

VIVEKANANDA COLLEGE

College with Potential for Excellence

(Residential & Autonomous – A Gurukula Institute of Life-Training)

(Affiliated to Madurai Kamaraj University)

(Re-accredited with 'A' Grade [CGPA 3.59 out of 4.00] by NAAC)

TIRUVEDAKAM WEST, MADURAI DISTRICT – 625 234



POST GRADUATE AND RESEARCH DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY

SYLLABUS

Choice Based Credit System

(For those who joined in June 2015 and after)

(2017-2019 Batch)

SCHEME OF EXAMINATION
(For those who joined in June 2015 and after)

FIRST SEMESTER

Part	Study Component	Subject Code	Title Of The Paper	Hours	Credit	Sessional Marks	Summative Marks	Total
III	Core	31CT11	Biochemistry	6	4	25	75	100
	Core	31CT12	Cell and Molecular Biology	6	4	25	75	100
	Core	31CT13	Microbiology	6	4	25	75	100
	Core	31CP14	Practical – I	6	3	40	60	100
	Elective	31EP11	Bioinformatics	6	5	25	75	100
			TOTAL	30	20			

SECOND SEMESTER

Part	Study Component	Subject Code	Title Of The Paper	Hours	Credit	Sessional Marks	Summative Marks	Total
III	Core	31CT21	Immunology	6	4	25	75	100
	Core	31CT22	Bio-statistics	6	4	25	75	100
	Core	31CT23	Developmental Biology	6	4	25	75	100
	Core	31CP24	Practical – II	6	3	40	60	100
	Elective	31EP21	Evolution	6	5	25	75	100
			TOTAL	30	20			

THIRD SEMESTER

Part	Study Component	Subject Code	Title Of The Paper	Hours	Credit	Sessional Marks	Summative Marks	Total
III	Core	31CT31	Genetics	6	4	25	75	100
	Core	31CT32	Physiology	6	4	25	75	100
	Core	31CT33	Principles of Biotechnology	6	4	25	75	100
	Core	31CP34	Practical – III	6	3	40	60	100
	NME	31NE31	Applied biology	6	5	25	75	100
			TOTAL	30	20			

FOURTH SEMESTER

Part	Study Component	Subject Code	Title Of The Paper	Hours	Credit	Sessional Marks	Summative Marks	Total
III	Core	31CT41	Applied Biotechnology	6	5	25	75	100
	Core	31CT42	Environmental Biology	6	5	25	75	100
	Elective	31EP41	Bio-farming technology	6	5	25	75	100
	Core	31CP44	Practical – IV	6	3	40	60	100
	Core	31PV45	Project & Viva Voce	6	12	20	80	100
			TOTAL	30	30			
			TOTAL NUMBER OF HOURS	120				
			TOTAL NUMBER OF CREDIT		90			

M.Sc. Zoology
CBCS – Distribution of credits
(For those who join in June 2015 and after)

Study Component	SEMESTER				Total
	I	II	III	IV	Credit
Core Subject	15	15	15	25	70
Elective Subject	5	5	5	5	20
TOTAL	20	20	20	30	90

M.Sc. Zoology CBCS Syllabus - SEMESTER – I
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title: BIOCHEMISTRY		
Subject Code: 31CT11	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6 hrs/week- 72 hrs

Objectives:

To enable the students

- *Structure of biomolecules*
- *Chemistry and metabolic importance of minerals and vitamins*
- *Metabolism and metabolic disorders of the macromolecules*
- *Metabolic role of hormones*

Unit I: Bio-molecular chemistry 15 hrs

- a) Carbohydrates, Proteins, Lipids – Classes, structure, properties
- b) Enzymes – classes, mechanism of action, kinetics, Isoenzymes.
- c) Vitamins, Minerals and Pigments – chemistry and metabolic importance.
- d) Hormones – Classes, mechanism of action, Messenger system, metabolic role.

Unit II: Carbohydrate metabolism 15 hrs

- a) Glycolysis, TCA cycle, Glycogenolysis, Glycogenesis, Gluconeogenesis and Intermediary metabolism.
- b) HMP shunt and metabolic integration.
- c) Metabolism of uronic acid and polysaccharides

Unit III: Protein metabolism 15 hrs

- a) Transamination, Transdeamination, Deamination Transmethylation, Transcarboxylation and Ornithine cycle
- b) Metabolism of Glutamate Family of amino acids
- c) Metabolism of Aspartate Family of amino acids
- d) Metabolism of Pyruvate Family of amino acids

Unit IV: Lipid metabolism 15 hrs

- a) Fatty acids – Biosynthesis and oxidation
- b) Metabolism of Phospholipids and ketone bodies
- c) Metabolism of cholesterol and steroid hormones
- d) Metabolism of Arachidonates (Prostaglandins)

Unit V: Nucleic Acid metabolism

12 hrs

- a) Biosynthesis and catabolism of purines
- b) Biosynthesis and catabolism of pyrimidines
- c) Biosynthesis and catabolism of nucleotide co-enzymes
- d) Various classes of DNA and RNA – structures and significances

Text Books:

- Ambika Shanmugam 2003. Fundamentals of Biochemistry, MMC, Chennai
- Satyanarayana and Chakrapani, 2006. Biochemistry, Books and Allied (P) Ltd., Kolkata.

Reference Books:

- A. L Lehninger, 1990. Principles of Biochemistry. CBS publishers & distributors pvt Ltd. International edition, New York.
- Geoffrey Zubay 1989. Biochemistry 2nd edition. Maxwell-Macmillan
- Harold and Harper et al 1977. Review of Physiological Chemistry. The kottari's book
- Voet .D and Voet G Judith 1990. Biochemistry. John Wiley and sons New York
- M.N.Chatterjee and Rana Shinde 2005. A Text book of Medical Biochemistry, JP bro, Delhi
- Mathews et al., 2000, Biochemistry, Pearson Education Pvt. Ltd. New Delhi.
- Abraham Mazur and Benjamin Harrow 1971. Text Book of Biochemistry, W.B Saunders Company, Philadelphia.

M.Sc. Zoology CBCS Syllabus - **SEMESTER – I**
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : CELL AND MOLECULAR BIOLOGY		
Subject Code: 31CT12	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/ week - 72 Hours

Objectives:

To enable the students

- *To understand the structure and functions of cell organelles*
- *To acquire the knowledge on replication of DNA, mechanism of protein synthesis and the principles of gene regulation.*

Unit – I Structure and function of the cell surface and Mitochondria 15 hrs

- a) Molecular dynamics of cell membrane – Composition – Molecular models – Liposome - Unit membrane - Fluid mosaic model – Cell permeability – Transport mechanisms – Differentiation- Cell recognition and inter cellular communication.
- b) Molecular organization of mitochondria and transduction of energy – Bioenergetics – Krebs cycle – Respiratory chain – Oxidative phosphorylation – Chemiosmotic hypothesis.

Unit – II Protein sorting, secretion and endocytosis 15 hrs

- a) The Endoplasmic reticulum and Golgi complex – Structure and molecular constituents – Movements of proteins through ER and Golgi complex – The mechanisms of sorting and distributing proteins – Signal hypothesis
- b) Lysosomes – Enzymes – Functions - Endocytosis and autophagy.

