

FAROOK COLLEGE (AUTONOMOUS)



**FAROOK COLLEGE (Autonomous)
M.Sc. ZOOLOGY PROGRAMME
SYLLABUS
CORE COURSES
&
ELECTIVE COURSES
With effect from 2019-20 admission onwards
(FCCBCSS PG 2019)**

Prepared by Board of Studies in Life Sciences

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 the academic year 2019-20 onwards.

Date:

Place:

P R I N C I P A L

**FAROOK COLLEGE (AUTONOMOUS)
CURRICULUM AND SYLLABI FOR M. Sc. ZOOLOGY
(CREDIT SEMESTER SYSTEM) from 2019 onwards**

Pattern of the Programme

- a. The name of the programme shall be M.Sc. Zoology under CSS pattern.
- b. The programme shall be offered in four semesters within a period of two academic years.
- c. Eligibility for admission will be as per the rules laid down by the University from time to time.
- d. Details of the programme offered are given in Table 1. The programme shall be conducted in accordance with the programme pattern, scheme of examination and syllabus prescribed

**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	*	-	
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	4	30	10
	MZL2L02	Practical related to Core Course V- Ecology & Ethology	4	30	10
	MZL2L03	Practical related to Core Course VI- Developmental Biology & Endocrinology	4	30	10
III	MZL3C07	Core Course VII –Physiology	4	36	5
	MZL3C08	Core Course VIII-Microbioogy & Biotechnology	4	36	5
	MZL3E01(5)	Elective Course I-Wildlife Biology I- Biodiversity & Biota	4	36	5
	MZL3L04**	Practical related to Core Course VII – Physiology	**	-	
	MZL3L05**	Practical related to Core Course VIII- Microbioogy & 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
	MZOL4L04	Practical related to Core Course IX – Immunology & Cytogenetics	4	30	10
	MZOL4(E)L01	Practical related to Elective Course II- Elective Course II-Wildlife Biology II- Wildlife Conservation	4	30	10
	MZOL4(E)L02	Practical related to Elective Course III- Elective Course III-Wildlife Biology III- Wildlife Conservation	4	30	10
	MZL4P01	Project Work	6	40	10
	MZL4V01	Viva voce (Both General & Project Viva	2	20	5

* Exam will be held at the end of Second semester.

** Exam will be held at the end of Fourth semester.

M -PG/M.Sc
ZL - Zoology
C - Core Course
L - Core course Practical
E - Elective Course
(E)L - Elective Practical

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 Project report & 2 credit for Project Viva)

(Project report / dissertation shall be presented by Power point 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)

B) 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

C) 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 IV Semester and carries 2 credits.
- 3) **Six Point Direct grading system:**

Evaluation and Grading should be done by 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:

<i>Evaluation</i>	<i>Weightage</i>
Internal	1 (or20%)
External	4 (or80%)

Both internal and external evaluation will be carried out using Direct Grading System, in 6 pointscale

D) CORE COURSE THEORY: EVALUATION SCHEME

1. Internal Evaluation

Table 2: Components of Evaluation

Sl.No	Components	Weightage
1	CAT-I & CAT II	1+1
2	Assignment	1
3	Seminar	1
4	Attendance	1
	Total Weightage	5

Table 3: Percentage of Attendance & Grade

Percentage	Grade
Above 90%	A+
85 – 89.99%	A
75 – 84.99%	B
75 -79.99%	C
70 -74.99%	D
< 70%	E

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 aquestionpaper				30

E) CORE/ELECTIVE COURSE PRACTICAL: EVALUATION SCHEME

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

Table :1 Scheme for Continous Assessment

<i>Sl No</i>	<i>Components</i>	<i>Weightage</i>
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 beauty of sketches..*

Table 2:% of Attendance and Eligible marks

Percentage	Grade
Above 90%	A+
85 – 89.99%	A
75 – 84.99%	B
75 -79.99%	C
70 -74.99%	D
< 70%	E

Table 3: Performance / Lab skill

<i>Criteria</i>	<i>Grades</i>
Excellent	A+
Very good	A
Good	B

Average	C
Below average	D

Table 4: Record Evaluation

<i>Criteria</i>	<i>Grade</i>
Excellent	A+
Very good	A
Good	B
Average	C
Below Average	D

External Examinations

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

With submission

Major question (one number) – Weightage=8
 Minor question (two numbers) - 2x5 = 10
 Spotters / One Minor =5
 Submission - = 3
 Record - =4

Total 30

Without submission

Major (one number) Weightage =8
 Minor (two number) 2x6 = 12
 Spotters (four numbers) / One Minor =6
 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 : 2 numbers
 - Slides: Histochemistry : 2+2 numbers (To test the presence of carbohydrate and protein along with Control slides)
- If a candidate fails to submit the field study / tour report, no marks for the record will be awarded.

PROJECT WORK

(6 credits)

Internal Evaluation-10 weightage

External Evaluation- 40 weightage

(24 Weightage for Dessertation & 16 Weightage for Viva voce)

The teachers who give project work can select any topic from the syllabi including the 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 faculty of the college/ scientists or faculties of recognised 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 that 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 sameday.

**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

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

Table 2: External Evaluation

Dissertation

<i>Sl. No</i>	<i>Criteria</i>	<i>Weightage</i>
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 he students	1
8	Style & neatness or dissertation	1
9	References	3

	Total	24
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Table 3: Project Viva

<i>Sl. No</i>	<i>Criteria</i>	<i>Weightage</i>
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

<i>Sl. No</i>	<i>Criteria</i>	<i>Weightage</i>
1	Knowledge of the student	2
2	Communications	1
3	Answers to questions	2
	Total	5

Table 2: External Evaluation

<i>Sl. No</i>	<i>Criteria</i>	<i>Weightage</i>
4	Knowledge of the student	8
5	Communications	4
7	Answers to questions	8
	Total	20

Audit courses:

In addition to the above courses there will be two Audit Courses (*Ability Enhancement Course & Professional Competency Course*) with 4 credits each. This course aims to have hands on experience for the students in their respective field of study, both in the core and elective subject area. Also it is a platform for the student community to have basic concepts of research and publication

These have to be done one each in the first two semesters. The credits will not be counted for evaluating the overall SGPA & CGPA. Students have to obtain only minimum pass requirements in the Audit Courses. The details of Audit courses are given below.

One particular AEC may be selected for all the students in a batch in the department or each student in a batch may choose one AEC, among the pool of courses suggested below. Either a single faculty from the department may be in charge of this course for a batch or each student may be assigned to a particular faculty in the department, in charge of this AEC, which will be decided by the department council/ HoD.

Semester	Course Title		Suggested Area
I	Ability Enhancement Course (AEC)	MZL1A01	Seminar presentation / Article review/ Case study /Community linkage programme / Book reviews etc.
II	Professional Competency Course (PCC)	MZL2A02	To test the skill level of students like testing the application level of different softwares such as SPSS/R/FASTA/BLAST/CLUSTAL X/Any software relevant to the programme of study

After conducting the AEC, the evaluation/examination should be done either common for all students in a batch or individually depending upon the AEC conducted. The evaluation/ examination must be conducted jointly by the teacher in charge of the AEC and the head of the department. The result of the AEC, duly signed and sealed by both teacher in charge and head of the department, should be **uploaded to the Controller of Examinations** during the stipulated time period in the third semester of the programme. **Evaluation/examination must be conducted by 30 weightage pattern, as in the theory**

courses and the GPA and overall grade of the AEC should be uploaded to the University.

Evaluation/examination on AEC must contain the following components: MCQ type written examination, Report on AEC, Presentation of AEC, Viva voce on AEC. Distribution of 30 weightage may be done by the teacher in charge in concurrence with the Head of the department.

