MANONMANIUM SUNDARANAR UNIVERSITY, TIRUNELVELI-12

B. Sc ZOOLOGY PROGRAMME
CHOICE BASED CREDIT SYSTEM – CBCS
Syllabus for Affiliated Colleges with effect from the academic year 2021- 2022 onwards
(incorporated with Learning Outcome based Curriculum Framework- LOCF)

VISION AND MISSION OF THE DEPARTMENT

VISION

"To provide quality education in biology for updating knowledge and developing skills to overcome global challenges that hinders the progress of our Nation".

MISSION

Empowerment and upliftment of downtrodden and weaker section of the community through learning biology

- teaching, research and outreach programmes .
- creating an academic environment that honours all sectors of society.
- offering possible off-campus educational and training programmes using High-tech biotechnology.
- inclusive and intensive education, especially for the rural and unreached segments for the improvement of the economy of the individuals and in turn our nation.

PREAMBLE

Biology is the branch of Science which investigates the origin, structure, function and distribution of life in all its forms. Zoology is a vast subject that advances workers in the field and tends to specialize in one or more of the subdivisions in which they can hope to become very proficient. The three year programme imparts education on the diversity of animal life, development as well as their genetic structure and functions. Students can obtain career paths globally in the field of biotechnology and genetic engineering, wild life conservation, environmental management, ecosystem monitoring, animal welfare as well as human health. Zoology is an interesting subject with immense number of avenues to open up new challenges like the control and prevention of Covid 19 outbreak, bioremediation and categorizing crisis management. Also it motivates the learners to crack the opportunities worldwide and finally gain expertise in their field to become Nobel Laureates.

B.Sc., ZOOLOGY PROGRAMME

CHOICE BASED CREDIT SYSTEM – CBCS

(with effect from the academic year 2021-2022 onwards)

B.Sc ZOOLOGY-COURSE STRUCTURE

Sem	Pt.I/ II/III IV/V	Subject Status	Subject title	Course /paper	Contact Hrs./ Week	Credits
I	I	Language	Tamil/Other Language	1	6	4
	II	Language	Communicative English-I	1	6	4
	III	Core	Animal Diversity-I Invertebrata	1	4	4
	III	Add on Major(Mandatory)	Professional English for Life Sciences-I	1	4	4
	III	Major Practical-I	Animal Diversity-I Invertebrata	1	2	1
	III	Allied-I	Cell Biology, Genetics and Bio-Technology	1	4	3
	III	Allied Practical-I	Cell Biology, Genetics and Bio-Technology	1	2	1
	IV	Common	Environmental Studies	1	2	2
			Sub total	8	30	23
II	I	Language	Tamil/Other Language	1	6	4
	II	Language	Communicative English-II	1	6	4
	III	Core	Animal Diversity-II-Chordata	1	4	4
	III	Add on Major(Mandatory)	Professional English for Life Sciences-II	1	4	4
	III	Major Practical-II	Animal Diversity-II-Chordata	1	2	1
	III	Allied-I	Developmental Zoology, Ecology, Animal Physiology & Evolution	1	4	3
	III	Allied Practical-I	Developmental Zoology, Ecology, Animal Physiology & Evolution	1	2	1
	IV	Common	Value based education	1	2	2
			Sub total	8	30	23
III	I	Language	Tamil/Other Language	1	6	4
	II	Language	English	1	6	4
	III	Core	Developmental Zoology	1	4	4
	III	Major Practical-III	Developmental Zoology	1	4	4
	III	Allied-I	Cell Biology, Genetics and Bio-Technology	1	4	3
	III	Allied Practical-I	Cell Biology, Genetics and Bio-Technology	1	2	1
	III	Skilled based-core	Home aquarium	1	4	4
	IV	Non-Major Elective	Bee Keeping	1	2	2

		Common	YOGA		**2**	**2**
			Sub-total	**8**	**30**	**25**
IV	**I**	Language	Tamil/Other Language	**1**	**6**	**4**
	II	Language	English	**1**	**6**	**4**
	III	Core	Cell and Molecular Biology	**1**	**4**	**4**
	III	Major Practical-IV	Cell and Molecular Biology	**1**	**2**	**1**
	III	Allied-II	Developmental Zoology, Ecology, Animal Physiology and Evolution	**1**	**4**	**3**
	III	Allied Practical-II	Developmental Zoology, Ecology, Animal Physiology and Evolution	**1**	**2**	**1**
	III	Skilled based-core	VermiTechnology	**1**	**4**	**4**
	IV	Non-Major Elective	Public Health and Hygiene	**1**	**2**	**2**
	V	Extension Activity	NCC/NSS/YRC/YW/PE			**1**
		Common	Computer for Digital Era			**2**
			Sub-total	**8**	**30**	**26**
V	**III**	Core	Ecology and Toxicology	**1**	**5**	**4**
	III	Core	Genetics	**1**	**5**	**4**
	III	Core	Animal Physiology and Biochemistry	**1**	**5**	**4**
	III	Core	Immunology and Microbiology	**1**	**5**	**4**
	III	Major Practical- V	Ecology and Toxicology and Genetics	**1**	**3**	**4**
	III	Major Practical- VI	Animal Physiology and Biochemistry	**1**	**3**	
	IV	Major Practical- VII	Immunology and Microbiology	**1**	**2**	
		Skill based common	Personality Development	**1**	**2**	**2**
			Sub-total	**8**	**30**	**22**
VI	**III**	Core	Evolution	**1**	**5**	**4**
	III	Core	Animal Biotechnology	**1**	**5**	**4**
	III	Core	Biostatistics, Computer applications & Bioinformatics	**1**	**5**	**4**
	III	Major Elective	Sericulture	**1**	**5**	**4**
	III	Major Elective	Apiculture	**1**	**4**	**4**
	III	Major Practical- VIII	Evolution and Animal Biotechnology	**1**	**2**	**4**
	III	Major Practical- IX	Biostatistics, Computer applications & Bioinformati	**1**	**2**	
	III	Major Elective Practical- X	Sericulture and Apiculture	**1**	**2**	
			Sub-total	**8**	**30**	**24**

All practical examinations are at end of each semester
*Extra credit for extra hours
Total number of hours: 180
Total number of Credits : 142

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The B. Sc Programme will enable the student to

PEO1: acquire knowledge of current trends and practices in all aspects of science.

PEO2: equip and fulfil the demands of various competitive examinations and career developments.

PEO3: inculcate the temperament and thirst of research on recent developments at inter disciplinary level.

PEO4: get easy access in references with the available e-Learning programmes.

PEO5: raise the standard of the students of our state on par with international standards.

PEO6: promote the overall development of each student in educational, personal, social, cultural and intellectual perspectives and transform him/her to become a responsible citizen.

PROGRAMME OUTCOMES (POs)

Upon completion of B.Sc Programme the student will be able to

PO1: provide deep understanding of fundamental facts and concepts of Science and develop critical thinking skills in the field of Science.

PO2: effectively communicate scientific concepts orally and in writing and ensure scientific thinking.

PO3: express and exchange ideas related to scientific concepts for promoting social responsibility.

PO4: pursue higher studies up to research in multidisciplinary level and/or interdisciplinary become professionals.

PO5: practice ethics in personal and professional life to build a healthy nation.

PO6: construct a safe environment and plan sustainable utilization of resources

PO7: expertise in independent decision making and become economically independent.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Upon completion of B.Sc. Zoology Programme, the student will be able to

PSO1: analyse and communicate fundamental concepts in Zoology.

PSO2: apply practical skills in the specific fields of Zoology.

PSO3: practice bioethical principles in profession and life.

PSO4: identify, formulate and find solutions for complex environmental problems and epidemiological and health issues for the betterment of sustainable development pertaining to a local community.

PSO5: explore their knowledge and acquired skills to access the qualitative and quantitative approaches using statistical packages for analysis and interpretation.

PSO6: clear competitive examinations in par with all levels.

PSO7: fulfil the needs of the society as Teachers, Professors, Researchers in Institutes and Biotech Companies, Biological Data Analysts, Wild life Biologists, Zoo-keepers, Curators of natural history museums, Lab technicians, Water quality analysts etc.

PSO8: support and be a part of nation building initiatives as an employee or an entrepreneur.

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -I /Core Course

CORE COURSE: 1. 1 - INVERTEBRATA

L	T	P	C
4	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- recall the diversity, taxonomy and relationship of animals.
- .classify the animals of invertebrate phyla and recognize their distinguishing features.
- elucidate the diversity of animals in a phylogenetic context and their evolution.
- . analyse and relate how the different body designs and adaptations solve biological problems of physiological and environmental challenges.
- .examine the role of invertebrates in biological communities, ecological interactions, and impact of conservation problems.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: relate the diversity and basic taxonomy of non- chordates.

CO2: interpret the biological status of the animals at basic level in their habitat.

CO3. analyse and examine the adaptations of the parasites and their impact on human health and welfare.

CO4. compare the diversity of arthropods and appraise their economic importance.

CO5: critically appraise the distribution and food value of molluscs and phylogenetic significance of echinoderms.

CO6: develop the conservation practices, sustainable economic utilisation and potentials in technological prospects and create awareness.

CO7: apply their acquired knowledge in invertebrates as foundation for studying further courses in higher level.

UNIT I

Classification of Animal Kingdom and Introduction

Concept of five kingdom classification of life. Introduction to Protista & Animal kingdom – Systems of classification & nomenclature levels of organization -Types of symmetry.

Protozoa: General characters & Classification up to classes with examples.

Type study: Paramecium

General topics: Protozoan parasites, Life cycle of Plasmodium, Locomotion & Nutrition in Protozoa.

(12L)

UNIT II

Porifera & Coelenterata: General characters & classification up to classes with examples Salient features of Ctenophora.

Type study: Leucosolenia & Obelia Colony

General topics: Canal system in sponges, Polymorphism in Coelenterates, Diversity /Types of corals and coral reefs.

(12L)

UNIT III

Platyhelminthes, Aschelminthes & Annelida: General characters & classification up to classes with examples.

Type study: Liver fluke, Ascaris & Neries

General topics: Nematode parasites & their adaptations, Metamerism in Annelids, Filter feeding in Polychaetes.

(12L)

UNIT IV

Arthropoda: General characters & classification up to classes with examples.

Brief descriptions of Limulus & Sacculina.

Type study: Prawn

General topics: Crustacean larvae, Mouth parts of insects, Social life in insects, Affinities of Peripatus.

(12L)

UNIT V

Mollusca and Echinodermata: General characters & classification up to classes with examples.

Type study: Pila & Starfish

General topics: Torsion & de-torsion in Gastropods, Cephalopods as an advanced Molluscs, Pearl and edible oyster culture, Echinoderm larvae and its phylogenetic significances.

