FAROOK COLLEGE (AUTONOMOUS)

Farook College PO, Kozhikode-673632

P.G Programme in Zoology

Under

Choice Based Credit Semester System

SYLLABUS

(2022 Admission Onwards)

Prepared By:

Board of Studies in Life Science

Farook College (Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the bona fide copies of the syllabus of M.Sc. Zoology programme to be effective from 2022 admission onwards.

Date: Principal
Place: Farook College

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Table I: M.Sc. Zoology Core Course Structure
Total Credits: 80

Semester	***Code No***	***Course Title***	***Credits***	***External Weightage***	***Internal Weightage***
I	MZL1C01	Core Course I: Biochemistry	4	30	5
	MZL1C02	Core Course II-Biophysics & Biostatistics	4	30	5
	MZL1C03	Core Course III-Systematics & Evolution	4	30	5
	MZL1L01	Practical related to Core Course I: Biochemistry	*	-	
	MZL1L02	Practical related to Core Course II-Biophysics & Biostatistics	*	-	
	MZL1L03	Practical related to Core Course III-Systematics & Evolution	*	-	
	MZL1A01	Audit Course: Ability Enhancement Course	4	(Not Included in CGPA)	
II	MZL2C04	Core Course IV- Molecular Biology	4	30	5
	MZL2C05	Core Course V- Ecology & Ethology	4	30	5
	MZL2C06	Core Course VI- Developmental Biology & Endocrinology	4	30	5
	MZL2L01	Practical related to Core Course IV-Molecular Biology	*	-	
	MZL2L02	Practical related to Core Course V-Ecology & Ethology	*	-	
	MZL2L03	Practical related to Core Course VI-Developmental Biology & Endocrinology	*	-	
	MZL2A02	Audit Course: Professional Competency Course	4	(Not Included in CGPA)	
III	MZL3C07	Core Course VII –Physiology	4	30	5
	MZL3C08	Core Course VIII-Microbiology& Biotechnology	4	30	5
	MZL3E01(5)	Elective Course I-Wildlife Biology I-Biodiversity & Biota	4	30	5
	MZL3L04**	Practical related to Core Course VII –Physiology	**	-	
	MZL3L05**	Practical related to Core Course VIII-Microbiology& Biotechnology	**	-	
	MZL3(E) L01**	Practical related to Elective Course I-Wildlife Biology I-Biodiversity & Biota	**	-	

IV	MZL4C09	Core Course IX-Immunology & Cytogenetics	4	30	5
	MZL4E02(5)	Elective Course II-Wildlife Biology II-Wildlife Conservation	4	30	5
	MZL4E03(5)	Elective Course III-Wildlife Biology III-Wildlife Management	4	30	5
	MZL4L04	Practical related to Core Course IX – Immunology & Cytogenetics	**	-	
	MZL4(E) L01	Practical related to Elective Course II-Elective Course II-Wildlife Biology II-Wildlife Conservation	**	-	
	MZL4(E) L02	Practical related to Elective Course III-Elective Course III-Wildlife Biology III-Wildlife Management	**	-	
	MZL4P01	Project Work	6	40	10
	MZL4V01	Viva voce	2	20	5

FIRST & SECOND SEMESTER- PRACTICAL COURSES

Code No	*Course Title*	*Credits*	*External Weightage*	*Internal Weightage*
MZL2L01	**Core Practical I**: BIOCHEMISTRY, BIOPHYSICS & BIOSTATISTICS	4	30	10
MZL2L02	**Core Practical II**: MOLECULAR BIOLOGY, DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY.	4	30	10
MZL2L03	**Core Practical III**: ECOLOGY, ETHOLOGY, SYSTEMATICS & EVOLUTION	4	30	10

THIRD &FOURTH SEMESTER- PRACTICAL COURSES

Code No	*Course Title*	*Credits*	*External Weightage*	*Internal Weightage*
MZL4 L04	**Core Practical IV**: PHYSIOLOGY, MICROBIOLOGY, BIOTECHNOLOGY, IMMUNOLOGY, CYTOGENETICS, HISTOCHEMISTRY & MICROTECHNIQUE	4	30	10
MZL4(E)L01	**Elective Practical- 1**: WILDLIFE BIOLOGY I &II	4	30	10
MZL4(E)L02	**Elective Practical II**: WILDLIFE BIOLOGY III	4	30	10

* Exam will be held at the end of the Second semester along with another practical course.
** Exam will be held at the end of the Fourth semester along with other practical courses.

TOTAL CREDITS - 80

Total number of theory courses - **12**
Total number of practical courses - **6**
Credit for each theory course - **4**
Credit for each practical course - **4**
Total credits for theory course - **48**
Total credits for practical courses – **24**
Project work: Credits - **6 (4 Credit for the Project report & 2 credits for Project Viva)**
(Project report/dissertation shall be presented PowerPoint software)
Viva Voce - **2**(General Viva voce)
Credit for Audit courses
(Not Added for SGPA/CGPA) **- 8** (Audit course 1(4 credit) & Audit course II (4 credit)

LIST OF ELECTIVES

Elective -I MZL3E01

MZL3E01 (1)-Entomology I-Morphology & Taxonomy

MZL3E01 (2)-Environmental Biology I-Man, Environment & Natural Resources

MZL3E01 (3)-Human Genetics I - Clinical Genetics

MZL3E01 (4)-Fishery Biology I-Taxonomy, Biology, Physiology & Ecology

MZL3E01 (5)-Wildlife Biology I-Biodiversity & Biota

Elective -II: MZL4E02

MZL4E02 (1) - Entomology II-Anatomy & Physiology

MZL4E02 (2)-Environmental Biology II-Environmental Pollution

MZL4E02 (3)-Human Genetics II- Diagnostic Genetics

MZL4E02 (4)- Fishery Biology II-Capture & Culture fisheries.

MZL4E02 (5)-Wildlife Biology II-Wildlife Conservation

Elective -III: MZL4E03

MZL4E03 (1)-Entomology III-Agricultural & Medical entomology, Principles of Insect pest management & Toxicology

MZL4E03 (2)-Environmental Biology III-Environmental Conservation

MZL4E0 (3)-Fishery Biology III-Harvesting, Post harvesting technology & Marketing

MZL4E03 (4)-Human Genetics III-Cancer Genetics & Genetic services

MZL4E03 (5)-Wildlife Biology III-Wildlife Management

SEMESTER - I
M ZL1C01 – BIOCHEMISTRY

COURSE OUTCOMES [COs]

CO1	The student develops an understanding of the importance of various chemical interactions in the biological system
CO2	The student develops the ability to analyse the structure, classification, and biochemical properties of carbohydrates from other organic molecules
CO3	The student develops the ability to describe classification, structural organization, and purification techniques of proteins
CO4	The student develops understanding of the classification and functions of lipids and fatty acids
CO5	The student develops Appreciation on the mechanism of enzyme action, inhibition, and classification of enzymes that facilitate the functioning of enzymes
CO6	The student develops appreciation on Watson and Crick model of DNA
CO7	The student develops the understanding of anabolic and catabolic pathways of biomolecules such as glucose, nucleic acids, amino acids and lipids
CO8	The student understands the principles of energetics in biological systems.

(90 hours)

1. Introduction **2 hrs**

1.1. Macromolecules and their subunits
1.2. Chemical bonds of biomolecules

2. Carbohydrates **10 hrs**

2.1. **Monosaccharides**
2.1.1. Classification with examples
2.1.2. Structure of glucose, fructose, galactose, mannose and ribose
2.1.3. Methods of representation of sugars (Ball and stick, projection formula and perspective formula)
2.1.4. Isomerism – Structural isomerism (functional group isomerism) and stereo isomerism (optical isomerism)- mention epimer, anomer and enantiomer with examples
2.1.5. Mutarotation
2.1.6. Reactions – Oxidation (by acids, metal hydroxides and H2O2), dehydration (by acid) and reduction (by alkali), reactions with alanine and phenyl hydrazine
2.1.7. Derivatives – ascorbic acid, acetal and hemiacetal, ketal and hemiketal, glycosides glycosidic bond and deoxyribose
2.1.8. Biological roles of monosaccharides

2.2. **Disaccharides**
2.2.1. Structure and biological roles of Maltose, Sucrose, Lactose, Cellobiose and Trehalose
2.2.2. Biosynthesis of trehalose and lactose

2.3. **Polysaccharides**

2.3.1. Homopolysaccharides – Structure and biological roles of cellulose, starch, glycogen, inulin and chitin

2.3.2. Mode of action of amylase on homopolysaccharides (starch and glycogen)

2.3.3. Heteropolysaccharide - Structure and biological roles of hyaluronic acid, chondroitin, chondroitin sulphate, keratan sulphate, heparin and agar-agar.

3. Proteins **8 hrs**

3.1. Amino acids

3.1.1. Classification: (a) on the basis of number of amino and carboxyl group (b) on the basis of the chemical composition of side chain (c) based on the polarity of side chain(R)

3.1.2. Amphoteric properties of amino acids

3.1.3. p*K* value and isoelectric point (pI) of amino acids

3.1.4. Peptide bond and peptides (di, tri, tetra, oligo and polypeptide)

3.2. Structure of protein

3.2.1. Primary structure, Secondary structure (α-helix –parallel & antiparallel and β pleated sheet), random coil conformation, Tertiary structure, Quaternary structure.

3.2.2. Brief note on protein domains, motifs, folds and Ramachandran plot.

3.2.3. Biological roles of proteins

4. Lipid **7 hrs**

4.1. Classification of lipids -Simple lipids (fats, oils and waxes), compound lipids (Phospholipids, glycolipids, lipoproteins and sulpholipids) and derived lipids.

4.2. Brief account of the chemistry of sterols, terpenes and carotenoids.

4.3. Acid number, saponification number, Iodine number, Polenske number and Reichert-Meisel Number of lipids

4.4. Biological roles of lipids – as food reserves (storage lipids), structural lipids in membrane, as signals, as co-factors, as pigments, as insulators, as vitamin carriers etc.

4.5. Prostaglandins – Chemical nature and types.

4.6. Fatty acids – definition; essential fatty acids

4.7. Classification with examples– Saturated, unsaturated, hydroxyl and cyclic fatty acids

4.8. Nomenclature of fatty acids – Genevan system

5. Nucleic acids **10 hrs**

5.1. Structural organization of DNA (Watson –Crick model)

5.2 Topology of DNA-supercoiling, role of topoisomerases.

5.2. Characteristic features of A-, B- C- and Z-DNA

5.3. Structural organization of t-RNA; brief note on micro-RNA

5.5. Biological roles of nucleotides and nucleic acids

5.6 Structural organization of Chromosomes- Chromatin structure- nucleosome- Ultrastructure and organization (Multistrand model, folded fibre model and solenoid model)-three levels of organization of chromosome.

5.7 Euchromatin, Heterochromatin, Unique and repetitive DNA

6. Enzymes **10 hrs**

6.1. Classification- (I.U.B. system)

6.2. Specificity of enzyme action

6.3. Mechanism of enzyme action: Formation of enzyme substrate complex- Gibbs free energy of activation; Michaelis-Menton theory, Fischer's template theory and Koshland's, induced fit theory. Electrostatic, hydrogen and Van der Waal's bonds in Enzyme-substrate complex.
6.4. Enzyme kinetics - Michaelis-Menten equation – derivation; significance of K*m* and V*max* Values.
6.5. Lineweaver-Burk equation and double reciprocal plot of enzyme reaction.
6.6. Enzyme inhibition – Competitive, non-competitive and uncompetitive inhibition (distinguish kinetically), suicide inhibition and feedback inhibition
6.7. Allosteric enzymes – positive and negative modulators
6.8. Iso-enzyme, ribozyme and coenzymes
6.9 Factors influencing enzyme action

7. Vitamins **3 hrs**

7.1 Classification
7.2 Structure and functions
7.3Role of B-complex vitamins as coenzymes

8. Bioenergetics **5 hrs**

8.1. Laws of thermodynamics and biological system, Enthalpy, Entropy, Free energy concept
8.2. Energy of activation, Standard free energy change
8.3. Role of ATP as a free energy carrier in the biological system

9. Metabolism and biosynthesis of biomolecules **14 hrs**

9. 1. Carbohydrate metabolism

9.1.1 The concept of metabolism
9.1.2 ATP- the energy currency, structure
9.1.3 Sun: as the ultimate energy source
9.1.4 Photosynthesis; Light reaction and dark reaction
9.1.5 Cellular respiration Vs Photosynthesis
9.1.6. Glycolysis – (PFK as pacemaker – Hexokinase conformation and change by glucose), Fate of pyruvic acid
9.1.7 Regulation of Glycolysis and PPP
9.1.8. Metabolism of 2, 3 DPG as regulator of oxygen transport
9.1.8. Citric acid cycle; Pyruvate dehydrogenase complex and ketoglutarate dehydrogenase complex
9.1.9. Electron transport system and oxidative phosphorylation; Redox potential, Chemiosmotic hypothesis; inhibitors of electron transport chain
9.1.10 Starvation Biochemistry-. Gluconeogenesis, Glycogenesis, Glycogenolysis; regulation of glycogen synthesis and breakdown
9.1.6. Pentose phosphate pathway (HMP pathway)

9.2. Amino acid metabolism **8 hrs**

9.2.1. Biosynthesis and degradation of amino acids – glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine, &histidine

9.3. Lipid metabolism **8 hrs**

9.3.1. Oxidation of fatty acids-Beta oxidation, alpha oxidation and omega oxidation. Ketone bodies.
9.3.2. Biosynthesis of fatty acids
9.3.3. Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Biosynthesis of cholesterol.
9.3.4 Prostaglandins: Synthesis and functions

9.4. Nucleic acid metabolism **5 hrs**

9.4.1. Biosynthesis of purines and pyrimidines
9.4.2 Degradation of purines and pyrimidines

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2. Robert Harper's Biochemistry, (1996) 24th Edition, K. Murray, Daryl K. Granner, Peter, A. Mayes and Victor, W. Rodwell Appleton and Lange, Prentice Hall of India Private limited, New Delhi,
3. Lubert Stayer,(latest) Biochemistry, II edition, W.H. Freeman & Co. NY
4. Oser, B.L, (1965) Hawk's Physiological Biochemistry, Mc Graw Hill Book Co.
5. Eric E. Conn, Paul K. Stumpf, George Bruening, Roy H. Doi, (latest) Outlines of Biochemistry, Vth edition, John Wiley & Sons, Inc, (2007).
6. Deb, A.C.(2004) Fundamentals of biochemistry, New Central Book Agency (P) Ltd.
7. Keith Wilson and John Walker (2008) Principles and techniques of Biochemistry and Molecular biology – 6th edn, Cambridge University Press
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10. Devlin,T.M. (2006), A Text of Biochemistry with clinical correlations, John Wiley & Sons

PRACTICALS

MZL1L01: BIOCHEMISTRY

COURSE OUTCOMES

CO1	The student develops an understanding and comparison of pH in biological processes.
CO2	The student familiarizes with qualitative tests to identify and distinguish various carbohydrates.
CO3	The student learns to conduct qualitative analysis to identify proteins and non-protein nitrogenous substances
CO4	The student learns to conduct Quantitative tests for carbohydrates, lipids, proteins and non-protein nitrogenous substances

1. Actual acidity and titrable acidity of a strong and a weak acid.
2. Comparison of the buffering capacities of two buffers of same pH
3. Qualitative tests for carbohydrates
    a) Qualitative tests for monosaccharides (Glucose and fructose)
    b) Qualitative tests for disaccharides (Lactose, Maltose & Sucrose)
    c) Qualitative tests for polysaccharides (Dextrin & Starch)
    d) Identification of unknown carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose, Dextrin & Starch) by suitable tests.
4. Quantitative estimation of carbohydrates
    4.1. Estimation of blood glucose by colorimetric method (Somogy-Nelson method/ O -Toludine method)
    4.2. Estimation of total carbohydrate by phenol-sulphuric acid method
5. Qualitative tests for proteins
    a) Colour reactions with proteins (Albumin, Casein, Peptones & gelatin)
    b) Precipitation reactions with proteins (Albumin, Casein, Peptones & gelatin)
    c) Identification of unknown protein (Albumin, Casein, Peptones & gelatin)
6. Qualitative tests for non-protein nitrogenous substances (urea, uric acid and creatinine)
7. Identification of unknown carbohydrates, protein and non-protein nitrogenous substances from a given solution.
8. Quantitative estimation of proteins
    a) Estimation of proteins by Biuret method
    b) Isolation of casein from cow's milk
9. Quantitative estimation of non-protein nitrogenous substances
    a) Quantitation of blood urea by diacetyl monoxine method
    b) Determination of urine creatine by alkaline picrate method
10. Quantitative estimation of lipids
    a) Estimation of total serum cholesterol by Zak's method
    b) Saponification number of oils – coconut oil & ground nut oil.
    c) Iodine number of fats

References:

1. Plummer David, T.(latest) An introduction to practical biochemistry –Tata Mc Graw-Hill, New Delhi
2. Oser, B.L., (1965) Hawk's Physiological Biochemistry, McGraw Hill Book Co.
3. Sadasivan, S. and Manickam, A., (2005), Biochemical methods, New Age International, New Delhi.
4. Keith Wilson and John Walker (2008), Principles and techniques of Biochemistry and Molecular biology – 6th edn, Cambridge University Press
5. Jayaraman, J.(latest.) Laboratory Manual in Biochemistry, Wiley Eastern Ltd.