FIRST SEMESTER M.Sc ZOOLOGY M ZOL-1B-01 - BIOCHEMISTRY

(90 hours)

1. Introduction

2 hrs

1.1. Macromolecules and their subunits

1.2. Chemical bonds of biomolecules

2. Carbohydrates

12 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

9 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. pK 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, Quarternary structure.
- 3.2.2. Brief note on protein domains, motifs, folds and Ramachandran plot.
- 3.2.3. Biological roles of proteins

4. Lipids

8 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-Meissl 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 functions.
- 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

5 hrs

- 5.1. Structure of nitrogen bases and nucleotides
- 5.2. Structural organization of DNA (Watson –Crick model)
- 5.3. Characteristic features of A-, B- C- and Z-DNA
- 5.4. Structural organization of t-RNA; brief note on micro-RNA
- 5.5. Biological roles of nucleotides and nucleic acids

6. Enzymes

14 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 and ribozyme

- 6.9. Vitamins as coenzymes
- 6.10. Factors influencing enzyme action

7. Vitamins **2 hrs**

- 7.1 Classification
- 7.2 Structure and functions

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

9.1. Carbohydrate metabolism **14 hrs**

- 9.1.1. Glycolysis – (PFK as pacemaker – Hexokinase conformation and change by glucose), Fate of pyruvic acid
- 9.1.2. Metabolism of 2, 3 DPG as regulator of oxygen transport
- 9.1.3. Citric acid cycle; Pyruvate dehydrogenase complex and ketoglutarate dehydrogenase complex
- 9.1.4. Electron transport system and oxidative phosphorylation; Redox potential, Chemiosmotic hypothesis; inhibitors of electron transport chain
- 9.1.5. 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 **6 hrs**

- 9.3.1. Oxidation of fatty acids
- 9.3.2. Biosynthesis of fatty acids
- 9.3.3. Biosynthesis of cholesterol

9.4. Nucleic acid metabolism **5 hrs**

- 9.4.1. Biosynthesis and degradation of purines and pyrimidines

References:

1. Lehninger, A.L. (2008), Principles of Biochemistry, Vth edition, CBS publishers and distributors, Delhi
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
8. Voet, D. and Voet, J.G. (2004), Biochemistry, John Wiley & Sons
9. Zubay, G (latest .), Biochemistry, Maxwell Macmillan International
10. Devlin,T.M. (2006), A Text of Biochemistry with clinical correlations, John Wiley & Sons

PRACTICALS

MZOL1B01(L)*- BIOCHEMISTRY

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 Toluidine 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

MZOL1B02-BIOPHYSICS AND BIOSTATISTICS

(90 Hours)

Section-A-Biophysics

(55 Hours)

1- Matter and mechanics of cells

3 hr

- 1.1 Colloids, properties of colloids, forms of colloids, Brownian movement and Tyndall phenomena

2- Diffusion and Osmosis

5 hr

- 2.1- Fick's law and diffusion coefficient.
- 2.3- Gibb's Donnan equilibrium
- 2.4- Application of diffusion processes in biology: haemolysis.
- 2.5 -Vant Hoff's laws
- 2.6-Osmotic concentration, Osmotic pressure and osmotic gradient
- 2.7- Electrosmosis.
- 2.8 -Electrolytic and ionic balance in biological fluid

3 –pH

2 hr

- 3.1. Dissociation of water
- 3.2. Dissociation of a weak acid
- 3.3. Henderson Hasselbalch equation
- 3.4. Buffers, pH meter
- 3.5. pH value calculation.

4 – Bioacoustics

5 hr

- 4.1-Characteristics of sound
- 4.2-Physical basis of hearing
- 4.3-Physical organization of ear
- 4.4- Physical aspects of sound transmission in the ear.
- 4.5-Audible sound frequency
- 4.6-Pitch reception and theories
- 4.7-Infrasonic and ultrasonic sounds
- 4.8 Echolocation; receiving and analyzing echoes

5 -Radiation Biology **9 hr**

- 5.1-, Properties of different types of radio isotopes normally used in biology, their detection and Measurement incorporation of radioisotopes in biological tissues and cells.
- 5.2- Molecular imaging of radioactive material, safety guidelines.
- 5.3-Biological effects of radiations
- 5.4- Radiation protection and therapy, Nuclear medicine.
- 5.5-Applications of tracer techniques: Radiation dosimetry, Radioactive isotopes, Ionizing radiations, Radiation Detectors (GM Counter, Liquid Scintillation Counter)
- 5.6- Autoradiography

6 - Biophysical methods (Brief account) **5 hr**

- 6.1-Analysis of biomolecules—using UV / visible fluorescence, circular dichroism
- 6.2- NMR and Electron Spin Resonance (ESR) spectroscopy
- 6.3- Structure determination using X-ray diffraction and NMR; analysis using light scattering.
- 6.4-Different types of mass spectrometry and surface plasma resonance methods

7- Electrophysiological methods (Brief) **3 hr**

- 7.1-Single neuron recording,
- 7.2-Patch clamp recording,
- 7.3-ECG,
- 7.4-Brain activity recording
- 7.5-Lesion and stimulation of brain
- 7.6-Pharmacological testing,
- 7.7-PET (Positron Emission Tomography), MRI, f MRI, CAT.

8 -Principles and applications of **8 hr**

- 8.1-Microscopy (Fluorescent, Interference , confocal -scanning and transmission electron microscopes
- 8.2-Resolving powers of different microscopes
- 8.3-Different fixation and staining techniques for EM, (freeze-etch and freeze fracture methods for EM-image processing methods in microscopy)
- 8.4- Laser and its applications in Biology

9 - Separation Techniques **10 hr**

- 9.1- Chromatography (Adsorption, Partition, and ion-exchange chromatography ,Column, Paper ,Thinlayer ,Gel-filtration, Gas chromatography, Affinity, HPLC)
- 9.2-Electrophoresis-(Paper, Disc, PAGE, Two dimensional PAGE, High voltage and Immunoelectrophoresis.
- 9.3. Isoelectric focusing.
- 9.4-Flow cytometry

10. Influence of gravity **3 hr**

- 10.1-Human body posture in the gravitational field
- 10.2- Influence of G force

- 10.3- Force of centrifugal acceleration – importance of aviation and space travel
- 10.4- Effect of positive G. Force & negative G. Forces
- 10.5- Protection against G. Force
- 10.6- Influence of linear acceleration on the body

11-Nanotechnology **2 hr**

- 11.1- Definition
- 11.2- Nanotechnology and its applications in the field of health care.
- 11.3- Roles of nanotechnology in environmental management.

Section –B –BIostatISTICS **(35 Hours)**

1. Introduction **2 hr**

- 1.1 Biostatistics: Definition, Terms, Applications, Role of biostatistics in modern research.

2. Data collection: **7 hr**

2.1 Types of data:

- Primary, secondary, qualitative, quantitative

2.2 Methods of data collection and classification:-

Types of sampling method-

Advantages and disadvantages of census and sampling method,

Classification of data, Tabulation

Methods of classification

Class intervals- exclusive and inclusive method

2.3 Diagrammatic and graphical presentation of data

Bar diagram – (types), Pie diagram, Histograms, Frequency polygon

Frequency curve (types. skewness, kurtosis, ogive)

3. Statistical Methods: Measures of central tendency and dispersal **8 hr**

3.1. Mean, median, mode, quartile

3.2 Range, Mean deviation, Quartiles deviation, variance, Standard deviation, Standard error, degree of freedom

4. Probability distributions **4 hr**

4.1. Basic concepts and definition:

4.2. Laws of probability

4.3. Probability distribution: -

Binomial, Poisson and Normal

5. Statistical inference **7 hr**

5.1. Difference between parametric and non-parametric statistics;

5.2. Testing of hypothesis

5.3. Errors

5.4. Confidence interval; levels of significance, Critical region;

5.5. Normality test

5.6. t-test, chi-square test, F-test, ANOVA

5.7. Kruskal-Wallis, Mann-Whitney

6. Correlation and Regression

7 hr

6.1. Types of correlation

6.2. Methods to measure correlation

Scatter diagram

Karl Pearson's coefficient of correlation

Spearman's correlation

6.3. Types of regression analysis

6.4. Regression equations

6.5. Difference between regression and correlation analysis

REFERENCES –

BIOPHYSICS

1. Ackerman, E. (1962). Biophysical Science. Prentice Hall Inc.
2. Alonso, A and Arrondo, J.L.R (2006) - Advanced techniques in Biophysics, Springer
3. Alok Srivastava and Ipsita Roy-(2009)-Bio-Nano- Geo Sciences- The future challenge-Ane Books Ltd.
4. Baker, E.J and Silverton, R.E. (1978) – Introduction to medical laboratory technology, ELBS
5. Bengt Nolting (2006), Methods in modern Biophysics, Springer.
6. Daniel, M (2002), Basic Biophysics for Biologists. Agro Botanics, Bikaner
7. Das, D. (1991) Biophysics and Biophysical Chemistry, Academic Publishers Calcutta.
8. Ernster, L (1985), Bioenergetics, Elsevier, New York.
9. Frank H. Stephenson (2006)- Calculations for Molecular Biology and Biotechnology- A guide to Mathematics in the laboratory-Academic Press- An imprint of Elsevier.
10. Hoppe, W, Lohmann, W, Markl, H and Ziegler, H (1983), Springer Verlag, New York.
11. Keith Wilson and John Walker (2008), Principles and techniques of Biochemistry and Molecular biology – 6th edn, Cambridge University Press
12. Marshall, A.G. (1978) Biophysical Chemistry, Principles, Techniques and Applications- John Wiley and Sons New York
13. Mohan P. Arora-(2007), Biophysics –Himalaya Publishing House.
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15. Narayan, P (2000) Essentials of Biophysics. New age international
16. Nagini.S (2009)- Instant Biochemistry-Ane Books Ltd.
17. Roy, R.N(1996)-A text book of Biophysics-New central book Agency Calcutta.
18. Srivastava, P.K (2006)-Elementary Biophysics, An introduction. Narosa publishing house New Delhi
19. Viswanathan. B(2009)-Nano Materials- Narosa Publishing House.

