



Estd. 1962
"A++" Accredited by
NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA

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शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र

दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१-२६०९०९४
०२३१-२६०९४८७



SU/BOS/Science/115

Date: 05/02/2024

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

The Head/Co-ordinator/Director
All Concerned Department (Science)
Shivaji University, Kolhapur.

Subject: Regarding syllabi of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

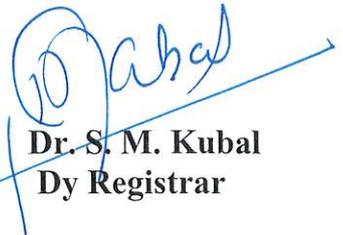
M.Sc.-II (Sem. III & IV) as per NEP-2020 (1.0)			
1.	M.A/M.Sc Geography	2.	M.Sc. Zoology

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in, NEP-2020 (Online Syllabus).

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,


Dr. S. M. Kubal
Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	4	P.G Admission / Eligibility Section
2	The Chairman, Respective Board of Studies	5	Computer Centre/ Eligibility Section
3	B.Sc. Exam/ Appointment Section	6	Affiliation Section (U.G.) (P.G.)

SHIVAJI UNIVERSITY, KOLHAPUR



Established: 1962

A⁺⁺ Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Science (Zoology)

under

Faculty of Science and Technology

(To Be Implemented From Academic Year 2024-25)

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1. Preamble

The Department of Zoology, Shivaji University, Kolhapur started in the year 1964. It offers M.Sc. and Ph.D. Programme 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 Cell Biology, Animal Physiology, Entomology, Aquaculture and Fisheries, and Sericulture.

Appropriate number 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, develop technical skills in Entomology, Aquaculture and Fisheries and Sericulture. The students will be able to analyze a situation critically and make decisions in the areas of their specialization.

2. Duration

- The course is full time and of two years duration.

3. Eligibility for Admission

- B. Sc. Zoology from any recognized Institutions.

4. Medium of Instruction: English

5. Programme Structure

Structure in Accordance with National Education Policy - 2020 With Multiple Entry and Multiple Exit Options M.Sc. (Zoology) Part – II (Level-6.5)

Semester III (Duration Six months)										
	Teaching Scheme				Examination Scheme					
	Course code	Lectures (per week)	Hours (per week)	Credit	Maximum marks	Minimum marks	Exam Hours	Maximum marks	Minimum marks	Exam Hours
Major Mandatory	MMT-301	4	4	4	80	32	3	20	8	1
	MMT-302	4	4	4	80	32	3	20	8	1
	MMPR-303	-	8	4	100	40	6	-	-	-
Major Elective	MME-304	4	4	4	80	32	3	20	8	1
	MEPR 305	-	4	2	50	20	3	-	-	-
Research Project	RP 306	-	8	4	100	40	6	-	-	-
TOTAL (Sem-III)		12	32	22	490	-	-	60	-	-
Semester IV (Duration Six Months)										
Major Mandatory	MMT-401	4	4	4	80	32	3	20	8	1
	MMT-402	4	4	4	80	32	3	20	8	1
	MMPR-403	-	8	4	100	40	6	-	-	-
Major Elective	MME-404	4	4	4	80	32	3	20	8	1
Research Project	RP405	-	12	6	150	60	9	-	-	-
TOTAL (Sem -IV)		12	32	22	490	-	-	60	-	-
Total (Sem III + Sem IV)		-	-	44	980	-	-	120	-	-

<ul style="list-style-type: none"> • MMT – Major Mandatory Theory • MMPR – Major Mandatory Practical • MET – Major Elective Theory • MEPR – Major Elective Practical • RP - Research Project 	<ul style="list-style-type: none"> • Total Marks for M.Sc.-II : 1100
	<ul style="list-style-type: none"> • Total Credits for M.Sc.-II (Semester III & IV): 44
	<ul style="list-style-type: none"> • <i>Separate passing is mandatory for University and Internal Examinations</i>
<p><i>RP405 includes 10 marks for seminars, 10 marks for Study tour, 50 marks for examination of experimental work based on elective MME403, 80 marks for evaluation of the project report by the external examiner.</i></p>	
<ul style="list-style-type: none"> • Requirement for Entry at Level 6.5: the student who exits after level 6.0 may join M. Sc. Part II (level 6.5) within next five year after exit. 	

6. 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.

7. Course Codes

M.Sc. Semester - III		
Sr. No.	Major Mandatory	
MMT301	Genetics (4 credits)	MSU0325MML939I1
MMT302	Enzymology (4 credits)	MSU0325MML939I2
MMPR 303	Practical MMPR 103 based on MMT 301 and MMT 302 (4 credits)	MSU0325MMP939I
MEPR 305	Practical MEPR 305 based on MET 304 (2 credits)	MSU0325MEP939I
RP 306	Research Project (4 credits)	MSU0325RP939I
	Major Elective	
MME 304	Immunology	MSU0325MEL939I1
	Physiology of Health	MSU0325MEL939I2
	Insect Anatomy and Physiology	MSU0325MEL939I3
	Aquaculture Practices	MSU0325MEL939I4
	Cytogenetics and Breeding of silkworm	MSU0325MEL939I5
M.Sc. Semester - IV		
	Major Mandatory	
MMT401	Animal Cell Culture (4 credits)	MSU0325MML939J1
MMT402	Toxicology (4 credits)	MSU0325MML939J2
MMPR 403	Practical MMPR 403 based on MMT 401 and MMT 402 (4 credits)	MSU0325MMP939J
RP 405	Research Project (6 credits)	MSU0325RP939J
	Major Elective	
MET 404	Cell Pathology	MSU0325MEL939J1
	Clinical Physiology	MSU0325MEL939J2
	Pest Management Concepts	MSU0325MEL939J3
	Fishery Technology	MSU0325MEL939J4
	Silkworm seed, silk production technology and Economics	MSU0325MEL939J5

8. Syllabus

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Genetics

Course Code: MSU0325MML939I1

Total Credits: 04

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

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

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

CO3: understand the molecular mechanism of mutation with suitable genetic examples.

