



**Rayat Shikshan Sanstha's
Sadguru Gadge Maharaj College, Karad.
(An Autonomous)**

**SYLLABUS
For**

**M.Sc. II Zoology
(Semester Pattern)
Sem. III to IV**



Estd. 1954

**'A+' Accredited by NAAC (2017)
with CGPA 3.63**

**As per the
National Education Policy 2020
(NEP2020)**

**To be implemented
from
June, 2024-25 onwards**

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1. Preamble

The Department of Zoology, Sadguru Gadge Maharaj College Karad, affiliated to Shivaji University, Kolhapur started in the year 1965. It offers B.Sc., M.Sc. and Ph.D. Programmes in Zoology. While designing this syllabus, emphasis was given to cover the syllabus of NET and SET examinations so that students will be able to qualify these exams easily. The syllabus is framed according to the guidelines of National Education Policy 2020 (NEP 2020), where students get an opportunity to select an elective course of his/her choice from the first semester of M.Sc. like Animal Physiology.

Appropriate numbers of hours are allotted for the lab Courses to offer skill development. During M.Sc. I, the lab courses are based on theory papers Viz. Molecular Cell Biology, Applied Entomology, Research Methodology in Zoology, Physiological Chemistry, Anatomy and Physiology. In Research Methodology, students will gain the knowledge of bioinstrumentation and biostatistics along with basics of Animal systematics. During M.Sc. II, students will study Genetics, Enzymology, Animal Cell Culture and Toxicology in theory classes and practical. Besides, students will have a theory and lab course of his/her specialization.

The syllabus offers opportunity of on job training or Field project to get an experience outside the walls of the classroom. During M.Sc. II, sufficient hours are allotted for Research Project to inculcate research attitude. The M.Sc. program in Zoology will help the students to understand the complex life processes at cellular and molecular level, the functioning of cells, tissues, organs and systems. The students will be able to analyze a situation critically and make decisions in the area of their specialization.

2. Duration

- The course is fulltime and of two years duration.

3. Eligibility for Admission

- M. Sc. Part 1 Zoology.

4. Medium of Instruction: English

**5. M.Sc. Programme Structure of
Zoology Part – II (CBCS pattern)
(2024-2025)**

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		Research Methodology	Open elective OJT/FP	Research project	Cumulative credits	Degree
			Mandatory 14 credits	Electives 4 credits					
Second	6.5	Sem III	MJ-MZT23-301 Genetics - 4 credits MJ-MZT23-302 Enzymology 4 credits MJ-MZP23-305 Practical V 4 credits (based on MJ-MZT23-301 and MJ- MZT23-302) MJ-MZP23-306 Practical VI 2 credits (Based on GE-MZT23-303)	GE-MZT23-303 Cell Biology GE-MZT23-303 Physiology of Health GE-MZT23-303 Entomology GE-MZT23-303 Aquaculture and Fisheries GE-MZT23-303 Sericulture	--	- -	FP-MZT23-304 Research Project 4 credits --	22	Master of Science
		Sem IV	MJ-MZT23-401 Animal Cell Culture 4 credits MJ-MZT23-402 Toxicology 4 credits MJ-MZP23-405 Practical VII 4 credits (based on MJ-MZT23-401 and MJ- MZT23-402)	GE-MZT23-403 Cell Biology GE-MZT23-403 Clinical Physiology GE-MZT23-403 Entomology GE-MZT23-403 Aquaculture and Fisheries GE-MZT23-403 Sericulture	--	--	FP-MZT23-404 Research Project 6 credits --	22	
Cumulative credits for PG Diploma			26	8			10	44	

Abbreviations: Yr: Year, Sem: Semester, MT: Mandatory Theory, MP: Mandatory Practical, E: Elective, OJT: On Job Training, FP: Field Project

6. Course Codes

SEMESTER-III (Duration- Six Month)											
	Sr. No.	Course Code	Theory and Practical			College Assessment (SEE)			Internal Assessment (CCE)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
NEP 2020	1	MJ-MZT23-301	4	4	4	80	32	3	20	8	1 Hr.
	2	MJ-MZT23-302	4	4	4	80	32	3	20	8	1 Hr.
	3	GE-MZT23-303	4	4	4	80	32	3	20	8	1 Hr.
	4	FP-MZT23-304	-	8	4	100	40	6	-	-	-
	5	MJ-MZP23-305	-	8	4	100	40	6	-	-	-
	6	MJ-MZP23-306	-	4	2	50	20	3	-	-	-
TOTAL (A)			12	32	22	490	--	--	60	--	--
SEMESTER-IV (Duration- Six Month)											
	1	MJ-MZT23-401	4	4	4	80	32	3	20	8	1 Hr.
	2	MJ-MZT23-402	4	4	4	80	32	3	20	8	1 Hr.
	3	GE-MZT23-403	4	4	4	80	32	3	20	8	1 Hr.
	4	FP-MZT23-404	-	12	6	150	60	9	-	-	-
	5	MJ-MZP23-405	-	8	4	100	40	6	-	-	-
TOTAL (B)			12	32	22	490	--	--	60	--	--
TOTAL (A+B)			--	-	44	980	--	--	120	--	--