BIOSTATISTICS

1. Agarwal, B.L. (1996) Basic statistics, New Age International(P) Ltd. Publishers, New Delhi.
2. Bailey, N.T.J. (1981) Statistical methods in Biology. Hodder and Stoughton, London.
3. Campell, R.C. (1978), Statistics for biologists. Blacker and Sons Publishers, Bombay.
4. Gupta, C.B. and Gupta, V. (2002) Statistical methods. Ika's Publishing House, New Delhi.

5. Rostogi, V. B. (2009) Fundamentals of Biostatistics. Ane's Students Edition New Delhi
6. Stephen W,Looney(2008) Methods in Molecular Biology-Biostatistical Methods- Springer International Edition
7. Zar, J.H.(2003) Biostatistical Analysis - Fourth edition. Pearson Education. Delhi.

PRACTICALS

MZOL1B02 (L)*: BIOPHYSICS & BIOSTATISTICS

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. Serum electrophoresis.
6. Demonstration of working principle of Light, Phase contrast and Fluorescence microscope, Camera Lucida and Photomicrographic equipment, HPLC.
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 coloured solution.
8. Absorption spectrum of a coloured solution (KMnO_4)

REFERENCES

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. Gasse, E. J. (1962). Biophysics Concepts and Mechanics. Van Nostrand Reinhold Co.
6. Daniel, M. (1998). Basic Biophysics for Biologists. 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.
3. Graphic presentation of population distribution in the form of histogram, frequency polygon and frequency curve
4. Computation of measures of central tendency and dispersion in anthropometric data of school

children.

5. Simulation of Binomial and Poisson distributions
6. Estimation of mean number of children per family from selected populations
7. Estimation of population of planktons
8. Designing of an experiment for the comparison of efficacy of a few diets on different types of by the method of ANOVA.
9. Regression analysis and correlation analysis of a data of heights and weight of a group of students.
10. Data analysis by SPSS

REFERENCES

1. John, T. (2002). Practical Statistics for Environmental and Biological Scientists. John Wiley & sons

*SEE will be at the end of Second Semester

MZOL1B03- SYSTEMATICS AND EVOLUTION

(90 hours)

Section A. Systematics (45 hours)

- 1. Definition and basic concepts in Systematics and Taxonomy** **4Hr**
 1. Historical resume of systematics
 - 1.1 Levels of Taxonomy: Alpha, beta, gamma taxonomy
 - 1.2 Place, importance and applications of taxonomy
 - 1.3 Goals of taxonomy
- 2. Classification** **4Hr**
 - 2.1 Practise of classification- purpose of classification
 - 2.2 Use of classification- storage of data, recovery of data
 - 2.3 Theories of biological classification- hierarchy of categories
 - 2.4 Types of classification—evolutionary & phylogenetic classification – typological classification, phonetic classification, omnispective classification, horizontal and vertical classification
 - 2.5 Components of classification
- 3. Taxonomic procedure** **8 Hr**
 - 3.1. Taxonomic collections- types of collections, value of collections
 - 3.2.. Curation- preservation of collection in field and laboratory
 - 3.3. Recording of field data, storage of collection, labelling and cataloguing of collections
 - 3.4. Identification- methods of identification
 - 3.4.1. Use of keys- kinds of keys, their merits and demerits
 - 3.5. Taxonomic descriptions: presentation of findings
 - 3.6. Kinds of taxonomic publications
 - 3.6.1. Taxonomic and ecological publication and their difference
- 4. Species concepts** **7 Hr**
 - 4.1. Species category- different species concepts: typological, Nominalistic, biological, evolutionary, recognition, ontological (theoretical) and operational (epistemological speciesconcepts)

4.2. Taxonomic diversity within species, different kinds of species, sub species and other infraspecific categories, hybrids.

5. Taxonomic characters **4 Hr**

5.1 Different kinds of taxonomic characters

5.2 Functions of taxonomic characters.

5.3 Taxonomic characters and classification

5.4 Taxonomic characters and evolution

6. Zoological nomenclature **5 Hr**

6.1 International Code of Zoological Nomenclature, development of Code of Zoological Nomenclature: its operative principles, interpretation and application of important rules in the formation of scientific names of various taxa.

6.2 Principle of priority

6.2.1 Homonymy and Synonymy

6.3 Type method and its significance

6.3.1 Different kinds of types in descriptive taxonomy

7. Newer trends in systematics **4 Hr**

7.1 Chemo and serotaxonomy

7.2 Cytotaxonomy

7.3 Numerical taxonomy

7.4 Cladistics

7.5. Molecular systematics

7.6 DNA bar coding vs traditional taxonomy

8. Ethics in taxonomy **5 Hr**

8.1 Ethics related to collections

8.1.1 credit

8.1.2 Lending and borrowing of specimens

8.1.3 Loan of material

8.1.4 Exchange of materials

8.1.5 Collaboration and co-operation with co-workers

8.1.6 Use of language

8.2 Ethics related to taxonomic publications

8.2.1 Authorship of taxonomic papers

8.2.2 Correspondence

8.2.3 Suppression of data

8.2.4 Undesirable features of taxonomic papers

8.3 Taxonomists and user communities

9. Taxonomic impediments **4 Hr**

9.1 Impediments to build up taxonomic collections and maintenance

9.2 Shortage of man power

9.3 Lack of funding for taxonomic research

9.4 lack of training in taxonomy

9.5 Lack of Library facilities

9.6 Impediments in publishing taxonomic work

9.7 Solutions to overcome the impediments

9.7.1 International co-operation

9.7.2 Development of Taxonomic centres

9.8 Need for efficient international networking

9.9 The desired end product

Section B. Evolution (45 hrs)

- 1. Natural Selection** **5 Hr**
1.1. Mechanism of natural selection - directional, disruptive and stabilizing selection
1.2. Sexual selection; Intrasexual and intersexual selection-secondary sex characteristics-sexual selection hypothesis-good genes hypothesis.
- 2. The Mechanisms** **10 Hr**
2.1. Population genetics – populations, gene pool, gene frequency; Hardy-Weinberg law, founder principle, bottleneck effect and genetic drift as factors in speciation.
2.2. Isolating mechanisms-*Prezygotic* and *Postzygotic isolating mechanisms*; speciation-allopatric, peripatric-parapatric-heteropatric- sympatric speciation; ecotypes.
2.3. Co-evolution; Microevolution, Macroevolution. Convergent (homoplasy) –divergent-parallel evolution.
- 3. Tempo of evolution** **8 Hr**
3.1. Gradualism Vs punctuated equilibrium.
3.2. Anagenesis Vs Cladogenesis.
- 4. Molecular evolution** **12 Hr**
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 sequences of proteins and DNA - orthologous and paralogous; parsimony analysis; nucleotide sequence analysis; DNA bar coding vs traditional taxonomy.
- 5. Evolutionary trends** **10 Hr**
5.1. Biochemical evolution- Collapse of Orthogenesis.
5.2. Stages in primate evolution including Homo: dry and wet nosed primates, prosimians and simians-humans and the African apes - African origin for modern humans. Y-chromosomal Adam- mitochondrial Eve.
5.3. Communication, speech, language and self awareness in primates.

References:

A. Systematics:

1. David, M. H, Craig Moritz and Barbara K. M. (1996) Molecular Systematics. Sinauer Associates, Inc.
2. David, M. S. (2009) DNA barcoding will frequently fail in complicated groups: an example in wild potatoes. *American Journal of Botany* 96(6): 1177–1189. Downloadable from www.vcr.uwisc.edu/spoonerlab/.../BarCodes%20and%20Wild%20Potatoes.pdf
3. Kapoor, V.C (1998) Theory and practise of animal taxonomy. Oxford & IBH ,Publi., Co. New Delhi
4. Kipling, W. W; Brent, D.M. and Quentin, D. W. (2005) The Perils of DNA Barcoding and the Need for Integrative Taxonomy. *Syst. Biol.* 54(5):844–851, Downloadable from sysbio.oxfordjournals.org/cgi/reprint/54/5/844.pdf
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6. Narendran, T.C (2008) An introduction to Taxonomy . Zoological survey of India.
7. Sneath P.H. A. (1973): Numerical Taxonomy: The Principles and Practice of Numerical

Classification, W H Freeman & Co.