CO4: Able to upgrade different perspectives of Genetic counseling.

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

Title of Course: Genetics

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 Nondisjunction, Aneuploidy, Patau syndrome, Edward syndrome, Down syndrome, Turner syndrome and Klinefelter syndrome
4. Genetic 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.
5. Prenatal Genetic Testing: Preimplantation 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

Course Code: MSU0325MML939I2

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 bisphosphate 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. (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, Black well, 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: Immunology

Course Code: MSU0325MEL939I1

Total Credits: 04

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

CO1: understand the fundamentals of immune system and role and mechanism of defense cells and organs

CO2: Illustrate the significance of antigens, antibodies, complements, MHCs, cytokines and chemokines in immune functions.

CO3: Understand the different types of hypersensitivity reactions

CO4: Gain knowledge of mechanism of maturation, activation and differentiation of T and B cells.

Unit – I: Overview of Immune system (15 Hrs.)

1. Immune system- Innate and adaptive immunity.
2. Organs of Immune System- Primary Lymphoid Organs, Secondary Lymphoid Organs
3. Cells involved in immune response-Lymphoid Cells, B-lymphocytes, T-lymphocytes, Natural Killer Cells, Mononuclear Phagocytes, Granulolytic Cells, Mast Cells, Dendritic Cells

Unit – II: Molecules involved in immune functions (15 Hrs.)

1. Antigens: nature, epitope, haptens.

2. Antibodies: structure, classes and biological activity, molecular basis of antibody diversity, monoclonal antibodies.
3. The complement system.
4. Major histocompatibility complex and antigen presentation
5. Cytokines and chemokines,
6. Molecular basis of transplant rejection.
7. Tumor immunology

Unit – III: Hypersensitivity Reactions (15 Hrs.)

1. Classification of Hypersensitivity Reactions.
2. IgE- Mediated (Type I) Hypersensitivity.
3. Antibody-Mediated Cytotoxic (Type II) Hypersensitivity.
4. Immune Complex-Mediated (Type III) Hypersensitivity.
5. Type IV or Delayed- Type Hypersensitivity (DTH)

Unit – IV: T and B-Cell maturation, activation and differentiation (15 Hrs.)

1. T Cell maturation-Thymic selection of the t-cell repertoire
2. T -Cell Activation-TCR mediated signalling, effector and memory T cells
3. T cell differentiation- effector and memory T cells
4. B Cell maturation-Progenitor B cell proliferation
5. B -Cell Activation-signal drive in B cells
6. B cell differentiation-cellular events within germinal centers, induction

Suggested Reading Material:

1. Kuby Immunology, WH Freeman, USA.
2. W Paul Fundamentals of Immunology.
3. I.M. Roitt, Essential Immunology, ELBS edition.
4. Roiff, I Brosfott, J and Male D – Immunology.
5. Sharma, J.M. : Avian Cellular Immunology.
6. Karger and Basel: The year of Immunology 1988.
7. Zapata A.G. and Co oper, E.L. The immune system.
8. Laurie Hoffman – Goetz : Exercise and immune function.
9. Cooper E.L and Brazier M.A.B : Immunology.

**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- III)

Course Code: MSU0325MEL939I2

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. Digestive glands.
2. Swallowing and oesophagus.
3. Stomach.
4. Small intestine
5. Appendix
6. Large intestine- constipation, diarrhoea, and defecation.

Unit II- Pathophysiology of Special senses

1. Hearing defects
2. Ocular defects
3. Hyperthermia and Hypothermia.
4. Defects in Chemoreception.

Unit III- Pathophysiology of respiratory and circulatory systems

1. Respiratory insufficiency- Chronic pulmonary Emphysema, Pneumonia, Atelectasis, Asthma, Tuberculosis.
2. Hypoxia, Hypercapnia, Hypocapnia.
3. Haemolysis and clotting defects
4. Congenital and Ischemic heart diseases,
5. Hypertension, cardiac arrest and heart failure.
6. ECG-defect, Angiogram and Angioplasty.

Unit IV - Pathophysiology of Blood, immunity and Viral Diseases

1. Genetic blood disorders
2. Polycythaemia and Leukaemia
3. Types of immunity and its mechanisms
4. Hypo and Hypersensitivity mechanism
5. 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. & Micbel, C.C. (eds) Americal Physiological Society, 1984.
5. Gayton 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- Cartiar 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 flerids Philadelphia, W.B. Saunders, Co., 1975.
9. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B. SaundersCo., 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. Thampson 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)

Title of Course: Insect Anatomy and Physiology

Course Code: MSU0325MEL939I3

Total Credits: 04

Course Outcomes: Upon successful completion of this course,

CO1: Students will understand the integument and anatomy, physiology of the digestive system of insects

CO2: Students will understand the respiratory, circulatory and excretory system of insects.

CO3: Students will understand the nervous and endocrine system of insects.

CO4: Students will understand the reproductive system and embryonic development of insects.

Unit – I:

(15 Hrs.)

1. THE INTEGUMENT:

1. Structure of Integument.
2. Physiology of Integument.
3. Functions of Integument.

2. DIGESTIVE SYSTEM AND ITS PHYSIOLOGY

1. The Alimentary canal and associated glands.
2. Digestion and Absorption
3. Enzyme dynamics.

Unit – II:

(15 Hrs.)