*SEE will be at the end of Second Semester

MZL1C02-BIOPHYSICS AND BIOSTATISTICS

(90 Hours)

Course outcomes (COs)

CO 1	The students understand the basic principles of physics involved in biological processes**.**
C02	The student develops an understanding about the biological aspects and implications of sound energy
CO 3	The student will be able to differentiate various ionizing radiations and to understand a comparative account of their biological effects.
CO 4	The student may familiarize with various biophysical and electrophysiological methods
CO 5	The students understand the principles of microscopy.
CO 6	The students understand the principles and applications of separation techniques.
CO 7	The student develops an understanding gravity 'G' force and its multi-faceted applications.
CO 8	Introduction and familiarization of Nano technology as a highly promising arena in biological investigations
CO 9	The students understand various methods of data collection, tabulation and presentation of data for biological research
CO 10	The student develops ability to apply measures of central tendency and dispersion in biological research, and various types of probability distribution.
CO 11	The students understand parametric and non-parametric tests and its applications in biological research

Section-A-Biophysics (50 Hours)

1. Principles of biophysical chemistry 6 hrs

1.1- pH, pH value calculation, Henderson Hassel batch equation, Electrometric determination of pH.

1.2- Buffers and its biological significance

1.3 - Diffusion: Fick's law and diffusion coefficient, Stoke, Einstein's law, Gibb's Donnan equilibrium. Application of diffusion processes in biology: hemolysis, cyclosis, plasmolysis

1.4 -Osmosis: Vant Hoff's laws, Osmotic concentration, osmotic gradient, Osmotic pressure, Electro-osmosis, Electrolytic and ionic balance in biological fluid

1.5-Viscosity: Factors affecting viscosity, Determination of viscosity of liquids, significance

2. Radiation Biology 8 hrs

2.1 -Radioactivity, ionizing radiations, interaction of radiation with matter

2.2 -Properties of different types of radioisotopes normally used in biology

2.3- Biological effects of ionizing radiations- effects at macromolecular, cellular and organ system level, effects of whole body irradiation.

2.4 -Detection and measurement of radioisotopes: Radiation dosimetry
2.4.1 -G.M. counter
2.4.2 -Ionizing chambers
2.4.3 -Autoradiography
2.4.4 -Cerenkov radiation
2.4.5 Liquid Scintillation
2.5 -Molecular imaging of radioactive materials in Nuclear medicine: MRI, FMRI, PET, SPECT
2.6 -Safety guidelines

3. Biophysical methods **5 hrs**

3.1 -Spectroscopy
3.1.2 -UV/visible
3.1.3 -Fluorescence
3.1.4 -Circular dichroism
3.1.5 -NMR and ESR spectroscopy
3.2- Structure determination using X-ray diffraction
3.3- Different types of mass spectrometry

4. Electrophysiological methods **3 hrs**

4.1 -Single neuron recording
4.2 -Patch-clamp recording
4.3 -Electrocardiography (ECG)
4.4 -Brain activity recording - Lesion and stimulation of brain
4.5 EEG, CAT

5. Microscopic techniques **8 hrs**

5.1- Resolving powers of different microscopes
5.2 -Phase contrast, fluorescent and confocal microscopy
5.3 -Electron microscopy: Scanning and transmission (SEM and TEM)
5.4 -Freeze-etch and freeze-fracture methods for Electron Microscope
5.5 -Cytophotometry
5.6 -Different fixation and staining techniques
5.7 -Cryotechniques
5.8 -Laser and its applications in biology

6. Separation techniques **10 hrs**

6.1- Chromatography
6.1.1- Principle and applications:
6.1.2- Adsorption chromatography
6.1.3- Partition chromatography
6.1.4 -Column chromatography
6.1.5- Paper chromatography
6.1.6- Thin layer chromatography
6.1.7 -Gel-filtration
6.1.8- Ion-exchange
6.1.9 -Gas chromatography
6.1.10 -Affinity chromatography
6.1.11- HPLC
6.2.- Electrophoresis

6.2.1 Paper electrophoresis
6.2.2- Disc electrophoresis
6.2.3- PAGE - Two-dimensional PAGE
6.2.4 -High voltage and immuno electrophoresis
6.2.5 -Isoelectric focusing
6.3. -Flow cytometry

8. Hydrodynamic techniques **3 hrs**

8.1- Principles and applications
8.2.- Centrifugation (Ultracentrifugation, Differential centrifugation and Density gradient centrifugation)

9. Bioacoustics **5 hrs**

9.1-Characteristics of sound
9.2-Physical basis of hearing
9.3-Physical organization of ear
9.4- Physical aspects of sound transmission in the ear.
9.5-Audible sound frequency
9.6-Pitch reception and theories
9.7-Infrasonic and ultrasonic sounds
9.8 Echolocation; receiving and analyzing echoes

10-Nanotechnology **2 hr**

10.1- Definition
10.2- Nanotechnology and its applications in the field of health care.
10.3- Roles of nanotechnology in environmental management

Biostatistics

(40 Hours)

1. Introduction **2 hrs**

1.1- Sample and test biostatistics
1.2- Descriptive and Inferential biostatistics
1.3 -Attributes and variables
1.4 -Applications of biostatistics
1.5 -Limitations of statistical methods
1.6 -Role of biostatistics in modern research

2. Measures of Central tendency **5 hrs**

2.1 -Characteristics
2.2- Arithmetic mean, Geometric mean and Harmonic mean
2.3 -Correcting incorrect arithmetic mean
2.4 -Combined arithmetic mean
2.5 -Merits and demerits
2.6 -Median – Computation in ungrouped and grouped data
2.6.1 -Graphical presentation of Median
2.7- Mode - Computation in ungrouped and grouped data
2.7.1 -Graphical presentation of Mode

3. Measures of dispersion or variability **7 hrs**

3.1- Variability or dispersion
3.2 -Importance of dispersion

3.3 -Range
3.4 -Quartile deviation
3.5 -Mean deviation
3.6 -Standard deviation
3.7- Variance
3.8 -Co-efficient of variation
3.9 -Standard error
3.10- Lorenz curve – construction

4. Probability distribution **7 hrs**

4.1.- Basic concepts and definition:
4.2.- Laws of probability
4.3.- Types of Probability distribution: -
4.3.1- Binomial distribution- Definition, Properties and Fitting of binomial distribution
4.3.2- Poisson Distribution-Definition and properties
4.3.3-Normal distribution - Definition and properties
4.3.3.1 -Skewness and Kurtosis
4.3.3.2-Nature of Skewness
4.3.3.3 -Measures of Skewness
4.3.3.4 -Fitting of normal curves

5. Statistical inference **8 h**rs

5.1- Test of significance
5.2- Test of hypothesis
5.3- Level of significance
5.4- Degree of freedom
5.5-Critical region
5.6 -Parametric and Non-parametric test
5.7- Type I and Type II error
5.8 -Type of t-tests
5.9 -Chi-square test
5.10. -Kruskal-Wallis, Mann-Whitney

6. Analysis of Variance **4 hrs**

6.1- Assumptions and techniques of ANOVA
6.1.1- One-way classification
6.1.2- Two-way classification
6.2- Basic introduction to Multivariate statistics

7. Correlation and Regression analysis **7 hrs**

7.1- Types of correlation
7.1.1- Graphic methods – Scatter diagram, Simple graph, Correlogram
7.1.2- Mathematical methods – Karl Pearson's co-efficient of correlation, Spearman's Rank correlation co-efficient
7.1.3- Tied ranks and Repeated ranks
7.1.4- Co-efficient of concordance
7.2 -Types of regression
7.2.1- Graphic method and Algebraic method
7.2.2 -Regression lines
7.2.3- Regression equation

REFERENCES

BIOPHYSICS

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BIOSTATISTICS

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2. Bailey, N.T.J. (1981) Statistical methods in Biology. Hodder and Stongtton, London.
3. Campell, R.C. (1978), Statistics for biologists. Blacker and Sons Publishers, Bombay.
4. Gupta, C.B. and Gupta, V. (2002) Statistical methods. Ikas Publishing House, New Delhi.
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6. Magurran AE. 2004. Measuring Biological Diversity. Blackwell Publishing
7. Stephen W,Looney (2008) Methods in Molecular Biology-Biostatistical Methods Springer International Edition
8. Zar, J.H. (2003) Biostatistical Analysis - Fourth edition. Pearson Education. New Delhi.

PRACTICALS
MZL1L02 *: BIOPHYSICS & BIOSTATISTICS

Course outcomes (COs)

CO1	The student familiarizes with the instruments/ techniques in biophysics; PH meter, Paper chromatography, TLC, Gel electrophoresis
C02	Application of colorimetry in quantitative analysis
C03	The student gather knowledge regarding Collection, grouping and graphical representation of data with special emphasis on Microsoft Excel.
C04	The student learns to calculate measures of dispersion and their applications in data analysis.
C05	Familiarising with data interpretation in statistics; ANOVA, Correlation and Regression analysis.

Biophysics

1. pH meter and measurement of pH
2. Paper chromatography of amino acids, mixtures, identification of unknown amino acids and sugars
3. Gel filtration chromatography (Separation of starch from glucose)
4. Thin layer chromatography of amino acids and sugars.
5. Gel electrophoresis.
6. Drawing using camera lucida.
7. Measurement of size of microscopic objects using stage and ocular micrometers
8. Determination of coefficient of viscosity using Ostwald's Viscometer
9. Determination of absorption coefficient and concentration of unknown solutions by calibration curve using a colorimeter.
8. Absorption spectrum and max of a coloured solution (KMnO4)

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1. Ackerman, E. (1962). Biophysical Chemistry, Prentice Hall Inc.
2. White, D. C. S. (1974). Biological Physics, Chapman and Hall, London.
3. Hoppe, W. (ed.) (1983). Biophysics, Springer Verlag.
4. Slayter, E. M. (1970). Optical Methods in Biology
5. Gassey, E. J. (1962). Biophysics Concepts and Mechanics. Van Norstrant Reinhold Co.
6. Daniel, M. (1998). Basic Biophysics for Biolgists. Agro Botanica, Bikaner.
7. Das, D. (1987). Biophysics and Biophysical Chemistry. Academic Publishers, Calcutta.

Biostatistics

1. Preparation of frequency table with given data

2. Diagrammatic presentation of census data in Kerala in the form of bar diagrams and pie diagrams. (Prepare same graph in Excel and keep print out)

3. Graphic presentation of population distribution in the form of histogram, frequency polygon and frequency curve. (Prepare same graph in Excel and keep print.

4. Computation of measures of central dispersion anthropometric data of School children. (Prepare same in Excel and keep print outs and add steps for excel)

5. Simulation of binomial and poison distributions.

6. Estimation of mean number of children per family (data from at least 10 families nearby campus) (prepare same in Excel and keep print outs and add steps for excel).

7. Designing of an experiment for the comparison of efficacy of a few diets on different types of animals by the method of ANOVA. (Prepare same in Excel and keep prints out and add steps for excel).

8. Regression analysis and correlation analysis of a data of height and weight of a group of students. (Prepare same in Excel and keep print outs and add steps for excel)

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*SEE will be at the end of Second Semester

MZL1C03- SYSTEMATICS AND EVOLUTION

(90 hours)

Course outcomes (COs)

CO1	The students gain an understanding of identification and taxonomic classification of organisms based on their characters
CO2	The student will be able to describe different levels of taxonomy
CO3	Aware about Place, importance, applications and goals of taxonomy
CO4	Learn about purpose of classification, use of classification, theories of biological classification and types classification
CO5	Explain taxonomic procedures like Taxonomic collections, Curation, recording of field data, storage of collection, labelling and cataloguing of collection Identification- methods of identification, Use of keys, Taxonomic descriptions, Taxonomic and ecological publication and their difference
CO6	Understand Species concept and the taxonomic diversity within species, different kinds of species, sub species and other infra specific categories, hybrids
CO7	Recognize the importance of Zoological nomenclature, International Code of Zoological Nomenclature
CO8	Interpret Principle of priority, Homonymy and Synonymy and Different kinds of types in descriptive taxonomy
CO9	Use new trends in Systematics especially Chemo and Sero-taxonomy, Cytotaxonomy, Numerical taxonomy, Cladistics, Molecular systematics and DNA bar coding vs traditional taxonomy
CO10	Recognize the ethics related to taxonomic collections and publication
CO11	Realize the taxonomic impediments
CO12	Describe the mechanism of natural selection and the evolutionary mechanisms
CO13	Explain tempo of evolution
CO14	Describe molecular evolutionary theories like Neutral theory of molecular evolution, Molecular clocks- genetic equidistance- human mitochondrial molecular clock and Phylogenetic relationships
CO15	Recognize Evolutionary trends in Biochemical evolution and primates' evolution
CO16	An enhanced knowledge about the Mechanism of natural selection –
CO17	To understand Hardy-Weinberg law, founder principle, bottleneck effect and genetic drift, ecotypes etc.
CO18	The major process involved in the Co-evolution; Microevolution, Macroevolution are recognised
CO19	The process involved in the Gradualism and punctuated equilibrium along with Anagenesis and Cladogenesis will be acquired
CO20	An enhanced understanding of Neutral theory of molecular evolution; molecular divergence; molecular drive, Molecular clocks- genetic equidistance- human mitochondrial molecular clock, Phylogenetic relationships- DNA barcoding vs traditional taxonomy etc

Part- A Systematics -50 Hrs

I. Introduction **(1 hr)**

2. Definition and basic concepts in Systematics and Taxonomy **(4 hrs)**

2.1 -Levels of Taxonomy: Alpha, Beta and Gamma taxonomy
2.2- Importance and applications of taxonomy
2.3 -Goals of taxonomy
2.4 -Definition of systematics
2.3 -Definition of classification

3. Species **(4 hrs)**

3.1-Monotypic species
3.2-Polytypic species
3.3-Ecospecies and Cenospecies
3.4-Morphospecies
3.5-Super species
3.6-Species as a Population Complex

4. Species Concepts **(6 hrs)**

4.1-Typological Species Concept
4.2-Nominalistic Species Concept
4.3-Biological Species Concept
4.4-Evolutionary Species Concept
4.5-Difficulties in the application of the biological species concept

5. Classification **(4 hrs)**

5.1-Uses of Classification
5.2-Purpose of Classification
5.3-Theories of Classification
(a) Essentialism (b) Nominalism (c) Empiricism (d) Cladism (e) Evolutionary Classification
5.4-Hierarchy of Categories
5.5-The objectives of classification

6. Taxonomic Collections and the Process of identification **(8 hrs)**

6.1-Taxonomic collections: Types of collections, Value of Collection
6.2-Purpose of scientific collection
6.3-Preservation of Specimens
6.4-Labeling
6.5-Curating of collections
6.6-Curating of types
6.7-Identification- Methods of identification
6.8-Use of keys, types of keys.
6.9-Merits and demerits of different keys
6.10-Description and publication

7. Taxonomic Characters **(5 hrs)**

7.1-Nature of taxonomic characters
7.2-Taxonomic characters and adaptation
7.3-Kinds of taxonomic characters
(a) Morphological (b) Physiological (c) Ecological (d) Ethological and
(e) Geographical characters
7.4-Taxonomic characters and classification
7.5-Taxonomic characters and evolution
7.6-Functions of taxonomic characters

8. Zoological Nomenclature **(5 hrs)**

8.1-Brief History of nomenclature
8.2-International Code of Zoological Nomenclature
8.3-The nature of scientific names
8.4-Species and infraspecies names
8.5-Gender of generic names
8.6-Synonyms and Homonyms
8.7-The Law of Priority
8.8-Rejection of names
8.9-Type method and different kinds of types

9. Newer trends in systematics **(5 hrs)**

9.1-DNA Bar coding
9.2-Molecular systematics
9.3-Chemo taxonomy and serotaxonomy
9.4-Cytotaxonomy
9.5-Numerical taxonomy
9.6-Cladistics

10. Ethics related to taxonomic publications **(4 hrs)**

10.1-Authorship of taxonomic papers
10.2-Correspondence
10.3-Suppression of data
10.4-Undesirable features of taxonomic papers
10.5-Taxonomist and user communities

11. Taxonomic impediments **(4 hrs)**

11.1-Impediments in taxonomic collections and maintenance
11.2-Shortage of man power
11.3-Lack of funding for taxonomic research
11.4-Lack of training and library facilities
11.5-Impediments in publishing taxonomic work
11.6-Solutions to overcome the impediments
(a) Improve international co-operation (b) Development of taxonomic centers
(c) Need for efficient international networking (d) the desired end product

Part- B Evolution (40 Hrs)

I. Natural Selection: (5 hrs)

1.1-Mechanism of natural selection- directional, disruptive, and stabilizing selection

1.2-Natural selection in islands

Sexual selection; intrasexual and intersexual selection- secondary sexual characteristics-sexy son hypothesis, good gene hypothesis

2. The Mechanisms (8 hrs)

2.1-Population genetics- populations, gene pool, gene frequency, Hardy-Weinberg law, founder principle, bottleneck effect, and genetic drift as factors in the evolution

2.2-Evidence for evolution: DNA evidence, fossil evidence, embryological evidence, geological evidence, evolution in action, imperfection of evolution

2.3-Coevolution, microevolution, macroevolution, convergent evolution (homoplasy), divergent (parallel) evolution

3. Tempo of evolution (7hrs)

3.1-Gradualism Vs punctuated equilibrium

3.2-Anagenesis Vs Cladogenesis

4. Molecular evolutions (10 hrs)

4.1-Neutral theory of molecular evolution, Molecular divergence, Molecular drive

4.2-Molecular clocks, genetic equidistance, human mitochondrial molecular clock

4.3-Phylogenetic relationships- Homology, homologous sequence of proteins and DNA, orthologous and paralogous evolution, nucleotide sequence analysis

5. Evolutionary trends (10 hrs)

5.1-Biochemical evolution- Collapse of orthogenesis

5.2-Stages in primate evolution including Homo: dry and wet nosed primates, prosimians and simians, human and the African apes, African origin for modern humans, Y chromosome Adam and mitochondrial Eve

5.3-Communication, speech, language and self-awareness in primates (on the basis of evolution)

REFERENCES

Part -A Systematics

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2. David, M.S (2009) DNA bar-coding will frequently fail in complicated groups: an example in wild potatoes. American journal of Botany 96(6) : 1177-1189. Downloadable from www.vcru.wisc.edu/spoonerlab/.../ Bar Codes %20 and % 20 wild% 20 Potatoes.pdf
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Part- B Evolution

9. Coyne, J.A and Allen O.H (2004) Speciation. Sinauer Associates Inc. Massachusetts, USA
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12. Gould, S.J (1997) Ontogeny & Phylogeny, Belkrap Press. Harvard University Cambridge
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PRACTICAL

MZL1 L03* Systematics & Evolution

Course outcomes (COs)

CO 1	The student may gather basic knowledge regarding the Collection and Identification of animals up to species level
CO2	Scientific handling of specimens collected, preservation and museum curation

Systematics

1. Collection, Preservation and curation of specimens
2. Identification of animals (Fishes/insects/any other) up to family/ generic / species level- minimum 15 specimens.
3. Preparation of dichotomous (simple bracket) keys to selected families with reference to insect orders Orthoptera, Hemiptera, Coleoptera, Diptera and Hymenoptera (minimum five specimens from each order)

Evolution

1. Exercises in convergent evolution.
2. Exercises in divergent evolution.
3. Sympatric and Allopatric speciation.
4. Exercises in co-evolution.
5. Calculation of genotype / gene frequency based on Hardy –Weinberg equilibrium.