<ul style="list-style-type: none"> • Student contact hours per week: 28 Hours (min.) 	<ul style="list-style-type: none"> • Total Marks for M. Sc. - II : 1100
<ul style="list-style-type: none"> • Theory and practical lectures: 60 minutes Each 	<ul style="list-style-type: none"> • Total credits for M. Sc. - II (Semester I & II): 44
<ul style="list-style-type: none"> • MJ: Major • GE: General Elective • MZT: Zoology Theory • MZP: Zoology Practical • FP: Field Project 	<ul style="list-style-type: none"> • Practical Examination is at the end of each semester. • SEE: Semester End Exam • CCE: Continues Comprehensive Exam • <i>Separate passing is mandatory for Theory, Internal and Practical Examination</i>

**M.Sc. Programme Structure of Zoology
Part – II (CBCS pattern) (2024-2025)**

Sr. No.	Course Code	Course Title		Credits
SEMESTER - III				
1	MJ-MZT23-301	Paper IX	Genetics	4
2	MJ-MZT23-302	Paper X	Enzymology	4
3	GE-MZT23-303	Paper XI	Any one of the following Elective papers <ul style="list-style-type: none"> • Cell Biology • Physiology of Health • Basic Entomology • Fisheries Resources: Inland and Marine Fisheries • General Sericulture and Mulberry cultivation 	4
4	FP-MZT23-304	Paper XII	Research Project	4
5	MJ-MZP23-305	Practical V	Based on MJ-MZT23-301 and MJ-MZT23-302	8
6	MJ-MZP23-306	Practical VI	Based on GE-MZT23-303	2
SEMESTER – IV				
7	MJ-MZT23-401	Paper XIII	Animal Cell Culture	4
8	MJ-MZT23-402	Paper XIV	Toxicology	4
9	GE-MZT23-403	Paper XV	Any one of the following Elective papers <ul style="list-style-type: none"> • Cell Biology • Clinical Physiology • Basic Entomology • Fisheries Resources: Inland and Marine Fisheries • General Sericulture and Mulberry cultivation 	4
10	FP-MZT23-404	Paper XVI	Research Project	6
11	MJ-MZP23-405	Practical VII	Based on MJ-MZT23-401 and MJ-MZT23-402	8
Total Credits				44
Theory and Practical examinations will be Semester wise.				

7. Programme Outcomes (POs)

PO1: Apply the knowledge of zoology in day today life.

PO2: Students are able to understand animals from their sub-cellular to ecosystem level.

PO3: Gain knowledge of agro based entrepreneurship like Sericulture, aquaculture, apiculture and lac culture for providing lab-to-land benefits to Society.

PO4: Students are able to frame hypothesis, design experiment, analyse data & generate conclusions.

PO5: Students are able to work to work in animal cell culture lab, taxonomy, able to operate different instruments in biological sciences like toxicity studies.

PO6: Students are able to work in different fields of biological sciences like animal cell culture, toxicology, enzymology, bio-instrumentation and taxonomy.

PO7: Students are able to address societal issues like pollution, health awareness, pest-parasite management and biodiversity conservation.

PO8: Students are able to gain knowledge on applied science and its application to sustainable development.

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)

(Introduced from Academic Year 2024-25)

Title of Course: Genetics

Paper - IX

Subject Code: MJ-MZT23-301

Total Credits: 04

Course Outcomes: Upon successful completion of this course, the student will be able to:

CO1: Able to understand the basics of human chromosome and molecular basis of sex determination

CO2: Able to understand how bacteria acquire resistance against antibiotics and bacteriophages, basics of population genetics.

CO3: Provides detail information about molecular mechanism of mutation with suitable genetic examples.

CO 4: Able to upgrade different perspectives of Genetic counseling.

Unit –I: Human Cytogenetics **(15 Hrs.)**

1. Human karyotype - banding, nomenclature
2. Techniques in human chromosome analysis
3. Numerical abnormalities of human chromosomes and related syndrome: Non-disjunction, Aneuploidy, Patau syndrome, Edward syndrome, Down syndrome, Turner syndrome and Klinefelter syndrome
4. Genetics basis of sex determination in human beings.
5. Dosage compensation
6. Androgen Insensitivity Syndrome.

