervous and reproductive system of Grass. 15

Hopper/ Chrysocoris/ Gryllotalpa/ Honey-bee.

2. Preparation of permanent slides- two out of the following : 10

a.) Whole specimens (Small Insect)

b.) Mouth Parts

c.) Wings

d.) Legs

e.) Antennae

f.) External Genitalia

g.) Poison apparatus

h.) Spiracles

i.) Scales

j.) Different tissues

3. Physiology/ Toxicology 10

a.) To determine the oxygen requirement of an aquatic insect.

b.) To determine Lc 50 of a common pesticide against a stored grain pest.

c.) Study of blood cells.

2nd sitting

4. Taxonomy- identification with reasons upto family of two insects (5*2=10)

5. Identification and comments upon spots 1-10: (10*2=20)

Whole mount	01.
Morphological slide	02.
Histological slide	02.
Embryological slide	01.
Beneficial insects	01.
Damaged material by a pest	01.
Larva/ Pupa	01.
Pest	01.

6. Field works & Records. 10

7. Viva-Voce. 25

Semester – IV
Paper – XVI **Full Marks - 100**
Special – Practical **Time – 6 Hours**

Cell Biology

1st Sitting

1. Vital staining of secretory granules , G.B. & mitochondria 05

2. Staining & mounting of epithelial cells , fibroblasts , muscle cell & nerve cells 05

3. Identification & comments upon spots 1 to 10 20

4. To demonstrate G.B. / Mitochondria an a microtome section 05

2nd Sitting

5. Histochemical demonstration of protein / lipid / carbohydrates/ enzymes / nucleic acids. 10

6. Experiments on cell physiology (one of the following) 10
   a. To determine permeability , / osmolarity on RBC membrane
   b. Preparation of ghost cell membrane
   c. Effect of pH on cytoplasmic streaming in *Chara / Nitella* cell
   d. Cell fractionation & ultracentrifugation

7. Tissue culture – Techniques, equipments, media preparation for different cell culture Monolayer and suspension cell culture 10

8. Records 10

9. Viva Voce 25

SEMESTER IV
PAPER XVI
SPECIAL PAPER FISH AND FISHERIES – PRACTICAL
1st SITTING

Full Marks - 100

Time – 6Hours

1. Dissection

Major :

Cranial Nerve , Internal ear , Afferent and efferent blood vessels of bony fish 12

Minor :

Weberian apparatus, Accessory respiratory organs 08

2. Mounting 05

Scales, Fry, Fingerlings

3. Identification and comments on spots 1-10 20
Bones – 4
Histological slides - 4
Museum Specimens -2

2nd SITTING

1. Identification of two Local fresh water fish with morphometric measurements 5x2= 10

2. Any one of the following : 10
   - To determine oxygen uptake of the fish
   - Physico – chemical analysis of water: Dissolved oxygen, Dissolved CO_2 and pH
   - Identification of Plankton

3. Class Records 10

4. Viva 25

RECOMMENDED BOOKS

PAPER – 1

1. Barrington. E.J.W., Invertebrate Structure and function, Nelson, London
2. Barnes, R.D. Invertebrate Zoology, Saunders, Philadelphia
3. Russel-Hunter W.D. A Biology of Higher Invertebrates, Macmillan, London.
4. Hymen, L.H. The Invertebrates Volumes I-VI, McGrew Hill Co., N.Y.
5. Sedgwick, A. A Student Text Book of Zoology, Vol I, II and III , Central Book Depot, Allahabad
6. Parker, T.J., Haswell, W.A. Text Book of Zoology, Vol I & II, Macmillan, London.
7. Alexander, R.M. The Chordata, Cambridge University Press, London.
8. Barrigton, E.J.W. The Biology of Hemichordata and Protechordata, Oliver and Boyd., Edinbourgh.
9. Kingsley, J.S. Outlines of Comparative Anatomy of Vertebrates, Central Book Depot, Allahabad.
10. Kent, C.G., Comparative Anatomy of Vertebrates.
11. Malcom Jollie, Chordate Morphology, East West Press , New Delhi
12. Montelli, A.R., The Chordates, Cambridge University Press, London.
13. Smith, H.S., Evolution of Chordata Structure, Hold Rinechart and Winstoin Inc., New York.
14. Tansley, K., Vision in Vertebrate, Chapman & Hall Ltd., London.
15. Torrey, T.W., Morphogenesis of Vertebrates, John Wiley and Sons Inc., New York and London.
16. Romer, A.S., Vertebrate Body, 3rd Ed. W.B. Saunders Co., Philadelphia.
17. Young, J.Z., Life of Vertebrates, Oxford University Press, London.
18. Young, J.Z., Life of Mammals, Oxford University Press, London.
19. *Collbert, E.H., Evolution of the Vertebrates, John Wiley and Sons Inc., New York.*
20. Romer, A.S., Vertebrate Palcontology, University of Chicago Press, Chicago.
21. Montagna, W., Comparative Anatomy, John Wiley and Sons Inc.,
22. *Waterman, A.J., Chordate Structure and Function, Macmillan Co., London.*
23. Kingsley Noble, G., The Biology of the Amphibia, Dover Publications, New York.