*SEE will be at the end of Second Semester

REFERENCES

1. Heywood, V. H and Watson, R. T. (1995). Global biodiversity assessment. UNEP, Cambridge University Press.
2. Mayr, E., Linsley, E .G. and Usinger, R. L. (1953). Methods and Principles of Systematic Zoology. McGraw Hill Book Company, Inc.,New York, 336 pp.
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4. Kapoor, V. C. (1998). Theory and Practice of Animal Taxonomy. Oxford & IBH Publ. Co., New Delhi.

SEMESTER- II
MZL2C04- MOLECULAR BIOLOGY

(90 Hours)

COURSE OUTCOMES

CO1.	The students learn to understand the mechanism of DNA replication- both chromosomal and extra chromosomal, enzymes involved, models of replication, inhibitors and the significance of DNA replication
CO2	The students learn to know the safeguard systems of DNA, restriction enzymes and their significance, mechanisms involved in damage and repair of eukaryotic DNA and its importance.
CO3	Learn to explain the general features of genetic code, special features of the genetic code in mitochondria, and variations in genetic code
CO4	The student gain in-depth knowledge regarding the structural organization of mRNA in prokaryotes and eukaryotes, the mechanism of transcription, translation, post transcriptional and translational modifications, structure, biogenesis and role of ribosomes in protein synthesis; and RNA editing.
CO5.	To gain knowledge regarding the regulation of gene expression in Phages, Bacteria, and in Eukaryotes; recent research findings like antisense RNA strategies and role of si RNA and mi RNA in the regulation of eukaryotic gene expression and their applications.
CO6	The components, organization and special features of eukaryotic genome, interrupted genes and their evolution; concept of gene families, and molecular evolutionary clock.
CO7	Introduction to transposition mechanisms in prokaryotes and eukaryotes, and their significance.
CO8	Molecular mechanisms of genetic recombination, models, and significance.
CO9	Special features of microbial genetics, and organelle genome, their replication and mapping
CO10	The students gain an in-depth knowledge regarding the events and regulation of cell cycle, its alteration and causes of cancer. Genes involved in the regulation of cancer and modern therapeutic interventions like immunotherapy and gene therapy

1. DNA replication **10 hrs**

1.1. Semi discontinuous synthesis-Okazaki fragments
1.2. Replication origin and replication fork
1.3. Unit of replication, extra chromosomal replicons of Ti plasmid.
1.4. Enzymes/proteins of replication- Primase, Replisomes, Helicase, DNA polymerases, Single strand binding proteins, Topoisomerases and Ligase; Fidelity of replication
1.5. Replication of the ends of eukaryotic chromosome – role of telomerase
1.6. Models of DNA replication –Rolling circle model and looped rolling circle model, D-loop model, θ-model
1.7. Inhibitors of DNA replication – Methotrexate and Fluorodeoxyuridylate

2. Safeguard systems of DNA **5 hrs**

2.1. Restriction: significance, role and features of Type I, II & III restriction enzymes
2.2. Modification: enzymes and significance
2.3. Repair:
2.3.1. Major kinds of damage to DNA and causes
2.3.2. Repair mechanisms: Direct reversal, Mismatch repair, Excision repair, Recombination repair, SOS response

3. Transcription of mRNA in prokaryotes and eukaryotes **10 hrs**

3.1. Structural organization and life span of mRNA; monocistronic and polycistronic mRNA
3.2. Initiation, elongation and termination of transcription
3.3. Promoter (mention Pribnow, TATA, CAAT and GC box), enhancer and silencer sites
3.4. Transcription factors; Transcription activators and repressors
3.5. Characteristic features of RNA polymerases of phages, prokaryotes and eukaryotes and their functions
3.6. Post transcriptional modification of RNA
3.6.1. Capping
3.6.2. Polyadenylation
3.6.3. Splicing
3.7. RNA editing: site specific deamination and role of gRNAs
3.8. mRNA transport

4. Genetic code **3 hrs**

4.1. Degeneracy of the code: Wobble hypothesis and isoacceptor tRNAs
4.2. Special features of the genetic code in mitochondria, mitochondrial tRNA
4.3. Variations in the genetic code in *Mycoplsma* and *Tetrahymena*
4.4. Point mutations that alter genetic code (missense, nonsense & frameshift)
4.5. Suppressor mutation, suppressor genes & suppressor tRNA

5. Ribosome: The site of protein synthesis: **4 hrs**

5.1- Structure

5.2-Composition; Reconstitution experiments

5.3-Active centres

5.4-Biogenesis of ribosome in eukaryotes

6. Translation in prokaryotes and eukaryotes **10 hrs**

6.1. Aminoacylation of tRNA & initiation, elongation and termination of protein synthesis
6.2. Aminoacyl tRNA synthetases & initiation, elongation and termination factors
6.3. Translational proof-reading
6.4. Differences in protein synthesis between prokaryotes and eukaryotes
6.5. Translational inhibitors in prokaryotes and eukaryote – role of tetracycline, streptomycin, neomycin, chloramphenicol, erythromycin, puromycin and diphtheria toxin
6.6. Post- translational modification of proteins: protein folding (role of chaperones) and biochemical modifications

7. Control of gene expression at transcription and translation level 10 hrs

7.1. Regulation of gene expression in Phages – alternate patterns of gene expression for control of lytic and lysogenic cycle in λ phage

7.2. Regulation of gene expression in bacteria – basic features of tryptophan, arabinose and galactose operons

7.3. Regulation of gene expression in eukaryotes –

7.3.1. Role of chromatin in regulating gene expression

7.3.2. Activation and repression of transcription

7.3.3. Regulation of translation by gene arrangement

7.3.4. Regulation of translation by alternate pathways of transcript splicing

7.3.5. Antisense RNA strategies for regulating gene expression

7.3.6. si RNA and mi RNA in regulation

7.3.7 Gene editing- CRISPR-Cas system

8. Eukaryotic genome 5 hrs

8.1. Special features of eukaryotic genome

8.2. Features, components and reassociation kinetics of Unique, moderately repetitive and Highly repetitive DNA

8.3. Junk DNA, Satellite DNA and Selfish DNA

8.4. Cot value and complexity of genome

8.5. Organization of human genome (brief account)

9. Interrupted genes 4 hrs

9.1. Definition and explanation

9.2. Organization and special features of interrupted genes

9.3. Evolution of interrupted genes

10. Gene families 6 hrs

10.1. Definition and concept

10.2. Classification with example

10.2.1. Simple multigene family - organisation of rRNA gene in *Xenopus*

10.2.2. Complex multigene family - organisation of histone genes in sea urchin and tRNA genes in *Drosophila*

10.2.3. Developmentally controlled complex multigene family e.g., globin gene

10.2.3.1. Globin genes and its products

10.2.3.2. Organisation of globin genes and its expression in Man

10.2.3.3. Evolution of globin genes

10.2.3.4. Concept of an evolutionary clock

10.2.3.5. Pseudogenes

11. Transposable genetic elements - Transposons 6 hrs

11.1. Definition, features and types

11.2. Transposition and mechanism

11.3. Transposons in bacteria

11.3.1. IS elements

11.3.2.Tn family

11.3.3.Mu phage as a transposable element

11.4. Transposons in eukaryotes

11.4.1. SINE, Alu family; LINE, L1
11.4.2. P elements in *Drosophila*
11.4.3. Transposons in Maize
11.5. Retroviruses and transposition

12. Molecular mechanisms involved in recombination of DNA 5 Hrs

12.1-Genetic recombination – types with example
12.2-Site specific recombination
12.3-non-homologous recombination
12.4-Homologous recombination
12.5-Molecular mechanism involved in homologous recombination of DNA in eukaryotes-Holliday model: Holliday intermediate, heteroduplex DNA, gene conversion
12.6-Role of Rec A protein in genetic recombination

13. Human genome 4 hrs

13.1. Human genome mapping
13.2. Sequencing human genome
13.3. Applications of whole genome sequencing in humans

14. Organelle genome 4 hrs

14.1. Extranuclear genes and maternal inheritance
14.2. Chloroplast genome: special features
14.3. Mitochondrial genome
14.3.1. Special features of yeast mitochondrial genome, petite mutants
14.3.2. Special features of human mitochondrial genome

15. Molecular biology of Cancer 4 hrs

15.1. Gene Mutations in cancer and Genetic rearrangements in progenitor cells
15.2. Oncogenes and tumor suppressor genes
15.3. Virus-induced cancer
15.4. Alteration of cell cycle regulation in cancer
15.5. Therapeutic interventions of uncontrolled cell growth – Gene therapy

References:

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2. Benjamin Lewin (2008): Genes, Vol. IX, Boston, Jones, Bartlet.
3. Brown, T.A. (2006): Genomes 3.Garland Science, New York.
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PRACTICAL

MZL2 L01- MOLECULAR BIOLOGY

Course outcomes (COs)

CO1	The student develops practical knowledge to isolate genomic DNA from animal tissues
CO2	The students acquire hands own training in the Quantification of DNA, RNA and Proteins by colorimetric methods
CO3	As a Core curriculum course, students completing this course along with the practical sessions will demonstrate competence in gathering, analyzing, synthesizing, evaluating and applying information gathered

1. Estimation of DNA by Diphenyl Amine method
2. Estimation of RNA by Orcinol method
3. Estimation of Protein by Lowry' method.
4. Agarose gel electrophoresis for separation of DNA
6. Isolation of plasmid DNA.
7. Isolation of genomic DNA.
8. Isolation of DNA from Liver/Spleen/Thymus.
9. Preparation and analysis of salivary gland polytene chromosome from drosophila larva

References:

1. Brown, T.A. (1998): Molecular biology Lab Fax. Vol. 1 and 2, Academic press
2. Brown, T.A. (2007): Essential Molecular Biology – A practical approach Vol. 2, Oxford University Press
3. Wilson & Walker (2006): Principles and techniques of Biochemistry and Molecular biology, Cambridge University Press

MZL2C05- ECOLOGY AND ETHOLOGY

(90 Hours)

MZOL2B05- ECOLOGY AND ETHOLOGY

COURSE OUTCOMES

CO 1	The student develops ability to differentiate between the concepts of Habitat, Niche
CO 2	The students explain the concepts of, Ecosystem energetic sand Mineral cycling.
CO 3	The students learn to appreciate nature's way to maximize efficiency in utilization of energy and resources; to reduce competition.
CO 4	To describe the characteristics of population growth and species interaction
CO 5	To explain the components of Ecological community, the process of Ecological succession, Biomes etc.
CO 6	To appreciate the complexity of relationship between organisms
CO 7	To describe the characteristics of various biogeographical realms, and Indian biodiversity.
CO 8	The student will be able to give explanation to the differential distribution of organisms across the world.
CO 9	To describe the characteristics of various biogeographical realms, and Indian biodiversity
CO 10	To explain the concept of Carbon credit, Carbon trading etc.
CO 11	To analyse various aspects of green building technology and interlinking of rivers.
CO 12	The students learn to appreciate the richness of Indian biodiversity and various strategies of Wildlife conservation
CO 13	To describe the components of animal behaviour, factors of motivation and conflict behaviour, properties of instinctive behaviour, types of learning, adaptiveness of behaviour, importance of biological rhythms and parental care, influence of hormones on behaviour.
CO 14	The student develops understanding to value the importance of nature watch and field study.
CO15	Develop theoretical understanding of neural basis of behaviour
CO16	Evaluate and review examples of how scientific knowledge has helped to improve the study of animal behaviour
CO17	Expand knowledge to equip with experimental methods demonstrating genetic basis of behaviour
CO18	Demonstrate the role of genes and environment in developing behaviour

Part-A-ECOLOGY 65 hrs

1. Introduction 2 hrs

1.1-Physical Environment - biotic and abiotic interactions.

1.2-Concept of Homeostasis and limiting factors;

2-Habitat and niche 3 hrs

2.1. Concept of habitat and niche

2.2. Niche width and overlap

2.3. Fundamental and realized niche

2.4. Resource partitioning

2.5. Character displacement

2.6 Resistance and Resilience stability

3- Ecosystem 7 hrs

3.1. Structure and function

3.2. Ecosystem energetics

3.3. Primary production,

3.4. Energy flow models,

3.5. Mineral cycling (CNP)

3.6. Trophic levels, Food chain, food web and secondary production.

3.7. Decomposers and detritivores.

3.8. Structure and function of some Indian ecosystems- terrestrial- major forest types in India with their features,

3.9 Fresh water, marine, coral reef, estuarine, wetland and mangrove ecosystems.

4 -Population Ecology 4 hrs

4.1. Characteristics of a population

4.2. Population growth curves, Life tables, survivorship curves, population regulation, Life history strategies, r and k selection, Demes and dispersal, intergenic extinctions, age structure of populations.

4.3 Concept of metapopulation, Levin's model of metapopulation & Comparison of Metapopulation and Logistic population model.

5 -Species interactions 4 hrs

5.1. Types of interactions, interspecific competition

5.2 Herbivory, Carnivory, Pollination, Symbiosis; -mutualism, commensalisms and protocooperation

6 - Community Ecology 8 hrs

6.1. Nature of communities

6.2. Characteristics of a biotic community

6.3. Species diversity and its measurements, Alpha diversity: Simpson's Diversity Index - Shannon index -Fisher's Alpha – Rarefaction; Beta diversity –Sorensen's similarity index- Whittaker's measure; Gamma diversity.

6.4. Latitudinal gradients in diversity,

6.5. Edges and ecotones.

7 -Ecological succession 4 hrs

7.1. Types, mechanisms

7.2. Changes involved in succession

7.3. Concept of climax

8 –Biogeography **6 hrs**

8.1. Major terrestrial biomes:

(a) Tropical rain Forest(b) Temperate deciduous Forest (c) Temperate boreal forest(d) Chaparral (e) Grassland (f) Desert (g) Tundra

9 -Theory of island biogeography **4 hrs**

9.1. Theory – Influencing factors

9.2 Applications in conservation biology- species-area relationship -single large or several small (SLOSS) - development of habitat corridors

10 -Biogeographical zones of India **4hrs**

10.1(a) Trans Himalayan zone; (b) Himalayan zone; (c) Desert zone; (d) Semiarid zone; (e) Western Ghats zone; (f) Deccan plateau zone; (g) Gangetic plain zone; (h) North east zone. (i) Coastal zone; (j) Islands present near the shore line.