1. RESPIRATION

1. Organs of Respiration- Tracheae, Tracheoles, Airsacs and Spiracles.
2. Types of tracheal systems.
3. Mechanism of gaseous exchange within tracheole
4. Respiration in aquatic and parasitic insects.

2. CIRCULATION

1. Structure of Circulatory organs- Dorsal vessel and Accessory pulsatile structures.

2. Haemolymph- Composition and function.
3. Haemocytes- Types and function.
4. Mechanism of Circulation.

3. EXCRETION

1. Excretory organs – Malpighian tubules and other excretory structure.
2. Physiology of Excretion
3. Osmoregulation.

Unit – III:

(15 Hrs.)

1. NERVOUS SYSTEM

1. Neuron- structure and type
2. Central nervous system.
3. Physiology

2. ENDOCRINE SYSTEM.

1. Endocrine organs.
2. Neurosecretory cells
3. Hormones and their functions

Unit – IV:

(15 Hrs.)

1. REPRODUCTION.

1. Male Reproductive system.
2. Female Reproductive system.
3. Physiology and reproduction.

2. EMBRYONIC DEVELOPMENT

1. Cleavage and Blastoderm Formation.
2. Formation and Growth of germ band.
3. Gastrulation.
4. Formation of amnion
5. Segmentation

Suggested Reading Material:

1. Ambrose, D.P., 2015. The Insects. Structure, Function and Biodiversity. Kalyani publishers, New Delhi. 626pp.
2. Chapman, R. F. (1998). The Insect structure and function, 4th Ed. Cambridge University Press, UK. PP 747.
3. Gillot, C. (1980). Entomology, 3rd Ed. Plenum Press, New York ,pp 730 .
4. Gullan, P. G. and Cranston, P. S., 2010. The insects. An outline of Entomology. Wiley Blackwell. pp. 565.
5. Mani, M. S. (1968). General Entomology. Oxford & IBH Publishing Co., pp 597.
6. Snodgrass, R. E. (1935). Principles of Insect Morphology, Tata Mc Graw -Hill, New York. pp 667.
7. Tembhare, D. B (2013). Modern Entomology. Himalaya Publishing House, India. pp 502.
8. Wigglesworth, V.B., 1939. The principles of Insect Physiology. Sixth ed. Methuen and Co. Ltd., London. pp 741.

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Aquaculture Practices

Course Code: MSU0325MEL939I4

Total Credits: 04

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

CO1: understand mariculture, carp culture and brackish water culture

CO2: know about the innovative concepts in aquaculture practices.

CO3: explain prawn culture and plankton culture.

CO4: know the details of mariculture and culture of pearl oysters

Unit 1: (15 hrs.)

A. Introduction:

Scope and principles of aquaculture, History of aquaculture, Objectives of aquaculture

B. Classification of Aquaculture:

Mariculture (Salmon culture, Eel culture, and Milkfish culture), Carp culture (Indian Major Carps, Common Carps, and Chinese Major Carps), Brackish water culture

Unit 2: (15 hrs.)

A. Fish Culture Practices: Aquaculture Management:

Monoculture and composite culture, Fish Hatchery management, Induced breeding and Stripping in fishes

B. Fertilization and Artificial Feeding in Aquaculture:

Need for fertilizing fish pond, Fertilizers (organic, inorganic and bio-fertilizers), Artificial fish feeds and their formulation, Balanced fish feeds and their preparation.

C. Aquatic Weeds and Their Control:

Introduction, position of aquatic weeds in fishery ponds, classification of aquatic weeds, aquatic weeds control measure, importance of aquatic weeds.

Unit 3: (15 hrs.)

A. Prawn Culture

Species of prawns, habit and habitat, food and feeding, types of prawn fishery, culture of freshwater prawn, culture of marine prawn, preservation and processing of prawns, pollutional impact on prawn fishery, environmental issues of prawn culture, fate of prawn culture.

B. Culture of Plankton:

Definition, occurrence, types of plankton, significance of plankton, and culture of plankton

Unit 4:**(15 hrs.)****A Mariculture:**

Production of marine molluscs through aquaculture, Species of edible molluscs, Culture of oyster and mussels, Different methods of culture – bottom culture, raft culture, long line culture.

B Pearl oysters

Species of pearl oyster, methods of pearl seed collection, techniques of pearl culture, Prospectus in India.

Suggested reading material:

1. Fishery Science: W.C. Royce.
2. Ecology, Utilization and Management of marine fisheries; G. A. Rounsefell.
3. Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.
4. Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.
5. Fish farming hand book: E.E. Brown and J.B. Gratzek.
6. Fresh water biology: K.F. Lagler.
7. Fish and Fisheries of India: V.G. Jhingran.
8. Advances in aquaculture: T.V.R. pillay.
9. Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.
10. Fishery management: S.C. Agarwal.
11. Applied fishery science (Vol. I & II): S.M. Shafi.

**M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)**

Title of Course: Cytogenetics and Breeding of silkworm**Course Code: MSU0325MEL939I5****Total Credits: 04****Course Outcomes:** Upon successful completion of this course, students will be able to,CO1: Understand basic concepts of Mendelian and neo-mendelian genetics with respect to *B. mori*.

CO2: Gives knowledge of inheritance of various traits of mulberry silkworm and environmental influence on it.

CO3: Illustrate various silkworm breeding, its status in India and various methods of breeding.

CO4: Explains about selection methods of superior breeds.