(12L)

(TOTAL 60L)

COs at Cognitive level and mapping with POs and PSOs

SEMESTER I **PART III : CORE COURSE 1.1 INVERTEBRATA**																	
CO	**COGNITIVE LEVEL**	**PO**							**PSO**								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	3	3	3	2	1	1	3	3	3	3	3	**3**	**2**	**-**
CO2	**K-3 Apply**	3	3	3	3	1	1	1	3	3	3	2	**2**	**2**	**1**	**-**
CO3	**K-3 Analyse**	3	3	2	3	1	1	1	3	3	2	**2**	**1**	**1**	**1**	**-**
CO4	**K-4 Analyse**	3	3	2	3	2	1	1	3	3	2	2	2	2	-2	-
CO5	**K-4 Analyse**	3	2	2	3	3	1	1	3	2	2	3	3	3	2	1
CO6	**K-5 Evaluate**	3	2	2	2	3	3	2	3	2	2	2	2	2	3	2
CO7	**K-6 Creativity**	3	2	1	2	3	2	2	2	1	1	1	2	3	3	

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

No Correlation (0)

Books for reference

1. Barnes, R.D. Invertebrate Zoology (1982) Vi Edition. Holt Saunders International Edition.

2. Ekambaranatha Ayyar & T.N. Ananthakrishnan, Manual of Zoology Vol –I , Part I & IIS. Viswanathan. Chennai.

3. Kotpal RL, Agarwal SK & Khetarpal RP Invertebrates,Rastogi Publications, Meerut.

4. Jordan And Verma Invertebrate Zoology S. Chand & Co, New Delhi

5. Anderson TA, Invertebrate Zoology, Oxford University Press, New Delhi.

6. Barrington EJW, Invertebrate Structure and Functions. English Language Book Society.

7. Hyman LH, The Invertebrates (6 vols).McGraw-Hill Companies Inc. NY

8. Nair NC, Invertebrata & Chordata, Saras Publication Nagercoil.

9. Nair NC, Leelavathy S, SoundaraPandian , Murugan T & Arumugam N A Text Book of Invertebrates, Saras Publication Nagercoil.

10. Ebanasar J & Sheeja BD Outlines of five kingdoms of life, Shine and Twinkle

Publications, Nagercoil.

11. Mahanta Rita & I.K. Bhattacharyya. Invertebrate Zoology. 1. 11. Kalyani Publishers, B1/1299, Rajaendar Nagpur, Ludhiana-141008.

12. Parker & Haswell. A text Book of Zoology, Invertebrates Volume I. AITBS Publishers and Distributors, J5/6 Krishna Nagar, Delhi-110051

13. Verma, A. Invertebrates: Protozoa to Echinodermata. Naros Publishing House Private Limited.3536 Greams Road, Thousand Lights, Chennai –

E Resources:

1. https://www.notesonzoology.com/protozoa/economic-importance-of-protozoa-zoology/13241

2. https://www.onlinebiologynotes.com/coral-reefs-types-formation-and-economic-importance/

3. https://www.biologydiscussion.com/invertebrate-zoology/phylum-coelenterata/obelia-habitat-structure-and-diagram/28685

4. https://courses.lumenlearning.com/microbiology/chapter/parasitic-helminths/

5. https://www.biologydiscussion.com/ecology/colony-of-insects-ecology/59828

6. https://www.studyandscore.com/studymaterial-detail/pearl-culture-technical-requirements-

process-and-methods

7.http://bncollegebgp.ac.in/wp-content/uploads/2020/04/BSc-Zoology-Part-I-Larval-forms-in-Echinoderms.pdf

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -I / Core Practical

CORE COURSE PRACTICAL - I
INVERTEBRATA

L	T	P	C
--	--	2	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- find the internal structural organization of invertebrate animals.
- :identify the animals of invertebrate phyla and recognize their distinguishing characters with examples.
- classify the animals and analyse their biological importance

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: analyse the distribution of non- chordates.

CO2: interpret the biological status of the animals.

CO3: appreciate the economic importance of the invertebrates

CO4: design a model for diversity and conservation of invertebrates

1. **Dissection and Mountings:** Cockroach- Nervous System, Digestive System, Trachea, Salivary Apparatus.
2. **Museum specimens, slides, models and charts:**
   Paramecium- entire, binary fission, conjugation, Plasmodium, Marine sponge, Obelia colony, Medusae of Obelia, Madrepora, Favia, Ascaris male and female, Fasciola, Earthworm, Nereis, Chaetopterus, Leech, Prawn, Limulus, Peripatus, Honey Bee, Nauplius larva, Zoea larva, Pila- shell, Sepia, Octopus, Pinctada, Edible oyster, Star fish, Bipinnaria larva, Auricularia larva and Sea cucumber.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER I PART III: CORE COURSE PRACTICAL I: INVERTEBRATA																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-3 Apply**	3	3	3	3	2	1	1	3	3	3	3	3	**3**	**2**	**-**
CO2	**K-4 Analyse**	3	3	3	3	1	1	1	3	3	3	2	**2**	**2**	**1**	**-**
CO3	**K-5 Evaluate**	3	3	2	3	1	1	1	3	3	2	**2**	**1**	**1**	**1**	**-**
CO4	**K-6 Creativity**	3	3	2	3	2	1	1	3	3	2	2	2	2	-	-

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)
No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -II /Core

CORE COURSE: 2.1 - CHORDATA

L	T	P	C
4	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- understand the taxonomy, relationship and evolution of chordate animals.
- identify the classes of vertebrates and recognize their distinguishing features.
- appraise the diversity of animals in view of phylogenetic context.
- explain how the different body designs solve biological problems related to physiological and environmental challenges.
- develop an appreciation for the role of vertebrates in biological communities, ecological interactions, and conservation problems.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: recall the diversity and basic taxonomy of chordates.

CO2: understand and examine the biological systems and evolution of chordates.

CO3: analyse and compare the adaptations and their importance in distribution.

CO4: identify and appreciate the functions of vertebrate animals at various levels.

CO5: apply their skills for conservation, sustainable development, economic utilisation and its potentials in technological prospects.

CO6: appraise the behavioural patterns and distribution of mammals.

UNIT I

Chordata

Subphylum: Protochordata & Vertebrata: General characters and classification of Chordates up to classes with examples.

Type study: Amphioxus

Ascidian - External features- Retrogressive metamorphosis

Balanoglossus- Morphology and Affinities of Hemichordates.

Agnatha: Petromyzon- Salient features -Migration- Ammocoete larva

Type study: Scoliodon

General topics: Accessory respiratory organs in fishes, Types of fins and functions, Migration of Fishes.

(12L)

UNIT II

Amphibia: General characters and classification up to order with examples.

Type study: Frog

General topics: Metamorphosis of Amphibian, Limbless amphibians, Parental care in Amphibian, Paedogenesis.

(12L)

UNIT III

Reptilia: General characters and classification up to order with examples.

Type study: Calotes

General topics: Identification of Poisonous and non-poisonous snakes – Poison apparatus and types of poison - Biting mechanism & First aid. Salient features of Chelonia & Crocodilia. Skull of Reptiles.

(12L)

UNIT IV

Aves: General characters and classification up to order with examples.

Type study: Pigeon;- external characters – feathers- synsacrum- girdles and limb bones- Circulatory system- Respiratory system - Urinogenital system.

General topics: Flightless birds, Flight adaptations in birds, Feet and Beak modifications, Migration in birds.

(12L)

UNIT V

Mammals: General characters and classification up to order with examples.

Type Study: Rabbit:- External features- Integument and its derivatives- Digestive system- Respiratory system- Circulatory system – Nervous system- Urinogenital system – Endoskeletal system: atlas, axis, typical vertebrae and appendicular skeleton.

General topics: Diversity of Marsupials, Affinities of Prototheria, Aquatic mammals and their adaptation and Dentition in Mammals.

(12L)

(Total 60L)

COs at Cognitive level and mapping with POs and PSOs

SEMESTER II PART III: CORE COURSE -2.1 CHORDATA																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	3	3	3	2	1	2	3	3	3	3	3	3	2	-
CO2	**K-3 Apply**	3	3	3	2	1	1	1	3	3	3	2	2	1	1	1
CO3	**K-3 Apply**	3	3	2	3	1	1	1	3	3	2	2	1	1	2	1
CO4	**K-4 Analyse**	3	3	2	3	2	1	2	3	3	2	2	2	2	2	1
CO5	**K-4 Analyse**	3	2	3	3	3	1	1	3	2	2	3	3	3	1	1
CO6	**K-5 Evaluate**	3	2	2	2	3	3	2	3	2	2	3	2	2	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

Books for references

1. Arumugam N Animal Diversity –Volume 2 .Chordata, Saras Publication, Nagercoil

2. Thangamani A, Prasannakumar S, Narayanan LM, Arumugam NA Text Book of Chordates, Saras Publication, Nagercoil.

3. Ekambaranatha Ayyar & T.N. Ananthakrishnan, Manual of Zoology Vol –II, S. Viswanathan. Chennai..

4. Kotpal RL Mordern Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut.

5.Young, J.Z. 1950. Life of Vertebrates.Clarendon Press, Oxford, UK.

6. Pough Harvey F, Christine M .Janis and John B. Heiser .2002. Vertebrate Life, Pearson Education Inc. New Delhi.

7. Verma PS, Chordate Zoology, S Chand Publishers, New Delhi

8. Alexander, R.M. The Chordates Cambridge University Press.

9.Bhamrah, H.S. et al. A text book of chordates.Anmol publication Limited, 4374/4B Ansari Road, Daryaganj, New Delhi 110002.

10. Jordan E.L. and P.S Verma. Chordata Zoology (11th Edition). S. Chand and Company Limited, 7361 Ram Nagar, Qutab Road, New Delhi-110 055.

12. Kardong, K. Vertebrates: Comparative Anatomy, Function, Evolution. Tata Mc Graw Hill publishing Company Limited, 444/1.Sri Ekambara Naicker, Industrial estate, Alapakkam, Porur, Chennai-600 116.

13. Kulshrestha, S.K. Comparative Anatomy of Vertebrates, Anmol Publishers a Private limited, 4374/14B, Ansari Road, Daryaganj,.New Delhi-110 002.

14. Mahanta Rita and I,K.Bhattacharyya.VertebrateZoology,Kalyanipublishers,B-1/1299,Rajinder Nagar, Ludhiana-141008.

15. Nigam, H.C. Biology of Chrodates. Vishal Publishing Company, Books Market, Old Railway Road, Jalandhar-144008.

16. Prasad, S.N.and Kashyap Vasantika, P. Text Book of Vertebrate Zoology, New Age International publishers,4835/24

E Resources:

1. https://www.britannica.com/animal/amphioxus
2. http://rkclnmu.ac.in/wp-content/uploads/2020/04/ZOOLOGY-B-SC.-PART-1-PAPER-2-GROUP-A-RETROGRESSIVE-METAMORPHOSIS-IN-HERDMANIA-NAYAK-SHYAMA-PRASAD-GOPAL-13.04.20.pdf
3. https://www.notesonzoology.com/india/fishery/fishes-of-india-17-main-fresh-water-fishes-of-india/2871

4. https://www.notesonzoology.com/phylum-chordata/fishes/parental-care-in-fishes-with-diagram-vertebrates-chordata-zoology/8064
5. https://abel.mcmaster.ca/publications/pdfs/2011_Parental_Care_in_Fishes.pdf
6. https://old.amu.ac.in/emp/studym/100007348.pdf
7. https://www.tnwatchablewildlife.org/files/DiscoverBirds_4_beaks_and_feet.pdf
8. https://sciencemadefun.net/blog/birds-beaks-and-adaptations/https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200405062753726 9amit_zool_Flightleass_Birds.pdf. Ansari Road, Daryaganj, New Delhi-1109002

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -II /Core Practical

CORE COURSE PRACTICAL- II
CHORDATA

L	T	P	C
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LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- find the structural deferments between invertebrates and chordates animals,
- understand the structural organization of chordates animals.
- identify the importance of chordates adaptation for the need of the chordates habits and habitat.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: understand and recognize the internal structure of the chordate animals.