11-Applied ecology **6 hrs**

11.1 Environmental Pollution - Brief account on environmental laws

11.2 Environmental Issues (Ozone hole, Global warming, Greenhouse effect, carbon budgeting)

11.3 Anthropogenic pressure on global climatic change, mitigation and adaptation, climate resilience, soil carbon sequestration

12-Conservation Ecology **5hrs**

12.1Restoration ecology

12.2Ecological foot printing

12.3 Principles of conservation

12.4 Green technology

13. Molecular ecology **4hrs**

13.1 Introduction to molecular ecology

13.2 Energetics of molecular ecology

13.3 Applications of Molecular ecology

14. Ecological Modeling

14. Ecological modeling **4 hrs**

14.1 Introduction

14.2 Statistical & non statistical model

14.3 Analytical & simulation model

14.4 Validation of models

Part B. ETHOLOGY **25 hrs**

1. Mechanisms of animal behaviour **2 hrs**

1.1. Introduction of study of Animal Behaviour

1.2. Definition of the object of study and methodology in Ethology

1.3. Ethology and other schools of studies on animal behavior

2. Development of behaviour **4 hrs**

2.1 Behavioural development – Genes and Environment

2.2 Environmental influence on Behavior

2.3 Genetic influence on Behavior

2.4 Single-Gene effects on behaviour

2.5 Experimental methods demonstrating genetic basis of behavior

2.6 Experimental methods demonstrating environmental basis of behavior

3. Classical Ethology **4 hrs**

3.1 Instinct and FAP

3.2 Signal stimuli, triggers, mimetics, and behavioural sequence and Stimulus filtering

3.4 Specific action energy, vacuum activity, and displacement activity

3.5 Psycho-hydraulic model of Lorenz and Hierarchical Model of Tinbergen

4. Physiology of behaviour **5 hrs**

4.1. Hormonal influence on behavior

4.2. Factors influencing effects of hormones on behaviour

5. Biological communications **5 hrs**

5.1. Means of communications in animals

5.2. Physical, behavioral and chemical means of communication- Pheromones in animals

5.4. Lee Boot effect

5.5. Whitten effect

5.6. Bruce effect

5.7. Coolidge effect

5.8. Vandenbergh effect

5.9. Anthropogenic impacts on animal behavior

6. Evolution and Social Behaviour **5 hrs**

6.1 Sexual and social behaviour

6.2 Sexual selection and sexual strategies

6.3 Altruism and Kinship selection, Parental Care, Development of sociobiology in relation to animal behaviour

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15. Birds of the Prey of the Indian Sub-Continent, Rishad Navroj

PRACTICAL

MZL2L02 - ECOLOGY AND ETHOLOGY

Ecology

Course outcomes (COs)

CO1	Develop practical knowledge about environmental quality assessment
CO2	Hand own experience to design and interpret the results of environmental relevance
CO3	Equipped the stakeholders to apply scientific knowledge to measure ecological index
CO4	Develop good laboratory practice in nutrient analysis
CO5	Use various ecological instruments and transfer the skill to field.

1-Identification, qualitative and quantitative estimation of marine plankton
2- Estimation of BOD in polluted water sample.
3-Estimation of COD in water sample
4-Estimation of salinity, phosphates, chlorides and silicates and nitrates in water samples
5-Separation and identification of soil arthropods using Berlese funnel.
6-Determination of moisture content of soil sample.
7- Determination of water holding capacity of soil sample.
8-Testing the transparency of water using Secchi disc
9- Determination of primary productivity in pond water using light and dark bottle.
10-Study of termitarium / ant colony
11-Principle and application of the following instruments-GPS, Thermo hygrometer, Altimeter, Air samplers, soil samplers, Berlese funnel, Lux meter, anemometer, Rain gauge, Plankton net, Plankton counting chamber, Weather balloon, Secchi disc etc (at least six items)

12- **FIELD STUDY**-A study tour of at least 3days duration (need not be at a stretch) to observe the ecology and behaviour of animals should be under taken. The places of visit include inter tidal region, fresh water bodies, lakes, rivers, hill streams, wetlands, mangroves, forests grasslands, drinking water treatment plants, and sewage treatment plants.
A report of the field study is to be included in the practical record to be submitted at the time of examination.

Ethology

Course outcomes (COs)

CO1	Demonstrate and identify various behaviours of animals
CO2	Develop practical skill to identify various patterns of behaviour
CO3	Identify the role of neurons for developing behaviour
CO4	Gain knowledge in observing and documenting the behaviours of different animals

1-Studying and reporting the behaviour and ecology of animals in selected fields (Social spider/Jungle

babbler/white headed babbler or Bonnet Macaques)
2-Study of circadian rhythm
3-Chemo reception and behaviour in flies –finding the tarsal threshold for sugar
4- Behavioural reaction to moisture and light using isopods.

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MZL2 C06- DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY

(90 Hours)

Course outcomes (COs)

CO1	To understand basic concepts in development
CO2	Explain the process of gametogenesis, fertilization and embryonic development
CO3	To understand cellular and molecular basis of development
CO4	To understand the genetic basis of development
CO5	Describe the process of ageing and mechanisms.
CO6	To understand the impact of environment on development
CO7	Describe different classes of chemical messengers and their physical characteristics
CO8	Explain how the secretion of hormone is regulated through positive and negative feedback mechanisms.
CO9	Summarize the anatomy, regulation, and physiological functions of the hormones of the hypophysis, thyroid, parathyroid, pancreas adrenal, hypothalamus and adrenal glands
CO10	Describe the anatomy of male and female reproductive systems including hormonal functions and pathophysiology

Part- A - DEVELOPMENTAL BIOLOGY (54 hrs)

1. Introduction: Basic concepts of development **6 hrs**

1.1 Potency
1.2 Commitment
1.3 Specification - autonomous, conditional
1.4 Induction
1.5 Competence
1.6 Determination and differentiation
1.7. Morphogenetic gradients

2. Gametogenesis, fertilization and early development **10hrs**

2.1 Production of gametes
2.2 Cell surface molecules in sperm-egg recognition in animals
2.3 Zygote formation
2.4 Cleavage and blastula formation
2.5 Embryonic fields
2.6 Gastrulation and formation of germ layers in amphibia

3. Embryogenesis and Organogenesis **10hrs**

3.1 Axis formation in amphibians - primary embryonic induction
3.2 Anterior posterior patterning in Amphibians - Hox code hypothesis
3.3 Anterior posterior patterning in *Drosophila* - gap genes, bicoid gradient, segmentation genes, pair rule genes, homeotic selector genes, realistor genes
3.4 Dorsoventral patterning and Left right patterning - dorsal protein gradient
3.6 Limb development in chick

3.7 Insect wings and legs
3.8 Vulva formation in *Caenorhabditis elegans*

4. Cellular and Molecular basis of development 8 hrs

4.1 Cellular interactions during development
Epithelial - mesenchymal interactions, paracrine factors, RTK pathway, cell death pathways
4.2 Cellular interactions concerned in fertilization
4.3 Cellular changes during Blastulation and gastrulation
4.4 Cellular interactions in organogenesis
4.5 Molecular basis of cellular differentiation - cadherins

5. Genetic basis of development: 7hrs

5.1 Differential gene expression
Promoters, transcription factors, silencers, DNA methylation, insulators, dosage compensation, differential RNA processing
5.2 Models of cell differentiation
5.3 Reversibility of patterns of gene activity

6. Metamorphosis, Regeneration and Aging 7hrs

6.1 Metamorphosis in Amphibians and Insects and their hormonal control
6.2 Types of regeneration - Super, Hetero, Epimorphic, Morphallactic and Compensatory regeneration, Histological process during regeneration
6.3 Ageing – cellular and extra cellular aging, Causes - Wear and tear, Oxidative damage, Mitochondrial genome damage, genetically programmed aging

8. Environmental regulation of animal development 4hrs

8.1 Environmental regulation of normal development – types of polyphenism
Sex determination in *Bonellia*; primary and secondary sex determination, environmental sex determination
8.2 Environmental disruptions of normal development (Teratogenesis)
Teratogenic agents - Alcohol, retinoic acid, bisphenol, heavy metals, pathogen
8.3 Environmental oestrogens

9. Developmental Mechanisms of Evolutionary change 2hrs

Heterotopy, Heterochrony, Heterometry, Heterotypy. (Brief)

Part B- ENDOCRINOLOGY (36 Hours)

1. Endocrine glands and their Hormones (Brief account**). 3 hrs**

1.1. Hormone secreting tissues –skin, liver, kidney, heart.
1.2. General classes of chemical messengers- Peptide, thyroid, steroid hormones, neurotransmitters and pheromones
1.3. Physical characteristics of hormones – latency, post-secretory modification and half life
1.4. Synthesis and delivery of hormones- storage, secretion and transportation.
1.5. Physiological roles of hormones.
1.6. Control of hormone secretion.

2. General mechanisms of Hormonal action 5 hrs

2.1. Cell signaling
2.2. Receptors and transducers; types of receptors, regulation of receptor number, receptor activation
2.3. Second messengers of hormone action, receptor signal transduction
2.4. Eicosanoids and hormone action

3. Anatomy of endocrine glands; structure, physiological functions, and control of secretion of their hormones and pathophysiology. 16 hrs

- 3.1. Hypothalamus
- 3.2. Hypophysis
- 3.3. Thyroid
- 3.4. Parathyroid
- 3.5. Adrenal
- 3.6. Pancreas

4. Hormones and male reproductive physiology 3 hrs

- 4.1. Synthesis, chemistry, and metabolism of androgens
- 4.2. Endocrine control of testicular function
- 4.3. Physiological roles of androgens and estrogens
- 4.4. Pathophysiology

5. Hormones and female reproductive physiology 6 hrs

- 5.1. Synthesis, chemistry, and metabolism of Ovarian steroid hormones
- 5.2. Physiological roles of Ovarian steroid hormones
- 5.3. Hormonal regulation of female monthly rhythm
- 5.4. Hormonal factors in pregnancy, parturition and lactation

6. Neurohormones 3 hrs

- 6.1. Gases as neural messengers
- 6.2. Endorphins- physiological roles, mechanism of action and pathophysiology
- 6.3. Brain hormones and behaviour
- 6.4. Neuroendocrine pathophysiology

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B - Endocrinology

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PRACTICAL

MZL2L03 - Developmental Biology & Endocrinology

Course Outcomes (COs)

CO1	To understand the identification of different developmental stages of frog.
CO2	To identify common larval forms.
CO3	To understand the vital staining technique.
CO4	To understand the whole mount preparation of different developmental stages of chick embryo.
CO5	To understand the mounting of various larval forms.
CO6	To study the insect development
CO7	To understand morphological and histological details of different types of placenta in mammals.
CO8	To understand the effect of hormones in amphibian metamorphosis.

1. Induced ovulation in fish.
2. Identification of different developmental stages of frog – Egg, blastula, gastrula, neurula, tadpole external gill and internal gill.
3. Vital staining of chick embryo.
4. Preparation of temporary/permanent whole mounts of chick embryo of the following stages to study the extent of development of the circulatory and nervous system in detail in 20, 24, 33, 48 & 72 hours of incubation.
5. Tracing the development of stained parts. Candling, identification of blastoderm, window preparation – staining using stained agar strips and following the development.
6. Preparation of stained temporary/permanent mounts of larvae.
7. Experimental analysis of insect development - *Drosophila*.
8. Regeneration studies in frog tadpole tail.
9. Demonstration of sperm of rat/calotes/frog.
10. Morphological and histological studies of different types of placenta in mammals.
11. Hormones in Amphibian metamorphosis - Thyroxine/Iodine solution.
12. Culture of early chick embryo *in vitro*.
13. Study of invertebrate/vertebrate larval forms (minimum 7).
14. Observation of the mid-sagittal sections and cross sections of the chick embryo through head/ heart region of 24, 48 & 56 hours of incubation.

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SEMESTER- III

MZL3C07- PHYSIOLOGY

(90 Hours)

Course outcomes (COs)

CO1	The students create an awareness among the society to promote balanced lifestyle and improve people's diet
CO2	The student will be able to explain the role of nutrition in health
CO3	Discuss the physiology of various organ systems in the body
CO4	The student will be able to differentiate the structure and functions of various organs in the human body
CO5	To describe different functional areas of cerebral cortex
CO6	To describe the cardiac cycle
CO7	To discuss the physiology and mechanisms of respiration
CO8	. Identify and define neuro-anatomical structures
CO9	Summarize the various neurological disorders
CO10	Discuss different types of excretory organs in different animal groups
CO11	Explain the role of excretory system in the regulation of water balance, acid base balance and electrolyte balance
CO12	Identify the symptoms of life style diseases and suggest ways to control them
CO13	Explain the environment's influence on the physiological function and performance of living organisms

1. **Nutrition:** **10hrs**

1.1. Constituents of normal diet and their daily requirements

1.2. Physiological calorie value of food stuffs

1.3. Antioxidant nutrients

1.4. Digestion of carbohydrate, protein & lipids– Brief note on the role of salivary glands, liver, pancreas and intestinal glands in digestion

1.5. Absorption of carbohydrates, lipids, amino acids, water, electrolytes, vitamins and minerals in GIT

1.6. Movements of GI tract: deglutition, gastric motility and emptying, intestinal motility and defecation

1.7. The role of hormones and neurotransmitters in the control of gastrointestinal motility

1.8. Energy balance and obesity-causes and consequences

1.9. BMR and its significance

2.Excretor system: **12hrs**

2.1 Introduction: Brief description of different types of excretory organs in different animal groups

2.2 Functional anatomy of mammalian kidney, nephron and juxtaglomerular apparatus -structure, parts and function

2.3 Urine formation (glomerular filtration, tubular reabsorption and tubular secretion)

2.4 Regulation of water balance -Mechanism of concentration of urine – Counter current system (counter current multiplier and counter current exchanger)
2.5 Renal regulation of acid base balance& electrolyte balance.
2.6 Composition (normal & abnormal) and characteristics of urine
2.7 Physiology of micturition& micturition reflex
2.8 Renal clearance – definition, concept and significance; clearance value of urea, creatinine, phosphate, potassium, chloride and sodium
2.9 Accessory excretory methods (Liver, Skin, Saliva & lung)

3.Respiratory system **10hrs**

3.1 Introduction: Brief description of major respiratory organs (tracheal system, book lungs, gills and ctenidia)
3.2 Physiological anatomy and histology of respiratory passage and lungs
3.3 Mechanism of pulmonary ventilation (inspiration & expiration) -
3.4 Alveolar ventilation, dead space and its effect on alveolar ventilation
3.5 Role of surfactant in alveolar expansion
3.6 Pulmonary volumes and capacities – definition & normal values (tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, functional residual capacity, inspiratory capacity, vital capacity, total lung capacity)
3.7 Exchange of gases
3.8 Transport of gases
3.8.1 Transport of oxygen and carbon dioxide
3.8.2 Oxygen dissociation curve – factors affecting binding of oxygen to haemoglobin (PO2, PCO2, CO, pH, body temperature, diphospho glyceric acid level, fetal haemoglobin and also myoglobin)
3.9 Neural and chemical regulation of respiration
3.10 Respiratory disorders

4.Nervous system: **18hrs**

4.1. Introduction: action potential& resting potential.
4.2. Gross neuroanatomy of the brain (histology & neural pathway not expected unless otherwise specified)
4.2.1. Cerebral cortex- Motor cortex: mention functional areas (including specialized areas) and their motor functions
4.2.2. Cerebral cortex- Association areas, their sub areas and their functions; Wernicke's area and its intellectual function
4.2.3. Memory – definition, types of memory (positive and negative memory), brief note on the mechanism of short term, intermediate long term and long-term memory, consolidation of memory
4.2.4. Brain stem – List the components (medulla, pons, mesencephalon, reticular and vestibular nuclei) and functions
4.2.5. Cerebellum- mention parts and functions
4.2.6. Basal ganglia – mention components and functions
4.2.7. Limbic system; structure and functions (emotion and motivation)
4.3. Gross neuroanatomy of the spinal cord
4.3.1. Spinal cord - structural organization
4.3.2. Reflex action – reflex arc, muscle spindle, Golgi tendon organ
4.3.3. Types of reflexes- monosynaptic reflex (e.g., Muscle stretch reflex, negative stretch reflex), polysynaptic reflex (e.g., withdrawal reflex)
4.4 Neural control of muscle tone and posture.

4.5. Diseased states of brain – brief description of epilepsy, depression, schizophrenia, Alzheimer's disease, Senile dementia & Parkinson's disease

5.Special lenses: 14hrs

5.1. **Vision:**

5.1.1. Structure of eyeball

5.1.2. Fluid systems of the eye

5.1.3. Layers of Retina and photoreceptors (rods & cones)

5.1.4. Brief notes on the neuronal cell types and neural circuitary of the retina and visual pathways from retina to visual cortex

5.1.5. Image formation

5.1.5.1. Formation of image on the retina

5.1.5.2. A brief general account of electrophysiology of vision

5.1.5.3. Photochemistry of vision & colour vision

5.1.6 Eye disorders (Myopia, Hypermetropia, Presbyopia, Glaucoma, Cataract, Astigmatism)

5.2. **Taste:**

5.2.1. Primary sensations of taste (agents and site of sensation)

5.2.2. Taste buds (location, structure, receptors and nerve supply)

5.2.3. Physiology of taste (receptor stimulation, generation of nerve impulse by taste buds and its transmission to CNS)

5.3. **Smell:**

5.3.1. Olfactory membrane and receptor cells

5.3.2. Physiology of olfaction (stimulation of olfactory cells and transmission of smell signals to CNS)

6.Tactile response:(Brief note**). 4hrs**

6.1.1. Mechanoreceptors and their stimulation

6.1.2. Pain receptors and their stimulation

6.1.3. Thermal receptors and their stimulation

7.Cardiovascular system 8hrs

7.1. Introduction: Brief description of vertebrate hearts

7.2. Structural organization of myogenic heart (in human beings)

7.3. Physiological anatomy of cardiac muscle – specialized tissue

7.4. Heart as a pump

7.5. Cardiac cycle

7.6. ECG – Principle and application

7.7. Neural and chemical regulation of heart function

7.8. Blood volume, its regulation and blood pressure

7.9. Physiological anatomy of coronary blood flow, coronary blood flow and its control

7.10. Ischemic heart disease – mention causes and example

8.Lymphatic system: 5hrs

8.1. Lymph channels of the body

8.2. Composition and formation of lymph

8.3. Functions of lymph and lymphatic system including role of in controlling interstitial fluid protein concentration, interstitial fluid volume and interstitial fluid pressure

9.Environmental physiology: 9 hrs

9.1. Thermoregulation

9.1.1. Comfort zone, normal body temperatures (oral, skin & core), heat production & heat loss, factors affecting body temperature, lethal temperature

9.1.2. Temperature regulating mechanisms (hot & cold), mention the role of hypothalamus, thyroid and adrenal glands

9.2 Stress physiology

9.2.1 Stress and strain- Environmental stressors

9.2.2 Nature of interaction with environmental stressors (Tolerance, Resistance, Acclimation & Acclimatization)

9.2.3 Physiological compensation to altered environment (Avoiders, Conformers & Regulators)

9.2.4 Physiological response to stress.

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2. William F.Ganong (1999): Review of Medical Physiology, Lange Medical Publications(Appleton & Lange).