Unit – III The Nucleus-cell cycle and cell division 15 hrs

- a) The molecular organization of interphase nucleus – Nuclear envelop – Chromatin-Chromosome-Nucleolus – r RNA Synthesis.
- b) Cell cycle-phases of cell cycle – Cell cycle regulations - Cell aging and cell death.
- c) Cell division – Mitosis and meiosis – General description (self study) - Mitotic apparatus.
- d) Cancer Biology- Characteristics, causes, carcinogens

Unit – IV

Fundamentals of molecular biology, DNA replication and genetic code 15 hrs

- a) The genetic material –DNA and RNA – experimental evidences.
Nucleic acids: The basic units and their arrangements – bonds - Watson and Crick model – Different forms of DNA – denaturation and renaturation – Molecular hybridization – Structure of RNA – Restriction mapping – RFLP.

- b) Replication and synthesis of DNA – Meselson and Stahl's experiment – Bacterial DNA replication – Role of enzymes in DNA replication. Genetic code – Deciphering the code – Properties of genetic code – Coding dictionary.

Unit – V Protein synthesis and Regulation of gene activity 12 hrs

- a) Transcription in prokaryotes and eukaryotes – Synthesis of mRNA — splicing mechanisms.
Translation – Role of ribosomes – Activation of tRNA – Stages of polypeptide synthesis – Inhibitors of protein synthesis.
- b) Principles of gene regulation- regulatory genes
Lac operon – Arabinose operon- Trp operon
Gene regulation in Eukaryotes.

Text Book:

- De Robertis E.D.P and De Robertis E.M.F. 2005. Cell and Molecular Biology, 8th Edition, B.I Publications PVT.Ltd.India.

Reference Books:

- Gerald Karp, 2010. Cell Biology John Wiley&Sons, Pvt.Ltd. Singapore.
- Gupta P.K. 2010. Cell and Molecular Biology, Rastogi Publications, Meerut, India.
- Craig & Co –authors, 2010. Molecular Biology Oxford University Press, UK.
- Jayanta K.Pal and Saroj S.Ghaskadbi 2009. Fundamentals of Molecular Biology, Oxford University Press, NewDelhi.
- Bruce Alberts& Co-authors, 2008. Molecular Biology of the Cell Garland Science, NewYork.
- Russel P.J. &Co-authors 2004. Cell and Molecular Biology, Cengage learning, Pvt.Ltd, NewDelhi.

M.Sc. Zoology CBCS Syllabus - SEMESTER – I
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : MICROBIOLOGY		
Subject Code: 31CT13	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6 hrs/week 72 hrs

Objectives:

To enable the students to

- *Understand basic aspects, classification, and culture of microbes*
- *Role of microbes in selected human diseases*
- *Applications of microbes in industries and environment*

Unit-I Principles of microbial classification and Microbial morphology 15 hrs

- a) Discovering the microbial world –Koch’s postulates-Five kingdom concepts-recent status of classification-Bergey’s manual of systematic bacteriology-Distinctive characteristics of the major groups of micro organisms-Bacteria, Fungi, Algae, Virus and Protozoa.
- b) Comparison of prokaryotic and Eukaryotic microorganisms, gross morphological and ultra structure of typical prokaryotic cell-morphology of bacteria, fungi, algae and protozoa.

Unit –II Nutritional requirements, culture/cultivation of microorganisms 15 hrs

- a) Nutrients-nutritional requirements of microbes-nutritional classification of micro organisms.
- b) Culture-culture media-types of culture media- maintenance and storage of culture.
- c) Physical condition for activation of microorganisms- Reproduction and growth of microorganisms- batch, synchronous and continuous growth of bacterial culture - synchronous growth methods-quantification of microorganisms.

Unit-III Microorganism and diseases- Classification- Pharmaceutical microbiology 15 hrs

- a) Normal flora of the healthy human host-effect of normal flora on the human host. General concepts of pathogenicity and principles of epidemiology-host parasite interaction-antibiotics-natural and synthetic antiviral drugs-other chemotherapeutic agents.
- b) Infectious disease of man.
 - i) Bacterial-Tuberculosis
 - ii) Viral- Polio .
 - iii) Fungal- *Candida albicans*

Unit- IV Environmental microbiology

15 hrs

- a) Soil micro organisms- The Rhizosphere and the phyllosphere-Factors influencing soil microbial population-interaction among the soil micro organisms-the role of micro organisms in recycling nitrogen, carbon, sulphur and phosphorous.
- b) Aquatic micro organisms-factors influencing aquatic microbial population-distribution of micro organism in aquatic environment and their role in aquatic environment.
- c) Microbiology of potable water and waste water-biological treatment of waste and pollutants.

Unit-V Food and Industrial microbiology

12 hrs

- a) Food as medium-microbial examination of foods-microorganisms found in fresh foods-spoilage of food-food preservation-food poisoning-food products by micro organisms.
- b) Microbial processes, production and optimization. Fermentation: fermenter design, types, kinetics, and bioprocess monitoring - Down stream processing and strain improvement - Production, recovery, stability and formulation of bacterial and fungal enzymes

Text Book:

- Michael J.Pelczar, J.R. Ecschan, Noel R Krieg 2010. Microbiology an Application Based Approach, Tata McGraw Hill Education Private Ltd, NewDelhi
- Ananthanarayanan and Panicker 2009. Text book of Microbiology, Universities Press,

Reference Books:

- Tortara, G.J. 2011. Microbiology An introduction, Addison Wisely, Newyork.
- Puvanakrishnan, R. 2012. Microbial Technology, MJP Publishers, Chennai
- Aneja, K.R. 2009. A text book of Basic and Applied Microbiology, New Age International Publishers, New Delhi.
- Willey, 2008. Microbiology, Mc Graw Hill, Boston, N.S. Subba Rao, fourth edition. Oxford and IBH. Pub. New Delhi.
- Subba Rao N.S., 2008. Soil Microbiologoy, Scoence Publishing INC, New Delhi
- Pommerville 2014. Alcamos fundamentals of Microbiology, Jones and Bartlette learning, New Delhi

M.Sc. Zoology CBCS Syllabus - SEMESTER – I
(For those who joined in June 2015 and after)

Core Subject Practical		
Subject Title : PRACTICAL - I		
Subject Code: 31CP14	Hours per week: 6	Credit: 3
Sessional Marks: 40	Summative Marks: 60	Total Marks: 100

Objectives:

To enable the students to

- *Quantification of Glycogen, protein and cholesterol*
- *Experiments to know about the enzyme activities*
- *Principle, uses of microscopy and preparation of permanent slides of animal tissues*

BIOCHEMISTRY

2 hrs/week

1. Estimation of sugar by Folin- Wu method.
2. Isolation and estimation of glycogen from Goat liver by Anthrone method.
3. Estimation of protein by Lowry's method.
4. Estimation of cholesterol in blood serum (Colorimetric).
5. Estimation of ascorbic acid by titrimetric method.
6. Effect of temperature on enzyme action (Colorimetric method).