CO2: identify the different groups of chordates based on the anatomical characters.

CO3: distinguish and analyse the distribution of local chordate animals.

CO4: predict and classify the chordate animals based on the classification and morphological characters.

CO5: to ensure the importance of conservation of chordate animals.

1. **Dissections and Mountings:**

- **Shark** – Placoid Scales.
- **Shark** – Digestive system (Demonstration only) – model / chart / CD – students have to draw the diagram and write detailed account of the digestive system in the observation note book.
- **Frog** – Arterial system (Demonstration only) – model / chart / CD – students have to draw the diagram and write detailed account of the arterial system in the observation note book.
- **Frog** – Brain (demonstration only) – model / chart / CD – students have to draw the diagram of dorsal and ventral view and write detailed account of the brain in the observation note book.

- **Rabbit** /**Rat**– Urinogenital system (Demonstration only) – model / chart / CD – students have to draw the diagram and write detailed account of the urinogenital system in the observation note book
- **Rabbit/Rat** – Heart (demonstration only) – model / chart / CD – students have to draw the diagram of external and internal structure and write detailed account of the heart in the observation note book

2. **Museum Specimens, Slides, Models and Charts**

Amphioxus, Balanoglossus, Ascidian, Petromyzon, Narcine, Hippocampus, Anabas, Ichthyophis, Rhacophorus, Ambystoma, Axolotl larva, Chelone mydas, Chameleon, Draco, Cobra, Dryophis, Sea snake, Pigeon, Bat, Atlas, Axis, Typical vertebrae, Girdles and limb vertebrae of Rabbit and Synsacrum of bird.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER II PART III: CORE COURSE PRACTICAL II: CHORDATA																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	**K2- Understand**	3	3	3	3	2	1	1	3	3	3	3	3	3	2	1
CO2	**K3- Apply**	3	3	3	2	1	3	1	3	3	3	3	2	3	3	1
CO3	**K4- Analyse**	3	3	3	3	3	3	1	3	3	3	2	3	2	3	2
CO4	**K5- Evaluate**	3	2	3	2	3	2	1	3	3	3	2	3	2	3	1
CO5	**K6 – Creativity**	2	3	3	2	3	2	1	2	3	3	2	3	3	2	2

Strongly Correlated (3), Moderately Correlated (2), Weakly Correlated (1), No Correlation (0)

Suggested List of Supplementary Web Resources for Laboratory Exercises:

1. Anatomy of Frog: Pro Dissector (CD)- www.prodissector.com

2.Physiology of Frog: Physio Ex 4.0 (CD)- www.physioex.com
3.Anatomy of Chordates: The Vertebrate Dissection Guide Series (CD)–Learning Development CentrE University of Portsmouth
4.Anatomy of earthworm: The dissection works (CD); Source – www.scienclass.com; www.neosci.com
5.Anatomy of shark: Shark dissection and anatomy (video)- www.neosci.com
6.Cockroach dissection- www.ento.vt.edu
7. Mammalian Physiology– www.biopac.com

SYLLABUS FOR

ALLIED ZOOLOGY
(Allied Course for I/II Year B.Sc Science Programmes Other Than Zoology Programme Students)
&
INDUSTRIAL FISH AND FISHERIES- ALLIED
(**Allied Course for I/II Year B.Sc Zoology Progrmme Students)**

Under Choice Based Credit system - CBCS (For the candidates admitted to the course in the academic year 2021 – 2022 onwards)

MSU/2021-22/UG-Colleges/Part-III (Allied Zoology) SEMESTER -I /III /Allied Course

(Allied Course For I/II Year B.Sc Science Programmes other than Zoology Programme Students)

ALLIED COURSE: 1.1
CELL BIOLOGY, GENETICS AND BIOTECHNOLOGY

L	T	P	C
4	--	--	3

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- elucidate the structure and functions of the cell organelles
- exemplify the concept of genetics, the principles of inheritance and the role of genes in determining characters.
- understand the application of the innovative biotechnology.
- manipulate living organisms or parts of organisms to make products useful to human.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: recall the basic structure and function of the animal cell
CO2: understand the genetic principles about the inheritance of traits
CO3: apply the knowledge of biotechnological techniques
CO4: evaluate the applications on the welfare of human beings.

CELL BIOLOGY

UNIT I

Ultra structure and functions of (a) Plasma membrane (b) Mitochondria (c) Nucleus. Chromosomes – Structure, types and functions; Giant Chromosomes (Polytene and Lamp brush Chromosomes)**(12L)**

UNIT II

DNA: Structure (Watson and Crick Model)- Replication.

RNA: Different types – r RNA – mRNA – tRNA; Protein synthesis.

Cancer cells and Carcinogenesis – Definition, Types, Causes, Properties, Diagnosis and Treatment.**(12L)**

GENETICS

UNIT III

Simple Mendelian traits in man; Multiple alleles – ABO blood groups in man – problems. Rh-factor in human – Erythroblastosis foetalis. Multiple gene inheritance.**(12L)**

UNIT IV

Sex determination in man; Sex linked inheritance in man – Haemophilia, Colour blindness and Hypertrichosis.

Non disjunction and Syndromes in man – Klinefelter‟s syndrome, Turner‟s syndrome and Down‟s syndrome.

Inborn Errors of Metabolism in man – Phenyl ketonuria, Alkaptanuria and Albinism. **(12L)**

BIOTECHNOLOGY

UNIT V

Definition, scope and importance of Biotechnology, Basic concepts of genetic engineering.

Restriction and modification system – Cloning vectors – (pBR 322, Lambda phage) Introduction of cloned genes into host cells(Any three methods)– Transgenesis – Transgenic animals and its application.**(12L)**

(TOTAL: 60L)

Books for reference

CELL BIOLOGY

1. Ambrose, E.J & Dorothy, M.E: Cell Biology (ELBS CAMLOTPRESS)
2. De Robertis & De Robertis: Cell & Molecular Biology. (W.B. Saunders &co, Philadelphia).
3. De Robertis, E.D.P, Nowinski, W.N & Saez, F.A : Cell Biology (W.B. Saunders &co, Philadelphia).
4. Dupraw, EJ : Cell & Molecular Biology (Academic Press, NewYork)
5. Dyson, R.D :Essentials of Cell Biology (Allyn &BaconInc. Boston). Giese.A.C: Cell Physiology (W.B. Saunders &co,Philadelphia).

GENETICS

1. Strickberger : Genetics(MacMillan).
2. Farnsworth : Genetics (Harper andRow).
3. P.K.Gupta: Genetics (RastogiPublications)
4. P.S. Verma and Agarwal: Genetics (S.Chand & Co.Ltd.)
5. Altonburg,E: Genetics (Oxford & IBH publishing company)
6. Burns G.W.: The Science of Genetics (MacMillan)
7. A.C.Pai: Foundations of Genetics (Mc Gaw –Hill)

BIOTECHNOLOGY

a. Prof.V. Kumaresan,"Animal Biotechnology", Saras Publication, A.R.P. Camp Road, Periavilai, Kottar P.O.,Nagercoil, K.K.Dist., - 629002.
b. Kumar H.D." A text book of Biotechnology, Affiliated East – West Press(P) Ltd., NewDelhi.

3.Animal Biotechnology,2006,R.Sasidhara,MJPPublishers,Chennai.

4.Dubey R.C "A text book of Biotechnology"S.Chand& Co.,Ltd.,NewDelhi.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER I/III PART III ALLIED COURSE: I.1 CELL BIOLOGY, GENETICS AND BIOTECHNOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	3	2	2	1	1	2	1	3	2	2	2	1	2	2	2
CO2	**K-2 Understand**	2	3	2	2	2	3	1	3	3	2	2	1	3	3	2
CO3	**K-3 Apply**	2	3	2	2	1	3	2	3	3	3	2	2	3	3	3
CO4	**K-4 Analyse**	2	2	3	1	2	3	2	3	3	3	3	2	3	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (Allied Zoology) SEMESTER -I /III /Allied Practical

ALLIED ZOOLOGY PRACTICAL- I
CELL BIOLOGY, GENETICS & BIOTECHNOLOGY

L	T	P	C
--	--	2	1

- Mounting of Giant Chromosome in Chironomous larva (or) Squash preparation of mitotic stages in onion root tip cells.
- Observation of Simple Mendelian Triats among the students.
- Study of the following through Charts, Slides and Figures:
  Mitochondria, Interphase Nucleus, DNA, tRNA, ABO Blood group.

  Colour Blindness, Haemophilia, Klinefelter‟s syndrome, Down‟s syndrome.

  pBR 322, Lambda Phage, Recombinant DNA

MSU/2021-22/UG-Colleges/Part-III (Allied Zoology) SEMESTER -II /IV - Allied Course

ALLIED COURSE: 2.1

DEVELOPMENTAL ZOOLOGY, ECOLOGY, ANIMAL PHYSIOLOGY AND

EVOLUTION

L	T	P	C
4	--	--	3

LEARNING OBJECTIVES (LOs)

The objectives the course are enabling the students to

- understand the sequential changes from cellular grade of organization to organ grade of organization in the development of multicellular organisms.
- study the interaction and the interdependence among environmental factors and living organisms.
- understand and analyse the functional significance of various organs and organ systems of animals.
- discern the evolutionary significance of the animals, origin of species, effects of mutation.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: recognize the basic concept of developmental stages of the animals
CO2: understand the interaction of abiotic and biotic factors in the ecosystem and its components
CO3: apply the knowledge of vital physiological functions of our body
CO4: evaluate the evolutionary concepts on origin of life.

UNIT I

DEVELOPMENTAL ZOOLOGY

Early development in Man: Structure of sperm and ovum; Fertilization – Cleavage, Morula, Blastocyst, Implantation and Gastrulation – Fate map. Placenta in mammals – types and functions. Test tube babies – Twins – Amniocentesis.
Nuclear Transplantation in Acetabularia.