3. Jain A.K. (2009): Text Book of Physiology (Vol. I & II), Avichal Publishing Company, New Delhi.

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11.Shepherd, G.M: Neurobiology-Principles of Neural Science, E. Kandel & P. Schwartz.

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PRACTICALS
MZL3L04 **– PHYSIOLOGY
Course outcomes (COs)

CO 1	The student gain practical knowledge regarding the methods of analysis of enzyme activity and its dependent factors
CO2	The students get a better understanding regarding the effects of abiotic factors on aquatic life
CO3	To gain a thorough practical knowledge related to the analysis of various blood parameters

1. Kymograph: working principle and applications
2. Effect of different substrate concentration, pH and temperature on human salivary amylase activity. Colorimetric method, plot graphs.
3. Qualitative demonstration of digestive enzymes in cockroach – amylases, lipases, proteases, invertases and controls.
4. Digestion in a vertebrate and calculation of peptic value.
5. Influence of temperature and pH on the ciliary activity in fresh water mussel/Mytilus using silver foil. Plot graphs
6. Determination of respiratory quotient – estimation of O2 consumption by an aquatic animal.
7. Determination of the rate of salt loss and gain in an aquatic animal (fish or crab).
8. Estimation of urea and ammonia in human Urine. Titrimetric method.
9. Rate of glucose – absorption – calculation of Cori coefficient
10. Estimation of haemoglobin of Fish/Man – Sahli's method.
11. Blood volume determination by dye dilution method (Vertebrate)
12. Blood: clotting time, bleeding time, rouleaux formation, preparation of haemin crystals.
13. Enumeration of RBCs in human blood.
14. Determination of lactic acid in muscle tissue.
15. Differential count of human WBCs
16. Hematocrit and ESR of human blood.
17. WBC total count

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1. Oser B. L.(1965). Hawk‟s Physiological chemistry, McGraw Hill Book Company
2. Hill R.W., Wyse G.A. (1989), Animal Physiology 2nd edition. Harper Collins Publishers
3. Schmidt-Nielsen, K. (1997), Animal Physiology, adaptation and environment, Cambridge University Press.
4. Dounersberger, Anne.B.Lesak, Anne,C and Timmons, Maichael,J.(1992).A laboratory Text Book Of Anatomy and Physiology. 5th ed. D.C.Heath & Co.

**SEE will be at the end of Fourth Semester

MZL3C08- MICROBIOLOGY & BIOTECHNOLOGY

(90 hours)

Course outcomes (COs)

CO1	To understand the features of various types of cloning vectors
CO2	To understand different steps involved in molecular cloning
CO3	To understand the techniques involved in the production of molecular probes, Genomic and CDNA library
CO4	To understand various types of PCR techniques
CO5	To analyze techniques involved in isolation, sequencing and synthesis of genes
CO6	To understand applications of biotechnology in animal health care, agriculture and environmental protection
CO7	To understand biotechnological techniques involved in animal cell tissue culture, gene silencing and cloning.
CO8	To understand ethical and social implications of biotechnology.
CO9	To understand taxonomy, structure, nutrition, growth of various microbes
CO10	To appreciates beneficial effects of microbes.
CO11	To analyze various types of microbial diseases and its control measures

Part-A-MICROBIOLOGY (45 Hours)

1. **Introduction** **(3 Hrs)**

1.1 History and scope of microbiology

1.3 Recognition of the role of microbes in diseases

1.4 Contributions of Louis Pasteur, Robert Koch, Alexander Fleming and Edward Jenner.

2. Microbial Taxonomy and Phylogeny **(4 Hrs)**

2.1. Major characteristics (classic and molecular)

2.2. Numerical taxonomy

2.3. Taxonomic ranks

2.4. Phylogenetic studies

2.5. Phenetic classification

2.6. Bergey's Manuel (mention major groups)

3. Bacterial cell structure and function **(6 hrs)**

3.2. Plasma membrane and internal system - Cytometrix, inclusions, ribosomes, nucleoid

3.3. Bacterial cell wall Peptidoglycan - structure-

3.4. Gram positive and gram-negative cell wall- Mechanism of gram staining

3.5. Components external to cell wall; pili and fimbriae, capsule and slime layers, Flagella and motility

4. Microbial nutrition **(3 hrs)**

4.1. Nutritional requirements,

4.2. Nutritional types (Auto, Hetero, Chemo, Phototrophs & obligate parasites)

4.3. Culture media and types of media-Mixed microbial population and pure cultures

5. Microbial growth (**5 hrs)**

5.1. Growth curve -synchronous growth
5.2. Continuous culture
5.3. Influence of environmental factors on growth
5.4. Measurement of growth
5.5. Measurement of cell numbers- Petroff, Hassuer counting Chamber, Spread plate and pour plate techniques
5.6. Measurement of cell mass-Turbidity and microbial mass measurements

6. Utilization of energy (**4 hrs)**

6.1. Biosynthetic process-peptidoglycan synthesis, amino acid synthesis, Non synthetic processes -Bacterial motility and transport of nutrients

7. Viruses (**3 hrs)**

7.1. General structural properties
7.2. Types: DNA viruses, RNA viruses, and enveloped viruses
7.3 Viral diseases

8. Control of microorganisms (**5 hrs)**

8.1. Disinfectants; A - physical- Heat, filtration and radiation
B-Chemical agents - Phenol and Phenolic compounds, alcohols, halogens and aldehydes.
8.2. Antibiotics- Penicillin's, Cephalosporins, Chloramphenicol, Tetracyclines
8.3. Microbial drug resistance

9. Environmental microbiology (**7 hrs)**

9.1. Aquatic microbes
9.1.1 Water as microbial habitat
9.1.2 Microorganisms in marine ecosystem (Coastal, Open Ocean & Benthic)
9.1.3 Microorganisms in fresh water (Lakes, rivers and streams)
9.2. Microbiological analysis of drinking water
9.3. Waste water- microbial characteristics and treatment
9.4. Microbial Bioremediation
9.5. Biogas plants.

10. Applied microbiology **5 hrs**

Microbiology of Food

10.1. Microbial growth and food spoilage
10.2 Control of food spoilage
10.3 Food borne disease outbreaks
10.4 Detection of food borne pathogens
10.5 Microbiology of fermented foods
10.6 Probiotics
10.7 Microbiology of drinking water

Part-B-BIOTECHNOLOGY (45 Hrs)

1. Introduction **(1 hr)**

Definition, branches, scope and importance

2. Genetic engineering **(4 hrs)**

2.1. Cloning vectors –

2.1.1. Properties of a good cloning vector

2.1.2. Types - plasmids (pBR322, pBR 327, pUC); phages (lambda phage, M13); cosmids, Phagemids, viruses (SV 40, CaMV), Transposones; Ac transposon and Ds transposon of Maize, P-element of Drosophila, Artificial chromosomes: BAC, YAC and MAC.

2.2. Shuttle vectors and expression vectors

3. Different steps involved in *in vivo* cloning (3hrs)

3.1. Construction of chimeric DNA (Blunt end ligation, cohesive end ligation, homopolymer tailing, use of linkers)

3.2. Selection of transformed cells –blue white selection method, colony hybridization, Plaque hybridization

3.3. Amplification – Multiplication, Expression and integration of the DNA insert in host genome

4. Molecular probes (2 hrs)

4.1. Production

4.2. Labelling

4.3. Applications

4.4. FISH, McFISH and GISH

5. Genomic and cDNA library (4 hrs)

5.1. Construction

5.2. Screening –By DNA hybridization, Screening by immunological assay, and screening by protein activity. (Refer unit 4-Molecular Biotechnology by Glick and Pasternak-ASM press)

5.3. Blotting techniques- Southern blot, Northern blot, Western blot, Dot blot and Slot blot, Chromosome walking

6. Polymerase Chain Reaction (2 hrs)

6.1. Basic PCR – raw materials and steps involved

6.2. Inverse PCR, Anchored PCR, Asymmetric PCR, PCR for mutagenesis and Real Time PCR

6.3. Applications of PCR in Biotechnology and genetic engineering

7. Molecular markers (brief notes). (3 hrs)

7.1. RFLP

7.2. AFLP

7.3. RAPD

7.4. Minisatellites (VNTR)

7.5. Microsatellites (SSR)

7.6. SNPs

8. Isolation, sequencing and synthesis of genes (3 hrs)

8.1. Isolation (for specific proteins and tissue specific proteins)

8.2. DNA sequencing –Maxam and Gilbert's chemical degradation method, Sanger's dideoxynucleotide synthetic method

8.3. Synthesis of gene-Chemical synthesis of tRNA gene, Synthesis of gene from mRNA, Gene synthesis machines

9. Transfection methods and transgenic animals (3hrs)

9.1. Definition, Methods - Electroporation, DNA micro injection, Calcium phosphate precipitation, Dextran mediated transfer, shot gun method, virus mediated, lipofection method, engineered embryonic stem cell method

9.2. Transgenic animals for human welfare

10. Biotechnology - Animal and human health care (**3 hrs)**

10.1. Vaccines
10.2. Disease diagnosis
10.3. Gene therapy
10.4. Transplantation of bone marrow, artificial skin,
10.5. Antenatal diagnosis
10.6. DNA finger printing
10.7. Forensic medicine

11. *In vitro* fertilization **(1 hrs)**

11.1. *In vitro* fertilization and embryo transfer in human
11.2. *In vitro* fertilization and embryo transfer in live stock

12. Animal cell and tissue culture **(2 hrs)**

12.1. Culture media – natural and artificial
12.2. Culture methods – primary explanation techniques, various methods of cell and tissue culture
12.3. Tissue and organ culture

13. Gene Silencing techniques (**2 hrs)**

13.1. Antisence RNA
13.2. RNAi
13.3. Gene knockouts

14. Cloning (**2 hrs)**

14.1. Cloning procedures (adult DNA cloning, Therapeutic cloning, Embryo cloning) –
14.2. Advantages and disadvantages of cloning

15. Environmental biotechnology (**3 hrs)**

15.1. Pollution control – cleaner technologies, toxic site reclamation, removal of oil spill, reducing of pesticides and fertilizers, biosensors, biomonitoring.
15.2. Restoration of degraded lands - reforestation using micro propagation, development of stress tolerant plants

16. Agricultural biotechnology **3 hrs**

16.1 Biofertlizers
16.2 Insect pest control (pheromones, hormone mimics, analogues)
16.3 Biopesticides (Baculovirus, *Bacillus thurugiensis*, NPV)

16. Intellectual property rights (**2 hr)**

16.1. Intellectual property protection,
16.2. Patents, copy right, trade secrets, trademarks
16.3. GATT and TRIPS, patenting of biological materials,
16.4. International co-operation, obligation with patent applications, implications of patenting-current issues.

17. The ethical and social implications - **(2 hrs)**

17.1. Ethics of Genetic engineering - Social impacts - Human Safety-Virus resistant plants-Animals and ethics-
17.2. Release of GEOs-Use of herbicide resistant plants-Human genome alterations by biotechnology
17.3. Social acceptance of biotechnology-Transgenic crops - Social acceptance of medical biotechnology- Acceptance of GM crops for food and pharmaceutical production, social acceptance of Industrial biotechnology

REFERENCES:

Part- A- Biotechnology

1. Alphey - DNA sequencing-Bios Scientific publishers-
2. Bernard R. Glick and Jack J. Pasternak-Molecular Biotechnology-Principles and applications of recombinant DNA- ASM press Washington D.C.
3. Charles Hardin (2008): Cloning, Gene expression, and Protein purification- Experimental procedures and process rationale - Oxford University Press.
4. Chatterji, A.K.(2007). Introduction to environmental biotechnology-Prentice Hall of India
5. Colin Ratledge and Bjorn Kristiasen-Basic Biotechnology - Cambridge University press. 6. Dale. J.W. and Malcom von Scantz. From genes to genome- Concepts and Applications of DNA Technology
7. Dominic, W.C. Wong-The ABCs of gene cloning-Springer international edition 8. Dubey, R.C. -A text book of biotechnology-S. Chand & Co.
9. Emmanuel. C., Rev. Fr. Ignacimuthu. S. and Vincent. S. Applied Genetics: Recent Trends and Techniques, MJP Publishers, Chennai
10. Gupta. P.K. -Elements of biotechnology-Rastogi publications.
11. Singh, B.D.(2002).Biotechnology-Kalyani publishers.
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15. Alberts,B., Bray, D., Lewis, J., Raff., M, Roberts, K. And Watson, J.D. (2000). Molecular Biology of the cell. Garland Science, New York.
16. Brown .T.A. (2002).Genomes II ed. John Wiley and Sons, New York.
17. Freshney, Ian R.(2006). Culture of Animal Cell. 5thed. Wiley-Liss Publications.
18. Glick,B.R.and Pasternak, J.J.(1998). Molecular Biotechnology-Principles and Applications of Recombinant DNA.

Part B- Microbiology

1. Gandhi-Microbiology and Immunology notes and cases-Blackwell publishing
2. Hans G. Schlegel (2008): General Microbiology-Cambridge low price editions.
3. Chakraborty.P.A.(2009). Text Book of Microbiology. New Central Book Agency. New Delhi.
4. Arora, D.R. and Arora, B.(2008).Text Book of Microbiology. CBS Publishers& distributers. New Delhi.
5. Mansi. Fermentation, Microbiology and Biotechnology-Taylor and Francis
6. Pelczar, M.J, Chan, E.C.S. and Krieg, N.R.(1998)-Microbiology-TMH edition
7. Prescot, L.M., Harley, J. P. and Klein. D.A. (2008). Microbiolgy. 7th ed. McGraw- Hill Inc. New York.
8. Rao, A.S. - Introduction to microbiology-Prentice Hall of India.
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13. Talase, Park, Kathelee, N. and Talaro, Arthur.(2002).Foundations of Microbiology. McGraw Hill Higher Education, New York.
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PRACTICAL
MZL3L05 **– MICROBIOLOGY & BIOTECHNOLOGY

MICROBIOLOGY
Course Outcomes (COs)

CO1	To gather hands own experience in isolation, staining and counting of bacteria
CO2	To gain better knowledge regarding various sterilization techniques and bacterial culture

1. Selective isolation and enumeration of bacteria.
2. Bacterial staining technique
a. Simple staining of bacteria.
b. Negative staining
c. Hanging drop technique.
d. Gram staining.
e. Endospore staining.
3. Turbidity test for contamination of milk.
4. Phosphate activity of milk.
5. Microbial filters and their application.
6. Preparation of media and sterilization.eg: Nutrient agar, mac conkey agar, sterilization by wet and dry heat, disinfection.
7. Cultivation of yeast and molds
8. Isolation of pure colonies of bacteria.
9. Growth curve of yeast - monitoring progress of microbial culture.
10. Bacteriological analysis of water e.g., fecal pollutants.
11. Anaerobic culturing.
12. Antibiotic sensitivity test.

BIOTECHNOLOGY

Course Outcomes (COs)

CO1	To secure hands own training to isolate plasmid DNA and RNA from bacteria and other tissues
CO2	To know how to separate DNA /RNA by electrophoresis
CO3	To acquire practical knowledge to work with PCR machine to amplify DNA and experience on cell immobilization

1. Isolation of plasmid DNA.
2. Isolation of total RNA from tissues
3. Separation of DNA by electrophoresis.
4. Bacterial transformation.
5. PCR
6. Cell immobilization.

REFERENCES:

1. Ausubel, F.M., Brebt R, Kingston, R.E., Moore, D. D., Seidman, J. G., Smith, J.A. and Struht, K. (2002): Short protocols in Molecular Biology. John Wiley & Sons,Inc.
2. Sambrook, J. and Russel, D.W. (2001): Molecular cloning: A laboratory Manual. CSHL Press, New York.