CELL AND MOLECULAR BIOLOGY

2 hrs/week

1. Principles and application of phase contrast and electron microscopy
2. Micrometry- Measurements of cells using Ocular and Stage micrometer
3. Microtome technique – Fixation, sectioning and staining – preparation of permanent slides of animal tissues
4. Observation of succinic acid dehydrogenase activity in liver homogenate

Spotters:

- a) Semi conservative model
- b) Transcription steps
- c) Translation steps
- d) tRNA
- e) Lac Operon

MICROBIOLOGY

2 hrs/week

Objectives:

- *Introducing basic aspects of microbiology*
- *Microbial culture preparation and culture techniques*
- *Introducing microbial specific staining procedures*
- *Isolation and characterization of certain biochemical characters*
 1. Simple staining of Bacteria (Direct and negative).
 2. Differential staining of Bacteria (Gram's stain)
 3. Preparation and sterilization of culture medium (nutrient agar)
 4. Determining number of microbes – quantitative plating techniques-spread plate & pour plate methods.
 5. Turbidometric estimation of bacterial growth.
 6. Effect of temperature and pH on bacterial growth,
 7. Bacteriological examination of Raw and Pasteurized milk.
 8. Degradation (Fermentation) of Starch by bacteria.
 9. Testing the sensitivity of bacteria to the antibiotics.

Spotters: Laminar flow hood

- a. Autoclave
- b. Colony counter
- c. Anerobic jar
- d. Colony morphology –Identification
- e. Millipore filter apparatus
- f. Counting chamber
- g. Culture systems-Continuous, batch and synchronous.

M.Sc. Zoology CBCS Syllabus - SEMESTER – I
(For those who joined in June 2015 and after)

Elective Subject Theory		
Subject Title : BIOINFORMATICS		
Subject Code: 31EP11	Hours per week: 6	Credit: 5
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week -72hrs

Objectives:

To enable the students to

- *Understand the basic aspects and functioning of computers and their packages*
- *Role of computers in the study of biology*
- *Understand the applications and need for Bioinformatics and their tools*

Unit I: Introduction to computers

15 hrs

- a. History, generations and component of computers.
- b. Classifications of computer-main frame, mini, micro and super computer.
- c. Operating system-Windows, Microsoft office and components.
- d. Popular software packages- MS word, MS power point, MS Excel- statistical applications

Unit II: System software

15 hrs

- a. Internet- Modem- TCP/IP protocols -on line services - commercial organization-Education, web browsers and portals.
- b. Creation of web pages using HTML- web page
- c. Electronic mail – Creation and management, data storage using email
- d. Virus- Booting virus -EXE. virus and antivirus

Unit III: Databases

15 hrs

- a. Bioinformatics – Databases- classification- Data type, Maintainer status, data access, Data source, Data Design and Organisation
- b. NCBI – Structure, Tools and database, Sequence submission, Sequence retrieval
- c. EMBL – Structure, Sequence submission, Sequence retrieval
- d. DDBJ – Structure, Mass submission, Sequence retrieval

Unit IV: Sequence analysis

15 hrs

- a. Sequence alignment- Concept- Scoring matrices- PAM, BLOSUM
- b. Sequence pairing – BLAST, Multiple sequence alignment
- c. Methods of Gene prediction methods and difficulties
- d. Molecular phylogeny – Mechanism- Phylogenetic markers, representation- Roots, Out, Distance scale, internal branch, CLADE, Horizontal branch, Cladogram, Dendrogram, Unrooted and rooted trees, Methods of phylogenetic analysis- Maximum like hood method, Distance method.

Unit V: Proteomics

12 hrs

- a. Protein structure and prediction - Confirmation parameters of secondary structures, Secondary structure types- Secondary structure prediction –Their limitations.
- b. Methods of protein modeling – Homology, Abinitio and Threading – Model refinement
- c. Comparative modeling – Swiss model
- d. Evaluation – Spdb`v and Ramachandran Plot. Internal evaluation, External evaluation of proteins

Text Books:

- Sanjay Saxena, 2007. A first course in Computers Based on Windows XP and office XP, Vikas Publishing House Pvt. Ltd. Nodia
- Zhumur Ghosh and Bibekanana Mallick, 2015. Bioinformatics Principle and application, Oxford University press.

Reference Books:

- Curran B.G. Walker R.J. and Bhatia S.C. 2010. Bioinformatics, CBS Publishers & distributions Pvt Ltd, New Delhi
- Sundararajan S. and Balaji R. 2002. Introduction to Bioinformatics, Himalaya Publishing House, Mumbai
- Prakash, Lohar S. 2009. Bioinformatics, MJP Publishers, Chennai
- Sinha P.K. 2007. Computer Fundamentals 4th edition, BPB Publication
- Anand Solomon K. 2008. Molecular Modeling and Drug Designing, MJP Publishers, Chennai

M.Sc. Zoology CBCS Syllabus - SEMESTER – II
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : IMMUNOLOGY		
Subject Code: 31CT21	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week -72hrs

Objectives:

To enable the students to

- *Understand the basic fundamentals of Immunology*
- *Know the components of Immune system and its mechanism*
- *Study the role of Immune system in relation to health and diseases*

UNIT- I: Fundamentals of Immunology

15 hrs

a) Antigen and its characters:

Definition- types- properties- role of biological system in immunogenicity- Adjuvants- epitopes-haptens

b) Immunoglobulin and their properties (Self study)

Basic structure- Isotype- allotype- idiotype- domains- constant and variable- IG classes- Sub classes- their properties and functions.

c) Genetic basis of antibody diversity:

Theory of germ line rearrangement- IG genes- light chain gene organization- heavy chain variable region diversity – heavy chain constant chain organization – production of diverse antibody

UNIT- II: Immune Effector Mechanism

15 hrs

a) Complement and its role: Complement components – classical and alternate complement pathways and consequence of complement activation.

b) Humoral and cell mediated immunity:

i) Humoral immunity-primary and secondary immune responses, Ag dependent and Ag independent activation, affinity maturation – role of T_H cells in B cell proliferation – class switching mechanism.

ii) Cell mediated immunity: - Role of T cell subsets- mechanism of lysis of cytotoxic cells.

c) Hyper sensitivity reactions:-

i) Ig E mediated hypersensitivity reactions (type 1)

ii) Antibody mediated hypersensitivity reaction (Type II)

iii) Immune complex mediated hypersensitivity reaction (Type III)

iv) T cell mediated (DTH) hypersensitivity reaction (Type IV)

Unit-III: Immune System in Health

15 hrs

- a) Autoimmunity– principles– organ specific and systemic Autoimmune diseases- Treatment of autoimmune diseases.
- b) Transplantation immunology:
Relationship of donor and recipient, HLA systems– principles of tolerance immunological basis of graft rejection. Role of immuno suppressive drugs, bone marrow and kidney transplantation
- c) Tumour and AIDS immunology:
 - i. Tumour antigens – classification, immune response to tumours, surveillance, immuno therapy.
 - ii. AIDS epidemic – clinical and immunological consequence of HIV.
 - iii. Immuno deficiency – Phagocytic deficiency – Humoral deficiency- cell mediated deficiency (one example each) - SCID.

Unit-IV Immune Response to Infectious Diseases

15 hrs

- a) Viral infection: Viral infection, and immunity. Viral strategies of immune evasion.
- b) Bacterial infection:
 - i) Immune response to extra cellular and intra cellular.
 - ii) Bacteria defence mechanism-inflammation.
 - iii) Bacterial evasion of host defence mechanism.
 - iv) Diphtheria and tuberculosis infection and immunity.
- c) Immune response against parasites:
 - i) Protozoan parasites-the effector function of NK cells during protozoan infection- *Plasmodium* and Trypanosomal infection and immunity.
 - ii) Immune response against Helminthic parasites-role of B cells in Helminth infection.