(13L)

UNIT II

ECOLOGY

Abiotic factors: Biological effects of Temperature and Light; Biotic factors: Symbiosis, Commensalism, Mutualism, Parasitism, Prey- Predator Relationship; Adaptations: Desert adaptations; Community: Ecosystem – Structure and dynamics of a pond.
(13L)

UNIT III

ANIMAL PHYSIOLOGY

Nutrition: Food constituents – Carbohydrates, Proteins and Fats. Digestion: Role of enzymes in carbohydrate, protein and fat digestion. Absorption: Absorption of digested food.

Metabolism: Carbohydrate metabolism: Glycogenesis, Glycogenolysis, Glycolysis. Respiration: Transport and exchange of Oxygen and Carbon-di-oxide.Haemoglobin.

(13L)

UNIT IV

Excretion: Structure of Nephron – Urine formation – Dialysis; Nervous Co-ordination: Structure and types of neurons – Nerve impulse, conduction of nerve impulse through neuron and synapse; Reproduction: Structure of human testis and ovary, Graafian follicle, Menstrual cycle and its hormonal control.
(13L)

UNIT V
EVOLUTION

Theories of Evolution: Darwinism, Mutation theory of De Vries. Adaptive radiation in birds. Mimicry and Colouration.

(8L)

(TOTAL: 60L)

BOOKS FOR REFERENCE

Developmental Zoology

1. Arora, M.P. Embryology. Himalaya Publishing House,Ramdoot,

Dr. Bhalerao Marg, Girgaon, Mumbai- 400 004.

2. Arumugam, N. Developmental Biology, Saras Publication, 114/35G,A.R.P camp Road, Nagercoil.

Ecology

1. Agrawal. A.k. Ecology and environmental biology, student edition agrobios (india), behind nasrani cinema. Chopasani road. Jodhpur-342 002
2. Odum, E.P. Fundementals of Ecology International Student Edition W.B. Sounders Company, Philadelphia, London.

Animal Physiology

1. Agarwal, R.A., A.K. Srivastava and Kaushal Kumar. Animal Physiology and Biochemistry (3rd Edition). S. Chand & Company Limited, 7361 Ram Nagar, New Delhi-110 055.
2. Arora,M.P Animal Physiology (6th Edition). Himalaya Publishing House, Ramdoot, Dr. Bhalerao Marg, Girgaon, Mumbai 400 004.

Evolution

1. Arora, M.P. Evolutionary Biology. Himalaya Publishing House, Ramdoot, Dr. Bhalerao Marg, Girgaon, Mumbai 400 004.

2. Tomar, B.S. and S.P. Singh. Evolutionary Biology. Rastogi Publications, Gangotri, Shivaji Road, Meerut-250 002.

3. Organic Evolution Arumugam, N. Saras Publication, 114/35G,A.R.P camp Road, Nagercoil,

COs at Cognitive level and mapping with POs and PSOs

SEMESTER II/IV PART III ALLIED COURSE: 2.1 DEVELOPMENTAL ZOOLOGY, ECOLOGY, ANIMAL PHYSIOLOGY AND EVOLUTION																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	**K2- Understand**	3	3	3	3	2	1	1	3	3	3	3	3	3	2	1
CO2	**K3- Apply**	3	3	3	2	1	3	1	3	3	3	3	2	3	3	1
CO3	**K4- Analyse**	3	3	3	3	3	3	1	3	3	3	2	3	2	3	2
CO4	**K5- Evaluate**	3	2	3	2	3	2	1	3	3	3	2	3	2	3	1

Strongly Correlated (3), Moderately Correlated (2), Weakly Correlated (1), No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (Allied Zoology) SEMESTER –II/IV - Allied Course Practical

ALLIED ZOOLOGY PRACTICAL COURSE- II
DEVELOPMENTAL ZOOLOGY, ECOLOGY, ANIMAL PHYSIOLOGY & EVOLUTION

L	T	P	C
--	--	2	1

1. Mounting and observation of live sperms of a vertebrate.
2. Estimation of dissolved oxygen in two water samples and discuss the results
3. Qualitative test for glucose, protein and lipid.
4. Effect of temperature on the opercular movement of fish- Calculation of Q_{10}.
5. Museum specimens, slides, models and charts:

Developmental Zoology: Human sperm, Human ovum, Blastula, Gastrula, Diffuse Placenta, Zonary Placenta, Discoidal placenta, Cotyledonary Placenta (any two).

Ecology: Identification of any two planktons- either Fresh water (or) marine samples.

Echeneis and Shark, Hermit crab and Sea anemone, Sacculina, Secchi disc.

Animal Physiology: Intestinal villi, Nephron, Heart of mammal.
Evolution: Ancon sheep.

CORE COURSE: 3.1
CELL BIOLOGY AND BIOCHEMISTRY

L	T	P	C
4	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- recall the types and structure of cell.
- elucidate the ultra structure and functions cell organelles.
- analyse and relate how the different cell organelles are functioning.
- explain the classification and role of biomolecules.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: understand cell, its biology, and origin of cells, diversity and structure and learn the basic differences between prokaryotic and eukaryotic cells and understand the basis of cytological techniques, principle of working and its application of microscope.

CO2: analyse the structural organization and function of plasma membrane, mitochondria, nucleus, lysosomes etc.

CO3: acquire knowledge about how cell divides by means of meiosis and mitosis and factors which control cell cycle, structure of DNA and replication of DNA in cells.

CO4: describe the process of transcription, RNA processing and translation in prokaryotes and eukaryotes.

CO5: understand the causes and effects of cancer.

CO6: explain the structure and biological significance of carbohydrates, aminoacids, proteins and lipids.

CO7: apply the acquired knowledge in cell and molecular biology as foundation for getting new avenues by joining further courses in higher studies.

UNIT I
INTRODUCTION TO CELL, CYTOLOGICAL TECHNIQUES &MICROSCOPY

Cell Biology- Scope in Modern perspective. Cell theory: Modern version and interpretation.
Prokaryotic and Eukaryotic cells: Structure.
Cytological techniques: Fixation–Sectioning & Staining.
Microscopy: Principle, resolving power & uses of Compound microscope, Phase contrast microscope and Electron microscope.
(12L)

UNIT II
CELL ORGANELLES- ULTRA STRUCTURE & FUNCTION

Plasma membrane- cell junction; Endoplasmic reticulum; Golgi apparatus; Lysosomes; Centrosomes; Ribosomes; Mitochondria - Glycolysis and Krebs cycle- Electron Transport Chain and Formation of ATP, Nucleus and Nucleolus.
(12L)

UNIT III

CHROMOSOMES &CELL CYCLE

Chromosomes: Structure, types and function-Chromatin–Nucleosome; Giant chromosomes.
DNA: structure, replication and types.

Cell cycle: cell division- mitosis and meiosis and interphase and its regulation. Mutations in the genes that regulate cell cycle and division - their role. Carcinogenesis: cancer types – carcinogen. Programmed cell death (Apoptosis).

(12L)

UNIT IV

TRANSCRIPTION &TRANSLATION
Transcription : types of RNA - m RNA synthesis, role of RNA- Structure of t-RNA. Properties of Genetic code.
Translation: Detailed study of Protein synthesis – Polysomes – differences in eukaryotes– short outline of post transcriptional modifications.
(12L)

UNIT V

BIOCHEMISTRY

Structure and Classification of Carbohydrates, Protein, Amino acids, Lipids.

Enzymes: classification - mechanism of action - factors influencing enzyme action – Enzyme Inhibition.

Metabolism: Glycogenesis– Glycogenolysis- Gluconeogenesis and HMP shunt; Deamination & Transamination; β - oxidation of fats.

(12L)

(Total: 60L)

Books for reference

1. Gupta PK, Cell Biology, Rastogi Publications, Meerut.
2. Jain JL, Jain N & Jain S. Fundamentals of Biochemistry, S. Chand Publications, New Delhi.
3. Pawar CB, Cell Biology, Himalaya Publications.
4. Ramadevi K, Ambika Shanmugam., Fundamentals of Biochemistry for Medical Students, Williams &Wilkins
5. Verma PS & Agarwal VK Cell Biology S.Chand Publishers, NewDelhi
6. Becker, W.M; Kleinsmith, L.J: Hardin. J. and Bertoni, G.P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, Sanfransisco.
7. Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
8. Zubay, G. (2017) Biochemistry (4th edition) Mc Graw- Hill

E-Resources:https://pdfcoffee.com.principles of biochemistry-zubay.

https://www.pdfdrive.com>biochemistry.

https://pubs.acs.org>doc>pdf

https://wepdf.com>biochemistrysc rastogi

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: III PART III: CORE COURSE : 3.1 CELL BIOLOGY AND BIOCHEMISTRY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	3	3	1	3	1	2	1	3	3	3	2	2	3	3	2
CO2	**K-2 Understand**	3	3	2	3	1	1	1	3	1	2	2	2	3	2	2
CO3	**K-3 Apply**	3	3	1	3	1	2	1	3	3	3	2	2	3	3	2
CO4	**K-4 Analyse**	3	3	2	3	1	1	1	3	1	2	2	2	3	2	2
CO5	**K-5 Evaluate**	3	3	2	3	3	1	1	3	1	2	2	2	3	2	2

CO6	**K-5 Evaluate**	3	2	2	2	3	3	3	3	3	3	2	3	3	3	2
CO7	**K-6 Create**	2	2	2	2	3	3	3	3	2	2	3	2	2	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0).

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -III /Core Practical

CORE PRACTICAL III: CELL BIOLOGY AND BIOCHEMISTRY

L	T	P	C
--	--	2	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- find out the mitotic stages and observe the chromosomal segregation in onion root tip cells.
- identify the structural organization of polytene chromosomes in chironomous larva.
- know how to prepare a smear / squash preparation of squamous epithelial cells, meiotic stages of grass hopper testis cells and human blood smear.
- determine the influence of temperature and enzyme concentration on salivary amylase activity.

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: understand the segregation of chromosomes in different mitotic stages.

CO2: analyse the organization of polytene chromosomes under high power of the light microscope.

CO3: develop the skill to prepare and identify the squamous epithelial cells, meiotic stages in grass hopper testis cells and distinguish the different types of blood cells.

CO4: test and analyse the qualitative tests for protein, carbohydrate and fat.

CO5: evaluate and verify the influence of temperature and enzyme concentration on salivary amylase activity.