Unit- II: Microbial Genetics and Population Genetics **(15 Hrs.)**

1. Horizontal gene transfer in bacteria by conjugation, transformation and transduction
2. Acquisition of antibiotic resistance
3. Acquisition of defence against bacteriophages
4. Hardy- Weinberg principle, Genetic drift, Genetic pool.

Unit- III: Mutations **(15 Hrs.)**

1. Introduction to the mutation- Types with examples.
2. Molecular basis of mutation-Radiation, Chemical and Biochemical Mutations.
3. Pleiotropy with examples.
4. Back mutation and Suppressor mutation.
5. Mechanisms of DNA repair.
6. Mutagenicity and carcinogenicity.

Unit- IV-Genetic counseling **(15 Hrs.)**

1. Introduction, Prospective and retrospective Genetic counselling.
2. Ethical aspects of Genetic counselling.
3. Psychological approach in genetic counselling.
4. Family pedigree, symbols and types, pedigree analysis.
5. Prenatal Genetic Testing: Pre implantation Genetic Diagnosis, Chorionic Villus sampling, Amniocentesis
6. Modern lifestyle and acquired genetic defects.

Suggested Reading Material:

1. Concepts of Genetics By Klug and Cummings
2. Principles of Genetics By Tamarind
3. Genetics By Strickberger
4. Facts of Genetics By Robert Edger
5. Introduction to biochemical genetics By Mather and Jinks
6. Molecular Genetics By Gunther Stint
7. Principles of Genetics By Peter, Snustad and Michael
8. Genetics of population by Philip Hedrick
9. Principles of Population Genetics By Hartl and Clark
10. Gene Clones By Ernst Winnacker

**M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)**

(Introduced from Academic Year 2024-25)

Title of Course: Enzymology

Paper - X

Subject Code: MJ-MZT23-302

Total Credits: 04

Course Outcomes: Upon successful completion of this course, Students will be able to

CO1: Understand the nomenclature and classification of enzymes and cofactors.

CO2: Understand the purification techniques and enzymes structure.

CO3: Understand the enzyme kinetics and factors affecting the kinetics.

CO4: Understand the organization of enzymes and their industrial applications.

Unit- I: (15 Hrs.)

1. Nomenclature and Classification of Enzymes, Isoenzymes, Multienzyme Complexes.
2. Cofactors.- Inorganic, Organic: Pyridoxyl Phosphate, Biotin, Lipoic acid, Thiamine diphosphate, Flavin nucleotides, Nicotinamide.

Unit- II: (15 Hrs.)

1. Purification of Enzymes: Objectives and strategies, Methods of separation: Centrifugation, Dialysis, Gel-filtration, Ion Exchange chromatography, Electrophoresis, Isoelectric focusing, Affinity chromatography.
2. Structure of Enzymes- Primary, Secondary, tertiary and quaternary, Active sites and Allosteric sites, Structure of chymotrypsin.

Unit- III: (15 Hrs.)

1. Enzyme Kinetics -Michaelis Menten equation., Briggs Haldane Hypothesis., The Line Weaver Burk Plot, The Halden relationship for reversible reaction, Effect of inhibitors on enzyme Kinetics, Effect of temperature, Thermal denaturation, Effect of pH on enzyme kinetics.
2. Enzyme Actions of Chymotrypsin, Fructose biphosphate aldolase.

Unit- IV: (15 Hrs.)

1. **Enzymes in Organized System-** RNA nucleotidyl transferase, Pyruvate dehydrogenase.
2. **Enzyme Technology-** Use of microorganisms in brewing and cheese making
Use of microorganisms in production of organic chemicals.
Enzyme immobilization and immobilization techniques

Suggested Reading Material:

1. Fundamentals of Enzymology: Price N.C. and L. Stevens e.. Oxford, New York.
2. Dixon, M., Webb, E.C; et al. (3rd Ed.) Longman, London.
3. Methods in Enzymology all volumes.
4. Scopes, R.K. Protein Purification, Principles and Practice Ferdinand, W. (1976) fundamentals of enzyme kinetics, Butterworths, London.
5. Enzyme by Palmer.
6. Niggins, I.J. Best D.J. and Jones, J. Biotechnology – Principles and applications, Blackwell, scientific oxford (1985).
7. Bullock, J. and Kristiansen, B- (1987) Basic biotechnology.

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)
Title of Course: Physiology of Health (Elective Paper)
Paper- XI
Subject Code: GE-MZT23-303
Total Credits: 04

Course Outcomes: Upon successful completion of this course students will be:

CO1: able to understand pathological conditions of digestive system.