Unit- V Immunotechniques

12 hrs

- a) Principles of precipitations- VDRL slide test.
- b) Radioimmuno assay of Insulin.
- c) ELISA Test.
- d) Immunodiffusion and Immunoelectrophoresis

Text Book:

- Gangal S. and Sontakke, S. 2013. Text Book of Basic and Clinical Immunology, University Press (India) Pvt, Ltd, Hyderabad

Reference Books:

- Hannigan B.M., Moore, C.B.T. and Quinn, D.G. 2010. Immunology, Viva books, New Delhi.
- Roitt, I. 1987. Essential Immunology, P.G. Publishing Pvt. LTd., New Delhi.
- Kubly, T.1994. Immunology, P.G. Publishing Pvt., LTd., New Delhi
- Tizard I.R.1995. Immunology – An Introduction IV ED. Saunders College Publication, Philadelphia.

M.Sc. Zoology CBCS Syllabus - SEMESTER – II
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : BIO-STATISTICS		
Subject Code: 31CT22	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week- 72hrs

Objectives:

To enable the students to

- *Understand the importance of statistics in biology.*
- *Study the role of statistics in demography.*

Unit I: Introduction to Biostatistics, Chi square and Probability Distributions

15 hrs

- a) Data-Collection, tabulation, classification, presentation and frequency distribution. Calculation of mean, median, mode, variance and standard deviation.
- b) Chi-Square analysis-degrees of freedom-Goodness of fit, calculation of chi-square value for genetic experiments and 2X2 contingency table.
- c) Probability -properties-types-theorems-Probability distribution-normal, binomial and Poisson – characteristics-formulae- skewness and kurtosis.

Unit II: Sampling statistics and ‘t’ distribution

15 hrs

- a) Sampling-characters-sample size-types
- b) Sampling distribution-comparison of means (samples and population) – Calculation of Student’s ‘t’ test-paired and unpaired data.
- c) Hypothesis test procedure- Null and alternate hypotheses- Standard error, confidence limits.

Unit III: Regression and Correlation

15 hrs

- a) Scatter diagram-linear regression-plotting of regression lines ‘y on x’ and ‘x on y’.
- b) Regression coefficient-testing the significances of regression.
- c) Correlation- Calculation of Karl Pearson’s correlation coefficient and rank correlation-applications.

Unit IV: F- test and analysis of variance

15 hrs

- a) F-distribution- definition and applications
- b) One way classification-total variation-variation with treatments, Variation between treatments, distribution of variations- Calculation.
- c) Two-way classification-variation of 2 factors experiment.

Unit V: Vital Statistics and Demography

12 hrs

- a. Introduction-uses of vital statistics, basic formulae, mortality and fertility rates.
- b. Construction of a life table, structure and applications
- c. Demographic characteristics of India.

Text Books:

- Gurumani, N. 2004. Biostatistics, M.J.Publishers, Chennai.

References Books:

1. Khan I.A.and Khanum A.1994. Fundamentals of Biostatistics, Ukaaz publication Hyderabad.
2. Zar. H.1984. Biostatistics Analysis 2nd edition, Prentice-Hall International, In New Jersey.
3. Mahajan B.K. 1984. Methods in Biostatistics, Lmt. Indumahajan Publication 4th edition.
4. Misra B.M. & Misra, K.M. 1983. Introductory Practical biostatistics. Naya Prakash Calcutta.
5. Finney D.J. 1980. Basic statistics for Biologists.. Chapman& Halt. London, science paperback.
6. Pillai R.S.N and Bagavathy V. 2003. Practical statistics, S.Chand & Co., New Delhi.

M.Sc. Zoology CBCS Syllabus - SEMESTER – II
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : DEVELOPMENTAL BIOLOGY		
Subject Code: 31CT23	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week-72hrs

Objectives:

To enable the students to

- *Reveal basic aspects of animal and human development*
- *Introduction of experimental embryology and its importance*
- *Imparting knowledge on various aspects of embryonic development*

Unit I: Gametogenesis and fertilization 15 hrs

Spermatogenesis-oogenesis- Spermatozoon-egg types - fertilization -Molecular basis of egg activation, Parthenogenesis.

Unit II: Early development of human embryo 15 hrs

Reproductive cycle-menstruous-ovulation-cleavage,gastrulation and peculiar feature of human development-extra embryonic membranes and placenta formation-teratogenesis and Malignancy.

Unit III: Experimental embryology 15 hrs

Organizer- Embryonic inductions and competence-types of induction-vertebrate lens neural induction-mechanism-competence and its molecular biology- Gradient theory-Nuclear transplantation.

Unit IV: Cell differentiation. 15 hrs

Types and characteristics of differentiation-chemical basis-role of cytoplasm on differentiation-molecular biology of differentiation-tissue maintenance and replacement-stem cells and its studies. Gene action and Hormonal control in development

Unit V: Metamorphosis and regeneration 12 hrs

Morphological, physiological and biochemical changes during amphibian metamorphosis-hormonal control of amphibian metamorphosis- Regeneration mechanism-Regeneration in amphibia- Wound healing- Blastema formation-Dedifferentiation and morphogenesis.

Text Books:

- Balinsky,B.I.and Fabian 2012, An introduction to embryology. Cengage Learning India Pvt, New Delhi.
- Inderbir Singh & Pal G.P. 2013, Human Embryology, 9 th edition MacMillan India. Ltd. Chennai.

Reference Books:

- Subramanian M.A 2012, Developmental Biology. MJP Publishers, Chennai
- Berril, N.J.1976- Development. Tata Mc.Graw. Hill .Pub.Co.Ltd.
- Scott F. Gilbert 1988. Developmental biology, Sinauer Associates and Pub. Massachutes.
- Verma, P. S and Agarwal, V.K. 2005, Chordate Embryology, S.Chand & Co, New Delhi.
- Jain P.C. 2007. Elements of developmental biology. Vishal Publication Jalandhar- Delhi

M.Sc. Zoology CBCS Syllabus - SEMESTER – II
(For those who joined in June 2015 and after)

Core Subject Practical		
Subject Title : PRACTICAL – II		
Subject Code: 31CP24	Hours per week: 6	Credit: 3
Sessional Marks: 40	Summative Marks: 60	Total Marks: 100

Objectives:

To enable the students to

- *Demonstrate certain important basic immuno- techniques*
- *Application of statistics in analyzing biological data*
- *Observe developmental process and perform certain experiments*
- *Testing evolutionary principles using colour beads*

IMMUNOLOGY

2hrs/week

1. Dissection in chick to show the lymphoid organs.
2. Differential count of Human WBC.
3. Counting of total RBC using haemocytometer.
4. Techniques of preparation of cellular, particulate, soluble Ags and emulsified Freund's adjuvant.
5. Injection schedule in rabbit to induce antibody.
6. Bleeding technique in rabbit and preparation of anti serum.
7. Ouchterlony double immune diffusion and Mancini single radial immune diffusion.
8. Haemagglutination titration assay: Commercial kits use-ELISA-HIV/Hepatitis, Blood grouping.
9. Immuno electrophoresis.

Spotters:

1. Lymphoid organs.
2. Primary and secondary immune response curves.
3. Latex test.
4. Blood group anti serum.
5. Anaphylactic reactions.
6. Arthus reaction.
7. Tuberculin types hypersensitivity.
8. Contact hypersensitivity.
9. Hashimoto's thyroiditis.