Unit - I: Basics of silkworm genetics

1. Law of dominances, Segregation and Independent assortment. Gene interactions- intra and intergenetic.

2. Quantitative inheritance and polygenic characters in silkworm, Hereditary traits in silkworm, heritability and its estimation.
3. Linkage maps, inheritance of cocoon colour, Inheritance of voltinism, moultinism and its hormonal control and environment influence.

Unit - II: Silkworm cytogenetics

1. Chromosome number, euploidy, aneuploidy and polyploidy, an and nature of chromosomes, gynogenesis- androgenesis, Parthenogenesis in silkworm - types and induction.
2. Origin and distribution of silkworm races, Distinct characters, classification based on voltinism, moultinism and geographical distribution. Characteristic features of temperate and tropical races.
3. Improvement of silkworm races. Heritability in *B. mori* and its estimation.

Unit –III: Breeding of silkworm and management

1. Present status of silk worm breeding in India.
2. Silkworm breeding - scope and objectives; methods – line breeding, inbreeding, cross-breeding, outcrossing, mutation breeding. Selection methods and techniques, Advantages and disadvantages. Effect of inbreeding, Homozygosity, Heterosis in silkworm: genetic and theoretical basis, Hybrid vigor, and its utilization in sericulture.
3. Combining ability. Maintenance of races and strains, Management of genetic resources: Collection, conservation, characterization and evaluation of silkworm breeds and their maintenance.

Unit –IV: Specialized Breeding of silkworm

1. Breeding for special characters -cocoon, fiber denier, silkworm polyphagy.
2. Sex limited characters- sex determination, yellow cocoon races, sex limited races in India and its relevance to Indian sericulture.
3. Breeding for disease tolerant/resistant silkworms- defence response, disease resistance- screening and selection. Breeding for temperature tolerance.

Reference Books:

1. Basavaraja, H.K., Aswath, S.K., Suresh Kumar, N., Mal Reddy, N. and Kalpana, G.V. (2005) *Silkworm Breeding and Genetics*. Central Silk Board, Bangalore.
2. Dilip De Sarkar (1998) *The Silkworm – Biology, Genetics and Breeding*. Vikas Publishing House Pvt. Ltd., New Delhi.
3. Eikichi Hiratsuka (2000) *Silkworm Breeding*. Oxford & IBH Publications, New Delhi.
4. Elcio P. Guimaraes, John Ruane, Beate D. Scherf, Andrea Sonnino and James D. Dargie (2007) *Marker-Assisted Selection*, FAO, Rome.
5. Falconer, D.S. (1972) *Introduction to Quantitative Genetics*. Oliver & Boyd, Edinburgh.

6. Kovalev, P.A. (1970) *Silkworm Breeding Stocks*. Central Silk Board, Bangalore.
7. Larnar, M.F. and Donald, H.P. (1969) *Modern Developments in Animal Breeding*. Academic Press, London.
8. Sreerama Reddy, G. (Ed.) (1998) *Silkworm Breeding*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi and Calcutta.
9. Yokoyama, T. (1959): *Silkworm Genetics illustrated*: Japan Society for Promotion of Science, Tokyo.
10. Tazima, Y. (1978): *The silkworm. An important laboratory tool*, Hodansha Publication, Tokyo.

M. Sc. Zoology (Part II) (Level-6.5) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Practical MMPR 303: Based on MMT-301 & MMT-302

Based on CC-301: Genetics

1. Human lymphocyte culture.
2. Preparation of metaphasic chromosomes from human lymphocyte culture.
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. Assessing quality and quantity of metaphases.
7. Harvesting of mitotic chromosomes from rat bone marrow.
8. Estimation of mitotic index.
9. Study of X chromosome heterochromatinization by Barr body staining.
10. G banding of rat chromosomes/Human chromosomes.
11. Genetic examples based on Mutations, Pleiotropy and Pedigree.
12. Karyotype identification with reference to Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome (from photographs).
13. Identification of cases of Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome from photographs by morphological/ symptomatic features
14. Principle of Fluorescence In Situ Hybridization, Interpretation of results FISH for Patau syndrome, Edward Syndrome, Down syndrome, Klinefelter syndrome and Turner syndrome (from photographs).
15. *Drosophila* culture
16. Sexual dimorphism in *Drosophila*
17. Study of heritable characters in *Drosophila*
18. Examples based on Hardy-Weinberg Equilibrium
19. Symbols used in Pedigree analysis
20. Studies of Human pedigrees concerned with autosomal recessive disorders, Autosomal dominant disorders, X linked dominant disorders and X linked recessive disorders.
21. Clinical test for Phenylketonuria by Guthrie test /Ferric chloride test
22. Study of bacterial transformation
23. Study of bacterial transduction
24. Any experiment set by a teacher

Based on CCO-302: Enzymology

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)**

Title of Course: Practical MEPR**Course Code: MSU0325MEP939I****Total Credits: 02****Practical MEPR 305: Based on MET 304 (As per the elective chosen by a student)****Cell Biology:**

1. Histology of Lymphoid organs- Spleen, Thymus, Ilium, Lymph node, Bone marrow
2. Study of different types of lymphocytes.
3. Study of Lymphocyte count
4. Study of cell surface antigen.
5. Immunization of experimental animals and detection of antibodies.
6. Immunodiffusion
7. To estimate the antigen concentration using rocket electrophoresis
8. Dot immunobinding assay to detect antibodies in the serum
9. To perform ELISA.
10. Study of allergic reactions.
11. Induction of granuloma
12. Study of different types of cells in granuloma
13. Quantitative analysis of granuloma
14. Any other practical / experiments set by the Department.