**SEE will be at the end of Fourth Semester

MZL3E01- BIODIVERSITY AND BIOTA

(90 Hours)

Course outcomes (Cos)

CO1	To understand various aspects of biodiversity. To definition of endemism and hotspots and to realize its importance and understand the diversity and floral and faunal wealth of Western Ghats.
CO2	To understand with the Gondwana principle and Sapura hypothesis
CO3	To understand the endangered and endemic fishes and amphibians of Western Ghats and also to realize the threats to conserve.
CO4	To understand the endangered and endemic reptiles of Western Ghats and also to realize the threats to conserve
CO5	To develop skills to identify various mammals and their characteristics, Biology, Status, Threats and Conservation
C06	To understand the various aspects of avian characteristics such as habitat preference, flocking, foraging, competition, courtship, parasitism, Flyways, vocalization, endemic species, economic importance etc.
C07	To state the various aspects of socio-biology of animals and to evaluate the importance of the territory and territoriality in animal life

1. Introduction **(6 Hrs)**

1.1. Biodiversity: Definition
1.2. Kinds of biodiversity
1.3. Biodiversity hot spots
1.4. Endemism
1.5. Western Ghats Biodiversity

2 Principles & Hypothesis **(4 Hrs)**

2.1 Gia hypothesis and its criticisms
2.2 Satpura Hypothesis and its criticisms

3. FISHES & AMPHIBIA **(5 Hrs)**

3.1 Endangered and Endemic Fishes of Western Ghats (Brief account with threat their survival.
3.2 Endangered and Endemic Amphibians of Western Ghats (Brief account with threat their survival

4. REPTILES (Brief account with threat to their survival only). **(7 Hrs)**

4.1-Crocodilia: Gharial, Estuarine crocodile, Marsh crocodile
4.2-Testudines: Logger headed sea turtle, Green Sea Turtle, Hawk's Bill Turtle, Olive Ridley Turtle, Leatherback Sea Turtle.
4.3-Squamata: Indian Monitor Lizards
4.4 Endangered and Endemic snakes of Western Ghats

5. Biology and taxonomy of Mammals **(30 Hrs)**

5.1 Brief study of the following animals with special emphasis on Western Ghats
5.1.1 Primates

Apes: Gibbon
Monkeys: Macaques (Bonnet, Rhesus, Assamese and Lion tailed)
Langurs :(Common, Capped, Golden, Nilgiri)
Lemurs: Ring tailed lemur
Loris: Slender Loris and Slow Loris
5.1.2Carnivora
Cats: Fishing cat, Leopard cat, Jungle cat,
Dogs: Wolf, Jackal, Indian Fox Otters: Common Otter, Smooth Indian Otter
Bears: Sloth bear, Brown bear, Himalayan black bear, sun bear Panda: Giant panda, Red panda
Hyaena: Striped hyaena
Civets: Malabar civet, Small Indian civet, Common palm civet
Mongoose: Common mongoose, Small Indian mongoose, striped necked mongoose
5.1.3Artiodactyla
Cervids: Chital, Sambar, Barking deer, Mouse deer.
Bovids: Indian Antelope, Four horned Antelope, Nilgiri tahr, Indian bison.
Suids: Indian Wild boar.
5.1.4- Proboscidae: Indian Elephant
5.1.5-Perisodactyla: One horned Rhinoceros.
5.1.6-Pholidota: Indian Pangolin
5.1.7-Lagomorpha: Hispid hare
5.1.8-Insectivora: Tree shrew,
5.1.9-Rodentia: Indian Giant squirrel, Flying squirrel, striped palm squirrel
5.1.10-Chiroptera: short nosed fruit bat, Indian pipistrelle
5.1.11-Cetacea: Common dolphin.
5.1.12-Sirenia: Sea cow

5.2 Biology and distribution, feeding and breeding habits, population status, major threats to their survival and conservation) of the following animals.

Bonnet Macaques, Lion tailed Macaques, Nilgiri Langur, Tiger, Lion, Leopard, Indian Wild dog, Sambar, One Horned Rhinoceros, Indian Pangolin, Hedgehog, Porcupine, Grizzled giant squirrel, Indian flying fox, Gangetic dolphin, sperm whale

6. BIRDS (30 Hrs)

6.1 General information on birds

6.1.1Habitat preference
6.1.2-Flocking /aggregation
6.1.3-Foraging behaviour, Food competition and selection
6.1.4-Courtship and pair selection,
6.1.5-Brood parasitism and cooperative breeding.
6.1.6-Vocalization and its Role in birds
6.1.7-Flyways with special emphasis to Central Asian flyway
6.1.8-Globally endangered Indian birds and their classification (At least 20 species).
6.1.9-Endemic Indian birds and important endemic bird areas.
6.1.10-Economic importance of birds- beneficial and harmful role.

6.2 Avian classification and brief biology with special reference to Indian species.

6.2.1-Columbiformes: Blue Rock pigeon, Spotted Dove.
6.2.2-Podicipediformes: Little Grebe
6.2.3-Pelecaniformes: Little and Large Cormorant, Darter
6.2.4-Ciconiformes: Pond heron, large egret, little egret, Median egret, Grey heron, purple heron

6.2.5-Ansariformes: Bar headed goose, Lesser whistling teal
6.2.6-Gruiformes: Indian Moorhen, Purple moorhen, White breasted waterhen
6.2.7-Charadriiformes: River tern, Red wattled Lapwing, Yellow wattled Lapwing, Black headed gull, Bronze winged jacana, Pheasant tailed jacana.
6.2.8-Falconiformes: Hawks, Vultures.
6.2.9-Cuculiformes: Indian cuckoo, Koel, Crow pheasant
6.2.10-Coraciiforms: White breasted kingfisher, Small blue kingfisher, Pied Kingfisher, Brown headed kingfisher, Chestnut headed Bea eater, Small green Bea eater, Hornbill
6.2.11-Pisciformes: Lesser Golden backed woodpecker, Indian golden backed woodpecker, Small green barbet
6.2.12-Psittaciformes: Rose ringed parakeet, Blossom headed parakeet, Lorikeet
6.2.13-Strigiformes: Indian horned owl, Mottled wood owl, Barn owl
6.2.14-Apodiformes: Palm swift
6.2.15-Passeriformes: Black headed Oriole, Golden Oriole, Tree Pie, Drongo, Racket tailed Drongo, Red whiskered Bulbul, Red vented Bulbul, Black headed Babbler, White headed Babbler, Munia, Magpie Robin, Jungle Babbler, Purple Sunbird, Purple rumped sunbird, Indian Roller, Indian Robin, White cheeked Bulbul, Tickell's flower pecker, Thick billed flower pecker, Paradise flycatcher.

6.3 Breeding behaviour of the following birds should study in detail:

Wood peckers, barbets, Hornbills, Kingfishers, Baya weaver bird, Sunbird

7. Sociobiology & Territoriality (8hrs)

7.1 Sociobiology of Lion
7.2 Sociobiology of Elephant
7.3 Sociobiology of Deer
7.4 Territoriality and functions of territory.

References:

1. Aaron, N.M. (1973): Wildlife ecology. W.H. Freeman Co. San Francisco, USA.
2. Alfred, J.R.S., Das, A.K. and Sanyal, A. K. (1998): Faunal diversity in India, ZSI Calcutta
3. Bird life International Red Data Book for Asia (1995), SACON, Coimbatore.
4. Daneil, J.C. The book of Indian Reptiles and Amphibians, Oxford publ.
5. Grzimek's Animal life Encyclopedia (1972): Vol. 1-13, Van Nostrand Reinhold Company
6. Induchoodan (2004): Keralathile Pakshikal (Malayalam) - IVth Edn. Kerala Sahitya, Academy, Thrissur.
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17. Trothy, J.B. Boyle and Boontawee – Measuring and monitoring Biodiversity in Tropical and Temperate Forest. Centre for International forestry Research, Bogor, Indonesia

PRACTICALS
ELECTIVE COURSE: WILDLIFE BIOLOGY-I
MZL3(E)L01- PRACTICAL PAPER – I**

1. Dissections.
    A) Arterial system of bird (Pigeon/quail/chicken)
    B) Flight muscles.
    C) Perching mechanism - pigeon
2. Examinati and identification of poisonous and non-poisonous snakes
3. Examination and identification of different types of feathers.
4. Examination and identification of horns and antlers.
5. Examination and identification of scales of reptiles, birds, and modified hairs of pangolin and porcupine.
6. Scats / pellet analysis – significance (Population estimation).
7. Study of the dental formula of various mammals.
8. Study of mammal necropsy procedures
9. Spotters: Pug marks, teeth like lophodont, carnassial dentition, nest of birds, Hair of mammals, feathers, spines, nails, claws, horns, antlers, and other item related to wildlife biology.

**SEE will be at the end of Fourth Second Semester

REFERENCES:

1. Shekhar Kolipaka, Tracks and Signs of Indian Wildlife- Kindle Edition
2. Romulus Whitaker - Snakes of India, The Field Guide.

SEMESTER - IV

MZL4C09– IMMUNOLOGY & CYTOGENETICS

90 Hrs

Course Outcomes (COs)

CO1	An in-depth knowledge in the process of immune cell synthesis and maturation, antigen receptor structure and the mechanisms of antigen recognition by B-cell and T-cells
CO2	To understand the Structure and diversity of Immunoglobulin, Antigens and its classification, production and clinical uses of monoclonal antibodies and antigen antibody interactions.
CO3	Gaining a strong understanding of key principles, procedure and applications of different Immunotechniques used in the biomedical field and to develop new methods and techniques on the basis of the earned knowledge
CO4	Mechanisms of humoral and cellular immunity, immune cell receptor and intracellular signal cascades related to immune system activation and response
CO5	Gaining an understanding of the fundamentals ofImmune effector mechanisms, chemical signaling through cytokines, its therapeutic uses and cytokine related diseases.
CO6	The complement system and its components, hypersensitivity and allergic responses, diseases related to hypersensitivity, autoimmune disorders and complement deregulation.
CO7	To understand the scientific principles behind vaccination, types of vaccines and their role in fighting diseases.
CO8	Understand the mechanism of autoimmunity and immune deficiency diseases.
CO9	The student learn about membrane transport mechanisms and properties , cytoskeletal elements and Intracellular trafficking
CO10	The students understand the cellular adhesion molecules, cell-cell and cell - matrix interactions, intercellular communications along with noted signal transduction pathways and intracellular signalling mechanisms and their significance
CO11	The students understand the process and significance of necrosis and apoptosis and, its regulation in the cellular level

Part A-IMMUNOLOGY (70 Hours)

1. Introduction **(4hrs)**

1.1. Innate and adaptive immunity
1.2. Cells and organs of the immune system
1.3. Antigens, Antigenicity, immunogenicity and Haptens
1.4. Factors influencing immunogenicity

2. Antibodies **(10hrs)**

2.1. Structure and functions of Antibody Molecules
2.2. Generation of Antibody diversity
2.3. Monoclonal antibodies-Hybridoma Technology and Applications
2.4. Antibody Engineering

3. Antigen-Antibody Interactions **(8hrs)**

3.1. Strength of Antigen Antibody Interactions
3.2. Cross reactivity, precipitation reactions, agglutination reactions
3.3. Immuno-techniques -Detection of molecules using ELISA, RIA, Western Blot,

Immunoprecipitation, Immunofluorence microscopy, Flowcytometry, FACS.

4. Generation of B Cell & T cell response (10 hrs)

4.1. Humoral & Cell mediated response
4.2. B & T cell receptors and CD3 Complex
4.3. Properties of B cell & T cell Epitopes
4.4. Activation and differentiation of B and T cells

5. Immune effector Mechanisms (12 hrs)

5.1. Cytokines & Antagonists
5.2. Compliment System-components & functions
5.3. Compliment activation and regulations (classical, alternate and lectin pathways)
5.4. Toll –like receptors
5.5. Cell mediated effector functions
5.6. Inflammation & hypersensitivity

6. Major Histocompatibility Complex (MHC). (8hrs)

6.1. General organisation and inheritance of MHC
6.2. MHC genes & molecules
6.3. Cellular distribution of MHC molecules
6.4. Antigen processing and presentation –Endogenous and Exogenous pathways. Presentation of non-peptide bacterial antigens.

7. Immune system in Health and Diseases (14 hrs)

7.1. Immune responses during bacterial (Tuberculosis) parasitic (malaria) and viral (HIV) infections.
7.2. Autoimmune diseases (organ specific and systemic)
7.3. Primary Immunodeficiency diseases (Bruton's disease, Di-George Syndrome & Severe combined immunodeficiency (SCID)
7.4. Secondary immunodeficiency Diseases (AIDS). Origin, means of infection, course of infection, structure and types of HIV, viral multiplication, mutation, diagnosis, antiretroviral therapy and AIDS vaccine.
7.5. Vaccines –Recombinant Vector, DNA vaccines, synthetic peptide vaccines and multivalent vaccines

8. Transplantation immunology (4 hrs)

8.1. Immunologic basis of graft rejection
8.2. General and specific immunosuppressive therapy
8.3. Transplantation antigens

PART B: CYTOGENETICS 20 hrs

1. Introduction to Cytogenetics (1 hr)

2. Membrane structure and function. (4 hrs)

2.1-Molecular organization of cell membrane - Lipid bilayer and membrane protein.
2.2-Molecular models of cell membrane.
2.3-Cell permeability-osmosis, diffusion, ion channels, active transport, membrane pumps.
2.4- Mechanism of sorting and regulation of intracellular transport.
2.5-Electrical properties of membranes.
2.6-Microvilli and cell coat.

3. Cellular communication (6 hrs)

3.1 Regulation of hematopoiesis
3.2 General principles of cell communication
3.3 Cell-cell interactions – cell adhesion and roles of different adhesion molecules
3.4 Extracellular matrix: Basal membrane and Laminin, Collagen, Proteoglycan, Fibronectin
3.5 Interaction of cells with extracellular matrix: Integrins. Focal adhesion and hemidesmosomes.
3.6 Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins, Adherens.
3.7 Neurotransmission and its regulation

4. Cell signaling (4 hrs)

4.1 Hormones and their receptors
4.2 Signal transduction2.3 Concept of cell-signaling
4.4 Signalling through intracellular receptors
4.5 Signalling through cell surface receptors: G protein linked receptors; signaling via cAMP, PKA, IP3, Ca2+/calmodulin, PKC, Ca-MK, ion channels.
4.6-Receptor desensitization
4.7 -Signaling by nitric oxide, carbon monoxide
4.8-Signaling network

5. Apoptosis and its significance (5 hrs)

5.1 Necrosis; Programmed and induced cell death
5.2 Process of apoptosis: Initiation, Execution: cytochrome C, caspases, Phagocytosis
5.3 Regulation of apoptosis - Extracellular and Intracellular
5.4 Genes involved in apoptosis
5.5 Therapeutic interventions of apoptosis

REFERENCES:

Part A : IMMUNOLOGY

1. Adul K Abbas and Andrew H Lichtman (2003).Cellular and Molecular Immunity (fifth edition).Elsevier Science,USA.
2. Carpenter. Immunology and Serology
3. Das Gupta, Modern Immunology
4. Godkar, P.B. (1998): A Text Book of Medical Laboratory Technology, Bhalani Bhalani Publishing House Mumbai
5. Hay & Hudson -Practical Immunology.
6. Janis Kuby (1997): Immunology. WH Freeman,New York
7. Joshi. K. R and Osamo N.O (1994). Immunology.Agro Bios Publishers,Jodhpurr
8. Peter Parham (2004).The immune System (2nd Edition), Garlands, New York
9. Roit, Essentials of Immunology.
10. Shetty. N (1993) Immunology Wiley Eastern Ltd, New Delhi
11.Weir-Hand book of Experimental Immunology(Volume 1,2&3).

Part B: CYTOGENETICS

1. Becker, W. M., Reece, J. B. and Poenie, M. F. (1999; 2000). The World of the Cell, 4th edition, Benjamin/Cummings Publishing Co.
2. Benjamin Lewin (2008). Genes IX. Jones & Bartlett Learning Publishers, New York.

3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter (2002). Molecular Biology of the Cell. 4th Edition, Garland Science, New York.
4. De Robertis, E. D. P. and De Robertis, Jr. E. M. F. (1996). Cell and Molecular Biology, Eighth Edition, B.I. Waverly Pvt Ltd, New Delhi.
5. Karp, G. (2002). Cell and Molecular Biology. John Wiley, New York.
6. Kleinsmith, L. J. and Kish, V. M. (1995). Principles of Cell and Molecular Biology (Second Edition). Harper Collins College Publishers, New York.
8. Peter Snustad, D. and Michael J. Simmons (2000). Principles of Genetics. 2nd Ed. John Wiley & Sons Inc.
9. Purves W. K., Orians G. H. and Heller H. C. (1995). Life: The Science of Biology, 4th Edition. Sinauer Associates, Sunderland.
10. Robert H. Tamarin (2002). Principles of Genetics, 7th Edition, Tata McGraw-Hill Education Pvt Ltd, New Delhi.
11. Watson J. D., Hopkins N. H., Roberts, J. W., Steits, J. A. and Weiner, A. M. (1987). Molecular Biology of the Gene 4th Edition. The Benjamin Cumming Publishing Company. Menlo Park, California.

PRACTICAL
MZL4L04- IMMUNOLOGY

Course Outcomes (COs)

CO1	Students may gain a thorough understanding regarding the immune components and production of antiserum in animals
CO2	A training on various immuno-techniques
CO3	Students are expected to demonstrate proficiency in Practical immunology in order to satisfactorily complete the course. In addition, the extent of a student's mastery of these objectives, will help guide the course evaluation and grade. Laboratory sessions throughout the Immunology course will help to integrate theory and practical skills meaning the students learn about all aspects of the field and develop strong transferable skills, both in and out of the lab

1. Study of cells of immune system.
2. Histology of organs of immune system.
3. Bleeding of animals and preparation of serum.
4. Separation of lymphocytes.
5. Demonstration of agglutination reaction.
6. Immuno Electrophoresis.
7. Demonstration of ELISA technique.
8. Production of antibodies.
9. Preparation of antiserum.
10. Titration of antiserum

MZL4L04-CYTOGENETICS

Course Outcomes (COs)

CO1	The student develops an understand the basics of differential centrifugation
CO2	Knowledge to process and visualize salivary gland polytene chromosome from drosophila larva
CO3	The students gain hands own training in preparing squash preparation of grass hopper testis, to visualize stained chromosomes to identify meiotic stages

1. Homogenization, cell fractionation and isolation of nuclear fraction
2. Drosophila banding technique and Karyotyping.
3. Grass hopper – (testes –squash preparation) to study various meiotic stages

MZL4L04 - MICROTECHNIQUE AND HISTOCHEMISTRY
Course Outcomes (COs)

CO1	To attain skills in Tissue fixation and staining
CO2	Student gets a thorough understanding of differential staining

1. Preparation of stained and unstained whole –mounts.
2. Identification of the various tissues of animals in serial sections prepared using Nuclear and cytoplasmic stains
3. Processing a few types of tissues for the histochemical staining-Staining of serial Sections to show the presence of
a) Carbohydrates by PAS method
b) Proteins by Mercuric bromophenol blue method
c) Fats by Sudan Black B method
d) DNA by Feulgen Technique.