B. Evolution

1. Coyne, J.A. and Allen, O.H. (2004) Speciation. Sinauer Associates Inc., Massachusetts, USA. 13
2. David, M. H, Craig Moritz and Barbara K. M. (1996) Molecular Systematics. Sinauer Associates, Inc.
3. David, M. S. (2009) DNA barcoding 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/.../BarCodes%20and%20Wild%20Potatoes.pdf
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5. Kipling, W. W, Brent, D.M. and Quentin, D. W. (2005) The Perils of DNA Barcoding and the Need for Integrative Taxonomy. *Syst. Biol.* 54(5):844–851, Downloadable from sysbio.oxfordjournals.org/cgi/reprint/54/5/844.pdf
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7. Motoo Kimura (1983) The neutral theory of molecular evolution. Cambridge University Press.
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9. Strikberger, M.W. (2005) Evolution, Jones and Bartett Publishers, London.

PRACTICAL

MZOL1B03(L)*Systematics & Evolution

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; minimum ten sets from the identified specimens.

Evolution

1. Exercises in convergent evolution.
2. Exercises in divergent evolution.

*SEE will be at the end of Second Semester

SECOND SEMESTER
MZOL2B04- MOLECULAR BIOLOGY

(90 Hours)

1. DNA replication:

(11 hrs)

- 1.1. Semidiscontinuous synthesis-Okazaki fragments
- 1.2. Replication origin and replication fork
- 1.3. Unit of replication, extra chromosomal replicons
- 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 organisation 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

(5 hrs)

4.1. Characteristics of genetic code

4.2. Start codons and stop codons

4.3. Degeneracy of the code: Wobble hypothesis and isoacceptor tRNAs

4.4. Special features of the genetic code in mitochondria, mitochondrial tRNA

4.5. Variations in the genetic code in *Mycoplasma* and *Tetrahymena*

4.6. Point mutations that alter genetic code (missense, nonsense & frameshift)

4.7. Suppressor mutation, suppressor genes & suppressor tRNA

5. Ribosome: The site of protein synthesis:

(5 hrs)

5.1. Composition, topography, active centres and biogenesis of ribosome

5.2. Experiments to understand Composition, topography, active centres and biogenesis of ribosome

5.2.1. Composition; Reconstitution experiments, r-protein mutants

5.2.2. Topography; Methods to study ribosome structure- Immune electron microscopy, cross linking

5.2.3. Active centres; affinity labelling

5.2.4. Biogenesis; anucleolate mutants in *Xenopus laevis*

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:

(9 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

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. Organisation of human genome (brief account)

9. Interrupted genes

(4 hrs)

9.1. Definition and explanation

9.2. Organisation 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. Microbial genetics:

(5 hrs)

12.1. Prokaryotic genome- Structural organisation of *Escherichia coli*

12.2. Methods of genetic transfers in bacteria- transformation (in *Streptococcus pneumoniae*), conjugation and sexduction, transduction

12.3. Brief note on mapping genes by interrupted mating (in bacteria)

13. Organelle genome:

(4 hrs)

13.1. Extranuclear genes and maternal inheritance

13.2. Chloroplast genome: special features

13.3. Mitochondrial genome

13.3.1. Special features of yeast mitochondrial genome, petite mutants

13.3.2. Special features of human mitochondrial genome

14. Cancer:

(5 hrs)

14.1. Genetic rearrangements in progenitor cells, oncogenes, protooncogenes and

tumour suppressor genes

14.2. Virus-induced cancer

14.3. Cancer and the cell cycle

14.4. Cancer and apoptosis

14.5. Interaction of cancer cells with normal cells

14.6. New therapeutic interventions of uncontrolled cell growth (immunotherapy and gene therapy)

References:

1. Attwood T.K, Parry-Smith D.J. (2003): Introduction to Bioinformatics. Pearson Education
2. Benjamin Lewin (2004): Genes, Vol. VIII, Pearson Prentice Hall, Singapore
3. Brown, T.A. (2006): Genomes 3. Garland Science, New York.
4. Elliott, W. H and Elliott, D. C. (1997): Advanced molecular Biology, Viva Books, New Delhi
5. Freifelder, D. (2003): Molecular Biology, Narosa Publishing House, New Delhi
6. Gupta, P. K. (2005): Cell and molecular Biology, Rastogi Publications, New Delhi
7. Kothekar, V. (2004): Introduction to Bioinformatics. DHRUV Publications, Delhi.
8. Kumar, H. D. (2001): Molecular Biology, Vikas publications, New Delhi
9. Malacinski, G. M. (2005): Essentials of Molecular Biology, Narosa Publishing House, New Delhi
10. Mayers, R.A (Ed) (1995). Molecular Biology and Biotechnology: A Comprehensive Desk Reference. VCH Publishers, Inc., New York
11. Russel, P. J. (2009): Cell and Molecular Biology, Cengage learning
12. Tropp, B. E. (2008): Molecular Biology, Jones and Bartlet.
13. Veer Bal Rastogi (2008): Fundamentals of Molecular Biology, Ane Books India
14. Watson, J. D. (1998): Molecular Biology of the gene, Benjamin Publishing house
15. Watson, J. D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R.. (2006). Molecular Biology of the Gene, Pearson Education.

MZOL2B 01(L) - MOLECULAR BIOLOGY

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
5. Isolation of RNA from Yeast.
5. Isolation of plasmid DNA.
6. Isolation of genomic DNA.
7. Isolation of DNA from Liver/Spleen/Thymus.
8. 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

MZOL2B05- ECOLOGY AND ETHOLOGY

(90 Hours)

Part-A-ECOLOGY

65 hrs

1- Natural history of Indian subcontinent:

2 hrs

1.1. Geographic origins and migrations of species

1.2. Seasonality of the subcontinent

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

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, Grassland, desert, 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, interdemec extinctions, age structure of populations.

5 -Species interactions-

4 hrs

5.1. Types of interactions, interspecific competition	
5.2 Herbivory, Carnivory, Pollination, Symbiosis;-mutualism, commensalisms and proto cooperation	
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, Green house effect, carbon budgeting)	
11.3 Anthropogenic pressure on global climatic change.	
12-Conservation Ecology	(5hrs)
12.1Restoration ecology	
12.2Ecological foot printing	
12.3 Principles of conservation	
12.4 Indian case studies on conservation & management strategy (concepts of project tiger, Biosphere reserves).	
12.5. Biodiversity management approaches- Exsitu and insitu conservation strategies.	
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	(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

Unit 1. Introduction

3hrs

- 1.1 Ethology as different from the other schools studying animal behaviour like behaviourism.
 - 1.2 Behaviour as a reaction to stimuli - sign stimuli, social releasers, 2hrs
- Ethograms, super normal stimuli, stimulus filtering.

Unit 2. Motivating factors

3hrs

- 2.1 General factors in motivation; Studies of motivation in guppies;
- 2.2 mating systems-parental investment and reproductive success

Unit 3. Conflict behaviour- stress-displacement activities- Ritualization.

2hrs

Unit 4. Instinctive behaviour & reflex action

3hrs

- 4.1 Learning, Neural basis of sleep and arousal.

Unit 5. Adaptiveness of behaviour

3hrs

- 5.1 JP Scotts categories of behaviour.

Unit 6. External stimulus

3hrs

- 6.1 Circadian rhythms
- 6.2- Proximate and Ultimate factors
- 6.3-Types of orientation-reafference theory of Von Holst & Mittel Stadt.
- 6.4-Navigation & migration

Unit.7 .Social Behaviour

4hrs

- 7.1 Parental care
- 7.2 Social behaviour of termites & Primates

Unit 8. Evolution of behavior

4hrs

- 8.1 Altruism, Kin selection, inclusive fitness, selfish gene theory
- 8.2 Cultural transmission of behavior
- 8.3 Domestication and behavioural changes.