Animal Physiology:

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 Fatty liver, pancreatic abnormality in Rat.
10. Study of Rectal Temperature in Rat or Mice.
11. Detection of Field of Vision or Blind spot.
12. Tests for detection of colour vision.
13. Test for Cochlear function and Audiometry.
14. Tests for coordination and movements
15. Examinations for Sensory systems.
16. Thermography in rat or in mammals
17. Effect of temperature on heartbeat.
18. Demonstration of the role of hormones in the developmental stage. (Chick Model)
19. Determination of Calcium in a given sample of blood plasma.
20. Estimation of blood Cholesterol.
21. To study pathophysiology of muscle fibre – smooth, skeletal and cardiac muscle (Histology and Histochemistry).
22. Any other practical set by the concerned teacher.

Entomology:

1. Dissection of any pest to study the digestive, nervous and reproductive systems.
2. Study of Total Haemocyte Count (THC) in insects.
3. Study of Differential Haemocyte Count (DHC) in insects.
4. Chromatographic analysis of amino acids in insect haemolymph/any tissue.
5. Estimation of digestive enzymes in insects (amylase/invertase/trehalase).
6. Study of uptake of dyes in Malpighian tubules.
7. Study of phagocytosis in insect haemocytes.
8. Determination of moisture given out by insects during respiration.
9. Qualitative estimation of nitrogenous waste products in the excreta of Cockroaches.
10. Any practical set by the concerned teacher.
11. Project Work.

Aquaculture and Fisheries:

1. Identification of fishes, prawns and mollusks.
2. Study of different nets, crafts and gears (models/drawings).
3. Estimation of glycogen, protein and lipids from fish tissue.
4. Study of fish products and by-products.
5. Any other experiment set by the concerned teacher

Sericulture:

1. Study of racial characters of the silkworm, *Bombyx mori*: Egg, larva, cocoon (pupa) and adult stages of univoltine, bivoltine and multivoltine type.
2. Estimation of fecundity and hatching percentage in various silkworm races /breeds.
3. Study of mutants of *Bombyx mori*: Larval (Ursa, Zebra and Knobbed), egg colour (pere), eye colour (white and red eye) and cocoon colour.
4. Study of inbreeding depression in silkworm.

5. Study of larval and cocoon character / segregation in F₁ and F₂ progenies of *multi x bi* hybrids to observe Mendelian pattern of inheritance.
6. Study of adult longevity in *Bombyx mori* – multivoltine and bivoltine races /breeds and sexes.
7. Assessment of qualitative and quantitative traits of silkworm for breeding.
8. Characterization of silkworm breeds/races - Bivoltine & Multivoltine
9. Evaluation of heterosis and over - dominance in F₁ silkworm hybrid.
10. Estimation of heritability of characters.
11. Any other practical set by concerned teacher.

M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Animal Cell Culture

Course Code: MSU0325MML939J1

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 and aseptic conditions

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, Huchinson & 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

Course Code: MSU0325MML939J2

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 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, Rastroggi 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: Cell Pathology

Course Code: MSU0325MEL939J1

Total Credits: 04

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

CO1: Understand cells stress response, basic mechanism of cell death by apoptosis and necrosis

CO2: Understand the basics of cancer biology

CO3: Understand the biology of aging

CO4: Impart knowledge of effect of metabolic inhibitors

Unit - I: Cell in stress and death (15 Hrs.)

1. Different types of stressful conditions on cell and cell response
2. Cell death and its regulation: Apoptosis-molecular mechanism and regulation
3. Cell organelles during cell degeneration/necrosis

Unit - II: Cancer Biology (15 Hrs.)

1. Tumor cells and onset of cancer
2. The genetic basis of cancer
3. Oncogenic mutations in growth promoting proteins
4. Mutations causing loss of growth inhibiting and cell-cycle controls
5. Carcinogens and caretaker genes

Unit - III: Aging (15 Hrs.)

1. Definition, Mechanism of ageing (Theories of ageing)
2. Internal and external causes of aging
3. Molecular and Cellular changes during aging
4. Immunological changes during aging
5. Strategies against ageing

Unit - IV: Effects of inhibitors on (15 Hrs.)

1. DNA synthesis (Mitomycin)
2. RNA synthesis (Actinomycin and Rifampicin).
3. Protein synthesis (Cyclohexamide, Tetracyclins, Chloramphenicol, streptomycins).
4. Mitochondrial metabolism (CN, CO, Actinomycin –A, Azide etc.)

Suggested Reading Material:

1. Cell & Molecular Biology by Gerald Karp (2005) published by John Wiley & sons.
2. Molecular cell biology by Lodish, Berk, Matsudaira, Kaiser, Krieger (2004) published by W. H. Freeman & company, New York.
3. The Cell by Bruce Alberts, published by Garland publishing Inc. New York & London.
4. Laboratory Investigation –Vol.14, 1965,.
5. Inhibitors of nucleic acid synthesis by Kersen & Kersen.
6. Inhibitors of Protein Synthesis FBII publication.
7. Metabolic Inhibitors Vol. I –IV.
8. Molecular Biology of gene by James Watson

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- IV)

Course Code: MSU0325MEL939J2

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. Pituitary glands
2. Thyroid glands
3. Parathyroid glands
4. Endocrine pancreas.
5. Adrenal gland
6. Gonads- Testis, Ovaries.

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

1. Acute renal failure- Peripheral internal and post renal failure.
2. Chronic renal failure – injury to glomeruli and interstitium
3. Hypertension and kidney diseases.
4. Uremic toxicity, dialysis and artificial kidney.
5. Kidney transplantation.