PRACTICALS

1. Observation of Chromosome segregation in mitosis - Onion root tip cells.
2. Observation of Polytene chromosomes in Chironomous larva
3. Meiosis in Grass hopper testis cells– (demonstration)
4. Preparation of smear of squamous epithelium and human blood.
5. Qualitative test for Carbohydrate (Glucose), Protein and Lipid- Any two tests for each.
6. Action of Salivary amylase in relation to enzyme concentration
7. Action of Salivary amylase in relation to temperature
8. **Slides**, **Models and Charts**- DNA, t-RNA, m- RNA, Ribosome, Interphase Nucleus, Mitochondria, Endoplasmic reticulum, Golgi complex, Protein synthesis, Glucose, Fructose, Sucrose, Amino acid.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: III PART III: CORE COURSE PRACTICAL III : CELL BIOLOGY AND BIOCHEMISTRY															
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	1	2	-	-	2	1	1	2	3	3	3	3	3	3	2
CO2	**K-3 Apply**	3	2	2	-	2	1	1	3	3	1	3	2	2	2	1
CO3	**K-4 Analyse**	3	3	2	2	2	1	1	3	2	1	-	1	2	3	1
CO4	**K-5 Evaluate**	3	3	-	3	2	1	1	3	3	1	=	1	2	3	1
CO5	**K-6 Create**	2	3	1	2	3	1	-	3	2	1	-	2	2	3	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

(SKILL BASED CORE COURSE)- Any one

SKB- CORE: 3.2A- HOME AQUARIUM

L	T	P	C
4	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- understand the construction of home aquarium.
- know the setting and maintenance of aquarium.
- acquire knowledge on selection, culture and breeding techniques.
- gain knowledge on reproduction of fishes, diseases control and prevention.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: find the prerequisites for the construction of standard home aquarium.

CO2: demonstrate setting up an aquarium and culture practices.

CO3: choose suitable species to culture and develop protocol for maintenance.

CO4: perceive knowledge on reproductive aspects and disease management.

CO5: propose plan to keep aquarium as a small scale industry

UNIT I

BASICS OF CONSTRUCTION

Construction of Home Aquarium: Materials needed – Wooden and metal frames – Frameless tanks – Sealants and Gums. Design and Construction of Public Freshwater and Marine Aquaria. Aerators and Filters – Hand net and other equipment. Water quality requirements – Temperature control and Lighting.

(13L)

UNIT II

AQUARIUM SETTING

Setting up an aquarium: gravel/ pebbles – Plants – Ornamental objects and fishes – Selection. of species – Introducing fishes to the aquarium. Nutritional requirements of aquarium fishes. Different kinds of feeds, Culture of food organisms. Preparation of dry feeds. Feeding methods

(11L)

UNIT III

CULTURABLE SPECIES

Species of ornamental fishes: Taxonomy and biology of Gold fish, Guppies, Sword tails, Marine fishes – Angels and Butterfly fishes. Fresh water species – live bearers and egg layers, one example each – Common Community fishes – Freshwater and marine, any two examples each.

(12L)

UNIT IV

REPRODUCTION

Reproductive biology of gold fish and angel fish: Maturation, Secondary sexual characters, Breeding habits, Spawning, Parental care, Fertilization and Development of eggs. Common diseases of freshwater and marine aquarium fishes: Parasitic, Fungal, Bacterial- Symptoms – Treatment – Prevention and control.

(13L)

UNIT V

FRESH WATER PLANTS & ORNAMENTAL ANIMALS

Taxonomy and morphology, any three of aquarium plants – provision of nutrient and optimum environmental condition for their growth. Other Ornamental organisms – Anemones, Lobsters, Shrimps, Octopus, Star fish etc.,

(11L)

(TOTAL: 60L)

Books for reference

1. Guide to tropical fish keeping, 1967, Braymer, J.H.P.ILiffe.
2. Tropical Marine aquaria, 1974. Cox, J.F.Hamlyn.
3. Tropical Fish: Setting up and maintaining fresh water and Marine aquaria,1972. Dussa Octopus Book Ltd.
4. Aquarium systems, 1981. Hawkins, A.S. (Ed.) Academicpress.

5. Living Aquarium, 1981. Hunnam, P. Ward Lock.
6. Aquarium Fishes and Plants, 1971, Rataj, K. and R. Zukal –Hamlyn.
7. Ornamental Fish for Garden and Home Aquariums, 1956, R and C.P. Home Aquariums.
8. Sea Water Aquariums, 1979. Spotte, S. JohnWiley.
9. Collins Guide to Aquarium Fishes and Plants, 1969.Schiotz, A.Collins. Complete Aquarium, 1963.Vogt, D. and H. Wermuth Thames.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: III PART III: SKILL BASED CORE COURSE : 3.2A- HOME AQUARIUM																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	1	3	-	-	-	2	-	1	1	-	3	2	-	2	3
CO2	**K-2 Understand**	3	3	2	2	-	2	2	3	3	2	3	2	2	3	3
CO3	**K-3 Apply**	3	3	2	3	-	3	2	3	3	2	3	2	2	3	3
CO4	**K-4 Analyse**	3	3	2	3	-	2	3	3	3	2	3	2	2	3	3
CO5	**K-5 Evaluate**	2	3	2	2	1	2	3	3	3	2	3	1	-	3	3
CO6	**K-6 Create**	2	3	2	2	1	2	3	-	3	-	3	1	-	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-IV (B.Sc. ZOOLOGY) SEMESTER -III /NME
(NON- MAJOR ELECTIVE) - Any one
NME COURSE: 3.3A- BEE KEEPING

L	T	P	C
2	--	--	1

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- know the knowledge of the types and life history of bees.
- understand the supply of food and arrangement of apiary.
- practice the capture of colony and maintenance.
- acquire the knowledge of modern bee keeping.
- insist the hygienic honey extraction and value of honey.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: recall the types of bees and identify the members of the colony.

CO2: acquire the knowledge of food of bees and relation with plants and apiary location and arrangement.

CO3: apply the principles on acquiring the bees and their behaviour and maintenance.

CO4: compare the primitive rearing methods and adopt modern methods in bee keeping and extraction of honey.

CO5: evaluate the properties and economic value of honey and marketing.

CO6: promote bee keeping as effective entrepreneur programme.

UNIT I

TYPES OF BEES

Comparative study of Rock bee, Indian bee, Little bee and Dammer bee – Life history of *Apis indica*. Queen, Drones and Workers – Identification, Salient features and Functions.

(6L)

UNIT II

FOOD OF THE BEES

Honey and pollen. Relationship of plants and bees. Arranging an apiary position – space – direction. Routine management- Seasonal management- Migratory bee keeping.

(6L)

UNIT III

ACQUIRING BEES

Care of newly captured colonies. Different kinds of cells- architecture of honey comb- Swarming - Supersedure. Diseases and enemies of bees and colony – Protection of the colony.

(6L)

UNIT IV

TYPES OF HIVES

Primitive hives – Different types. Advantages and disadvantages of primitive hives. Modern hives- Newton‟s bee hive and its architecture. Appliances used in Apiaries.

(6L)

UNIT V

HARVESTING AND MARKETING BEE PRODUCTS

Collection and Extraction of honey, preservation, storage, physical properties, chemical composition, nutritive value, medicinal values- Honey as Daily Food. Bee wax & Venom and Royal Jelly.

(6L) (TOTAL: 30L)

Books for reference

1. Bee Keeping in India – Sardar Singh- K.A.R, Delhi.
2. Bee keeping in South India – Cherian M.C. & Ramachandran, Govt.Press,Chennai.
3. Handbook of bee keeping – Sharma P.L. & Singh S.,Chandigarh.
4. Apiculture – Johnson J. & Jeyachandra, Marthandam, Tamil Nadu.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: III NON - MAJOR ELECTIVE COURSE : PART IV- COURSE: 3.3A- BEE KEEPING																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	3	3	2	1	2	2	2	3	2	-	2	2	3	2	2
CO2	**K-2 Understand**	2	3	3	1	2	2	3	3	3	-	2	3	3	3	3
CO3	**K-3 Apply**	2	3	3	2	2	1	3	3	3	2	2	3	3	3	3
CO4	**K-4 Analyse**	3	3	3	1	3	1	2	3	3	2	2	3	3	3	3
CO5	**K-5 Evaluate**	3	3	2	2	3	2	2	3	3	-	2	3	3	3	3
CO6	**K-6 Create**	2	3	2	2	3	1	3	2	3	-	3	3	2	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -IV /Core

CORE COURSE: 4. 1 - GENETICS

L	T	P	C
4	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- learn the basic principles of inheritance at the molecular, cellular and organismal levels.
- understand causal relationships between molecule/cell level phenomena -"modern" genetics and organism-level patterns of heredity -"classical" genetics.
- learn the mechanism of Mutation and will able to understand how mutations bring changes in an organism.
- understand the human genetics and modern approaches in gene concept.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: analyse the basic principles of Mendelian inheritance and Genic interaction.

CO2: construct Chromosome map using crossing over.

CO3: explain the concept and factors involved in gene mutation.

CO4: assess the impact of chromosomal abnormalities in human.

CO5: relate Eugenics & Euthenics and Inbreeding & Outbreeding.

CO6: apply Hardy-Weinberg law in a population and find out the percentage of heterozygotes.

CO7: combine the knowledge about gene transfer techniques helps to develop new techniques in biotechnology

UNIT I

MENDELIAN GENETICS

Mendelian Laws of Inheritance: Monohybrid experiment – Dihybrid experiment- Back Cross and Test Cross. **Genic Interaction:** Non-Allelic gene interaction (Complete dominance - Incomplete dominance – Co-dominance), Allelic gene interaction (Complementary genes - Supplementary genes - Lethal genes) and **Epistasis**. **Multiple Alleles:** ABO Blood Group – Rh Blood group**. Multiple Genes:** Skin colour of Man..

(12L)

UNIT II

CHROMOSOMES

Linkage - Crossing over - Mechanism and theories. Chromosomal maps & its construction. Chromosomal Aberrations, Gene Mutations– Physical & Chemical mutagens – DNA repair.

(12L)

UNIT III

INHERITANCE

Sex determination in Drosophila and Man. **Sex Linked Inheritance:** X- linked (Haemophilia and Colour Blindness) & Y- linked (Hypertrichosis) inheritance – Genic Balance theory - Barr bodies. **Chromosomal variation & Non-disjunction:** Euploidy, Aneuploidy, Monosomy, Trisomy - Klinefelter‟s, Turner‟s & Down‟s syndromes – Cytoplasmic inheritance. (12L)

UNIT IV

HUMAN GENETICS

Inborn errors of Metabolism: Phenylketonuria, Alkaptonuria, Albinism, Sickle cell anaemia. Pedigree Analysis - Eugenics – Euthenics - Genetic Counselling - Inbreeding and Out breeding - Hardy-Weinberg Law and its Applications.

(12L)

UNIT V

MODERN GENETICS

Concept of Gene: Cistron – split gene – promoter – repetitive DNA – Transposons. **Bacterial Genome:** Transformation – Conjugation – F- factor – Sex duction – Transduction – Generalised & Specialised - Plasmids. **Operon Concept** (Lac & Tryp operon- brief outline only).

(12L)

(TOTAL: 60L)

Books for reference

1.Gardner EJ Principles of genetics. London, UK, John Wiley & Sons, Inc.

.2.Meyyan RP Fundamendals of Genetics, Saras Publication Nagercoil.

3.Primrose SB, Twyman R. Principles of gene manipulation and genomics. John Wiley & Sons; 2013 May 28.

4.Strickberger MW, Genetics, Pearson publishers.