CO2: able to understand pathophysiology of special senses.

CO 3: able to understand basics of abnormalities in respiratory and circulatory system

CO 4: able to understand basics of blood defects.

Unit I- Pathophysiology of gastrointestinal system

1.1. Digestive glands

1.2. Swallowing and oesophagus

1.3. Stomach

1.4. Small intestine

1.5. Appendix

1.6. Large intestine- constipation, diarrhoea, and defecations.

Unit II- Pathophysiology of Special senses

2.1. Hearing defects

2.2. Ocular defects

2.3. Hyperthermia and Hypothermia.

2.4. Defects in Chemoreception.

Unit III- Pathophysiology of respiratory and circulatory systems

2.1. Respiratory insufficiency- Chronic pulmonary Emphysema, Pneumonia, Atelectasis, Asthma, Tuberculosis.

2.2. Hypoxia, Hypercapnia, Hypocapnia.

2.3. Haemolysis and clotting defects

2.4. Congenital and Ischemic heart diseases,

2.5. Hypertension, cardiac arrest and heart failure.

2.6. ECG-defect, Angiogram and Angioplasty.

Unit IV - Pathophysiology of Blood, immunity and Viral Diseases

3.2. Genetic blood disorders

3.3. Polycythaemia and Leukaemia

3.4. Types of immunity and its mechanisms

3.5. Hypo and Hypersensitivity mechanism

3.6 Viral Diseases and epidemiological implications.

Suggested Reading Material:

1. Human Physiology – by A.C. Guyton. Saunders Company London, Toronto.

2. Shepherd G.M. Neuro Biology, New York Oxford University Press 1987.

3. Hurst J.W et al (eds) The Heart 7th ed. New York McGraw- Hill Book Co. 1990.

4. Hand Book of Physiology Vols. Circulation. Renkin, E.M. & Michel, C.C.
(eds) American Physiological Society, 1984.

5. Guyton A.C. et al. Circulation Overall regulation Annu Re. Physiol. 34: 13 1972.
6. Guyton A.C. 1980 Arterial pressure & Hypertension Philadelphia, W.B. Saunders Co-
Cardiac output & its regulation 1973.
7. Kaplan N.M. et al 1989- The Kidney in Hypertension (Perspectives in hypertension
vol.2) New York. Raven Press.
8. Guyton A.C. et al 1975 Dynamics & Control of the Body fluids Philadelphia, W.B.
Saunders, Co., 1975.
9. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B.
Saunders Co., 1986.
10. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University
Press.
11. Johnson L.R. et al Physiology of the gastrointestinal tract 1987 New York Raven press.
12. Thompson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book
co., 1987.
13. Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
14. Guthrie H.A. 1988. Introductory Nutrition 7th ed. St.Louis C.V. Mosby Co.,
15. Felig P et al (eds) 1987. Endocrinology & Metabolism New Your MacGraw- Hill Book

**M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)**

(Introduced from Academic Year 2024-25)

Practical V MZP23- 305

(Based on MJ- MZT23-301: Genetics and MJ-MZT23-302 Enzymology)

1. Demonstration of Human lymphocyte culture.(by photograph or videos)
 2. Demonstration of Preparation of metaphasic chromosomes from human lymphocyte culture.
(by photograph or videos)
 3. Study of human chromosomes explaining aspects of chromosome structure.
 4. Study of human normal karyotype.
 5. Manual preparation of human karyotype from metaphasic chromosomes.
 6. Estimation of mitotic index.
 7. Study of X chromosome heterochromatinization by Barr body staining.
 8. G banding of rat chromosomes/Human chromosomes. (by photograph or slides)
 9. Genetic examples based on Mutations, Pleiotropy and Pedigree.
 10. Karyotype identification with reference to Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome (from photographs).
 11. Identification of cases of Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome from photographs by morphological/ symptomatic features
 12. Principle of Fluorescence In Situ Hybridization, Interpretation of results FISH for Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome (from photographs).
 13. Drosophila culture
 14. Sexual dimorphism in Drosophila
 15. Study of heritable characters in Drosophila
 16. Examples based on Hardy-Weinberg Equilibrium
 17. Symbols used in Pedigree analysis
 18. Studies of Human pedigrees concerned with autosomal recessive disorders, Autosomal dominant disorders, X linked dominant disorders and X linked recessive disorders.
 19. Examples of pedigree analysis
 20. Clinical test for Phenylketonuria by Guthrie test /Ferric chloride test
 21. Any experiment set by a teacher
-
1. Estimation of proteins.
 2. Estimation of Amylase / any other suitable enzyme.
 3. Effect of pH on Amylase activity / any other suitable enzyme.
 4. Effect of temperature on Amylase activity / any other suitable enzyme.
 5. Michaelis – Menten constant determination for Amylase / any other suitable enzyme.
 6. Effect of modifiers on enzyme activity / Thermolability of enzyme.
 7. Isolation of Amylase or any other enzyme.
 8. Any other practical set by the concern teacher.