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

1. Disorders of Cerebrospinal fluid (CSF)
2. Pathophysiology of Psychosis
3. Pathophysiology of Epilepsy
4. Pathophysiology of Alzheimer's diseases
5. Pathophysiology of Parkinson's
6. Inherited neurological disorders.

Unit IV – Cancer Biology **(15 hrs.)**

1. Different types, characters of cancers.
2. Brain cancer
3. Breast cancer
4. Skin cancer
5. Gonadal cancer
6. Biopsy: Types, procedures and prognosis.

References:

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

2. Shepherd G.M. Neurobiology, 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. Brenner B.M. & Rector, F.C. (Jr) 1986. The kidney 3rd ed. Philadelphia, W.B. Saunders Co., 1986.
5. Brooks V.B. 1986. The neural Basis of motor control New York, Oxford University Press.
6. Johnson L.R. et al Physiology of the gastrointestinal tract 1987 New York Raven press.
7. Thompson J.C. et al (eds) Gastrointestinal Endocrinology. New York McGraw Hill book co., 1987.
8. Setchell K.D.R. et al eds 1988. The Bile Acids New York Plenum Pub. Corp.
9. Guthrie H.A. 1988. Introductory Nutrition 7th ed. St.Louis C.V. Mosby Co.,
10. Felig P et al (eds) 1987. Endocrinology & Metabolism New York MacGraw- Hill Book Co.,
11. DeGroot L.J. et al 1989. Endocrinology 2nd ed. Philadelphia, W.B. saunders Co. 1989.
12. Kannan, C.R. 1988. The adrenal gland New York Plenum Pub. Corp.
13. Wozney J.M. et al 1988. Novel regulators of bone formation: Molecular clones & cultivates science 242: 1528.
14. Martin R.B. & Burr D.B. 1989. Structure, function & adaptation of compact Bone New York, Raven Press 1989.
15. Knobil E. et al (eds) The physiology of Reproduction New York, Raven Press 1988.
16. Leung P.C.K. et al (eds) Endocrinology & Physiology of reproduction New York Plenum Pub. Corp. 1987

M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: PEST MANAGEMENT CONCEPTS

Course Code: MSU0325MEL939J3

Total Credits: 04

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

CO1: to understand methods and principles of pest control

CO2: to understand biological pest control

CO3: to understand chemical pest control

CO4: to understand Integrated Pest Management.

Unit –I:

(15 Hrs.)

Methods and principles of pest control,

1. Natural control of Insect Pests: Biotic and Abiotic Factors.

2. Cultural, Mechanical, Physical and Legal control of Insect Pests.

Unit –II:

(15 Hrs.)

3. Biological Pest Control:

Definition, history, methods, biocontrol agents, aspects of biocontrol, organizations, Biocontrol programs in India.

4. Microbial Control:

Definition, Pathogens used in microbial control (Fungi, Bacteria, Viruses, Protozoans, Nematodes etc.) Toxins produced and mode of action and application.

Unit –III: (15 Hrs.)

5. Genetic Control: Definition, methods and application.

6. The role of Hormonal and Radiation Control in Pest Management.

7. Behavioral Control:

Pheromones – mode of action and applications.

8. Chemical Control:

Plant origin and synthetic (organic and inorganic) insecticides, chemistry, mode of action and applications.

Unit –IV: (15 Hrs.)

9. Integrated Pest Management:

Definition, Need of IPM, Tactics and strategies of pest management (IPM),

10. Recent Advances in Pest management

a. The role of Antifeedent, Attractants, Repellents and Chemo-sterillants in Pest Management.

b. Green Chemistry in pesticides: Mode of action and Applications of Neem in plant protection.

Suggested Reading Material:

1. Agricultural Pests of India and South East Asia – A.S. Atwal, 1986.
2. A textbook of applied Entomology, Vol. II-K.P. Shrivastava.
3. Genetic control of insect pests- G. Davidson.
4. Biological Pest Suppression – Copell & Martins, 1977.
5. Agrochemicals and Pest Management – T.V. Sathe 2003.
6. Biological Pest Control – T.V. Sathe, P. M. Bhoje, 2000
7. Insect sex pheromones – Martin.
8. Pest Management: Ecological concepts – T.V. Sathe and Jyoti Oulkar, 2010.
9. Vermiculture and Organic Farming – T.V. Sathe, 2004.

M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Fishery Technology

Course Code: MSU0325MEL939J4

Total Credits: 04

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

CO1: Understand the scientific method and concepts in fishing technology.

CO2: Understand the techniques of breeding food fishes and maintenance of fresh water aquarium

CO3: Understand the Biotechnology in Aquaculture

CO4: Understand the post harvest technology

Unit 1:

Fishing Technology:

Conventional fishing methods: types of crafts and gears, Unconventional fishing methods, Modern methods of fishing, Rules and regulations for fishing operations and safety at sea.

Unit 2:

A. Techniques of Breeding Food Fishes:

Breeding habits of food fishes, Environmental control of reproductive cycles, Fecundity studies of fishes.

B. Maintenance of Freshwater aquarium:

Introduction, Equipment's used in the maintenance of Aquarium, Common diseases of aquarium fishes, Common freshwater aquarium fishes, and maintenances routine

Unit 3:

Biotechnology in Aquaculture:

Prospects of aquaculture biotechnology, Biotechnological tools in diagnosis of diseases in aquaculture, Application of hybridism technology in aquaculture, Cryopreservation technology in fishes, Application of biotechnology in health management in aquaculture

Unit 4:

Post-Harvest Technology:

Reasons for spoilage of fishes, methods for fish preservation, refrigeration, deep freezing, freeze drying, salting, smoking, drying, canning, demerits of fish preservation, fish by products, HACCP for fish processing industry.