BIOSTATISTICS

2 hrs/week

1. Collection of data and construction of frequency tables.
2. Calculation of mean, median, mode.
3. Calculation of standard deviation and variance.
4. Comparison of means of two samples by student's "t" test.
5. The correlation of measurements (e.g length and weight of fish; no.of seeds and seed pod length).
6. Regression analysis.
7. Probability distribution (Normal, Binomial, Poisson and skewed 2.distribution).
8. Chi square analysis (genetic experiment and 2X2 contingency table).
9. Analysis of variance.

DEVELOPMENTAL BIOLOGY

2hrs/Week

1. Observation of chick embryos (24 Hrs, 48 Hrs 72 Hrs and 96 Hrs)
2. Temporary mounting of chick blastoderm.
3. Effect of thyroxin on amphibian metamorphosis.
4. Regeneration in frog tadpoles.

Spotters

1. Extraembryonic membranes (Human)
2. *Xenopus laevis*

EVOLUTION

2hrs/Week

1. Experiment to demonstrate the Natural selection in large population
2. Experiment to demonstrate Genetic drift in small population
3. Study of Darwinian fitness
4. Experiment to estimate the proportion of homozygous and heterozygous allele in a population (a case study with human trait)

Spotters

1. Darwin's finches
2. Industrial melanism
3. Human evolution (causes)

PG Summative Practical Examination

Question Paper Pattern

Practical I & II

Time: 4hrs

Marks: 60

- | | |
|---------------------|------------------|
| 1. Major Practical | 15 mark |
| 2. Minor Practical | (2 x 10) 20 mark |
| 3. Spotter | (5 x 3) 15 mark |
| 4. Viva-Voce | 5 mark |
| 5. Record note book | 5 mark |

Total 60 marks

M.Sc. Zoology CBCS Syllabus - SEMESTER – II
(For those who joined in June 2015 and after)

Elective Subject Theory		
Subject Title : EVOLUTION		
Subject Code: 31EP21	Hours per week: 6	Credit: 5
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week-72 hrs

Objectives:

To enable the students to

- Impart knowledge of origin of life and to trace human evolution
- Introduction of evolutionary theories & their significances
- Make them to understand species concept and distribution of animals

Unit I: Modern concepts of Natural Selection 15 hrs

Darwinian principles- Modern understanding of natural selection- Modes and types of selection. Darwinian fitness- genetic drift and natural selection.

Unit II: Molecular evolution 15 hrs

Amino acid sequences of proteins-Amino acid substitution-protein evolution. Electrophoretic analysis of genetic variation - DNA phylogeny-neutrality theory of protein evolution- molecular clock of evolution.

Unit III: Speciation 12 hrs

Nature of Speciation- Modes of speciation- allopatric, sympatric, Parapatric and Quantum speciation- Types of isolating mechanism- Pre zygotic and post zygotic.

Unit IV: Origin of higher taxa 15 hrs

Simpson's definition of higher taxa-Mechanism- polyploidy – Deviation – Allometry –Neotony- Preadaptation. And post adaptation -Modes of Origin of higher taxa:Mosaic mode-connecting links between vertebrates-Quantum evolution -Simpson's adaptive grid- Rates of evolution: Horotely-Bradytely-Tachytely-Gradualism Vs Punctuated equilibrium-Extinction and its causes.

Unit V: Human evolution 15 hrs

Fossil history of early man- Australopithecines-*Homo habilis* – *Homo erectus* – Neanderthal man, – Fossil sites, Dating of fossils, Cultural evolution –Stone tool culture – Language –self-awareness and death awareness – Biological evolution of man. Selfish gene – Altruism – Kin selection, Eugenics, Euthenics and Euphenics.

Text Book:

- Hall B.K and B. Hallgrimsson 2014 Strickberger's Evolution, Jones and Bartlett India Pvt Ltd, New Delhi

Reference Books:

- VeeraBala Rastogi, 2005. Organic Evolution, Kedarnath Ramnath P
- P.A.Moody, 1995. Introduction to evolution, Kalyani Pub, New Delhi.
- Dobzhansky, Th., Ayala, F. J., Stebbins, G. Ledyard & Valentine, J. W., 1977. Evolution W. H. Freeman and Company, San Francisco
- Chattopadhyay, 2002. Life –Origin, Evolution and adaptation, Books and Allied P Ltd, Kolkata.

M.Sc. Zoology CBCS Syllabus - SEMESTER – III
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : GENETICS		
Subject Code: 31CT31	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week-72 hrs

Objectives:

To enable the students to

- *Basic understanding of classical, mendelian and modern concept of gene*
- *Study of Prokaryotic genetics, the mechanism of gene transfer and their significances*
- *Impart knowledge on Mutation, types of repair mechanism and their evolutionary significances*
- *Focuses genetic basis of cancer, Human genome project and its implications*

UNIT I: Gene concept and molecular basis of heredity 15 Hrs

- a. Classical gene concept – Mendelian concept – Deviation of Mendelian concept - Chromosomal map
- b. Modern gene concept – Fine structure of gene - Cistron – Recon – Muton.
- c. Gene isolation and restriction mapping

UNIT II: Microbial genetics 15 Hrs

- a. Essential genetics of haploid organisms and gene transfer mechanism- Genetic notation, Conventions and Terminology.
- b. Plasmids-types-detection – isolation – replication – transfer and uses.
- c. Bacterial transformation – discovery-detection – competence-molecular mechanism. Bacterial conjugation – insertion of “F” into the *E coli* chromosome – Hfr transfer, genetic Recombination of F plasmids, mechanism of chromosomal transfer.

UNIT III: Viral genetics 15 Hrs

- a. Genetic organisation of viruses.
- b. Transduction – DNA transfer- specialized and generalized transduction.
- c. Bacteriophage - lambda phage-lambda DNA and its genetic structure – lytic life cycle-early and late genes-DNA replication-concatamer-assembly and lysis of cell, Transposable elements.

UNIT IV: Mutation, DNA repair and recombination 15 Hrs

- a. Mutation-types – molecular mechanism – deletion – addition – substitution- spontaneous mutation – mutation rates-origin of spontaneous mutation- tautomeric and frame shift mutation- suppressor mutation.
- b. DNA repair– photoreactivation, excision repair, mismatch repairs, SOS repair.

- c. Genetic recombination –breakage and reunion-heteroduplex DNA –simple and double stranded breaks- isolation and recombination intermediates-Inter allelic recombination- specialised recombination at specific sites.

UNIT V: Human Genetics

12 Hrs

- a. Pedigree analysis, congenital malformations, diagnosis and genetic counselling. Genetic basis of human cancer, detection of oncogenes, cellular function of oncoproteins and diagnosis.
- b. The Human genome project and its implications
- c. Eugenics, euthenics and euphenics.

Text Books:

- Gardner. A & Davies. T, 2010. Human Genetics, Viva Books, New Delhi.
- Graig N.L., Cohen-Fix.O, Green R., Greider, C.W., Storz, G., Wolgerger.W. 2010. Molecular Biology- Principles of Genome Functioning, Oxford University Press

Reference Books:

- David Friefelder 1990. Microbial genetics Narosa Pub. House, New Delhi.
- Hartl and Jones 1998. Genetics–Principles and analysis Jones and Bart latt , Pub.
- Watson J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A., and Weiner, A.M. 1987. Molecular biology of Gene I & II
- Suzuki, D.T., Griffiths, A.J.F., Miller, J.H., Lewontin, R.C., 1986. An introduction to genetics analysis W. H. Freeman and Co. New York.
- Cossman. J 1990. Molecular genetics in cancer diagnosis Elsevier, New York.
- Brown, T.A. 2006. Genomes by Garland science New York.