PAPER – II

1. Kato, M., The Biology of Biodiversity, Springer.
2. Avise, J.C., Molecular Markers, Natural History and Evolution Chapman & Hall, New York.
3. Simpson, G.G., Principle of Animal Taxonomy, Oxford IBH Pub Co
4. Mayer, E., Elements of taxonomy
5. Snedecor, G.W. and Cochran, W.G., Statiscal Methods, East west Press, New Delhi.
6. Green, R.H., Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & sons New York.
7. Brown, Jr. & Hllainder, Statistics : A Biomedical Introduction. John Wiley & Sons, New York.
8. Daniel, Biostatistics : A Foundation for Analysis in the Health Sciences, John Wiley & Sons, New York.
9. Mahajan, Methods in Biostatistics, Jaypee Bross.
10. Milton & Tsokos : Statistical Methods in Biological and Health Sciences, McGrew Hill.
11. Sokal & Rohif Introduction to Biostatistics, Freman, Toppan.
12. Steel & Torrie, Principles & Procedures of Statistics, McGrew Hill

PAPER – III

1. Masters, R.W John, Animal Cell Culture – A Practical Approach, IRL Press.
2. Robert Braun, Introduction to Instrumental Analysis, McGrew Hill
3. Wilson, K.& Goulding, K.H., A Biologists Guide to Principles and Techniques of Practical Biologists Guide to Principles and Techniques of Practical Biochemistry, ELBS Edn.
4. Verley, H., Clinical Biochemistry.
5. Pearse, Histochemistry.
6. Lilley, Histochemistry.
7. Bancroft, Histochemistry.

PAPER – IV

1. Austen, C.R. & Short, R.V., Reproduction in Animals.
2. Schatten and Schatten, Molecular Biology of Fertilization.
3. Longo, F.T., Fertilization, Champamn & Hall
4. Edwards, R.G., Human Reproduction.
5. Gaieton, Human Physiology.
6. Gilbert, S.F., Development Biology, Sinauer Associates Inc., Massachusetts.
7. Ethan Bier, 'The Cold Sprin' Cold Spring Harbor Laboratory Press, New York.
8. Gilbert, S.F., Development Biology.
9. Balinsky, B.I., Introduction to embryology.
10. Torrey, T.W., Morphogenesis of Vertebrates.
11. Patton, Foundation of Chock Embryology.

PAPER – V

1. Barrington, E.J.W., General and Comparative Endocrinology , Oxford Clarendon Press.
2. Bentley, P.J., Comparative Vertebrate Endocrinology, Cambridge University Press.
3. Williams, R.H., Text Book of Endocrinology, W.B. Saunders.
4. Martin, C.R., Endocrine Physiology, Oxford university Press.
5. Gorbman, A., Comparative Endocrinology, John Wiley & sons
6. Turner and Bagnara, Endocrinology
7. Prosser, C.L. & Brown, Comparative Animal Physiology, W.B. Saunders & Company
8. Eckert, R., Animal Physiology : Mechanisms and Adaptation, W.H. Freeman & Company.
9. Hoar, W.S., General and Comparative Animal Physiology.
10. Schiemdt-Nielsen, Animal Physiology : Adaptation and Environment Cambridge.
11. Proser, C.L., Environment and Metabolic Physiology, Wiley Liss, New York.

PAPER – VI

1. Dernell, J. Lodish II and Baltimore, D., Molecular Cell Biology, Scientific American Book, Ine. USA
2. Alberts, B. Bray, D. Lewis, J., Raff, M. Robert, K & Watson, J.D., Molecular Biology of the Cell, Garland Publishing Inc, New York.
3. Watson, J.D. Hopkins, N.H. Robert, J.W., Steilz, J.A. & Weiner, A.M Molecular Biology of the Gene, The Benjamin/ Cummings Publishing Co., Inc., California
4. Meyers, R.A., Molecular Biology and Biotechnology, VCH Publishing, New York.