REFERENCES

ECOLOGY

1. Ahluwalia and sunitha malhorta-Environmental Science-Ane Books Pvt.Ltd
2. Allan Beebi and Anne Maria Brennan-2006- First Ecology-Ecological principles and environmental issues-Oxford university press
3. Archbold, O. W. *Ecology of World Vegetation*. New York, NY: Chapman and Hall, 1995.
4. Begon,Harper,Townsend- Ecology-Individuals,Populations,and communities-Blackwell Science,Second edition
5. Brewer Richard-The Science of Ecology-Saunders college publishing
6. Chapman J.L and Reiss.M.J- Ecology principles and applications-Cambridge law price editions
7. Charles J .Krebs- Ecology .The experimental analysis of distribution and abundance
8. David Quammen. 1997. *The Song of the Dodo: Island Biogeography in an Age of Extinctions*. Scribner. ISBN 0-684-82712-3
9. Dick Neal- Introduction to population Biology- Cambridge University Press
10. Eugene P.Odum- Fundamentals of Ecology- W.B.Saunders Company
11. MacArthur, R. H. and Wilson, E. O. 1967. *The Theory of Island Biogeography*. Princeton, N.J.: Princeton University Press.
12. Magurran, A. E. 2004. *Measuring biological diversity*. Oxford: Blackwell Publishing. ISBN 0-632-05633-9
13. May and Mc Lean- Theoretical Ecology principles and applications-Oxford university press

14. Whittaker, Robert H. Communities and Ecosystems New York: MacMillan Publishing Company, Inc., 1975.

ETHOLOGY

1. Chris Barnard (2003) : Animal Behaviour: Mechanism, Development, Function and Evolution, Publisher: Pearson Education.
2. David McFarland (1999) : Animal Behaviour: Psychobiology, Ethology and Evolution, 3rd Edition. Publisher: Pearson Education.
3. David Mcfarland (2006) A Dictionary of Animal Behaviour. Publisher: Oxford University Press.
4. Goodenough, J; McGuire B. and Robert, W. (1993) Perspectives on Animal Behaviour. John Wiley and Sons, Lond.
5. Graham Scott (2004) Essential Animal Behaviour. Publisher: Wiley-Blackwell
6. Lenher, P. (1996) Handbook of Ethological methods. Cambridge Univ.Press, Lond.
7. Manning, A. (1967) An Introduction to Animal Behaviour. Edward Arnold Pub., London.
8. Manning, A. and Dwakins, M.S. (1995) An Introduction to Animal Behaviour. Cambridge Univ. Press, Lond.
9. Scott, J.P. (1972) Animal Behaviour. Publisher: Univ of Chicago

MZOL2B02 (L)- ECOLOGY AND ETHOLOGY

Ecology Practicals

- 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 termitorium / 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.

Reference for Practicals

- 1- NC Aerry 2010– A manual of environmental analysis . Ane books private limited.

Ethology Practicals

- 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.

References:

- 1. Goodenough, J; McGuire B. and Robert, W. (1993) Perspectives on Animal Behaviour. John Wiley and Sons, Lond.
- 2. Manning, A. (1967) An Introduction to Animal Behaviour. Edward Arnold Pub., London.

MZOL2B06- DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY

(90 Hours)

Part- A - DEVELOPMENTAL BIOLOGY (55 hrs)

Unit 1. Introduction: Basic concepts of development (7hrs)

- 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

Unit 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

Unit 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*

Unit 4. Cellular and Molecular basis of development: (10hrs)

- 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

Unit 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

Unit 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

Unit 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

References – Developmental biology

1. Balinsky, B. I. An introduction to Embryology.

2. Berril, N. J. Developmental biology.

3. Deuchar, E. M. Cellular interactions in animal development.

4. Gilbert, S. F. Developmental Biology. Sinauer Associate, 8th edition

5. Hodge, R. Developmental Biology: From a Cell to an Organism.

6. Hopper, A. S. & N. H. Hart. Foundation of animal development.

7. Lash, J & J. R. Whittaker. Concepts of development.

8. Muller, W. A. Developmental biology. Springer.

9. Snustad, D. P., J. M. Simmons & J. B. Jenkins. Principles of Genetics.

Wolpert, L. Principles of Development. Oxford university press, 2nd edition

Part B Endocrinology (35 Hours)

Unit 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.

Unit 2. General mechanisms of Hormonal action

5 hrs

- 2.1. Cell signalling
- 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

Unit 3. Anatomy of endocrine glands; structure, physiological functions, and control of secretion of their hormones and pathophysiology. 15 hrs

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

Unit 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

Unit 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

Unit 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

References - Endocrinology

1. Bentley, P. J. Comparative vertebrate endocrinology
2. Bern, H. A. Text book of comparative endocrinology
3. Bolander, F. F. 2006. *Molecular endocrinology*, Academic press, New Delhi.
4. Ganong, W. F. 2005. *Review of medical physiology*, Mc Graw Hill, New Delhi.
5. Hadley, M. E. 2000. *Endocrinology*, Pearson education, Inc., New Delhi.
6. Harris, G. W. 1995. *Neural control of the pituitary gland*, Edward Arnold, London.
7. Hazelwood, R. 1990. *The endocrine pancreas*, EnglewoodCliffs, Prentice Hall, NJ.
8. Horrbins, D. F. Essentials of Biochemistry, endocrinology and nutrition.
9. Prakash Lohr. Hormones and human health
10. Nelson R. J. Introduction to behavioural endocrinology
11. Norris D. O. 2005. Vertebrate endocrinology.
12. Vinzen, G. Et al, 1992. Adrenal cortical steroid hormones, EnglewoodCliffs, Prentice Hall, NJ.

MZOL2B03 (L)- Developmental Biology & Endocrinology

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.

Reference for Practicals

1. Adamstone, E. B. & Waldo Shumway (1954). 3 Ed. A Laboratory Manual of Vertebrate Embryology. John Wiley & Sons, Inc.
2. Roberts Rugh (1961). Laboratory Manual of Vertebrate Embryology. Indian Ed., Allied Pacific Pvt. Ltd.
3. Browden, L. W., Erikson, C. A., & Jeffery, R. W. (1991). Developmental Biology. 3 Ed., Saunders College Publi., Philadelphia.
4. Zarrow, M. X., Yochim, J. M., Mc Carthy, T. L. & Sanborn, R. C. (19964). Experimental Endocrinology: A source book of basic Techniques. Academic Press, New York.
5. Thomas, J. A. (1996). Endocrine methods. Academic press, New York.
6. Humason, G. L. (1962). Animal Tissue techniques. W. H. Freeman & Co.

THIRD SEMESTER

MZOL3B07- PHYSIOLOGY

(90 Hours)

1. Nutrition:

12hrs

- 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 (Ref. 4)

2. Excretory 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
- 2.6 Composition (normal & abnormal) and characteristics of urine
- 2.7 Physiology of micturition

2.8 Renal clearance – definition, concept and significance; clearance value of urea, creatinine, phosphate, potassium, chloride and sodium

3. Respiratory system:

13hrs

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 (PO_2 , PCO_2 , CO, pH, body temperature, diphosphoglyceric acid level, foetal haemoglobin and also myoglobin)

3.9 Neural and chemical regulation of respiration

4. Nervous system:

18hrs

4.1. Introduction: Basic details of neurons and action 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. Diseased states of brain – brief description of epilepsy, depression, schizophrenia, Alzheimer's disease, Senile dementia & Parkinson's disease

5. Special senses:

13hrs

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 circuitry 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
- 5.2. **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 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:

5hrs

- 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

9.1.3. Acclimatization

REFERENCES

1. Arthur C. Guyton & John E. Hall (2003): Textbook of Medical Physiology, Saunders (An imprint of Elsevier).
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.
4. Deb, A.C. (2002): Fundamentals of Biochemistry (2002): New Central Book Agency (P) LTD, India.
5. Prosser & Brown, Comparative Animal Physiology
6. William S. Hoar, Comparative Animal Physiology
- 7 Kunt-Schmidt-Nielsen: Animal Physiology, Adaptation and Environment.
- 8 Jensen D. (1976): Principles of Physiology, Appleton Century Crafts, N.Y.
- 9 Lonco, G.N. (1993): Physiological Animal Ecology. Longman Scientific and Technical, Essex.
- 10 Caer BL-Haw's Physiological chemistry, 14th Edn. Tata McGraw Hill Pub. Co. New Delhi.
- 11 Shepherd, G.M: Neurobiology-Principles of Neural Science, E. Kandel & P. Schwartz.
- 12 Campbell *et al.* (1984): Clinical Physiology, 5th Edn. Blackwell Scientific Publications, Oxford.
- 13 Pragnelli, C.V & Farhi, L.E. (1989): Physiological function of special Environment- Springer verlag, N.Y.
- 14 Davie IV & Lewid S.M.- Practical Haematology, 6th Edn. Churchill, Livingstone, Edinburgh.