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)
Practical VI- MZP23- 306
(Based on GE-MZT23-303: Physiology of Health (Elective Paper))
Total Credits: 02

1. Study of Routine haematological values with blood indices.
2. Study of Electrocardiogram (ECG).
3. Study of Arterial blood pressure (BP).
4. Effect of Insulin on blood sugar level.
5. Effect of Adrenaline on blood sugar level.
6. Study of colour index from blood sample by using haemocytometer.
7. Study of Vascularization (Angiogenesis) in Chick animal model
8. Study of Histological changes in the liver of diabetic rats
9. Study of Rectal Temperature in Rat or Mice.
10. Detection of Field of Vision or Blind spot.
11. Tests for detection of colour vision.
12. Test for Cochlear function and Audiometry.
13. Tests for coordination and movements
14. Examinations for Sensory systems.
15. Thermography in rat or in mammals
16. Effect of temperature on heartbeat.
17. Determination of Calcium in a given sample of blood plasma.
18. Estimation of blood Cholesterol.
19. Survey of digestive enzymes in the gut of Cockroach / Fish
20. Estimation of uric acid in urine/ blood
21. Estimation of creatinine in blood.
22. Determination of Icterus index of blood.
22. Any other practical set by the concerned teacher

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)
Research Project: FP-MZT23 304

It will be of **100 marks** (Four Credits).

70 marks will be for the successful completion and submission of project report

30 marks will be for the presentation before the panel of examiners (Internal and External Examiner) in the form of Open defense

**M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)**

(Introduced from Academic Year 2024-25)

Title of Course: Animal Cell Culture

Paper-XIII

Subject Code: MJ-MZT23-401

Total Credits: 04

Course Outcomes: Upon successful completion of this course, students will be able to,
CO1: Understand the basic requirement for animal cell culture, laboratory set up, aseptic conditions and carry out Animal cell culture

CO2: Illustrate growth media requirement of mammalian cell culture.

CO3: Gain knowledge of various invitro cytotoxicity and viability assays, growth parameters in culture.

CO4: Understand concept of surgical manipulations of IVF, culturing of differentiated cells, preparation of feeder layer and reconstituted basement membrane rafts.

Unit - I: Laboratory design, aseptic techniques, types of culture and cryopreservation (15 Hrs.)

1. Design of Tissue Culture Laboratory
2. Equipments: Laminar Flow Hoods, CO₂ incubator, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous Equipments.
3. Glass wares/plastic wares and filters for tissue culture
4. Basic Aseptic Techniques
5. Primary cell culture, Established cell line, transformed cell line
6. Cryopreservation for Storage and shipment

Unit - II: Growth media and Basic Techniques of mammalian cell culture (15 Hrs.)

1. Physical requirements and Nutritional Requirements of Cells
2. Natural media
3. Basal salt solution (BSS)-Various types
4. Minimum Essential Medium(MEM)
5. Serum dependent defined media
6. Serum independent defined media – Cell specific media
7. Antibiotics in media
8. Types of cell cultures – Open and closed cell cultures
9. Monolayer, Suspension, Clonal culture, Mass culture: micro carrier culture, Stem cell cultures (ESC)

Unit - III: Biology and Characterization of cultured cells and applications of Animal cell culture (15 Hrs.)

1. Viability measurement and cytotoxicity
2. Contamination Testing of Culture
3. Karyotyping
4. Measurement of growth parameters
5. Cell cycle analysis and Synchronization of cultures

Unit - IV: Applications of Animal cell culture, Cell surgery and tissue engineering (15 Hrs.)

1. Evaluation of Chemical carcinogenicity, Cell malignancy Testing
2. Uses of Embryonic stem cells and Pluripotent stem cells

3. Hybridoma cell preparations and their properties
4. Surgical manipulation of *in vitro* fertilization : ICSI, Assisted zona hatching, cytoplasmic transfer
5. Capillary culture Unit
6. Techniques for culturing differentiated cells: Use of feeder layer, use of Reconstituted basement membrane rafts.