5. Sambrook, J., Frisch, E.F. and Maniatis, T., Molecular Cloning, Cold Spring Harbor Laboratory Press, New York.
6. Dabre, P.D., Introduction to Practical Molecular Biology, John Wiley & Sons, N.Y.
7. DeRobertis and DeRóbertis, Cell and Molecular Biology, Lee & Febiger, Philadelphia.
8. Giese, Cell Physiology, W.B.Saunders

PAPER – IX

1. Voet, D.& Voet, J.G., Biochemistry, John Wiley & Sons Ltd., N.Y.
2. Conn et al ., Outline of Biochemistry, John Wiley & Sons Ltd., N.Y.
3. Lehninger et al, Principle of Biochemistry, Worth Publisher Inc.
4. Mathews & Van Holde, Biochemistry, Benjamin/ Benjamin/ Cumming Publish.
5. Stryer, Biochemistry, Freeman & Co.
6. Zubay, Biochemistry, W.C.B.
7. Mazur, A and Harrow, B., Biochemistry, Sunders
8. Kuby, Immunology, W.H. Freeman, USA
9. Paul W., Fundamentals of Immunology
10. Roitt, I.M., Essential Immunology, ELBS Edition
11. Barrett, Immunology

PAPER – X

1. Alocock, J., Animal behavior, An Evoluntionary Approach, Sinauer Assoc., USA
2. Bradhury, J.W. and S.L. Behrencamo, Principles of Animal Communication, Sinauer Assoc., USA
3. Clutton-Brock, T.H., The Evolution of Parental Care, Princeton University Press Princeton, NJ, USA
4. Eibl-Eibesfewldt, I. Ethology, The Biology of Behavior, Holt, Renehart & Winston, N.y.
5. Gould, J.L., The Mechanisms and Evolution of Behaviour
6. Hauser, M., The Evolution of Communication, MIT Press, Cambridge Mass, USA.
7. Hinde, R.A., Animal Behaviour, A synthesis , Ethology and Comparative Psychology, McGrew Hill, N.Y.
8. Krebs, J.R. and N.B. Davies, Behavioural Ecology, Blackwell, oxford UK.
9. Wilson, E.O., Sociobriology, The New Synthesis, Harvard University Press, Cambridge, Mass, USA.
10. Dobzhansky, Th., Genetics and Origin of Species, Columbia University Press.
11. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine EVOLUTION, Surjeet Publication, Delhi.
12. Futuyama, D.J., Evolutionary Biology, Sinauer Associtiation, Inc., Massachusetts.
13. Hartl, D.L., A Primer of Population Genetics, Associates, Inc. Publishers, Dunderland
14. Jha, A.P., Genes and Evolution, John Publication, New Delhi
15. King, M., Species Evolution – The Tole of Chromosomal Change, The Cambridge Univeristy Press, Cambridge.
16. Merrel, D.J., Evolutionary Genetics, holt, Rinchart and Winston Inc.
17. Smith, J.M., Evolutionary Genetics, Oxford University Press. N.Y.
18. Strikberger, M.W., Evolution, Jones and Barret Publishers, Boston, London

PAPER – XI

1. Atherly, A.G., J.R., Girton and J.F. McDonald, The Science of Genetics, Saunders College Publishing, Harcort Brace College, Publishers, N.Y.

2. Brooket, r.j., Genetics : Analysis and Priciples Benjamin/ Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson Genetics – The Continuity of Life Brooks/ Cole Publishing Co ITP, NY, Toronto
4. Gardner, E.J., M.J. Simmons and D.P. Snustad, Principles of genetics, John Wiley and Sons, Inc. NY .
5. Griffiths, A.J..F., J.H. Miller, D.T. Suzuki , R.C. Lewontin and W.M. Gelbart, An Introduction to Genetic Analysis, W.H. Freeman and Co, NY
6. Lewin, B., Genes VI, University Press, Oxford, NY, Tokyo
7. Snustad, D.P. and M.J. Simmouns, Principles of Genetics, John Wiley and Sons, Inc. NY
8. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Syritz and A.M. Weiner, Mp, eci,ar, Biology of genes, The Benzamin/Cummings Publishing Co., InC., Tokyo

PAPER – XII

1. Begon, M., J.L. Harper and C.R. Townsend, Ecology, Individuals, Populations and Communities, Blackwell Science, Oxford, UK
2. Cherret, J.M., Ecological Concepts, Blackwell Sci., Oxford, UK
3. Elaseth, B.D. and K.M. Baumgartner, Population Biology Van Nostrand Co. NY.
4. Jorgensen, S.E., Fundamentals of Ecological Modeling, Elsevier, NY.
5. Krebs, C.J., Ecology, Harper & Row, NY.
6. Krebs, C.J., Ecological Metholigy, Harper & Row. NY
7. Ljudwing, J.A . and J.F. Reynolds, 1988 Statistical Ecology, John Wiley & Sons, NY.
8. Pianka, R.E., Evolutionary Ecology, Harper & Row.NY
9. Ricklefs, R.E. and G. Miller, Ecology, W.H. Freeman & Co.Ny
10. Roughgarden, J., Ecological Methods
11. Southwood, T.R.E.
12. Swartzman, G.L. and S.P. Kaluzny, Ecological Simulation Primer MacMillan, NY
13. Rooff, D.A., The Evolution of Life Histories Theory and Analysis Chapman & Hall, Londonm, UK