Submission:

Stained/unstained Whole mounts - 4 numbers
Double stained serial histology slides - 2 numbers
Histochemical slides - 4 numbers (Carbohydrate & Protein along with controls)

REFERENCES:

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2. Oser, B.L., (1965) Hawk's Physiological Biochemistry, McGraw Hill Book Co.
3. Sadasivan, S. and Manickam, A., (2005), Biochemical methods, New Age International, New Delhi.
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6. Thimmaiah ,S.K.(2004). Standard methods of Biochemical analysis. Kalyani Publishers, Ludhiana.
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8. Winchester.A.M.(1964). Laboratory Manual Genetics. Brownca Publishers, Dubuque,Iowa.
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11. Sambrook, J. and Russel, D.W. (2001): Molecular cloning: A laboratory Manual. CSHL Press, New York.
12. Talwar, G. P. and Gupta, S. K. (2002). A handbook of practical and clinical immunobiology (2nd Edition) CBS Publishers, India

ELECTIVE COURSE: WILDLIFE BIOLOGY- II
MZL4E02 - WILDLIFE CONSERVATION

(90 Hours)

CO1	To get a holistic view of Wildlife conservation in India
CO2	To understand the scope and history of wildlife
CO3	To identify various types of wildlife habitats such as forest, grasslands, mangroves and sacred grooves.
CO4	To understand the importance of *in-situ* and *ex-situ* conservation methods
CO5	To understand different tribal groups in Kerala and their roles in forest management and eco-development projects
CO6	To understand protected areas in Kerala, India and Worldwide
CO7	To clearly understand the laws and regulations related to wildlife in India
CO8	To understand the features of Red data book
CO9	To describe various conservation schemes in India for wildlife such as project Tiger, Project elephant.
CO10	To appreciate the efforts taken by Government and voluntary organizations for wildlife protection
CO11	To understand ecological principles of conservation and ecotourism in India

1. Conservation - Scope and History (8 hrs)

1.1 History of conservation in India- Status of wildlife in India (Past and Present)

1.2 Values of Wildlife - conservation values & ethics

1.3 Causes of depletion of Wildlife resources - habitat loss, construction of dams, collection for trophies, hunting, poisoning, poaching and other developmental activities.

1.4 The ecological, genetic, economic and Philosophic reasoning of conservation.

1.5 Man and Wildlife conflict - crop depredation, cattle lifting, human encounters case -studies in Kerala (Brief account only), control and management.

2. Wildlife Habitat (14 hrs)

2.1 Forest types - classification by Champion & Seth, mention major plant species of Indian forests.

2.2 (a). Deforestation - reasons for deforestation- shifting cultivation, illicit felling and encroachment, grazing and lopping, forest fire, industrial development, mining, plant diseases, insect pest, human settlements.

(b). Afforestation & Reforestation.

2.3 Grasslands, Mangroves and Sacred groves (Mention conservation and Management)

2.4 Forestry (Social, Production, Plantation and Protection)

2.5 Hydel projects and their impacts (mention habitat fragmentation, loss of forest- corridors & isolation of Wildlife population), case studies in Kerala.

2.6 In Situ and Ex situ conservation (Gene banking, conservation and exchange)

2.7 National River Conservation Programme (NRCP)

3. Tribals and Wildlife **(4 hrs)**

3.1 Tribal groups in Kerala

3.2 Role of tribals in Wildlife conservation - Joint Forest Management

3.3 Ecodevelopment Projects

4. Exotic and pet animals **(4 hrs)**

4.1 Introduction of Exotic animals (Flora and Fauna) in India: Principles and problems

4.2 Illegal Wildlife Trade and Pet Trade in India- Major trade centres, routes and related issues.

5. Protected Areas **(18 hrs)**

5.1 National parks and Sanctuaries: Important National Parks and Sanctuaries in India with special importance to Kerala - characteristics features, importance, declaration, formation, protection and administration and management.

5.2 Marine Sanctuaries and National Parks of India: Gulf of Mannar, Gulf of Kutch & Andaman

5.3 Important Bird Sanctuaries of India: Bharatpur, Ranganathittoo, Thatekkad & Vedanthangal Bird Sanctuary, Tamil Nadu

5.4. Man and Biosphere reserves (MAB) in India - concept, importance, ecological features and management (Brief Account). Nilgiri biosphere reserve (NBR) and Agastyavanam Biosphere reserve. Mention other biosphere reserves in India

6. Wildlife - Laws and Regulation **(5 hrs)**

6.1 Wildlife administration and legislation: administrative set up (central and state level), statutory bodies,

6.2. Wildlife Protection Act -1972 with its latest amendments.

6.3. Indian Forest act (Brief Account only).

7. Red Data Book **(3 hrs)**

7.1 Red data book on animals

7.2 IUCN criteria and definition regarding extinct (EX), extinct in the wild (EW), critically endangered (CD), low risk (LR), data deficient (DD) & not evaluated animals (NE). The problems in the application of criteria in the wild.

8. Government and Voluntary Organizations **(10 hrs)**

8.1 Role of Government and voluntary organization in wildlife conservation (IBWL, IUCN, ICF, WWF, BNHS, WPS, MNHS, TRAFFIC, CITES, NBA etc.)

8.2 Environmental Education and UN conferences on Environmental Issues

8.3 Resource depletion and Sustainable development

8.4 Earth Summit and World summit

9. Conservation Schemes **(15 hrs)**

9.1 Project Tiger

9.2 Project Hangul

9.3 Crocodile breeding project

9.4 Gir Lion Project

9.5 Project Sangai

9.6 Project Elephant

9.7 Sea turtle project

9.8 Snow Leopard Project.

10. Ecological Principles of Conservation **(5 hrs)**

10.1 Concept of minimum viable area

10.2 Minimum viable population

10.3 Compression hypothesis

10.4 Stable limit cycle
10.5 Fragmentation and isolation of habitats - role of corridors
10.6 Environmental and demographic stochasticity
10.7 Effective population size.
10.8 Genetic isolation (Island Biogeography theory) and genetic viability

11. Ecotourism **(4 hrs)**

11.1 Tourism and Wildlife - Importance of Tourism in Wildlife conservation - tourism requirements, visitor impact, visitor management - control and safety rules.
11.2 Ecotourism- role of ecotourism in sustainable development

REFERENCES:

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2. Abdul Jamil Urfi (2004): Birds beyond Watching, University Press (India) Pvt. Ltd.
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6. Grimmet, R., Inskipp, C. & Inskipp, T. (1999): Pocket Guide to the birds of Indian Subcontinent, Oxford University Press, New Delhi.
7. Hosetti, B.B. (2003): Wetlands Conservation and management, Pointer Publishers, Jaipur, India.
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12. Salim Ali (2002): The book of Indian Birds, revised edn. BNHS & Oxford University press, New Delhi.
13. Sharma B.K and Kaur, H. (1986): Environmental Chemistry. Goel Publishing House, Meerut.
14. Teague R.D. (Ed.). 1980. A Manual of wildlife conservation, The Wildlife society Washington D.C.
15.WII, A guide to chemical restraint of animals

PRACTICAL- ELECTIVE
MZL4(E)L01 -WILDLIFE BIOLOGY-II

1. Taxidermic procedures – Skinning, curing of a common bird (Pigeon / Quail).
2. Pterylography and comparison (Pigeon/ Quail)
3. Study of ecto and endo parasites of locally available bird and mammal
4. Hair sample analysis.
5. Identification of Fresh water fishes, Reptiles, Endangered amphibians, birds and mammals. Good quality photographs may be used for the purpose
6. Identification and interpretation of calls of local birds (from recorded cassettes).
7. Recording of zoo diseases and control measures, management of zoo animals.
8. Remote sensing (Photographic interpretation)
9. Typical vertebra of a bird, reptile and mammal
10. Spotters: Ecto and Endo parasites, bones of characteristic importance in the skull of crocodile, snake, dog, monkey and other items relevant to wildlife biology.

REFERENCES:

1. Dalton Harriott (2015) The Essential Guide to Taxidermy - From Trap to Trophy: How to Trap, Skin, Prepare, Mount and Stuff Animals, Birds, Reptiles, Fish and Insects
3. Koppikar, B.R. & J.H. Sabnis (1976). Identification of mammalian hair of some Indian animals. Journal of the Bombay Natural History Society 73(1): 5–20.
4. Salim Ali (2002): The book of Indian Birds, revised edn. BNHS & Oxford University press, New Delhi.
5. Daneil, J.C. The book of Indian Reptiles and Amphibians, Oxford publ.
6. Prater, S.H. The Book of Indian Animals. BNHS/Oxford

ELECTIVE COURSE: WILDLIFE BIOLOGY - III
MZL4E03- WILDLIFE MANAGEMENT

(90 Hours)

Course Outcomes (COs)

CO1	To understand concepts, principles and laws of wildlife management
CO2	To gain the basic understanding on the different components and evaluation of habitat and management.
CO3	To Familiarize the modelling software and techniques of data collection
CO4	Get acquainted with various methods to assess wildlife population
CO5	Acquiring knowledge on modern techniques in wildlife management
CO6	Knowledge about various food habit analysis to strengthen management of wildlife the natural habitats.
CO7	To analyze importance of prey in the habitat and management of predators
CO8	Critical evaluation on the pollution and other developmental activities on wetlands and its fauna
CO9	Learner will understand the concept and components of Zoo and its importance in the wild life Management
CO10	Scientific awareness to understand the health care of wild animals.

1. Wildlife Management **(4hrs)**

1.1 Concepts and Principles

1.2 Policies and laws in wildlife management

2. Habitat Management **(16 hrs)**

2.1. Components of habitat (Physical and Biological), Mention different types of habitats.

2.2. Habitat Evaluation Procedures (HEP).

2.3. Habitat Suitability Index (HSI)

2.4. Environmental Impact Assessment (EIA).

2.5. Food selection and patterns of habitat utilization.

2.6. Forest and fire: Impacts of fire on vegetation succession, effects of fire on soil, forest development and wildlife, Fire prevention, fire detected system, fire control and suppression procedures in India and developed nations.

2.7. Impacts of pollution on forest and wildlife, Environmental sanitation.

2.8 Vegetation profile: Techniques for estimation of plant abundance, frequency, dominance and importance value index, Preparation of vegetation profile, various techniques for assessment of vegetation cover

3. Modeling techniques **(5Hrs)**

3.1 Various software platforms for modeling- Collecting data for modeling

3.2 Applications of Modeling

3.4 Case studies

4. Wildlife population estimation (13hrs)

4.1. Direct Count: - Total count, Drive count, Time area counts and transect count

4.2 Indirect Count: - Call count, Track count and Pellet count/dung count

4.3. Capturing and Marking Techniques: - Live trapping &marking of birds and Mammals, Peterson or Lincoln Index method.

4.4 Chemical immobilization- Drug delivery equipment and accessories. Immobilization drugs - action, dosage, response and side effects, safety measures, complications, Handling of animals

4.5 Various audio recording techniques, Sonogram and its evaluation

4.4. Determination of Age and sex in animals and birds

4.5- Sampling Methods of Amphibians& Reptiles

5. Modern Methods of Wildlife study (13hrs)

5.1 Wildlife photography: Still and Videography, Camera Trap- Recording of calls.

5.2- Tracks and Signs of Animals

5.2 Remote sensing, GIS, Radar in wildlife research.

5.3 Radio telemetry: Importance, scope and methodology, Ethics in telemetry applications

5.4 Digital" tagging & its applications (e.g. implanting microchips)

5.4 Genetics in wildlife management- Pedigree analysis and karyotyping techniques

6. Food habit analysis (8 hrs)

6.1 Sampling method: Direct and indirect methods, qualitative and quantitative methods

6.2. Kinds of study materials, preservation and analytical procedures.

7. Prey predators management (5 hrs)

7.1. Foraging behaviour, optimal foraging theory, Group foraging, Depredation, Forage poisoning

8. Wetland Management (10 hrs)

8.1. Study of Waterfowl, waterfowl management, Habitat manipulation, food production, water development and cover improvement.

8.2. Management of Indian Cranes. Endangered and Non-endangered crane, Crane Conservation, migration, impact of pollution on wetland birds.

8.3 Conventions related to Wetland management, Ramsar sites in India.

8.4. Pheasants and Pheasant management- Pheasantry.

9. Zoo management (7hrs)

9.1. Basic consideration for designing a modern zoo,

9.2. Functions of a modern zoo,

9.3. Zoo layout and exhibition of animals,

9.4. Zoo services

9.5. Zoo sanitation

9.6. Captive breeding,

9.7. Safari parks

9.8. Moonlit zoo

10. Healthcare and disease management (9 hrs)

10.1 Disease monitoring and control, surveillance of disease.

10.2 Review of major viral, bacterial, rickettsial, mycoplasmal protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibians and reptiles.

10.3 Nutritional deficiency disease, worm infestation and related disease, Zoonosis.

10.4 Planning and management of wildlife health programmes.

REFERENCES:

1. Aaron, N.M. (1973): Wildlife ecology. W.H. Freeman Co. San Francisco, USA.
2. Abbassi and Ramaswami (1999): Biotechnological methods of pollution.
3. Barret, E.C and Anton Micallef (1991): Remote Sensing for Hazard Monitoring and Disaster Assessment, Taylor and Francis, London.
4. Canter, L.W. and Graw, MC, Environmental Impact Assessment, Hill publication, New York.
5. Chang – Kang, Tsung (2002): Introduction to Geographic information system. Tata McGraw-Hill Publishing Company Limited. New Delhi
6. Choudary, Suahant and Malik, Pradeep. A guide to chemical Restraint of Wild Animals. Nataraj Publishers, Dehradun
7. Dasman R.F. (1964): Wildlife biology, John Wiley and Sons, New York.
8. Giles R.H. Jr. (Ed) (1984): Wildlife management techniques-3rd Edition, the wildlife society, Washington D.C.
9. Gopal, Rajesh (1992): Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
10. Hosetti, B.B. (1997): Concepts in Wildlife Management, Daya Publishing House, Delhi.
11. Lilleand, T.M, and Kieffer, R.W., John Wiley and Sons. Remote Sensing and image Interpretation.
12. Negi, S.S. (1993): Biodiversity and its conservation in India. Indus Publishing Co., New Delhi.
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14. Robert, G.H. (1978): Wildlife management. W.H. Freeman and Co., San Francisco, USA.
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16. Rodgers W.A (1991): Techniques for wildlife census in India.
17. Sabbins, F.E., Freeman, Remote sensing: Principles and Applications.
18. Saharia V.B. (1982): Wildlife of India
19. Samar Singh – Natural heritage
20. Sanayal, Ram Bramha (1995): A Handbook of the Management of Animals in Captivity.
21. Schaller (1978): The deer and Tiger.
22. Sharma B.K. and Kaur, H. (1996): Environmental chemistry. Goel publishing House, Meerut.
23. Sharma, B.D. (1999): Indian wildlife resources: Ecology and development. Daya publishing House, Delhi.
24. Singh, S.K (2005): Textbook of Wildlife Management. IBDC.Lucknow
25. Singh, Samar (1987): Conserving India's Natural Heritage. Nataraj Pulblication.
26. Teague R.D. (Ed), (1980): A manual of wildlife ecology Conservation, The wildlife society Washington D.C.
27. Tikkader (1994): Threatened animals of India.
28.WII, A Guide to chemical restraints of animals.

PRACTICAL
ELECTIVE COURSE: WILDLIFE BIOLOGY-III
MZL4(E)L02-WILD LIFE MANAGEMENT

1. Qualitative analysis of digestive enzymes of the gut. (Herbivores/ Carnivores/Omnivores).
2. Measurements (Morphometry) for systematic study. Total length, body length, tail length, various dimensions of the skull etc. of mammals, birds, reptiles, amphibians and fishes.
3. Quantitative estimation of uric acid in birds and reptiles.
4. Identifying features of the beaks and feet of common birds. Students are expected to identify from photographs / Xerox.
5. Assessment of the age of mammals using their teeth.
6. Measurement of temperature, light, rainfall, humidity, transpiration and wind speed.
7. Collection and quantitative and qualitative analysis of soil fauna.
8. Territory mapping. Quadrate sampling, Line transect, Line intersect, Point prime methods of population study. Pellet counting for deer population of elephant dung in a sanctuary.
9. Spotters: Various item related to wildlife biology.

Study Tour
A study tour of not less than 8 days duration (need not to be at a stretch) to sanctuaries, National Parks, Zoos, Research Institutes and other places of ecological importance. The field report with the dated signature of the teacher concerned and duly certified should submit at the time of examination.
Slides should be submitted at the time of examination during IV semesters.