PRACTICALS

MZOL3B04 (L) ** – PHYSIOLOGY

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. Haematocrit and ESR of human blood.
17. WBC total count

References

1. Oser B. L., 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

**SEE will be at the end of Fourth Semeste

MZOL3B08- MICROBIOLOGY & BIOTECHNOLOGY

(90 hours)

Part-A-MICROBIOLOGY

(45 Hours)

1. Introduction- (3 Hrs)

- 1.1 History and scope of microbiology
- 1.2 Spontaneous generation concept
- 1.3 Recognition of the role of microbes in diseases
- 1.4 Composition of the microbial world
- 1.5 Turning points in microbial research
- 1.6 Microorganisms and the evolution of the earth
- 1.7 Modern age of micro biology

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 (4 hrs)**
- 7.1. General structural properties
- 7.2. Types: DNA viruses, RNA viruses, and enveloped viruses
- 8. Microbial diseases (4 hrs)**
- 8.1. Human diseases caused by bacteria- Strepto cccocal diseases, Typhoid, Cholera, tetanus, Leprosy, tuberculosis and Pneumonia.
- 8.2. Human diseases caused by viruses- AIDS, Small pox, Rabies, Measles, Swine Flu, Bird flu, SARS
- 8.3. Fungal diseases- Candidiasis
- 9. Control of microorganisms (5 hrs)**
- 9.1. Disinfectants; A - physical- Heat, filtration and radiation
B-Chemical agents - Phenol and Phenolic compounds, alcohols, halogens and aldehydes.
- 9.2. Antibiotics- Penicillin's, Cephalosporins, Chloramphenicol, Tetracyclines
- 9.3. Microbial drug resistance
- 10. Microbial fermentation (4 hrs)**
- 10.1. Lactic fermentation Homolactic and heterolactic fermenters, Mention dairy products ,cheese, Yogurt, kefir etc
- 10.2. Alcoholic fermentation-Alcoholic beverages
- 11. Environmental microbiology (3 hrs)**
- 11.1. Aquatic microbes
- 11.2. Microbiological analysis of drinking water
- 11.3. Waste water- microbial characteristics and treatment
- 11.4. Microbial Bioremediation
- 11.5. Biogas plants.

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, BAC, YAC and MAC.

2.2. Shuttle vectors and expression vectors

2.3. Enzymes for r DNA technology- Restriction enzymes and ligases

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

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, FISH and GISH, 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 (2 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 (3 hrs)

12.1. Culture media – natural and artificial

12.2. Culture methods – primary explantation techniques, various methods of cell and tissue culture

12.3. Tissue and organ culture

13. Gene Silencing techniques (2 hrs)

13.1. Antisense 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. 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- B- Biotechnology

1. Alphey - DNA sequencing-Bios Scientific publishers-

2. Bernard R. Glick & 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. -Introduction to environmental biotechnology-Prentice Hall of India
5. Colin Ratledge and Bjorn Kristiasen-Basic Biotechnology - Cambridge University press.
6. Dominic, W.C. Wong-The ABCs of gene cloning-Springer international edition
7. Dubey, R.C. -A text book of biotechnology-S. Chand & Co.
8. Gupta. P.K. -Elements of biotechnology-Rastogi publications.
9. Singh, B.D.-Biotechnology-Kalyani publishers.
10. Sobti, R.C. & Suparna, S .Pachauri-Essentials of Biotechnology-Ane Books Pvt.Ltd.
11. Wilson & Walker (2008): Principles and techniques of Biochemistry and Molecular biology- Cambridge low price editions.**Part A- Microbiology**
12. Gandhi-Microbiology and Immunology notes and cases-Blackwell publishing
13. Hans G. Schlegel (2008): General Microbiology-Cambridge low price editions
14. Kanika Sharma-Manual of microbiology tools and techniques-Ane's student edition-Ane books Pvt. Ltd
15. Monica Cheesbrough - District laboratory practice in tropical countries, Part I and II - Cambridge low price editions
16. Mansi- Fermentation, Microbiology and Biotechnology-Taylor and Francis
17. Pelczar, M.J, Reid, R.D. & Chan, E.C.S-Microbiology-TMH edition
18. Prescott, Harley and Klein- Microbiology, IVth ed. McGraw-Hill
19. Rao, A.S.-Introduction to microbiology-Prentice Hall of India.
20. Tortora, Funke and Case - Microbiology : An Introduction Eight edition- pearson education, Veerbala Rastogi-Fundamentals of Molecular biology-Ane books
21. Wise-Bioinstrumentation and Biosensors-Taylor and Francis

MZOL3B05 (L)- MICROBIOLOGY**

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.

MZOL3B05 (L)- BIOTECHNOLOGY**

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

MZOL3E01- BIODIVERSITY AND BIOTA

(90 Hours)

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. Biology and Taxonomy of Mammals & Birds

(60 hrs)

Biology and Taxonomy of the following animals with special emphasis on Western Ghats (Biology should include population status, distribution, feeding and breeding habits, major threats to their survival and conservational significance)

2.1. MAMMALS

(30 hrs)

Order Primates

Apes: Gibbon

Monkeys: Macaques (Bonnet, Rhesus, Assamese and Lion tailed)

Langurs (Common, Capped, Golden, Nilgiri)

Lemurs: Slender Loris and Slow Loris

Order Carnivora

Cats: Tiger, Lion, Leopard, Fishing cat, Leopard cat, Jungle cat, Indian Wild Dog,

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

Hyena: Striped hyaena

Civets: Malabar civet, Small Indian civet, Common palm civet

Mongoose: Common mongoose, Small Indian mongoose, striped necked mongoose

Order Artiodactyla

Cervids: Chital, Sambar, Barking deer, Mouse deer.

Bovids: Indian Antelope, Four horned Antelope, Nilgiri tahr, Indian bison.
Suids: Indian Wild boar.
Order Proboscidae Indian Elephant
Order Perisodactyla One horned Rhinoceros.
Order Pholidota Indian Pangolin
Order Lagomorpha Hispid hare
Order Insectivora Tree shrew, Hedgehog
Order Rodentia Indian Giant squirrel, Grizzled giant squirrel, Porcupine, Flying squirrel, striped palm squirrel
Order Chiroptera Indian flying fox, Short nosed fruit bat, Indian pipistrella
Order Cetacea Gangetic dolphin, Common dolphin, Sperm Whale.
Order Sirenia Sea cow

2.2. BIRDS

(30 hrs)

2.2.1. Habitat preference
2.2.2. Flocking and aggregation.
2.2.3. Foraging behaviour,
2.2.4. Food competition and selection
2.2.5. Courtship and pair selection,
2.2.6. Brood parasitism and cooperative breeding.
2.2.7. Vocalisation and its Role in birds
2.2.8. Flyways and peculiarities of bird migration in the Indian Subcontinent
2.2.9. Avian classification and distribution with special reference to Indian species.
Order Columbiformes Blue Rock pigeon, Spotted Dove.
Order Podicipediformes Little Grebe
Order Pelecaniformes Little and Large Cormorant, Darter
Order Ciconiformes Pond heron, Large egret, Little egret, Median egret, Grey heron, Purple heron
Order Ansariformes Bar headed goose, Lesser whistling teal
Order Gruiformes Indian Moorhen, Purple moorhen, White breasted waterhen
Order Charadriiformes River tern, Red wattled Lapwing, Yellow wattled Lapwing, Black headed gull, Bronze winged jacana, Pheasant tailed jacana.
Order Falconiformes Hawks, Vultures.
Order Gruiformes Indian cuckoo, Koel, Crow pheasant
Order Coraciformes White breasted kingfisher, Small blue kingfisher, Pied kingfisher, Brown headed kingfisher, Chestnut headed Beak eater, Small green Beak eater, Hornbills
Order Pisciformes Lesser Golden backed woodpecker, Indian golden backed woodpecker, Small green barbet
Order Psittaciformes Rose ringed parakeet, Blossom headed parakeet, Lorikeet
Order Strigiformes Indian horned owl, Mottled wood owl, Barn owl
Order Apodiformes Palm swift
Order 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.

2.2.10. Globally endangered Indian birds and their classification (At least 20 species).

2.2.11. Endemic Indian birds and endemic bird areas.

2.2.12. Economic importance of birds- beneficial and harmful role.

3. Fishes, Amphibians & Reptiles

(12 hrs)

3.1 FISHES Endangered and Endemic fishes of Western Ghats (Brief account with threat to their survival).

3.2. AMPHIBIA Amphibians endemic to Western Ghats (Brief account with threat to their survival)

3.3 REPTILES

Order Crocodylia Gharial, Estuarine crocodile, Marsh crocodile.