Suggested reading material:

- 1 Fishery Science: W.C. Royce.
2. Ecology, Utilization and Management of marine fisheries; G. A. Rounsefell.
3. Fisheries development of India: U.K. Shrivastava and M. Dharma Reddy.
4. Aquaculture research needs for 2000 AD: Jaw. Kai. Wang and P. V. Dehadari.
5. Fish farming hand book: E.E. Brown and J.B. Gratzek.
6. Fresh water biology: K.F. Lagler.

7. Fish and Fisheries of India: V.G. Jhingran.
8. Advances in aquaculture: T.V.R. pillay.
9. Fishes an introduction to ichthyology: P.B. Moyle and J.J. Cech.

M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Silkworm seed, silk production technology and Economics

Course Code: MSU0325MEL939J4

Total Credits: 04

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

CO1: Understand silkworm seed production, its storage, incubation and embryonic development.

CO2: Gain knowledge about assessment of silk and cocoon properties.

CO3: Illustrate silk processing including cocoon storage, reeling and spinning.

CO4: Learn concept of marketing of cocoons and silk; economics of sericulture and silk processing industries.

Unit –I: Silkworm seed production technology

General concept of grainage. Concept of P4, P3, P2 and P1, Rearing of P1 seeds;

Grainage: Location and capacity; model grainage; grainage equipment and their uses; disinfection and hygiene; Silkworm egg production process – bivoltine and multivoltine. Embryonic development, Diapause and non-diapause eggs, Incubation of eggs and related aspects; Byproducts of grainage and their utilization. Entrepreneurship in silkworm seed production (LSP)

Unit –II: Silk production technology and management

Physical and commercial characteristics of multivoltine and bivoltine cocoons.

Cocoon markets – organization and functions; cocoon sorting – objectives and procedure; defective cocoons.

Storage & preservation of cocoons in silk reeling units, Cocoon stifling, Cocoon cooking, Silk reeling, re-reeling, Raw silk testing, Spun silk yarn, Silk weaving.

Byproducts of silk reeling industries.

Entrepreneurship development in silk reeling, weaving and marketing

Unit –III: Organization, marketing, value addition and economics of sericulture

Organizational set up of sericulture in state and country

Economics: Principles of economics, micro and macro economics; classification of costs – explicit and implicit, fixed, variable, marginal, average; profits – gross and net.

Economics of mulberry cultivation practices, commercial cocoon production, seed cocoon production, raw silk production

Marketing concepts for seed, raw silk and finished products.

Entrepreneurship development in value added products

(Mulberry tea, fodder, pharma , cosmetics products and cocoon handicrafts)

Unit –IV: Extension Education in Sericulture:

Extension education: Objectives and importance; principles, concepts and functions of extension education; teaching and learning process.

Extension programme management; sericulture development through plans; major programmes in sericulture.

Classification of various extension teaching methods its importance

Extension teaching methods adopted in sericulture. Use of audio-visual aids in sericulture. Training: meaning, principles, methods and training programmes in sericulture.

Central Silk Board, Directorate of Sericulture,

Mahareshim abhiyan, Various govt., schemes.

Reference Books:

1. Akira Nakamura (2000) Fiber Science and Technology. Oxford & IBH Publications, New Delhi.
2. Gubrajani, M.L. (1986): Silk Dyeing, printing and finishing, IIT, New Delhi.
3. Byung, Jo. (1987): Silk Textile Engineering, Moon, Halk Publication Scol. Korea.
4. Rayner Hollin (1903): Silk Throwing and Waste Silk Spinning Scott. Greenwood and Sons, London.
5. Koshy, T.D. (1990): Exports and Development, Ashish Publications, New Delhi.
6. Anonymous (1972): Hand Book of silk rearing, Agriculture techniques Manual I., Fuji Publication, Tokyo.
7. Jolly, M.S.: Appropriate Sericultural Techniques CSR and TI Mysore.
8. Strunnikov, V.A. (1983): Control of silkworm reproduction, Development and sex MIR publications, Moscow.
9. Annual report of Central Sericultural Research and Training Institute, Mysore.
10. Annual report of Central Sericultural Research and Training Institute, Bangalore.
11. A Treatise on acid treatment of silkworm eggs, CSR and TI, Mysore.
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M. Sc. Zoology (Part II) (Level-6.5) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2024-25)

Title of Course: Practical – MMPR 203

Course Code: MSU0325MMP939J

Total Credits: 04

Practical MMPR-403: Based on MMT-401 & MMT-402

Based on CC-401: Animal Cell culture

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. Chemical 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.

Based on CCO-402: Toxicology

1. Evaluation of acute toxicity by using static renewal bioassay test (In fish / Insect).
2. Determination of LC₅₀ of toxicant in fish / stored grain pest by employing probit analysis.
3. Effect of toxicant on O₂ consumption rate in fish.
4. Effect of toxicant (sublethal dose) on fish gill and alimentary tract in fish and in insect on alimentary canal haemolymph (Mulberry silkworm)
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. Acetylcholinesterase 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

Course Code: MSU0325RP939J

Total Credits: 06

It includes 10 marks for seminars, 10 marks for Study tour, 50 marks for examination of experimental work based on elective MME403, 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

Based on Elective MET401

Cell Biology:

1. Study of unilateral renal necrosis
2. Study of histology of stressed kidney
3. Study of histology of necrotic kidney
4. Age related lipid peroxidation in various organs of rat / mouse.
5. Drug induced lipid peroxidation in liver & kidney (CCl₄ / any suitable drug).
6. Histochemical demonstration of lipofuscin granules by oil red O.
7. Demonstration of lipofuscin granules by carbol fuchsin.
8. Any other practical / experiments set by the Department.