REFERENCES:

1. Gopal, Rajesh (1992): Fundamentals of Wildlife Management, Justice Home, Allahabad, India.
2 Dalton Harriott (2015) The Essential Guide to Taxidermy - From Trap to Trophy: How to Trap, Skin, Prepare, Mount and Stuff Animals, Birds, Reptiles, Fish and Insects
3 Koppikar, B.R. & J.H. Sabnis (1976). Identification of mammalian hair of some Indian animals. Journal of the Bombay Natural History Society 73(1): 5–20.
4 Salim Ali (2002): The book of Indian Birds, revised edn. BNHS & Oxford University press, New Delhi.
5 Daneil, J.C. The book of Indian Reptiles and Amphibians, Oxford publ.
6 Prater, S.H. The Book of Indian Animals. BNHS/Oxford

MODEL QUESTION PAPER

FAROOK COLLEGE (Autonomous)
FIRST SEMESTER M.Scs. DEGREE EXAMINATION
(CSS) Zoology
MZL 1C01- BIOCHEMISTRY

Time: 3 Hrs **Max Weightage: 30**

I. Answer any eight questions (Each question carry 1 Weightage)

1. Vitamins as co enzyme
2. What are isozymes?
3. Define saponification number of fats. What information does it provide?
4. What are prostaglandins?
5. Explain mutarotation.
6. Significance of Km and Vmax values.
7. Compare the structure of cellulose and starch
8. Structure of fructose.
9. Explain the role of PFK as pacemaker
10. Nitrogenous bases of DNA
11. Write a note on Amphoteric property of amino acid
12. Differentiate saturated and unsaturated fatty acids

(1x8=8 wtg)

II. Answer any Four (Each question carry 3 Weightage)

13. Inhibitors of electron transport chain
14. Biosynthesis of methionine
15. What is beta oxidation?
16. Write a note on Ribozymes.
17. Role of ATP as free energy carrier in the biological system.
18. Give a note on heteropolysaccharides with suitable examples
19. Write a note on 2,3-bisphosphoglycerate and its metabolism

(3x4=12 wtg)

III. **Answer any 2 of the following (Each question carry 5 Weightage)**

20. Explain the classification of lipids.
21. Explain the sequence of Electron transport system.
22. Describe the HMP pathway.
23. Biosynthesis of cholesterol**.** **(5x2=10 wtg)**

FAROOK COLLEGE (Autonomous)
SECOND SEMESTER M. Sc. DEGREE EXAMINATION
(CSS)
Zoology
MZL 2 C04- MOLECULAR BIOLOGY

Time: 3 hours **Max Weightage: 30**

I. Answer any *eight* questions (Weightage – 1)

1. Distinguish between monocistronic and polycistronic mRNA.
2. Name two non-sense codons and their common names.
3. Enlist the rRNAs of eukaryotic ribosome
4. Name two antibiotics as translational inhibitors. Mention their action.
5. What are chaperones? Mention their role in post-translational modification.
6. Distinguish between minisatellite and microsatellite.
7. What is site specific recombination? Cite example.
8. Distinguish between transduction and transformation.
9. What is a promoter site? Mention 3 consensus sequences of eukaryotic promoter site.
10. Comment on start codons
11. What is gRNA? What is its function?
12. Give short note on supressor tRNA

(8 x 1 = 8)

II. Answer any *four* questions (Weightage – 3)

13. Explain psuedogenes.
14. Describe the rolling circle model of DNA replication.
15. Write short note on posttranscriptional modification of RNA.
16. Explain wobble hypothesis.
17. Compare translation in eukaryotes and prokaryotes.
18. Describe the basic features of tryptophan operon.
19. What is siRNA and miRNA? What are their roles in regulating gene expression?

(4 x 3 = 12)

III. Answer any *two* questions (Weightage – 5)

20. Give an account of semiconservative method of replication. Add a brief note on the enzymes and protein involved in DNA replication.
21. Write an essay on the organization of interrupted genes and their evolution.
22. Describe the various methods of DNA repair.
23. (a) What are transposons? Give an account of the mechanism of transposition, and transposons in eukaryotes and prokaryotes.

(2 x 5 = 10)

FAROOK COLLEGE (Autonomous)
THIRD SEMESTER M. Sc. DEGREE EXAMINATION
(CSS) Zoology
ELECTIVE COURSE: WILDLIFE BIOLOGY - I
M ZL3 E 01 - BIODIVERSITY AND BIOTA

Time: Three Hours **Max Weightage: 30**

I. Answer any *eight* of the following: - (Weightage –1)

1. Nilgiri Tahr
2. Gaur
3. Indian Pangolin
4. Barn Owl
5. Little Cormorant
6. Gangetic Dolphin
7. What are Hot spots? Mention hot spots of India?
8. Flyways of bird migration
9. Brood parasitism
10. Guano and its commercial value
11. Ecological role of vultures.
12. Nesting habits of Hornbills.

(8 x 1= 8)

II. Answer any *seven* of the following: - (Weightage – 3)

13. Critically evaluate Satpura hypothesis.
14. Comment on territoriality in animals.
15. Briefly explain taxonomic positions of endangered birds of Western Ghats.
16. Explain birds as pollinators
17. Write notes on Endemic fresh water fishes of Western Ghats.
18. Explain Gondwana hypothesis.
19. India is a mega biodiversity country. Explain?

(4 x3 = 12)

III. Answer any *two* of the following*:* - (Weightage – 5)

20. Comment on different types of calls in birds? Briefly explain the role of vocalisation in recent avian research.
21. Briefly explain the population status and major threats to the survival of larger predators of Western Ghats.
22. Explain the sociobiology of elephants.
23. Briefly explain the endemic mammals of Western Ghats. Add notes on their population status, threats and conservational significance.

(2 x 5 = 10)

FAROOK COLLEGE (Autonomous)
FOURTH SEMESTER M. Sc. DEGREE EXAMINATION
(CSS)Zoology
ELECTIVE COURSE: WILDLIFE BIOLOGY - II
MZL 4E 02 - WILDLIFE CONSERVATION

Time: Three Hours **Max Weightage: 30**

I. Answer any *eight* of the following (Weightage -1)

1. What is meant by sustainable Development? Explain resource exploitation.
2. What is the role of UN in environmental conservation? Briefly explain Earth summit.
3. Explain the role of governmental and non-governmental organizations in environmental education?
4. What is endemism? Give two examples from mammals?
5. Which is the flagship animal of Eravikulum National Park? Briefly explain the significance of the habitat.
6. Differentiate between vulnerable and endangered species with reference to IUCN Red Data Book. Give examples.
7. Write notes on BNHS? Mention two important publications?
8. What is illegal wildlife trade? How it affects the conservation of wildlife?
9. What is a wildlife corridor? Mention its significance.
10. What is ecotourism? Mention its significance in conservation with two examples of Ecotourism sites from Kerala.
11. What is the role of IBWL in promoting wildlife conservation in India?
12. Briefly explain Red Data Book on animals.

(8 x 1 = 8 Weightage)

II. Answer any *four* of the following (Weightage – 3)

13. Give an account of project Tiger with special reference to Kerala.
14. Give an account of Project Elephant?
15. Write notes on human – animal conflict and its impacts on wildlife?
16. Explain briefly on the following.

a) Compression hypothesis
b) Effective population size
c) Inbreeding depression
d) Minimum viable population

17. Give an account of habitat fragmentation and its effect on wildlife corridors giving examples.
18. Distinguish between sanctuaries, national parks and Biosphere reserves.
19. Explain the role of tribal in conservation and management of protected areas.

(4 x 3= 12 Weightage)

III**. Answer any *two* of the following: - (Weightage – 5)**

20. Give a brief account of wildlife protection Act 1972 in India and its amendments.
21. Explain causes of depletion of wildlife in Kerala.
22. Discuss the impacts of hydroelectric projects on wildlife.
23. Write an essay on the forest types of India. **(2 x 5 = 10 Weightage)**

FAROOK COLLEGE (Autonomous)
FOURTH SEMESTER M.Sc. DEGREE EXAMINATION
(CSS)Zoology
ELECTIVE COURSE: WILDLIFE BIOLOGY
MZL4E03- WILDLIFE MANAGEMENT

Time: Three Hours **Max Weightage: 30**

I. Answer any *eight* of the following: - (Weightage – 1)

1. Mention different techniques for the assessment of vegetation cover?
2. Write down any four methods to determine age of mammals.
3. Comment on functions of a modern zoo.
4. Briefly explain food selection and patterns of habitat utilization.
5. Write notes on importance of radiotelemetry in wildlife studies.
6. What are Ramsar sites? Mention Ramsar sites in India.
7. Comment on endangered Indian cranes.
8. Write notes on Zoonosis.
9. Give an account on fire control and suppression procedures in India.
10. Write down the policies and laws in wildlife management.
11. What are safari parks? Mention demerits of this concept.
12. Briefly explain four capturing techniques in wildlife.

(18 x 1 =8 weightage)

II. Answer any *seven* of the following:-

13. Explain wildlife photography.
14. Write notes on Habitat Suitability Index.
15. Discuss components of wildlife habitat.
16. Explain briefly on the following:-

a) Carnivory
b) Depredation
c) Optimal foraging theory
d) Pheasantry

17. Briefly explain any two viral and bacterial diseases on wildlife.
18. Give a brief account on Pheasant management?
19. Comment on captive breeding and their role in wildlife conservation **(4 x 3 = 12 Weightge)**

III. Answer any *two* questions.

20. Explain various methods adopted in wild life for the food habit studies.
21. What are Wetlands? Explain wetland management with special emphasis on Waterfowl.
22. Comment on Impacts of pollution on forest and wildlife. Add notes on Environmental sanitation.
23. Discuss the direct and indirect methods for the wildlife population estimation.

(2 x 5 = 10 Weightage

APPENDIX

GRADING AND EVALUATION

1) Accumulated minimum credit required for successful completion of the course shall be 80.
2) A project work of 6 credits is compulsory and it should be done in III & IV semesters. Also, a comprehensive Viva Voce may be conducted by external examiners at the end of the IV Semester and carries 2 credits.
3) **Six Point Direct grading system:**

Evaluation and Grading should be done by the direct grading system. All grading during the evaluation of courses and the semester is done on 6 point scale (A+, A, B, C, D, E). Grading in 6-point scale is as given below.

Grade	Grade Point
A+	**5**
A	**4**
B	**3**
C	**2**
D	**1**
E	**0**

The calculation of GPA, SGPA & CGPA Shall be based on the direct grading system using 10 point scale as detailed below.

Letter Grade	Grade Range	Range of Percentage (%)	Merit / Indicator
O	4.25 – 5.00	85.00 –100.00	Outstanding
A+	3.75 – 4.24	75.00 –84.99	Excellent
A	3.25 – 3.74	65.00 –74.99	Very Good
B+	2.75 – 3.24	55.00 –64.99	Good
B	2.50 – 2.74	50.00 –54.99	Above Average
C	2.25 – 2.49	45.00 –49.99	Average
P	2.00 -2.24	40.00 –44.99	Pass
F	< 2.00	Below 40	Fail
I	0	-	Incomplete
Ab	0	-	Absent

Pass in a course

P grade and above (GPA 2.00 and above).
Pass in all courses in a semester is compulsory to calculate the SGPA.
GPA, SGPA and CGPA – between 0 to 5 and in two decimal points.
An overall letter grade (Cumulative Grade) for the whole programme shall be awarded to the student based on the value of CGPA using a 10-point scale given below.

CGPA	Overall Letter Grade
4.25 – 5.00	O
3.75 – 4.24	A+
3.25 – 3.74	A
2.75 – 3.24	B+
2.50 – 2.74	B
2.25 – 2.49	C
2.00 -2.24	P
< 2.00	F
0	I
0	Ab

The evaluation scheme for each course contains two parts: *viz.,* internal evaluation and External Evaluation.

Its weightages are as follows:

Evaluation	***Weightage***
Internal	1 (or20%)
External	4 (or80%)

Both internal and external evaluations will be carried out using Direct Grading System, in 6-point scale

CORE COURSE THEORY: EVALUATION SCHEME

1. Internal Evaluation

Components of Evaluation

Sl. No	Components	Weightage
1	Test	2
2	Assignment	1
3	Seminar	1
4	Attendance	1
	Total Weightage	**5**

2.External Evaluation

External Evaluation Carries 30 Weightage for each theory course. Examinations will be conducted at the end of each semester.

Table I: Pattern of Question paper

Division	Type	No. of Questions	Weightage	Total Weightage
Section A	Short Answer	8 out of 12	1	8
Section B	Short Essay	4 out of 7	3	12
Section C	Essay	2 out of 4	5	10
			Total Weightage in a question paper	**30**

CORE/ELECTIVE COURSE PRACTICAL: EVALUATION SCHEME

Practical examinations are conducted at the end of the second and fourth semester.

Scheme for Continuous Assessment

Sl No	***Components***	***Weightage***
1	Attendance/ Involvement	3
2	Lab skill/ Performance	2
3	Model Practical test	3
4	Record	2
	Total	10

Record- *Students are expected to make sketches with notes, while they study the specimens in the laboratory/field itself. The record must carry sketches with notes of all specimens. Emphasis must be on scientific accuracy and not on the beauty of sketches.*

External Examinations
Weightage for Semester End practical examination can be distributed as follows-

Without Submission

Questions	**Weightage**
Major (one number).	8
Minor (two number).	2x6 = 12
Spotters (four numbers) / One Minor	6
Record	4
TOTAL	30

With Submission

Questions	**Weightage**
Major (one number).	8
Minor (two numbers).	2x5 = 10
Spotters / One Minor	5
Submission	3
Record	4
TOTAL	**30**

No submission is required for the practical in elective course.
A candidate has to submit the following at the time of practical examination related to **MZL 4L04**
Whole-mount: 4 numbers
Slides: Histology: 4 numbers
Slides: Histochemistry: 2 numbers (To test the presence of carbohydrate and protein. Control slides not required)
If a candidate fails to submit the field study/tour report, no marks for the record will be awarded.

PROJECT WORK

(4 Credit for Project Report & 2 credits for Project Viva)
Internal Evaluation-10 Weightage
External Evaluation- 40 Weightage
(24 Weightage for Dissertation & 16 Weightage for Viva-voce)

The teachers who give project work can select any topic from the syllabi including th**e** elective course and the topic shall be assigned to each student. The research work on this topic shall be carried out by each student under the supervision of the faculty of the college/ scientists or faculties of recognized research institutions. The report of the research work shall be submitted by each student in the form of a Dissertation which shall be submitted for evaluation a day prior to the date of Viva - voce pertaining to

the Dissertation. A declaration by the student to the effect the hat dissertation submitted by him/her has not previously been formed the basis for the award of any degree or diploma and a certificate by supervising teacher to the effect that the dissertation is an authentic record of work carried out by the student under his/her supervision are to be furnished in the dissertation. Viva-Voce on the project will also be done on the same day.

General Viva-Voce
(2 credits)
Internal Evaluation-5 Weightage
External Evaluation- 20 Weightage

At the end of IVth semester each student shall appear for a comprehensive general viva voce before a team of two examiners. General Viva voce will be based on all core and elective courses of the entire programme on a separate day.

PROJECT WORK: EVALUATION SCHEME
(External: 40 Weightage, Internal: 10 Weightage)

Project evaluation will be conducted at the end of sixth semester.

Table 1: Internal Evaluation

Sl. No	***Criteria***	***Weightage***
1	Dissertation	6
2	Presentation/Viva voce	4
	Total	10

Table 2: External Evaluation

Dissertation

Sl. No	***Criteria***	***Weightage***
1	Introduction, Review of literature etc	2
2	Objectives and relevance of the study	3
3	Methodology	4
4	Results	3
5	Discussion & Interpretation	4
6	Conclusion	3
7	Involvement of the students	1
8	Style & neatness or dissertation	1
9	References	3
	Total	**24**

Table 3: Project Viva

Sl. No	*Criteria*	*Weightage*
1	Quality and correctness of slides	2
2	Time management	2
3	Way of Presentation	2
4	Clarity of presentation	3
5	Communication skill	3
6	Answer to questions	4
	Total	**16**

VIVA VOCE: EVALUATION SCHEME
(External: 20 Weightage, Internal: 5 Weightage)

At the end of IVth semester, each student shall appear for a comprehensive general viva voce before a team of two examiners. General Viva voce will be based on all core and elective courses of the entire programme on a separate day.

General Viva

Table 1: Internal Evaluation

Sl. No	*Criteria*	*Weightage*
1	Knowledge of the student	2
2	Communications	1
3	Answers to questions	2
	Total	**5**

Table 2: External Evaluation

Sl. No	*Criteria*	*Weightage*
4	Knowledge of the student	8
5	Communications	4
7	Answers to questions	8
	Total	**20**

AUDIT COURSES

Each student will undergo an audit course viz. Ability enhancement course (AEC) and Professional Competency Course (PCC) in the I and II semesters respectively. The student should undergo any one course listed under each category (AEC and PCC) in the respective semesters. Each student will be under the supervision of a faculty who will be responsible for monitoring the course and evaluation. The allotment of the faculty will be decided by the Department Council. The examination and evaluation for the Professional competency course should focus on evaluating the skill component involved.

1. Ability enhancement course (AEC) – (In the I semester)

a) Documentation and scientific writing
b) Paper review on a topic of choice.
c) Internship for a minimum of 40 hours.
d) Industrial or Practical training for a minimum of 40 hours.
e) Community linkage programme for a minimum of 40 hours.

f) Seminar presentation on a frontier area of biological research.

The topic should be from outside the syllabus.

2. Professional Competency Course (PCC) (In the II semester)

a) Statistical (SPSS/R/any software relevant to the programme of study) Softwares
b) Hands-on on training on skills relevant to programme study (Minimum of three days)
c) Museum curation skills (Taxidermy etc.)

Semester	Course Title	Course Code	Suggested area
I	Ability Enhancement Course (AEC)	**MZL1A01**	a) Documentation and scientific writing b) Paper review on a topic of choice. c) Internship for a minimum of 40 hours. d) Industrial or Practical training for a minimum of 40 hours. e) Community linkage programme for a minimum of 40 hours. f) Seminar presentation on a frontier area of biological research. (The topic should be from outside the syllabus).
II	Professional Competency Course (PCC)	**MZL2A02**	a) Statistical (SPSS/R/any software relevant to the programme of study) software's b) Hands-on training on skills relevant to programme study (Minimum of three days) c) Museum curation skills (Taxidermy etc.)