Suggested Reading Material:

1. Morgan, S.I. Animal Cell culture 1993 Bio. Scientific Publishers Ltd Oxford.
2. Freshney, R.I. Culture of Animal Cells: A manual of Basic Technique, 1994, John Wiley & Sons Inc. Pub. USA.
3. Butler, M. Mammalian Cell Biotechnology.: A practical Approach 1991 IRL Press Oxford.
4. Jenni P. Mather & David Barnes Eds: Animal Cell culture Methods. Methods in Cell Biology Vol. 57 Academic press.
5. Cell Culture: Methods in Enzymology, vol. 58 1979/recent volume. Academic Press.
6. Kuchler, R.J. Biochemical Methods in Cell culture & vivology 1977. Dowden, Hutchinson & Ross, Inc. Strausberg, USA.

M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)

(NEP-2020)

(Introduced from Academic Year 2024-25)

Title of Course: TOXICOLOGY

Paper XIV

Subject Code: MJ-MZT23-402

Total Credits: 04

Course Outcomes: Upon successful completion of this course, students will be able to,

CO1: Gain knowledge of toxic compounds, its effects on health and environmental deterioration.

CO2: Imparts knowledge of types of toxicities, toxicological tests and its application in toxicity assessments.

CO3: Understand harmful effects and toxicokinetics of commonly used toxicants like pesticides and metal ions.

CO4: Gain knowledge of Bioaccumulation and biotransformation of various persistent toxicants and its issue in toxicity.

Unit- I: (15 hrs.)

Concept and Scope of Toxicology: Definition, History, Recent development, Disciplines of toxicology, Classification of toxicants, Toxic effects, Principle aspects and importance of toxicology, Types of toxicity test methods: based on exposure duration, acute and chronic toxicity test, Calculation of LD₅₀/ LC₅₀ by graphical and statistical methods

Unit II: (15 hrs.)

Routes of toxicant entry: Inhalation (breathing), Absorption (skin contact), Ingestion (eating), Injection. Dose, Duration, Frequency-response relations; Factors influencing toxicity; Types of human exposure- Categories of toxic effects; Dose - response relationship and genotoxicity; Target organs and mechanism of action.

Unit III: (15 hrs.)

Heavy metal toxicity: Mercury, Lead and Cadmium source and their impacts on animals, Synthetic pesticides of Organochlorine, Organophosphate, Carbamate and synthetic Pyrethroids toxicity symptoms, Biotransformation sites, Biotransformation reaction (Phase I and Phase II) of organochlorine and organophosphate and Factors affecting biotransformation of xenobiotics.

Unit- IV: (15 hrs.)

Food additives: contaminants, adulterants, food poisoning. Poisons, Toxins, and Venoms, Molecular and functional diversity of natural toxins and venoms, Natural roles of toxins and venoms, Major sites and mechanisms of toxic action, Animal venoms and toxins and toxin and venom therapy.

Suggested Reading Material:

1. Sharma, P. D. 1996 Environmental Biology and Toxicology, Rastogi Publication, Meerut, India.
2. Bhattacharya, S. 2011. Environmental Toxicology, Books and Allied (P) Ltd., Kalkata.
3. Panday, K. and Shukla, J.P. 2010. Elements of Toxicology, Wisdom Press, New Delhi.

E-resources

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4144270/>
2. <https://www.ncbi.nlm.nih.gov/pubmed/2190453>

3. https://ehs.unl.edu/documents/tox_exposure_guidelines.pdf
4. <http://medcraveonline.com/JBMOA/JBMOA-04-00085.pdf>
5. <http://farmasi.unud.ac.id/ind/wp-content/uploads/Bio-Transformation-of-Xenobiotics.pdf>
6. <https://www.nap.edu/read/2126/chapter/6>

M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2024-25)
Title of Course: Clinical Physiology (Elective Paper)
Paper XV
Subject Code: GE-MZT23-403
Total Credits: 04

Course Outcomes: Upon successful completion of this course, students will be able to,
CO1: Students will be able to understand Endocrine pathologies.
CO2: Enable to understand excretory defects with its symptoms.
CO 3: Provides recent information about neuropathology.
CO 4: Able to understand the basics of cancer.

Unit I- Pathophysiology of Endocrine glands (15 hrs.)

- 1.1. Pituitary glands
- 1.2. Thyroid glands
- 1.3. Parathyroid glands
- 1.4. Endocrine pancreas.
- 1.5. Adrenal gland
- 1.6. Gonads- Testis, Ovaries.

Unit II- Pathophysiology of Renal system (15 hrs.)

- 3.1. Acute renal failure- Peripheral internal and post renal failure.
- 3.2. Chronic renal failure – injury to glomeruli and interstitium
- 3.3. Hypertension and kidney .
- 3.4. Uremic toxicity, dialysis and artificial kidney.
- 3.5. Kidney transplantation.