Animal Physiology

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.
7. Study of Biopsy Protocol and Investigation Techniques.
8. Study of different types of Cancer.
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. Any other practical set by the concerned teacher.

Entomology:

1. Study of insecticide appliances.
2. Insect pest damage detection.
3. Study of economically important parasitoids (Biocontrol agents).
4. Study of economically important insect predators (Biocontrol agents).
5. Study of vertebrate biocontrol agents of insect pests.
6. Study of insect traps in pest control method.
7. Effect of contact pesticides on insects.
8. Effect of fumigants on insects.
9. Any practical set by the concerned teacher.

Aquaculture and Fisheries

1. Identification and control measures of aquatic weeds and insects
2. Assessment of pollutants from farm water – heavy metals and pesticides
3. Estimation of primary productivity of water sample by light and dark bottle experiment.
4. Qualitative and quantitative study of zooplankton.
5. Method of fish preservation.
6. Any other experiment set by the concerned teacher.

Sericulture:

1. Identification of textile fibres by microscopic, physical and chemical tests.
- 2 Study of physical and commercial characters of cocoons in multivoltine and bivoltine races / breeds.
3. Sexing in silkworm pupae and moths.
4. Acid treatment (hot and cold) of hibernating silkworm eggs and mother moth examination.
5. Mounting of embryo – pin head and blue egg stages.

6. Sorting of cocoons – identification of good and defective cocoons.
7. Cocoon stifling and cooking.
8. Determination of alkalinity and hardness of reeling water by titration methods.
9. Reeling techniques: Epprouvette, Charaka, Multi-end and Automatic reeling devices.
10. Study of different types of silk wastes.
11. Preparation of garlands / handicrafts by silk waste / pierced cocoons.
12. Visit to silk reeling establishments.
13. Visit to field and farmers rearing house to study sericulture technologies adopted.

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 4 credits **theory course** shall be of **100 marks** (80 university examination + 20 internal assessment).
- 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.

11. Nature of Question Paper and Scheme of Marking

Theory:

Pattern of question paper for MMT, MET and RM course.

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 in MMT, MET and RM courses, student must score minimum 32 marks out of 80 in theory examination.

Practical:

Practical MMPR 303 based on MMT301 and MMT302, 100 marks

Que. 1 Experiment/Experiments Based on **MMT301** 20

Que. 2 Experiment/Experiments Based on **MMT301** 20

Que. 3 Experiment/Experiments Based on **MMT302** 20

Que. 4 Experiment/Experiments Based on **MMT302** 20

Que. 5 *Viva voce* 10

Que. 6 Journal 10

For passing in MMPR303, student must score minimum 40 marks out of 100 in practical examination

Practical MEPR 305 based on MET-304 50 marks

Que. 1 Experiment/Experiments Based on MET 304 20

Que. 2 Experiment/Experiments Based on MET 304 20

Que. 5 *Viva voce* 05

Que. 6 Journal 05

For passing in MEPR305, student must score minimum 20 marks out of 50 in practical examination

Practical MMPR 403 based on MMT401 and MMT402, 100 marks

Que. 1 Experiment/Experiments Based on **MMT401** 20

Que. 2 Experiment/Experiments Based on **MMT401** 20

Que. 3 Experiment/Experiments Based on **MMT402** 20

Que. 4 Experiment/Experiments Based on **MMT402** 20

Que. 5 *Viva voce* 10

Que. 6 Journal 10

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 powerpoint 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 306: 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 405: 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 MME403, 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 defence.

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

12. Equivalence of courses

M. Sc. Part II (Semester III and IV)

Old Course				Equivalent Course		
Sem No.	Course Code	Title of Old Course	Credit	Course Code	Title of New Course	Credit
III	CC-301	Genetics	4	MSU0325MML939I1	Genetics	4
III	CCO-302	Enzymology	4	MSU0325MML939I2	Enzymology	4
III	CCPR-405	Practical III	4	MSU0325MMP939I	Practical MMPR 103	4
III	CCPR-405	Practical III	4	MSU0325MEP939I	Practical MEPR 305 based on MET 304	2
III				MSU0325RP939I	Research Project	4
III	CCS-403	Immunology	4	MSU0325MEL939I1	Immunology	4
III	CCS-403	Physiology of Health	4	MSU0325MEL939I2	Physiology of Health	4
III	CCS-403	Physiology of Health	4	MSU0325MEL939I3	Insect Anatomy and Physiology	4
III	CCS-403	Physiology of Health	4	MSU0325MEL939I4	Aquaculture Practices	2
III	CCS-403	Physiology of Health	4	MSU0325MEL939I5	Cytogenetics and Breeding of silkworm	4
IV	CC-401	Animal Cell Culture	4	MSU0325MML939J1	Animal Cell Culture	4
IV	CCO-402	Toxicology	4	MSU0325MML939J2	Toxicology	4
IV	CCPR-406	Practical IV	4	MSU0325MMP939J	Practical MMPR 403	4
IV			4	MSU0325RP939J	Research Project	6
IV	CCS-404	Cell Pathology	4	MSU0325MEL939J1	Cell Pathology	4
IV	CCS-404	Clinical Physiology	4	MSU0325MEL939J2	Clinical Physiology	4
IV	CCS-404	Pest Management Concepts	4	MSU0325MEL939J3	Pest Management Concepts	4
IV	CCS-404	Fishery Technology	4	MSU0325MEL939J4	Fishery Technology	4
IV	CCS-404	Silkworm seed, silk production technology and Economics	4	MSU0325MEL939J5	Silkworm seed, silk production technology and Economics	4