Order Testudines Logger headed sea turtle, Green Sea Turtle, Hawk's Bill Turtle, Olive Ridley Turtle, Leatherback Sea Turtle. (Brief account with threat to their survival)

Order Squamata Indian Monitor Lizards (Brief account only)

Endangered and endemic snakes of Western Ghats (Brief account only)

4. Sociobiology & Territoriality

(8hrs)

4.1 Sociobiology of Lion, Elephant and Deer

4.3 Territoriality and functions of territory.

5. Principles & Hypothesis

(4 hrs)

5.1 Gondwana principle

5.2 Satpura Hypothesis

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.

7. IUCN, WRI and UNEP (1992): Global biodiversity Strategy.

8. Kratiger, A. F. *et al.* - Global Biodiversity strategy

9. Mc Neely, J. A. *et al.*, (1990): Conserving the world's biological diversity, IUCN. Gland

10. Negi, S.S. (1993) Biodiversity and its conservation in India. Indus Publishing Co., New Delhi.

11. Prater, S.H. The Book of Indian Animals. BNHS/Oxford

12. Salim Ali (2002). The book of Indian Birds, revised edn. BNHS & Oxford

university press, New Delhi.

13. Salim Ali and Ripley (1983): Handbook of birds of India and Pakistan (2nd Ed.). Oxford University Press.
14. Sharma, B.D. 1999. Indian wildlife resources: Ecology and development. Daya publishing House, Delhi.
15. Singh, Samar (1987): Conserving India's Natural Heritage. Nataraj Publication.
16. Sukumar, R. (1989): Asian Elephant. Cambridge Univ. Press
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
MZOL3E01(L)- PRACTICAL PAPER – I**

1. Dissections.
 - A) Arterial system of bird (Pigeon/quail/chicken)
 - B) Flight muscles.
 - C) Perching mechanism - pigeon
2. Examination 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

FOURTH SEMESTER

MZOL4B09– IMMUNOLOGY & CYTOGENETICS

(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. Immunotechniques -Detection of molecules using ELISA, RIA, Western Blot, Immunoprecipitation, Immunofluorescence 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. Complement System-components & functions
- 5.3. Complement 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 h)

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

PART A: CYTOGENETICS

20 hrs

1. Cellular communication (6 h)

- 1.1 Regulation of hematopoiesis
- 1.2 General principles of cell communication
- 1.3 Cell-cell interactions – cell adhesion and roles of different adhesion molecules
- 1.4 Extracellular matrix: Basal membrane and Laminin, Collagen, Proteoglycan, Fibronectin
- 1.5 Interaction of cells with extracellular matrix: Integrins. Focal adhesion and hemidesmosomes.
- 1.6 Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins, Adherens.
- 1.7 Neurotransmission and its regulation

2. Cell signaling (4 h)

- 2.1 Hormones and their receptors
- 2.2 Signal transduction
- 2.3 Concept of cell-signaling
- 2.4 Signalling through intracellular receptors
- 2.5 Signalling through cell surface receptors: G protein linked receptors; signalling via cAMP, PKA, IP₃, Ca²⁺/calmodulin, PKC, Ca-MK, ion channels.

3. Apoptosis and its significance (5 h)

- 3.1 Necrosis; Programmed and induced cell death
- 3.2 Process of apoptosis: Initiation, Execution: cytochrome C, caspases, Phagocytosis
- 3.3 Regulation of apoptosis - Extracellular and Intracellular
- 3.4 Genes involved in apoptosis

3.5 Therapeutic interventions of apoptosis

4. Molecular mechanisms involved in recombination of DNA :

(5 hrs)

4.1. Genetic recombination – types with example

4.1.1. Site specific recombination

4.1.2. Non-homologous recombination

4.1.3. Homologous recombination

4.2. Molecular mechanism involved in homologous recombination of DNA in eukaryotes- Holliday model: Holliday intermediate, heteroduplex DNA, gene conversion

4.3. Role of Rec A protein in genetic recombination

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, Jodhpur
8. Peter Parham (2004). The immune System (2nd Edition), Garland, 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

MZOL4B04(L)- IMMUNOLOGY

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

MZOL4B04(L)-CYTOGENETICS

1. Cell fractionation and Differential Centrifugation to isolate mitochondria, nuclei and nucleolus.
2. Dosophila banding technique and Karyotyping.
3. Grass hopper – (testes –squash preparation) to study various meiotic stages

MZOL4B04 (L)- MICROTECHNIQUE AND HISTOCHEMISTRY

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:

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.
3. 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
MZOL4E02 - WILDLIFE CONSERVATION

(90 Hours)

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 Why conserve? The ecological, genetic, economic and Philosophic reasoning.
- 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, management, protection and administration.

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

5.3 Important Bird Sanctuaries of India: Bharatpur, Ranganathitoo, Thatekkad & Vedan Thangal

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 **(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.

11.3 Ecotourism, role of ecotourism in sustainable development

References:

1. Abbassi and Ramaswammi (1989): Biotechnological methods of pollution control. University Press.
2. Abdul Jamil Urfi (2004): Birds beyond Watching, University Press (India) Pvt. Ltd.
3. Dasmann, R.F. (1964) Wildlife biology, John Wiley and Sons, New York.
4. Gary, K., Meffe, Carroll, C.R. and Contributors (1997): Principles of Conservation Biology - 2nd Edition, Sinauer Associates, Inc Sunderland Massachusetts.
5. Giles, R.H. Jr. (Ed 1984): Wildlife management techniques - 3rd edition, The wildlife society, Washington D.C.
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.
8. Induchoodan (2004): Keralathile Pakshikal (malayalam) - IVth Edn. Kerala Sahitya, Academy, Thrissur.
9. Kazmerezak Krys and Van Perlo Ber (2000): A field Guide to the birds of India, OM Book Series, New Delhi.
10. Olvin Sewall Pettingil (1970): Ornithology in Laboratory & Field, Burgess Publishing Company, USA.
11. Robinson W.L. and Eric G. Bolen (1984): Wildlife Ecology and Management, Millen Publishing Co. New York.
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.

ELECTIVE COURSE: WILDLIFE BIOLOGY-II MZOL4E01 (L)-PRACTICAL PAPER I

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.

ELECTIVE COURSE: WILDLIFE BIOLOGY - III
MZOL4E03 - WILDLIFE MANAGEMENT

(90 Hours)

1. Wildlife Management

(5 hrs)

- 1.1 Concepts and Principles
- 1.2 Policies and laws in wildlife management

2. Habitat and management

(18 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. Concept of herbivory, frugivory and carnivory (predation).
- 2.6. Food selection and patterns of habitat utilization.
- 2.7. 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.
- 2.8. Impacts of pollution on forest and wildlife, Environmental sanitation.
- 2.9 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. Wildlife population estimation

(12 hrs)

- 3.1. Direct Count: - Total count, Drive count, Time area counts and transect count
Indirect Count: - Call count, Track count and Pellet count/dung count
- 3.2. Abundance estimation techniques for mammals, birds, reptiles and amphibians.
- 3.3. Capturing and Marking Techniques: - Live trapping of birds and Mammals, Chemical immobilization, methods of marking captured birds and mammals, Peterson or Lincoln Index method.
- 3.4. Determination of Age and sex in animals and birds

4. Modern Methods of Wildlife study

(15 hrs)

- 4.1 Wildlife photography: Still and Videography, recording of calls, study of animal evidences.
- 4.2 Remote sensing, GIS, Radar in wildlife research.
- 4.3 Radio telemetry: Importance, scope and methodology
- 4.4 Genetics in wildlife management- Pedigree analysis and karyotyping techniques

5. Food habit analysis

(8 hrs)

- 5.1 Sampling method: Direct and indirect methods, qualitative and quantitative methods

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

6. Prey predators management (5 hrs)

6.1. Foraging behaviour, optimal foraging theory, group foraging, depredation, forage poisoning

7. Wetland Management (10 hrs)

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

7.2. Management of Indian Cranes. Endangered and Non-endangered crane, crane conservation, migration, impact of pollution on wetland birds. Conventions related to Wetland management.

7.3. Ramsar sites in India, Conventions on wetlands

7.4. Pheasants and Pheasant management- Pheasants of Himachal Pradesh, Pheasantry.

8. Zoo management (10 hrs)

8.1. Basic consideration for designing a modern zoo,

8.2. Functions of a modern zoo,

8.3. Zoo layout and exhibition of animals,

8.4. Zoo services

8.5. Zoo sanitation

8.6. Captive breeding,

8.7. Safari parks

8.8. Moonlit zoo

9. Healthcare and disease management (7 hrs)

9.1 Disease monitoring and control, surveillance of disease.

9.2 Viral, bacterial, rickettsial, mycoplasmal, and protozoan disease.

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

References:

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2. Abbassi and Ramaswami (1999): Biotechnological methods of pollution.
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Co., New Delhi.