Unit III- Pathophysiology of Nervous system (15 hrs.)

- 4.1. Disorders of Cerebrospinal fluid (CSF)
- 4.2 Pathophysiology of Psychosis
- 4.3 Pathophysiology of Epilepsy
- 4.4 Pathophysiology of Alzheimer's diseases
- 4.5 Pathophysiology of Parkinson's
- 4.6. Inherited neurological disorders.

Unit IV – Cancer Biology (15 hrs.)

- 4.1. Different types, characters of cancers.
- 4.3. Brain cancer
- 4.4. Breast cancer
- 4.4. Skin cancer
- 4.5. Gonadal cancer
- 4.6. Biopsy: Types, procedures and prognosis.

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5. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford UniversityPress.
6. Johnson L.R. et al Physiology of the gastrointestinal tract 1987 New York Raven press.
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**M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)**

(Introduced from Academic Year 2024-25)

Practical VII MZP23- 405

(Based on MJ- MZT23-401: Animal Cell Culture and MJ-MZT23-402 Toxicology)

Total Credits: 04

1. Study of equipments required for Animal Cell culture
 2. Study of laboratory design of Animal Cell culture
 3. Washing and sterilization of glassware for animal cell culture
 4. To test the sterility of the BSS/MEM/Serum
 5. Enzymatic Dissociation of cells for primary cell culture
 6. Mechanical dissociation of cells for primary cell culture
 7. Primary culture of fibroblasts by explant culture
 8. Study of Viability by trypan blue dye exclusion method
 9. Primary Culture of Fibroblast by cell dissociation
 10. Measurement of LDH activity in the culture medium
 11. MTT assay
 12. Passaging of fibroblast culture
 13. In vitro chick embryo culture
 14. Any experiment designed by a teacher.
-
1. Evaluation of acute toxicity by using static renewal bioassay test (In fish / Insect).
 2. Determination of LC_{50} of toxicant in fish / stored grain pest by employing probit analysis.
 3. Effect of toxicant on O_2 consumption rate in fish.
 4. Effect of toxicant (sub-lethal dose) on fish gill and alimentary tract in fish or in insect on alimentary canal haemolymph.
 5. Detection of heavy metal from animal issue by AAS (Lead/cadmium/chromium).
 6. Detection of pesticide by TLC method from water sample (organochlorine/organophosphate).
 7. Evaluation of toxicity by Comet assay
 8. Study of Micronucleus assay
 9. Effect of toxicants on mitosis
 10. Cytotoxicity determination by MTT, LDH and neutral red uptake assay.
 11. Acetyl cholinesterase assay for pesticide toxicity
 12. Any experiment designed by a teacher.

**M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)**

(Introduced from Academic Year 2024-25)

Title of Course: Research Project

Subject Code: FP-MZT23-404

Total Credits: 06

It includes 10 marks for seminars, 10 marks for Study tour, 50 marks for examination of experimental work based on elective GE-MZT23-403, 80 marks for evaluation of the project report by the external examiner. Two credits are exclusively reserved for satisfactory completion of experimental protocols based on elective course as under

1. Study of Endocrine disorders.
2. Urine Examination: Physical and Chemical.
3. Urine Examination: Microscopic observation for – different types of cells and casts.
4. Study of different types of Urine crystals and miscellaneous structures in Urine.
5. Kidney function tests.
6. Histochemical detection of uric acid crystals by using the AgNO₃ Formalin method. (White Horn's method)
7. Study of Biopsy Protocol and Investigation Techniques.
8. Study of different types of Cancer.(Slides and Photographs)
9. Dusting and identification of fingerprints.
10. Study of different stress factors (Natural and Induced) as per animal model.
11. Effect of toxicant / drug to the digestive/ reproductive cell/ glands (Histology and Histochemistry).
12. Study of developmental brain deformities with prognosis in chick embryo model.
13. Study of animal models (Invertebrate & Vertebrate) used in forensic investigation.
14. Study of Digitalization and modern techniques in Animal physiology.
15. Effect of temperature on rate of O₂ consumption of fish.
16. Study of gastric digestion in fish.
17. Any other practical set by the concerned teacher.

- **Research Project 404: It will be 150 marks (six credits) includes 10 marks for seminars, 10 marks for Study tour, 50 marks for examination of experimental work based on elective GE-MZT23-403, 80 marks for evaluation of the project report by the external examiner. The evaluation will be carried out by the panel of examiners (Internal and External Examiner) in the form of Open defense.**

9. Scheme of Teaching

- a. Each unit in theory course will be taught in 15 lectures, each lecture of 60 minutes duration and there will be four lectures per theory course per week.
- b. Each practical course shall be of minimum three hours duration.