M.Sc. Zoology CBCS Syllabus - SEMESTER – III
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : PHYSIOLOGY		
Subject Code: 31CT32	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week-72hrs

Objectives:

To enable the students to

- *Mechanism and physiology of vision*
- *Mechanics of muscles*
- *Blood circulation*

Unit I:

15 hrs

- a. The exchange of gases-respiratory organs and their ventilation – transport of gases
- b. Metabolic and respiratory responses –rate of metabolism – oxygen as limiting factor in the environment – effects of hydrostatic pressure – buoyancy.
- c. Osmotic and ionic regulation - maintaining water and electrolyte balance – hormones and the regulation of water and electrolytes
- d. Endocrine regulation of reproduction - invertebrate hormones of reproduction - vertebrate controls.

Unit II:

15 hrs

- a. Photo biology (Vision and Bioluminescence)
- b. Physiology of receptors
- c. Bioelectricity and Neuro physiology
- d. Physiology of heat therapy, physio-therapy, photo-therapy, magneto-therapy and mega voltage therapy

Unit III:

15 hrs

- a. Mechanics of Muscle and animal movements
- b. Mechanics of pulmonary ventilation and counter current mechanism
- c. Haemodynamics and cardiac cycle.

Unit IV:

15 hrs

- a. Neuron to brain; Reflex to planned action.
- b. Properties of inter neuron.
- c. Organization of Nervous system.
- d. Physiology of behaviour

Unit V:

12hrs

- a. The body fluids.
- b. Circulation of Blood.
- c. Vascular pump and Cardiac rhythms.
- d. Blood flow and blood pressure

Text Books:

- William S. Hoar. 2004. General and comparative physiology Prentice-Hall Publication
- R.C.Dalela Verma and S.R. Verma. 1995. Animal Physiology and Related Biochemistry Jaiprakash Nath & Co,

Reference Books:

- Marieb E.N. 2006. Human Anatomy and Physiology, Pearson Edu.
- Prosser C.L and Brown F. A. 1962. Comparative animal physiology, W.B. Saunders Company Ltd. London.

M.Sc. Zoology CBCS Syllabus - SEMESTER – III
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : PRINCIPLES OF BIOTECHNOLOGY		
Subject Code: 31CT33	Hours per week: 6	Credit: 4
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6 hrs/week-72hrs

Objectives:

To enable the students

- *To have a knowledge on scope and ethical issues of Biotechnology*
- *To understand the tools and techniques of Biotechnology*

UNIT I: Principles of Biotechnology 15 hrs

- ❖ Present status and scope of biotechnology - current scenario of Indian Biotechnology
- ❖ Biosafety- Guidelines for DNA research activity.
- ❖ Patents and IPR (Proprietary and patent rights) - WTO-GATT & TRIPS -
- ❖ Bioethics - Social and Ethical issues- risk management.

UNIT-II: Molecular Tools– I 15 hrs

- ❖ Restriction endonucleases: types and mode of action
- ❖ Nucleases: exo- and endo-nucleases (DNAses, RNAses)
- ❖ DNA-ligases and DNA modifying enzymes.
- ❖ DNA and RNA markers

UNIT-III: Molecular Tools -II 15 hrs

- ❖ Cloning and expression vectors: Plasmids, Cosmids, Artificial chromosomes, Shuttle vectors and Phagemids
- ❖ Ti and Ri plasmids: General features and mechanism of DNA transfer,
- ❖ Vectors in human gene therapy (viral and non viral vectors)
- ❖ Identification of Recombinant DNA (Direct and indirect methods)

UNIT-IV: Techniques 15 hrs

- ❖ Restriction mapping of DNA fragments
- ❖ Nucleic acid blotting techniques: Southern, Northern, Dot and Western blotting
- ❖ DNA sequencing: principles and methods
- ❖ Polymerase chain reaction: Principle and applications / Micro array

UNIT-V: Gene Cloning and Gene Libraries

12 hrs

- ❖ Methods of gene transfer:
- ❖ cDNA synthesis and genomic libraries
- ❖ Gene cloning strategies
- ❖ Screening strategies: Screening by DNA hybridization and colony hybridization.

Text Books:

- Biotechnology, Satyanarayana, 2010, Books and Allied Pvt Ltd, Kolkata
- Principles of Biotechnology, A.J. Nair, 2007, Lakshmi Publications Pvt Ltd, Bangalore

Reference Books:

- H. K. Das 2007. Text Books of Biotechnology, Wiley Precise text books.
- Channarayappa, 2006. Molecular Biotechnology Principles and practices University Press.
- Satyanarayana, U. 2008. Biotechnology, Books and Allied, Kolkatta

M.Sc. Zoology CBCS Syllabus - SEMESTER – III
(For those who joined in June 2015 and after)

Core Subject Practical		
Subject Title : PRACTICAL – III		
Subject Code: 31CP34	Hours per week: 6	Credit: 3
Sessional Marks: 40	Summative Marks: 60	Total Marks: 100

GENETICS (Practical)

2hrs/week

Objectives:

To enable the students to

- *Behavior of blood group genes in human population and gene transfer mechanism*
 - *Diagnosis of genetic defects/disorders in human by using molecular markers*
 - *Information about Human Genome Project (HGT)*
1. Genes in population- A survey of blood group alleles in a population.
 2. DNA extraction (demonstration).
 3. Antibiotic sensitivity test in *E.coli*. (demonstration).
 4. Observation of Human Genome project through internet
 5. Culture of *Drosophila* and observation of variations

Spotters:

- a. Griffith experiment on recombination
- b. Frame shift mutation
- c. Photo reactivation
- d. Excision repair
- e. Molecular mechanism of recombination
- f. Bacterial conjugation
- g. Transduction
- h. Transposons
- i. Structure of lambda phage DNA
- j. Microarray
- k. PCR
- l. RFLP

PHYSIOLOGY (Practical)

2hrs/week

Objectives:

- *Understand the physiological mechanism of Osmoregulation and Thermoregulation in test animals.*
 - *Biomolecules in human blood and urine samples*
 - *Working principle of biomedical instruments in a clinical laboratory.*
1. Crystal studies in blood & urine (any 3 of the following)
A) Haemin B) Uric/Urate C) Osazone D) Calcium oxalate E) Leucine/Tyrosine
 2. Osmoregulation in earth worm

3. Thermo regulation / water loss analysis in Frog/Slug/Earthworm.
4. Effects of UV/IR radiations on earthworm or silkworm or slug or frog
5. Demonstration of photosynthesis
6. Demonstration of Plasmolysis
7. Volumetric analysis of pulmonary ventilation.
8. Study of vision tests.
9. Study of hearing tests.
10. Observation of circulation in wings of insects.
11. Study of architecture and functional importance (spotter)
 - a) Photoreceptor b) Phono receptor c) Tango receptor d) Olfactory receptor
 - e) Thermo receptor f) Proprioceptor g) Chemo receptor h) Buccal receptor
 - i) Mechano receptor j) Thigmo receptor
- 12) Visit to a hospital laboratory for the observation of ECG, EMG, EEG, ERG, EOG, SCAN, LASER and Auto analyser