PAPER – XIII & XIV

1. Brown, The Physiology of Fishes, Vol. I and II , Academic Press
2. Brown, & Gratzek, Fish Farming Handbook, Van Nostrand Reinhold Co.
3. Chakroff, Freshwater Fish Pond Culture and Management Scientific Publishers
4. Datta- Munshi & Hughes, Air – Breathing Fishes of India, Oxford and IBH Publ. Co. New Delhi
5. Duijin, Diseases of Fishes, London LLiffe Books Ltd.
6. Hoar & Randall, Fish Physiology, Series Vol. I-II , Academic Press
7. Hoar & Pillay, Handbook of Fish Culture in the Indo-Pacific region. FAO. Publ.
8. Huer, Textbook to Culture, Breeding and Cultivation of Fish, Fishing News Book Ltd.
9. Hughes, Comparative Physiology of Vertebrate Respiration. Heinemann Educational Books Ltd.
10. Jhingran, Fish and Fisheries of India, Hindustan Publ. Copn.
11. Laglar, Studies in Fresh- Water Fishery Biology, J.W. Edwards
12. Laglar, Bardaew and Miller, Lothyology
13. Maty, Fish Endocrinology, Croom helm
14. Norman & Grenwood, A History of Fishes
15. Nikolasky, The Ecology of Fishes

PAPER – XIII & XIV

ENTOMOLOGY SPECIAL

1. Ananthakrishna, Dimesions of Insect- Plant Interactions, Oxford NIBH
2. Atwal, Agricultural Pests of India and South- East Asia Kalyani Publ. New Delhi
3. Chapman, The Insects , Structure and Function, ELBS
4. Imms, A General text book of entomology, Vol. I-II, Asia Publ. House
5. Metcalf & Fint, Destructive and useful insects and their control, MacGraw Hill
6. Pruthi, A Text Book of Agricultural Entomology, ICAR, New Delhi
7. Rockstein, Biochemistry of Insects, Academic Press
8. Srivastava, A Text Book of Applied Entomology, Vol. I-II ,Kalyani Publ. New Delhi
9. Wigglesworth, Principles of Insect Physiology, ELBS
10. Ayyar, Handbook of Economic Entomology for South India, Controller of Stationary & Printing, Govt. of Madras
11. Roy, Entomology : Medical Veterinary, Exceisor Press and Brown, AWA Calcutta

PAPER – XIII & XIV

CYTOLOGY SPECIAL

1. Darnell. J, Lodish II & Baltimore, D., Molecular Cell Biology, Scinetific American Book, Inc. USA
2. Alberts, B, Bray D. Lewis J, Raff M, Robert K, and Watson. J.D. Molecular Biology of the Gene. Garland Publishing Inc. New York
3. Watson J.D., Hopkins. N.H., Robert J.W., Steitz. J.A. and Weinner A.M. Molecular Biology of the Gene, The Benjamin/ Cummings Publishing Co., Inc., California
4. Meyers R.A ., Molecular Biology and Biotechnology, VCH Publ. N.Y.
5. Sambrook J. Fritsch E.F., and Maniatis T., Molecular Cloning Cold Spring Harbor Laboratory Press, N.Y.
6. Dabre, P.D., Introduction to Practical Molecular Biology, John Wiley & Sons Ltd. N.Y.
7. DeRobertis and DeRoberties, Cell and Molecular Biology, Lee & Febiger, Philadelphia Giesse, Cell Physiology, W.B. Saunders.

The meeting of Board of syllabus of University Department of Zoology J.P.UNIVERSITY CHAPRA, was held in the office chamber of Head University Department of Zoology on 27/4/2012 at 11 A.M. to discuss the syllabus of M.sc. Zoology for semester system to be introduced from session 2012-2013.

The following member of the Dept. attended the meeting

1. Dr. Shyam Narayan Singh:- H.O.D. Chairperson.
2. Dr. Ashok Singh :- Faculty member
3. Dr. R.K. Singh :- do
4. Dr. R. Prasad :- do
5. Dr. D.K. Singh :- do
6. Dr.Raj Kumar :- H.O.D .Zoology (Rajendra College Chapra)

Following the External Experts who kindly made it to attend the meeting

7. Prof. V.N. Singh :- Univ. Dept of Zoology,T.M.Bhagalpur Univ Bhagalpur External experts.
8. Prof.S.N. P.Singh :- Univ Dept . Zoology BRA Bihar Univ. Muzzafarpur External Expert.

RESOLUTION :-

The Syllabus was discussed and resolved to approve for implementation in Semester System in J.P.UNIV. CHAPRA from Session 2012-2013.

S.N.SINGH.