10. Examination Pattern

Theory:

Theory examinations will be conducted **semester wise**.

- a. Entire programme of M. Sc. Zoology will be of **2200** marks. Every Semester will be of 550 marks.
- b. Examination of each 4credits**theory course** shall be of **100 marks** (80 university examination + 20 internal assessments).
- c. University examination of 80 marks (3 hours' duration) will be conducted at the end of each Semester. Internal assessment of 20 marks will be done before the semester examination during each semester.

Practical:

- a. Practical examinations will be conducted **semester wise**.
- b. Practical Examination of each major mandatory practical course shall be of 100 marks for 4 credits. Practical examination of major elective practical course will be of 50 marks for 2 credits.

On Job Training:

On job training shall be of 100 marks for 4 credits. 70 marks will be for completion and submission of its report and 30 marks will be for presentation. The candidate has to summarize the day wise duties and achievements during the training program and the skills/ expertise obtained during the training program in the form of power point presentation.

Field Project:

Field project shall be of 100 marks for 4 credits. 70 marks will be for completion and submission of its project report and 30 marks will be for the presentation before the panel of examiners (Internal and External Examiner) in the form of Open defence.

Research Project 304:

It will be of 100 marks (Four Credits). 70 marks will be for the successful completion and submission of project report and 30 marks will be for the presentation before the panel of examiners (Internal and External Examiner) in the form of Open defence.

Research Project 404:

It will be 150 marks (six credits) *includes 10 marks for seminars, 10 marks for Study tour, 50 marks for examination of experimental work based on elective GE-MZT23-403, 80 marks for evaluation of the project report by the external examiner. The evaluation will be carried out by the panel of examiners (Internal and External Examiner) in the form of Open defense.*

11. Nature of Question Paper and Scheme of Marking

Theory:

Pattern of question paper

There will be five descriptive questions, each carrying 16 marks.

Que. 1 Descriptive Question from Unit I 16

OR

Descriptive Question from Unit I

Que. 2 Descriptive Question from Unit II 16

OR

Descriptive Question from Unit II

Que. 3 Descriptive Question from Unit III 16

OR

Descriptive Question from Unit III

Que. 4 Descriptive Question from Unit IV 16

OR

Descriptive Question from Unit IV

Que. 5 Write notes on (Any two) 16

a. From Unit I

b. From Unit II

c. From Unit III

d. From Unit IV

For passing student must score minimum 32 marks out of 80 in theory examination.

Practical V: MZP23-305**(Based on MJ- MZT23-301: Genetics and MJ-MZT23-302 Enzymology) 100 marks**

Que. 1 Experiment/Experiments Based on MJ- MZT23-301	20
Que. 2 Experiment/Experiments Based on MJ- MZT23-301	20
Que. 3 Experiment/Experiments Based on MJ-MZT23-302	20
Que. 4 Experiment/Experiments Based on MJ-MZT23-302	20
Que. 5 <i>Viva voce</i>	10
Que. 6 Journal	10

For passing in **MZP23-305**, student must score minimum 40 marks out of 100 in practical examination

Practical VI: MZP23- 306 based on GE-MZT23-303 50 marks

Que. 1 Experiment/Experiments Based on GE-MZT23-303	20
Que. 2 Experiment/Experiments Based on GE-MZT23-303	20
Que. 5 <i>Viva voce</i>	05
Que. 6 Journal	05

For passing in **MZP23- 306**, student must score minimum 20 marks out of 50 in practical examination

Practical VII: MZP23-405**(Based on MJ- MZT23-401: Animal Cell Culture and MJ-MZT23-402 Toxicology)**

	100 marks
Que. 1 Experiment/Experiments Based on MJ- MZT23-401	20
Que. 2 Experiment/Experiments Based on MJ- MZT23-401	20
Que. 3 Experiment/Experiments Based on MJ-MZT23-402	20
Que. 4 Experiment/Experiments Based on MJ-MZT23-402	20
Que. 5 <i>Viva voce</i>	10
Que. 6 Journal	10

For passing in **MZP23-405**, student must score minimum 40 marks out of 100 in practical examination

Research Project Practical protocol on GE-MZT23-403: 50 marks

Que. 1 Experiment/Experiments Based on GE-MZT23-403	20
Que. 2 Experiment/Experiments Based on GE-MZT23-403	20
Que. 5 <i>Viva voce</i>	05
Que. 6 Journal	05

For passing in Research Project Practical protocol, student must score minimum 20 marks out of 50 in practical examination