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14. Robert, G.H. (1978): Wildlife management. W.H. Freeman and Co., San Francisco, USA.

15. Robinson W.L and Eric G. Bolen (1984): Wildlife ecology and management. MC Millen Publishing Co. New York.

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 Publication.

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
MZOL4E02 (L)-WILD LIFE MANAGEMENT**

10. Qualitative analysis of digestive enzymes of the gut. (Herbivores/ Carnivores/ Omnivores).

11. Measurements (Morphometry) for systematic study. Total length, body length, tail length, various dimensions of the skull etc. of mammals, birds, reptiles, amphibians and fishes.

12. Quantitative estimation of uric acid in birds and reptiles.

13. Identifying features of the beaks and feet of common birds. Students are expected to identify from photographs / Xerox.

14. Assessment of the age of mammals using their teeth.

15. Measurement of temperature, light, rainfall, humidity, transpiration and wind speed.

16. Collection and quantitative and qualitative analysis of soil fauna.

17. Territory mapping. Quadrata sampling, Line transect, Line intersect, Point prime methods of population study. Pellet counting for deer population of elephant dung in a sanctuary.

18. Spotters: Various item related to wildlife biology.

Study Tour

A study tour of not less than 8 days duration (need not to beat 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.

MODEL QUESTION PAPER

FAROOK COLLEGE (Autonomous)
FIRST SEMESTER M.Sc DEGREE EXAMINATION
PAPER MZOL 1B01- BIOCHEMISTRY

Time: 3 Hrs

Max Weightage: 36

I. Answer all (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 K_m and V_{max} 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
13. Synthesis of glutamic acid.
14. Aromatic amino acids.

(1x14=14 wtg)

II. Answer any seven (Each question carry 2 Weightage)

15. Inhibitors of electron transport chain
16. Biosynthesis of methionine
17. What is beta oxidation?
18. Write a note on Ribozymes.
19. Role of ATP as free energy carrier in the biological system.
20. Give a note on heteropolysaccharides with suitable examples
21. Write a note on 2,3-bisphosphoglycerate and its metabolism
22. Structural organisation of DNA
23. Koshlands induced fit hypothesis
24. Distinguish between competitive and non competitive inhibition.

(2x7=14 wtg)

III. Answer any 2 of the following (Each question carry 4 Weightage)

25. Explain the classification of lipids.
26. Explain the sequence of Electron transport system.
27. Describe the HMP pathway.
28. Biosynthesis of cholesterol.

(4x2=8 wtg)

FAROOK COLLEGE (Autonomous)
SECOND SEMESTER M. Sc. DEGREE EXAMINATION
(CSS)
Zoology
MZOL 2 B04- MOLECULAR BIOLOGY

Time: 3 hours

Max Weightage: 36

I. Answer **all fourteen** 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
13. What is affinity labeling? What is its application in ribosome studies?
14. What are petite mutants? Name the petite mutants of Yeast.

(14 x 1 = 14)

II. Answer any **seven** questions (**Weightage – 2**)

15. Explain psuedogenes.
16. Describe the rolling circle model of DNA replication.
17. Write short note on posttranscriptional modification of RNA.
18. Explain wobble hypothesis.
19. Compare translation in eukaryotes and prokaryotes.
20. Describe the basic features of tryptophan operon.
21. What is siRNA and miRNA? What are their roles in regulating gene expression?
22. What is cot ½? How it is related to complexity of the genome?
23. What is a complex multigene family? Explain the organization of histone gene in sea urchin.
24. Human mitochondrial genome.

(7 x 2 = 14)

III. Answer any **two** questions (**Weightage – 4**)

25. Give an account of semiconservative method of replication. Add a brief note on the enzymes and protein involved in DNA replication.

26. Write an essay on the organization of interrupted genes and their evolution.
27. Describe the various methods of DNA repair.
28. (a) What are transposons? Give an account of the mechanism of transposition, and transposons in eukaryotes and prokaryotes.

(2 x 4 = 8)

FAROOK COLLEGE (Autonomous)
THIRD SEMESTER M. Sc. DEGREE EXAMINATION
(CSS) Zoology
ELECTIVE COURSE: WILDLIFE BIOLOGY - I
M ZOL3 E (1) - BIODIVERSITY AND BIOTA

Time: Three Hours

Max Weightage: 36

I. Answer 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.
13. Endemism
14. Classify any four birds of your locality.

(14 x 1 = 14)

II. Answer any seven of the following: - (Weightage – 2)

15. Critically evaluate Satpura hypothesis.
16. Comment on territoriality in animals.
17. Briefly explain taxonomic positions of endangered birds of Western Ghats.
18. Explain birds as pollinators
19. Write notes on Endemic fresh water fishes of Western Ghats.
20. Explain Gondwana hypothesis.
21. India is a mega biodiversity country. Explain?
22. Write notes on Monitor Lizards
23. Explain major contributions of Dr. Salim Ali
24. Briefly explain the impacts of exotic species on wildlife

(7 x 2 = 14)

III. Answer any two of the following: - (Weightage – 4)

25. Comment on different types of calls in birds? Briefly explain the role of

- vocalisation in recent avian research.
26. Briefly explain the population status and major threats to the survival of larger predators of Western Ghats.
 27. Explain the sociobiology of elephants.
 28. Briefly explain the endemic mammals of Western Ghats. Add notes on their population status, threats and conservational significance.

(2 x 4 = 8)

FAROOK COLLEGE (Autonomous)
FOURTH SEMESTER M. Sc. DEGREE EXAMINATION
(CSS)Zoology
ELECTIVE COURSE: WILDLIFE BIOLOGY - II
MZOL 4E (2) - WILDLIFE CONSERVATION

Time: Three Hours

Max Weightage: 36

- I. Answer 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 Eravikulam 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.
 13. Write notes on exotic species and related problems with two examples.
 14. Differentiate afforestation from reforestation.

(14 x 1 = 14 Weightage)

- II. Answer any seven of the following (Weightage – 2)
 15. Give an account of project Tiger with special reference to Kerala.
 16. Give an account of Project Elephant?
 17. Write notes on human – animal conflict and its impacts on wildlife?
 18. Explain briefly on the following.
 - a) Compression hypothesis
 - b) Effective population size
 - c) Inbreeding depression
 - d) Minimum viable population
 19. Give an account of habitat fragmentation and its effect on wildlife corridors giving examples.
 20. Distinguish between sanctuaries, national parks and Biosphere reserves.
 21. Explain the role of tribal in conservation and management of protected areas.

22. What are mangroves? Discuss its ecological role?
23. What is afforestation? Explain with reference to social Forestry?
24. What is meant by MAB Program? Briefly explain its importance and ecological features, giving two examples?

(7 x 2 = 14 Weightage)

III. Answer any two of the following: - (Weightage – 4)

25. Give a brief account of wildlife protection Act 1972 in India and its amendments.
26. Explain causes of depletion of wildlife in Kerala.
27. Discuss the impacts of hydroelectric projects on wildlife.
28. Write an essay on the forest types of India.

(2 x 4 = 8 Weightage)

FAROOK COLLEGE (Autonomous)
FOURTH SEMESTER M.Sc. DEGREE EXAMINATION
(CSS)Zoology
ELECTIVE COURSE: WILDLIFE BIOLOGY
M ZOL 4E (3)- WILDLIFE MANAGEMENT

Time: Three Hours

Max Weightage: 36

I. Answer 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.
13. Discuss mycoplasmal disease.
14. Comment on convention on Wetlands.

(14 x 1 =14 weightage)

II. Answer any seven of the following:-

15. Explain wildlife photography.
16. Write notes on Habitat Suitability Index.
17. Discuss components of wildlife habitat.
18. Explain briefly on the following:-
 - a) Carnivory
 - b) Depredation
 - c) Optimal foraging theory
 - d) Pheasantry
19. Briefly explain any two viral and bacterial diseases on wildlife.
20. Explain the importance of Radar and GIS in wildlife research.
21. Give a brief account on Pheasant management?
22. Briefly explain Chemical immobilization techniques in wildlife research.
23. Give a brief account on basic consideration for designing a modern zoo.
24. Comment on captive breeding and their role in wildlife conservation. (7 x 2 = 14 Weightage)

III. Answer any two questions.

25. Explain various methods adopted in wild life for the food habit studies.
26. What are Wetlands? Explain wetland management with special emphasis on

waterfowl.

27. Comment on Impacts of pollution on forest and wildlife. Add notes on Environmental sanitation.

28. Discuss the direct and indirect methods for the wildlife population estimation.

(2 x 4 = 8 Weightage)