PRINCIPLES of BIOTECHNOLOGY

2hrs/week

Objectives:

- *To know the isolation techniques of plasmid and genomic DNA from prokaryotes.*
 - *To demonstrate the cell/enzyme immobilization by using sodium alginate beads.*
 - *To demonstrate the Electrophoretic techniques.*
1. Isolation of plasmid DNA from bacteria. (demonstration only)
 2. Isolation of chromosomal DNA from bacteria. (demonstration only)
 3. Demonstration of Immobilisation technique (any one enzyme and measurement of its activity)
 4. Techniques
 - a) Typical cloning b) Callus culture c) Hybridization d) Blotting techniques
 5. Instruments
 - a) PCR b) Electrophoresis c) UV-Illuminator

PG DEPARTMENT OF ZOOLOGY - SEMESTER – III
(For those who joined in June 2015 and after)

II M.Sc. Chemistry and II M.Com CBCS SYLLABUS

Non Major Elective		
Subject Title : APPLIED BIOLOGY		
Subject Code: 31NE31	Hours per week: 6	Credit: 5
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

5 hrs/week- 60hrs

Objectives:

To enable the students to

- *Improving the quality of human life and protecting them from dangerous diseases*
- *Raise disease resistant high yielding varieties of crops*
- *Development of gene therapy*
- *Conservation and management of natural resources*

Unit-I: Sustainable development 12 hrs

Water management, soil management, pest management, energy management, live stock management and human resource management

Unit II: Food Biotechnology 12 hrs

Biotechnology in Agriculture – Plant tissue culture – food products- fermentation – single cell protein

Unit-III: Animal biotechnology 12 hrs

Biotechnology in animal husbandry – Embryo transfer – hybridization – growth hormones – Treatment of animal diseases

Unit-IV: Medical Biotechnology 12 hrs

Biotechnology in medicine and public health – vaccines – human genome project – gene therapy

Unit-V: Society and biotechnology 12 hrs

Biotechnology-Risks and Ethics in Medicine, Agriculture, Animal, Environment and Human

Text Books:

- Kumaresan 2014. Biotechnology, Saras Publications

Reference Books:

- Chatwal G.R. and Harish Sharma, 2004. A Text Book of Environmental Studies, Himalaya Publishing House
- S. Ignacimuthu 2012. Biotechnology –An Introduction, Narosa Publication house
- M.S. Swaminathan 1991. Biotechnology in agriculture — MacMillan India Ltd.

M.Sc. Zoology CBCS Syllabus - SEMESTER – IV
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : APPLIED BIOTECHNOLOGY		
Subject Code: 31CT41	Hours per week: 6	Credit: 5
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6 hrs/week- 72hrs

Objectives:

To enable the students to

- *Explore the knowledge of biotechnology in medicine, agriculture, veterinary and environmental sciences*
- *Concept of transgenesis, manipulation and strategies of gene transfer among animals*
- *Technique to achieve the improvement in quality and quantity of agricultural products*
- *Knowledge of nano science technology and their applications*

Unit I: Human Biotechnology 15 hrs

- ❖ Molecular Medicine- Molecular analysis of human diseases
- ❖ Gene therapy, molecular diagnostics- monoclonal antibodies production and its application
- ❖ Tissue engineering- Types of biomaterials and their applications
- ❖ Advances in drug targeting and therapy-virulence factors as drug targets

Unit II: Animal Biotechnology 15 hrs

- ❖ Manipulation of reproduction in animals - Artificial Insemination, Embryo transfer, *In vitro* fertilization. Embryo cloning.
- ❖ Transgenic methods - Retro viral vector- Microinjection- Electroporation
- ❖ Engineered embryonic stem cells
- ❖ Cloning by nuclear transfer- YAC- transgenesis

Unit III: Plant Biotechnology 15 hrs

- ❖ Techniques of plant cell and tissue culture and their application
- ❖ Genetic engineering in plants, germplasm storage and GM food
- ❖ Bioinsecticides – Types and applications
- ❖ Biofertilizers - Types and applications

Unit-IV: Nanobiotechnology 15 hrs

- ❖ Scope - Properties of nanoparticles
- ❖ Strategies for nanoparticle synthesis (Physical, Chemical and Biological)
- ❖ Characteristics of nanoparticles
- ❖ Applications of nanobiotechnology in medicine – drug designing

Unit V: Environmental Biotechnology 12 hrs

- ❖ Sewage and waste: Principles of conventional and modern treatment methods

- ❖ Solid waste management
- ❖ Bioremediation technologies: Principles involved in bioconversion, biotransformation, biodegradation, biodeterioration, biorecovery, biomining, Oreleaching and oil recovery.
- ❖ Bioenergy: Bioenergy Park, Biodiesel and Biogas production

Text Books:

- Satyanarayana, 2010. Biotechnology, Books and Allied Pvt Ltd, Kolkata
- A.J. Nair, 2007. Principles of Biotechnology, Lakshmi Publications Pvt Ltd, Bangalore

Reference Books:

- Mohan P. Arora, 2003. Biotechnology, Himalaya publishing house.
- Ratledge C. and Kristiansen B. 2001. Basic Biotechnology, Cambridge University.
- Barnum S.R.2003. Biotechnology an Introduction, Thomson Books / cole-Australia.
- D. Bourgaize 2003. Biotechnology, Pearson education Singapore

M.Sc. Zoology CBCS Syllabus - SEMESTER – IV
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : ENVIRONMENTAL BIOLOGY		
Subject Code: 31CT42	Hours per week: 6	Credit: 5
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6 hrs/week-72hrs

Objectives:

To enable the students to

- *Law of environment and fundamental limits of natural sources.*
- *Environmental issues, analysis and solutions*
- *Ways to protect the environment for the next generation*

Unit- I: Ecosystem and Bio-geochemical Cycles

15 hrs

a. Concept and dynamics of Ecosystem. Components and process of Ecosystem – Food chain – food web - trophic levels – Energy flow - Productivity- Ecological energetics– Trophic structure and ecological pyramids.

Biogeo chemical cycles and Limiting factors – Principles and concepts– Leibniz law and Shelford's law of maximum

b. Community and Biodiversity

15 hrs

Biotic community – Concept – structure and composition- community and stability- concept of ecological niche - Ecological succession.

Biodiversity- measures of diversity- species richness- Evenness - Endangered species – Bioindicators and their role in Environmental monitoring – Remote sensing.

Biodiversity conservation –Methods of conservation - (in situ and ex-situ) - germplasm conservation –Economic evaluation of Biodiversity – Intellectual property rights - Documentation of Biodiversity.

Unit- II Economic Ecology and Field Biology

15 hrs

- a. Basic facts of conservation of natural resources- Natural resources – Impact of civilization on sustainable development – Soil erosion and soil conservation – Water resources- Conservation – Rain water Harvesting – Forest conservation .
- b. Monsoon – its origin – Kinds – Its impact on Indian peninsula.
- c. Non-conventional energy resources.