5.Verma P.S & Agarwa,l V.K Genetics, S. Chand Publishers, New Delhi

6. Farnsworth : Genetics (Harper and Row).

7. P.K.Gupta: Genetics (Rastogi Publications)
8. Altonburg, E: Genetics (Oxford & IBH publishing company)
9. Burns G.W.: The Science of Genetics (Mac Millan)
10. A.C.Pai: Foundations of Genetics (Mc Gaw –Hill)
11. J.A.Serra: Modern Genetics (3 Volumes)
12. Sinnot, Dunn and Dobzhansky: Principles of Genetics (McGraw Hill)

COs at Cognitive level and mapping with POs and PSOs

SEMESTER IV **PART III- CORE COURSE: 4. 1 - GENETICS**																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-4 Analyse**	3	3	1	3	2	1	1	3	3	1	1	3	3	1	0
CO2	**K-3 Apply**	3	3	1	3	1	2	1	3	3	1	1	3	3	1	1

CO3	**K-2 Understand**	3	3	3	3	3	1	2	3	3	1	1	1	3	1	0
CO4	**K-5 Evaluate**	3	3	3	3	1	2	1	3	2	1	1	1	3	2	2
CO5	**K-1 Remember**	3	3	3	1	3	0	0	3	3	1	1	2	3	1	0
CO6	**K-3 Apply**	3	3	3	1	1	0	0	3	3	1	1	3	3	1	2
CO7	**K-6 Create**	3	3	1	3	1	3	1	3	3	1	1	3	3	2	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -IV /Core Practical

CORE PRACTICAL IV: GENETICS

L	T	P	C
--	--	2	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- prove the monohybrid and dihybrid ratio of Mendelian laws with colour beads.
- elucidate the blood group inheritance among students.
- test the inheritance of simple mendelian traits in student population.
- study the polygenic inheritance with height and weight of the students.
- observe the models and charts to know their genetic importance.

COURSE OUTCOMES (Cos):

On successful completion of the practical course the student will be able to

CO1: explain the segregation and assortment of chromosomes during inheritance of the characters with colour beads and prove chi-square test.

CO2: describe and prove the inheritance of simple mendelian traits.

CO3: develop the skill to interpret the polygenic inheritance with quantitative traits.

CO4: analyse the pattern of inheritance of ABO and Rh grouping in students.

CO5: design an experiment to explain the genetic concepts.

PRACTICALS

1. Breeding Experiment: Chi Square test to be illustrated with beads/ coin tossing a) Monohybrid Cross b) Dihybrid Cross.
2. Observation of Simple Mendelian traits in man – to be recorded.
3. Observation and study of Polygenic inheritance of quantitative traits to be interpreted in graphs:-a) height of students/ b) weight of students / c) length of shells / d) length of pods.
4. Blood group to be analyzed in a population with a minimum of 30 students.
5. Spot Tests: Models of genetic significance to be studied *E.coli*, T_4 Phage- Down‟s syndrome, Klinefelter‟s syndrome, Turner‟s syndrome, Sex -linked inheritance : Colour Blindness, Haemophilia, Hypertrichosis.
6. Culture of Drosophila and observation of its life cycle and mutants

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: IV PART III: CORE COURSE PRACTICAL IV : GENETICS																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	2	2	3	2	1	1	2	3	3	3	3	3	3	1
CO2	**K-3 Apply**	3	2	2	3	2	1	1	3	3	1	3	2	2	2	1
CO3	**K-4 Analyse**	3	3	2	2	2	1	1	3	2	1	-	1	-	3	1
CO4	**K-5 Evaluate**	3	3	1	3	2	1	1	3	3	1	=	1	2	3	1
CO5	**K-6 Create**	2	3	1	2	3	1	1	3	2	1	-	2	2	3	3

Strongly Correlated (3);Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -IV /SKB -Core

(SKILL BASED CORE COURSE) -Any one

SKB- CORE COURSE: 4.2B-VERMITECHNOLOGY

L	**T**	**P**	**C**
4	**--**	**--**	**4**

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- gain knowledge of agro based small scale industries using vermicompost preparation.
- understand the environmental conservation process and its importance, pollution control, biodiversity and protection of earthworms through vermiculture.
- assure that Vermitechnology is used to control environmental pollution and global warming.
- contribute their knowledge to develop organic fertilizer with rural and urban biodegradable wastes using the Earthworms.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: find out Vermicomposting is an eco-friendly, economically and socially acceptable technology.

CO2: illustrate that Vermitechnology is useful for stabilization and recycling of both industrial and domestic organic waste.

CO3: utilize Vermitechnology to improve the soil texture, soil aeration, improve the water retention capacity in the soil.

CO4: apply Vermitechnology to conver rural and urban garbage into nutrient rich ecofriendly organic manure.

CO5: apply the ethical principles and commit to pledge responsibilities to protect and save environment.

CO6: improve Vemitechnology to manufacture the vermicompost in small scale industry by which the economy of the farmer is improved. It provides the employment opportunity in rural and urban areas.

CO7: justify and prove that the Earthworms are having the capacity to observe heavy metals into their body tissues and converting the soil without heavy metals.

UNIT I

TAXONOMY OF EARTHWORM

Morphological and anatomical – Classification of earthworms – Food habits – Digestive system – Excretion – Reproduction and Life cycle – Earthworm as farmer‟s friend.

(11L)
UNIT II
TYPES OF EARTHWORM

Exotic and native species – South Indian and North Indian species used in Vermicomposting – Collection and Preservation of earthworms for vermicomposting – Culture techniques of earthworms.

(11L)
UNIT III
VERMICOMPOST PRODUCTION

Requirements – Different methods of Vermicomposting – Heap method – Pot method and Tray method – changes during Vemicomposting.

(11L)
UNIT IV
ROLE OF EARTHWORMS IN SOIL FERTILITY

Use of Vermicompost for crop production – Use of earthworms in land improvement and land reclamation – Economics of Vermicompost and Vermiwash production. Earthworms as animal feed – Medicinal value of earthworm meal – Roles of Earthworms in Solid Waste, Sewage and faecal waste management and Vermifilters. Earthworms as bioreactor.

(15L)
UNIT V
INTERACTIONS OF EARTHWORMS WITH OTHER ORGANISMS

Influence of chemical inputs on earthworm activities – Large scale manufacture of Vermicompost, packaging of vermicompost and its marketing – Financial supporting – Government and NGOs for vermiculture work.

(12L)
(TOTAL 60)

Books for Reference

1. Invertebrate Zoology – Ekambaranatha Ayyar.
2. Earthworm in Agriculture – S.C. Talashikar and Dosani, Agrobios Publications, Near Nasarani Cinema, Jodhpur, 342 002.
3. Vermicompost for sustainable Agriculture – P.K. Gupta Agrobios 2nd Edition.

4. Organic Farming for sustainable Agriculture – A.K.Dahama,Agrobios. 5.A Hand book of Organic farming – A.K.Sharma.Agrobios publication.
6. Earthworm ecology – Clive A. Edwards St. Lucie press – CRC Press Washington DC.
7. Biology of Earthworm - Edward and Lofti – Chapman and Hall Publication.
8. Vermicology – Sultan A. Ismail – Orient Longman Press.
9. Vermiculture Biotechnology – U.S. Bhawalkar BERI, PUNE

COs at Cognitive level and mapping with POs and PSOs

SEMESTER IV PART III: SKILL BASED CORE COURSE - 4.2B: VERMITECHNOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**POS**							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	**K1 Remember**	3	3	3	3	2	3	1	3	3	3	3	3	3	2	1
CO2	**K2 Understand**	3	3	3	2	2	3	3	3	3	3	3	2	3	3	3
CO3	**K3 Apply**	3	2	3	3	3	2	2	3	3	3	2	3	2	3	2
CO4	**K3 Apply**	3	3	3	2	3	2	3	2	3	3	1	3	3	3	1
CO5	**K3 Apply**	3	2	3	3	3	3	2	3	2	2	3	3	3	2	1
CO6	**K4 Analyse**	2	3	3	2	3	3	1	3	3	3	2	2	3	1	1
CO7	**K5 Evaluate**	3	3	2	3	1	3	2	2	3	2	3	3	2	3	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-IV (B.Sc. ZOOLOGY) SEMESTER -IV /NME

(NON -MAJOR ELECTIVE COURSE) –Any one

NME COURSE : 4.3A - PUBLIC HEALTH AND HYGIENE

L	T	P	C
2	--	--	1

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- understand the physical, mental and social health.
- know the safer disposal of various wastes.
- create awareness about first aid and accede.nts
- improve the awareness about healthy and hygienic practices.
- instruct the health standard and status and schemes.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: relate the concepts, definition and principles of health and hygiene in our daily life.

CO2: illustrates the hygienic uses of water and make use of standard housing recommendations.

CO3: identify the safety disposal of excreta and practise it.

CO4: classify the diseases as communicable and parasitic diseases.

CO5: assesses the safety procedures for health and hygiene.

CO6: propose solution for the health related problems/issues in the light of eradication schemes of government and the involvement of NGOs.

UNIT I

DEFINITION AND BASICS

Physical, Mental, Social and Positive health – Quality of life Index. Nutrition and Health – Food hygiene – Food toxicants. Population explosion in India – Birth control measures. **(6L)**

UNIT II

ENVIRONMENT AND HEALTH

Water – Sources of water – Uses of water. Water borne diseases – Cholera – Ascariasis. Standards of Housing – Ventilation. **(6L)**

UNIT III

EXCRETA DISPOSAL & **FIRST AID**

Importance – Methods of excreta disposal. Sanitary health measures during fares and festivals. First aid with reference to accident. **(6L)**

UNIT IV

COMMUNICABLE DISEASE

Viral diseases: AIDS, Rabies. Bacterial diseases: Tuberculosis, Typhoid. Protozoan diseases: Amoebiasis. Helminth diseases: Filariasis.

(6L)

UNIT V

HEALTH SITUATION IN INDIA

Health problems – Primary health care in India – PHC – National Programmes – National AIDS control – National Malaria Eradication Programme – National Tuberculosis Control Programme.

(6L)

(TOTAL 30L)

Books for Reference

1. Anderson R.Cliford. Your Guide to Health.
2. Basu, S.C. Preventive and Social Medicine.
3. Goel, S.O.L. Public Health Administration.
4. Harold Shoryock and Hubert O. Swartout. You and Your Health illustratedDealing with Diseases.
5. Park, K. & Park. S. Text Book of Preventive and Social Medicine.BanarsidasBhanot Publishers,1167 PremNager, Jabalpur – 482001.
6. Ramarao, V.First Aid in accidents. Sri Krishna brothers, Thambu Chetty Street, Chennai.
7. Sanitarians Hand Book. Theory and Administrative Practice. Pearles Publications, New

COs at Cognitive level and Orleans, USA.**mapping with POs and PSOs**

SEMESTER: IV

PART IV: NON- MAJOR ELECTIVE COURSE

NME COURSE: 4.3A - PUBLIC HEALTH AND HYGIENE

CO	COGNITIVE LEVEL	PO							PSO							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-1 Remember	2	3	2	2	2	3	1	3	3	3	2	-	3	2	2
CO2	K-2 Understand	3	3	2	-	3	3	2	3	3	2	3	-	3	3	2
CO3	K-3 Apply	2	3	2	2	3	3	2	3	3	3	3	2	3	2	3
CO4	K-4 Analyse	2	2	2	2	3	3	3	3	3	3	3	2	2	2	3
CO5	K-5 Evaluate	2	2	2	3	3	2	2	3	2	2	3	2	-	3	3
CO6	K-6 Create	-	2	1	3	2	3	3	2	2	3	1	2	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -V /Core

CORE COURSE: 5.1 - DEVELOPMENTAL ZOOLOGY

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- develop critical understanding to realise how a single celled fertilized egg becomes an embryo and become adult.
- understand the three important processes of cell division, cell differentiation and morphogenesis.
- get awareness about the relevance of developmental biology in medicine and its role in development of diseases.
- acquire knowledge on the life cycle and metamorphic stages in animals.
- determine the factors affecting embryogenesis and methods and gain knowledge on treatment and prevention of diseases.

COURSE OUTCOMES (COs)

On successful completion of course the student will be able to

CO1: find the processes right from fertilization of a single cell egg to the formation of a well structured and functional multicellular organism.

CO2: understand and gain knowledge about the developmental stages like fertilization, cleavage and gastrulation.

CO3: compare the human embryo development to other animals and the regeneration, metamorphosis, transplantation and differentiations of stem cells in the organisms.

CO4: identify the integrative aspects of building of organisms and examine the developmental abnormalities and other conditions such as cancer.

CO5: analyse the developmental biology as a key subject in Zoology and justify it as a

motor for research, in the human diseases and fertility.

CO6: assume and conclude that the embryonic development provides a thorough knowledge to study other subjects like genetics, evolution, physiology, cell and molecular biology etc.,

CO7: determine the mechanism and principles to develop an embryo.

UNIT I

GAMETES & FERTILIZATION

Basic concepts of Developmental Zoology- Structure & types of Spermatozoa and egg-Spermatogenesis –Oogenesis. Fertilization: mechanism and significance –Parthenogenesis. **(15L)**

UNIT II

BLASTULATION & GASTRULATION

Cleavage : Patterns – Blastulation- Morphogenetic movements -Gastrulation , Fate map in frog **(15L)**

UNIT III

ORGANOGENESIS

Development of Brain and Heart in Frog. Development of Pronephric, Mesonephric & Metanephric kidneys.

Foetal membranes in Chick and Placentation in Mammals. **(15L)**

UNIT IV

APPLIED EMBRYOLOGY

Organizer concept – Mechanism of induction and competence. Nuclear transplantation in Acetabularia-Teratogenesis –Regeneration: types and mechanism. Embryonic stem cells and its significance.

(15L)

UNIT V

EMBRYOLOGICAL TECHNIQUES

Infertility: causes and treatments- Assisted Reproductive Technology: Artificial Insemination-IVF and test tube baby - Embryo transfer. Twins - Erythroblastosis foetalis – Amniocentesis. Birth control.

(15L)

(TOTAL 75L)

Books for reference

1.Arumugam NA Text Book of Embryology, Biotechnology. Saras Publication Nagercoil.

2.Balnisky BI An Introduction to Embryology, W.B. Saunders and Co.

3.Berril NJ, Kars G (1986). Developmental Biology, McGrawHills

4.Gilbert SF (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

5.Majumdar NN. Vertebrate embryology; Tata McGraw-Hill, New Delhi.

6.Verma PS & Agarwal VK Chordate Embryology, S. Chand Publishers, New Delhi

7. Arora, M.P. Embryology. Himalayan Publishing House, Ramdoot, Dr. Bhalero Marg (Kelewadi) Girgaon, Mumbai – 400004.

8.Diwan,A.P.Avian Embryology, Anmol Publications Private Limited,4374/4B Ansari Road , Daryaganj, New Delhi-110 002.

9. Gilbert, Developmental Biology ,ANE Books India, Avantika Niwas, 19,Doraiswamy Road,T.Nagar,Chennai-600 017.

10, Goel,S.CP.Principles of Animal Developmental Biology,Himalaya Publishing House, NRamdoot,Dr.Bhalerao Marg (Kelewadi)Girgaon,Mumbai – 400 004.

11. Jain,P.C. Elements of Developmental Biology (Chordate Embryology).vishal Publishing Company,BooksMarket,Old Railway Road,Jalandhar – 144 008.

12. Jangir, O.P.Developmental Biology – A Manual.Agrobios (India),Behind NasraniCinema,ChopasaniRoad,Jodhpur – 342 002.

13. Nelson, E.Comparative Embryology of Vertebrates.Tata McGraw Hill Publishing Company Limited,No. 444/1 Sri EkambaraNaicker Industrial Estate, Alapakkam,Porur, Chennai – 600 116.

14. Ramesh Mathurand Meenakshi Metha. Embryology.Anmol Publications Private Limited,4374/4B,ansari road,Daryaganj,New Delhi – 110 002.

15. Rao, K.V. Developmental Biology. A Modern Synthesis. Oxford & IBH Publishing company Private Limited, S-155 Panchshila Park, New Delhi 110017.

16. Sastry.K.V. and VineetaShukal, Developmental Biology Rastogi Publications Gangotri, Shivaji Road, Meerut-250 002.

17. Slack, Essential Developmental biology. ANE Books India. Avantika Niwas, Doraiswamy Road,T.Nager,Chennai-600 017.

18. Subramoniam, T. Developmental Biology. Narosa Publishing House Private Limited,

COs at Cognitive level and mapping with POs and PSOs

SEMESTER V PART III: CORE COURSE 5.1 – DEVELOPMENTAL ZOOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	**K-1 Remember**	3	3	3	3	2	1	1	3	3	3	3	3	3	2	1
CO2	**K-2 Understand**	3	3	3	2	2	3	3	3	3	3	3	2	3	3	3
CO3	**K-2 Understand**	3	2	3	3	3	2	2	3	3	3	2	3	2	3	2
CO4	**K-3 Apply**	3	3	3	2	3	2	1	2	3	3	1	3	3	3	1
CO5	**K-4 Analyse**	3	2	3	3	3	3	2	3	2	3	3	3	3	2	3
CO6	**K-4 Analyse**	2	3	3	2	3	3	1	3	3	3	2	2	3	1	3
CO7	**K-5 Evaluate**	3	3	2	3	2	3	2	2	3	2	3	3	2	3	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -V /Core

CORE COURSE : 5.2 MICROBIOLOGY AND IMMUNOLOGY

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- impart knowledge on the taxonomy, organization and infection of microbes and to develop expertise in microbial techniques.
- give awareness on the basic principles of food, industrial and environmental microbiology.
- familiarize the fundamentals of immunology, importance of immune system, lymphoid organs and key principles of immune system.
- give an insight on immune response, antigens, antibodies, immunoglobulins and how they are related to health and diseases.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO 1: understand the structure, classification and culture techniques of microbes.

CO 2: analyse and distinguish food poisoning, food spoilage and preservation methods.

CO 3: develop entrepreneurial skills with the knowledge on the role of microbes in fermentation, microbial products and the role of pathogens in human infectious diseases.

CO 4: understand the concepts of immune system, cellular and molecular basis of immune responses, autoimmunity and immunoglobulins.

CO 5: describe the different types of lymphoid organs, antigen- antibody reactions, cells of immune system and their functions.

CO 6: infuse their knowledge on histocompatibility, and immunodeficiency

to describe transplantation, vaccine and immunization techniques.

UNIT I

INTRODUCTION TO MICROBIOLOGY

Scope of Microbiology- Characters and Five kingdom classification .

Ultrastructure of bacteriophage (T4 phage), *E. coli* and fungi (Yeast).

(15L)

UNIT II

BACTERIAL CULTURE

Sterilization-Types of Culture medium –Culture of Bacteria –Bacterial growth and growth curve –factors influencing bacterial growth and maintenance. Staining of bacteria, Bio-fermenters and its role in mass culture.

(15L)

UNIT III

APPLIED MICROBIOLOGY

Role of Microbes: Preservation of Milk –Microbes in Food Spoilage. Culture of Yeast and its economic importance - Microbial Nitrogen fixation .Fermentation : Ethanol and Penicillin production. Probiotics- SCP.

Microbial diseases in man: Bacterial - Cholera & Typhoid; Viral- Rabies & HIV; Fungal - Candidiasis & Dandruff.

(15L)

UNIT IV

BASIC IMMUNOLOGY

Scope: Immunity-classification and types; Lymphoid organs- types; Cells of immune system Types of immune responses. Immunoglobulin: types and Structure of IgG. Epitopes, Paratopes, Haptens & Adjuvants. Antigen- Antibody reactions ; T- Cell and B- Cell activation; Basic properties and functions of Cytokines, Interferons and complement proteins

(15L)

UNIT V

APPLIED IMMUNOLOGY

Basic concepts of major histocompatibility complex (MHC) - Types of hypersensitivity.

Concepts of autoimmunity and immunodeficiency ;Transplantation; Monoclonal antibodies-

Vaccines & Immunization.

(15L)

(TOTAL 75L)

Books for reference

1. Dubey RC & Maheshwari DK, A Textbook of Microbiology, S. Chand Publishers, New Delhi.
2. Mani A, Selvaraj A.M, Narayanan L.M, Arumugam A, Microbiology, Saras Publication, Nagercoil.
3. Pelczar MJ, Chan EC, Pelczar MF. Elements of microbiology. McGraw-Hill International Book Company.
4. Ryan KJ, Ray CG, editors. Sherris medical microbiology. McGraw-Hill Education.
5. Willey JM, Sherwood L, Woolverton CJ. Prescott's microbiology. Singapore: McGraw-Hill.
6. Abul AbbasAndrew H. Lichtman Basic Immunology, Saunders.
7. Delves PJ, Martin SJ, Burton DR, Roitt IM. Essential immunology. John Wiley & Sons.8.Ramesh SR, Immunology, Mcgraw Higher Ed.
8. Kuby, Immunology (W.H.Freeman)

9. C.B.Powar General Microbiology

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: V **PART III: CORE COURSE: 5.2 MICROBIOLOGY AND IMMUNOLOGY**																
CO	**CONGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	3	3	3	2	3	2	3	3	2	3	1	2	3	3
CO2	**K-4 Analyse** **K-3 Apply**	3	3	3	3	3	2	2	3	2	2	3	1	2	3	3
CO3	**K-3 Apply** **K-6 Create**	3	3	3	3	2	3	3	3	3	2	3	1	2	3	3
CO4	**K-2 Understand** **K-1 Remember**	3	3	3	3	2	2	2	3	3	2	3	1	2	3	2
CO5	**k-3 Apply** **K-5 Evaluate**	3	3	2	3	2	2	1	3	3	2	2	1	3	3	3
CO6	**K-2 Understand** **K-3 Apply**	3	3	2	3	3	2	2	3	3	2	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

CORE PRACTICAL: V
DEVELOPMENTAL ZOOLOGY & MICROBIOLOGY AND IMMUNOLOGY

L	T	P	C
--	--	3	2

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- know the systematic handling procedures and protocols.
- give importance to the microscopic examination of gametes and microbes.
- gain knowledge on the basic concepts and principles of techniques.
- familiarize the blood group identification and immunization.