Unit – III Environment toxicology and Radiation Ecology

15 hrs

- a. Basic concepts of toxicology – Sources of toxicants (air, water, soil – Brief account) Toxicological testing methods- Toxicants of public health hazard- xenobiotics

- b. Radiation ecology and environment:-
- c. Radioactivity- Nuclear radiations- Half life period- $E=mc^2$ – Safety hazards of the nuclear power plants – Radioactive fallout problems – Disposal of radioactive wastes- Biological effects of nuclear radiations.

Unit –IV Demography and Urban ecology 15 hrs

- a. Population ecology of man- History of human population growth- Population explosion – social impacts and ecological implications- Population control .
- b. Urban ecology – History and development of urbanization Formation of urban areas- central business district – satellite towns – Impact of transport systems on urban environment – Housing – Slums its nature- Characteristics and problems on urban environment – drainage and storm water drainage.
- c. Space ecology – Life supporting system.

Unit- V Environmental Education and Organization 12 hrs

- a. Goals, objectives and principles of environmental education – Environmental education programmes-Environmental education in India –Environmental laws – role of pollution control board. An account of Natural calamities (Flood, earth quake, forest fire, volcanoes, cyclones)
- b. International bodies- Man and Biosphere Programmes (MAB)- National organization – Department of environment , forest and wild life – A list of important of Environmental agencies

Text Books:

- Eugene P.Odum 1971. Fundamentals of ecology wb. Saunders Co.

Reference Books:

- Jonathan Turk and Amas Turk. 1988. Environmental science, Saunder's college publishing, Philadelphia.
- Trivedi P.R. and Gurdeep Raj 1992. Encyclopaedia of Environmental sciences, Vol. 1 to Vol. 25 Akeshdeep publishing house New Delhi.
- Micheal Begon 1996. Ecology, Blackwell science, Oxford.
- Gupta P.K and D.K Salunka 1985. Modern Toxicology, Vol. 1 to 3 - Metropolitan book co. New Delhi.
- Robert Leo Smith 1990. Ecology and field biology- Harper Collins. Pub New York.

M.Sc. Zoology CBCS Syllabus - SEMESTER – IV
(For those who joined in June 2015 and after)

Core Subject Theory		
Subject Title : BIOFARMING TECHNOLOGY		
Subject Code: 31EP41	Hours per week: 6	Credit: 5
Sessional Marks: 25	Summative Marks: 75	Total Marks: 100

6hrs/week- 72hrs

Objectives:

To enable the students to

- *Developing self-employment skills*
- *Exposure to entrepreneurial avenues in animal studies*

Unit I: Vermitechnology

15 hrs

Earthworm – Biology, Vermicomposting – process – methods – harvesting – vermicast - its characteristics – application; preparation of vermiwash – characteristics and applications of vermiwash Role of Vermitechnology in organic farming

Unit II: Apiculture

15 hrs

Honey bee – Races of Bees – life cycle – bee hives – bee keeping methods – Bee disease and enemies- Apiary site- Harvesting of honey – Nutritive and Medicinal value of honey-Value added products-Marketing

Unit III: Sericulture

15 hrs

Moriculture – propagation – pests and diseases – control measures. Sericulture – Mulberry silkworm – Biology of *Bombyx mori* – Rearing – pests and diseases – control measures- Brief account on Non-mulberry silkworms (Eri, Muga and Tasar) – Brief account on grainage and silk technology.

Unit IV: Pisciculture

15 hrs

Edible fishes – Biology of Indian major carps, Characteristics of Culturable fishes, Ornamental fish culture - Induced spawning technique – pests and diseases – control measures –

Unit V: Dairy Farming and Poultry

12 hrs

Characteristics of Dairy breeds – Exotic, Hybrid and Native, Housing system, feeding and breeding– artificial insemination, Dairy products.

Poultry – common breeds – housing – feeding – management – diseases and control measures.

Reference Books:

- Scientific Farm Animal Production An Introduction to Animal Science 2012, T.G. Field PHI Learning Private limited, New Delhi
- P.K.Gupta, 2003.Vermicomposting for Sustainable Agriculture AgroBios (India) P.K.Gupta., Jodhpur
- E.F.Phillips 2003. Beekeeping AgroBios (India) P.K.Gupta., Jodhpur
- G.C.Banerjee, 2012. A Text Book of Animal Husbandary Oxford & IBH Publishing Co. Pvt.Ltd, New Delhi
- G.Ganga and J. Sulochana Chetty 2006. An introduction to Sericulture– Oxford and IBH Pub. Co. Pvt.Ltd, New Delhi
- V.G.Jhingram 1983. Fish and Fisheries of India, Hindustan Publishing Corporation (India) New Delhi

M.Sc. Zoology CBCS Syllabus - SEMESTER – IV
(For those who joined in June 2015 and after)

Core Subject Practical		
Subject Title : PRACTICAL – IV		
Subject Code: 31CP43	Hours per week: 6	Credit: 3
Sessional Marks: 40	Summative Marks: 60	Total Marks: 100

Objectives:

To enable the students to

- *Importance of commercial bio products and vermincomposting techniques*
- *Methodology to study population density in terrestrial organisms*
- *Methods of rearing the silk worms*

ADVANCED BIOTECHNOLOGY

(2hrs/week)

1. Installation, operation and maintenance of Bio-gas Plant (visit to biogas Plant)
2. Models a) Typical fermenter b) Culture systems – Batch and continuous culture c) Trickling filter
3. Substrates a) Starch b) Agricultural waste c) Energy crops
4. Commercially important bio-products a) amino acid b) Lactic acid c) Citric acid d) Ethanol e) Enzyme f) Antibiotics g) Vitamins h) Hormones i) Vaccines
5. Composting strategies and Vermicomposting methods

ENVIRONMENTAL BIOLOGY

(2hrs / week)

1. Morphometry of a Fresh water Pond.
2. Estimation of Primary Productivity in a pond using Dark and Light bottle method.
3. Estimation of Calcium and Magnesium in Water Samples.
4. Estimation of Nitrates and Phosphates in Water samples.
5. Qualitative and quantitative Estimation of Planktons in a pond.
6. BOD- Estimation.
7. Estimation of tolerance limits of Pesticides on an organism.
8. Study of Population density in grassland using quadrature method.
9. Observation of Pollution indicator organisms
10. Estimation of Population size in an Imaginary Pond.

Objectives:

- *Hands on training in bio farming technologies*
- *Industrial and field visits to develop confidence among students to become Bio-entrepreneur*

Practical, demonstration and field visit

1. Maintenance of mulberry farm – study on the biology of mulberry plant – pests (any five) – Chawki leaves.
2. Morphology of silkworms – male and female identification in the larva, pupa and adult stages.
3. Rearing of silkworm from disease free laying – harvesting of cocoons
4. Morphology of Earthworm – segmentations – pores – ecotypes
5. Visit to Vermicomposting unit – observation for precomposting – composting
6. Observation of vermicast – Qualitative analysis of vermicast
7. Preparation of vermiwash - Qualitative analysis of vermiwash
8. Identification of Honey bees
9. Structure of bee hive - parts
10. Identification of poultry breeds
11. Identification of any three edible fishes (Morphology)
12. Identification of any three ornamental fishes (Morphology)

PG Summative Practical Examination**Question Paper Pattern****Practical III & IV****Time: 4hrs****Marks: 60**

1. Major Practical		15 mark
2. Minor Practical	(2 x 10)	20 mark
3. Spotter	(5 x 3)	15 mark
4. Viva-Voce		5 mark
5. Record note book		5 mark

Total 60 marks