COURSE OUT COMES (COs)

On successful completion of the practical course the student will be able to

CO1: recollect the fundamental procedure of Developmental Zoology, Microbiology & Immunology**.**

CO2: understand the principles and adopt the techniques for their future courses.

CO3: describe the structure and classification of microbes and immunoglobulisns.

CO4: apply the theoretical knowledge of food preservation, fermentation and immunization schedule.

CO5: evaluate the present situation to check any outbreak of contagious diseases.

CO6: conclude the prevalence of diseases in adverse condition and able to formulate solution to manipulate/ manage the dangerous situation.

DEVELOPMENTAL ZOOLOGY PRACTICALS

1. Mounting and Observation of live sperms of a vertebrate
2. Mounting and Observation of egg of a vertebrate
3. Temporary mounting and Observation of chick embryo development: 24, 48, 72 & 96 hours.

Museum Specimens, **Slides**, **Models and Charts**

4. Sperm of a vertebrate
5. Hen‟s egg/ Frog‟s egg
6. Blastula and Gastrula of frog
7. Chick embryo development stages – 24, 48, 72 & 96 hours
8. IUCD: Condom, Mala – D, Copper T / (any three)
9. Placenta in mammals: Discoidal, Cotyledonary, Zonary and Diffuse placenta.

MICROBIOLOGY PRACTICALS

1. Preparation of culture media for microbes and serial dilution technique.
2. Distribution of microorganisms in nature- soil, water & air.
3. Aseptic transfer of microbes & pure culture of bacteria and cultural characteristics of Micro-organisms.
4. Simple staining of bacteria
5. Gram‟s staining of bacteria
6. Serial dilution technique.
7. Microscopic examination of living bacteria - Hanging drop method.
8. Microscopic counting of microbes using Haemocytometer (Demonstration only)
9. Measurement of microbes using Ocular & Stage micrometers (Demonstration only)

Charts, **Slides**, **Equipments and Photos**

Autoclave, Hot air oven, Agar plate, Agar stab, Agar slant, Inoculation needle.

IMMUNOLOGY PRACTICALS

1. Identification of ABO blood grouping and Rh blood grouping among the students.
2. Lymphoid organs in Rat (Demonstration only)

Charts, Models, Slides and Photos: T- Cell, B- Cell, Stem cells, Phagocytes - Thymus,

Bone marrow, Spleen, Lymph node (T.S/ entire organ), Immunoglobulins - Ig G & Ig M.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: V **PART III: CORE PRACTICAL :V- DEVELOPMENTAL ZOOLOGY & MICROBIOLOGYAND IMMUNOLOGY**																
CO	**CONGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	3	3	2	2	2	1	2	3	3	2	2	1	2	3	2
CO2	**K-2 Understand**	3	3	3	3	3	2	2	3	2	2	2	1	2	3	3
CO3	**K-3 Apply**	3	3	3	3	2	2	3	3	3	2	3	1	2	3	3
CO4	**K-4 Analyse**	3	3	3	3	2	2	2	3	3	3	3	1	2	3	2
CO5	**K-5 Evaluate**	3	3	2	3	2	2	1	3	3	2	2	1	3	3	3
CO6	**K-6 Create**	3	3	2	3	3	2	2	3	3	2	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -V /Core
CORE COURSE: 5.3 – ANIMAL PHYSIOLOGY

Credits: 4

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- find the basic understanding of the fundamental process and mechanism of the higher animals,
- understand the modifications and disorders o humans.
- develop knowledge about the functions of organs and tissues in different animals.
- elucidate the biological functions and how they adapt under various environmental conditions.
- analyse the animals‟ behaviour and their physiological response to their environment

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: list out the physiological concepts in nutrition, digestion, metabolism, respiration etc.,

CO2: compare the various physiological processes in the animals.

CO3: identify the working mechanisms of effectors, homoeostasis and understand how the animals adapt in the environments.

CO4: analyse the fundamental interactions between physiology and endocrinology.

CO5: justify the correlation of structure, coordination of functions and working system in the organs in the human body.

CO6: determine and understand the various physiological disorders due to the imbalance of hormones, chemicals and metabolism.

CO7: develop thorough knowledge about the structure and function of the organisms and execute the ideas in research projects.

UNIT I

NUTRITION & RESPIRATION

Nutrition: Gastrointestinal tract of man. Digestion - role of enzymes and absorption of carbohydrates, proteins and lipids. Minerals & Vitamins – their deficiency.

Respiration: Structure of lungs in man. Respiratory pigments: structure of haemoglobin, Transportation and exchange oxygen and carbon dioxide – Bohr‟s effect - bronchitis, asthma - Physiological effects of smoking.

(15L)

UNIT II

CIRCULATION & EXCRETION

Blood- composition and functions, Mechanism of clotting. Structure of heart – Heart beat & Pace maker – Cardiac cycle – ECG – Pulse rate and Blood Pressure- Heart diseases.

Kinds of excretory products & Patterns of excretion in animals- Structure of kidney - Nephron - mechanism of urine formation - composition of urine – Nephritis- Dialysis.

(15L)

UNIT III

MUSCLE & NERVE PHYSIOLOGY

Types of muscles, Ultrastructure of striated muscle - Muscle contraction & properties. Simple muscle twitch- Tetanus – Muscle fatigue.

Neurons – structure & types - Impulse propagation, synaptic transmission, neurotransmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer‟s disease, Parkinson‟s disease.

(15L)

UNIT IV

SENSE ORGANS

Eye: structure, physiology of vision, visual elements and pigments. Eye defects- myopia, hyperopia, presbyopia, astigmatism, cataract, glaucoma.

Ear: Structure and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease.

Olfactory, gustatory and tactile and mechanical sense organs.

(15L)

UNIT V

ENDOCRINE GLANDS & REPRODUCTIVE PHYSIOLOGY

Endocrine glands and Hormones: Structure, their action and disorders- Pituitary, Thyroid, Parathyroid, Adrenal, Islets of Langerhans, Testis & Ovary.

Reproductive Physiology : Testis and Ovary- Graafian follicles- menstrual cycle- puberty, adolescence, pregnancy, parturition, lactation, menopause. Oestrous cycle in cattle.

(15L)

(TOTAL 75L)

Books for reference

1. Arumugam N&.Mariakuttikan A Animal Physiology Saras Publications, Nagercoil.

2. Bhagavan NV, Medical biochemistry, fourth edition
Academic Press

3. Guyton AC, Hall JE, Text Book of Medical Physiology, Elsevier4.Jain AK Textbook of Physiology. Avichal Publishing Company.

5. Lehninger AL, Michael Cox, Nelson DL, Biochemistry. Macmillan.

6. Tyagi BS, Agarwal VK & Verma PS Animal Physiology S. Chand Publishers,New Delhi.

7. Hoar, W.S.(1975). Text Book Of Medical Physiology, W.B. Saunders Co.

8. Juneja, Kavita, Animal physiology. Anmol Publications Pvt. Ltd, 4374/4B AnsariRoad, Daryaganj. New Delhi

9. Nagabhushanam, R.M.S. Kodarkar and R. Sarogini. Text Book of Animal Physiology 2nd Edition. Oxford & IBH Publishing Company Private Limited, S – 155, Panchshila Park, New Delhi.

10. Nigam, H.C. Animal Physiology. Vishal Publishing Company, Books Market Old Railway Road,Jalandhaar.

11.Prosser, L. and A. Brown Comparative Animal Physiology. Saunders &Co.Philadelphia.

12.Prosser,C.L.(1978). Comparative Animal Physiology. W.B. Saundersco.

13.William, S. Hoar, General and Comparative Physiology. Prentice – Hall of India,M-97 Connaught Circus, NewDelhi.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER V PART III : CORE COURSE: 5.3 - ANIMAL PHYSIOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	**K1- Remember**	3	3	3	3	2	1	1	3	3	3	3	3	3	2	1
CO2	**K2- Understand**	3	3	3	2	2	3	3	3	3	3	3	2	3	3	3
CO3	**K3- Apply**	3	3	3	3	3	2	2	3	3	3	2	3	2	3	2
CO4	**K4- Analyse**	3	3	3	2	3	2	1	2	3	3	1	3	3	3	1
CO5	**K5- Evaluate**	3	2	3	3	3	3	2	3	2	3	3	3	3	2	3
CO6	**K5- Evaluate**	3	3	3	3	3	3	2	3	3	3	2	2	3	1	3
CO7	**K6- Creativity**	3	3	2	3	2	3	2	2	3	2	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -V /Core Practical

CORE PRACTICAL : VI- ANIMAL PHYSIOLOGY

L	T	P	C
3	--	--	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- know the principle of the rate of oxygen consumption of a fish.
- understand the physiological function by experiments.

- attain a level of understanding to handle practicals.
- gain knowledge on basic physiological functions.

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: find and calculate the rate of oxygen consumption of a fish by Winkler‟s method.

CO2: analyse the effect of temperature on physiological activity.

CO3: verify the basic principles and appl it to solve the problem.

CO4: compare the results and confirm the qualitative tests.

CO5: design an experiment to prove the physiological principles and concepts.

PRACTICALS

1. Rate of Oxygen consumption in a fish.
2. Effect of temperature on the Opercular movement of a fish – Calculation of Q_{10}.
3. Action of Salivary amylase in relation to enzyme concentration.
4. Qualitative test for carbohydrate (glucose), protein and lipid.
5. Demonstration of blood pressure using Sphygmomanometer.
6. Estimation of Haemoglobin – demonstration only.
7. Counting of different kinds of blood cells using Haemocytometer – demonstration only.
8. Qualitative test for Ammonia, Urea and Uric acid.

Slides, Models and Charts – Glucose, Fructose, Glycogen, Amino acid, Cholesterol, Intestinal villi, Haemoglobin, Myoglobin, ECG, Sphygmomanometer, Haemometer, Haemocytometer, Kymograph, Cardiac muscle, Striated muscle and Non – Striated muscle, Simple muscle twitch. Testis, Ovary- T.S

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: V PART III: CORE COURSE PRACTICAL: VI – ANIMAL PHYSIOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand K-3 Analyse**	2	2	1	2	2	3	2	3	3	3	2	3	3	1	3
CO2	**K-3 Analyse K-5 Evaluate**	2	3	2	3	2	2	3	3	2	3	2	2	2	1	2
CO3	**K-4 Apply**	2	3	2	3	2	3	3	2	3	3	2	2	2	3	3
CO4	**K-5 Evaluate**	3	3	1	3	2	3	3	2	3	3	3	2	2	3	3
CO5	**K-6 Create**	2	3	3	3	2	2	2	3	3	2	3	2	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -V /Core

CORE COURSE: 5.4 - ECOLOGY

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- know the fundamental concepts and facts about the environment and the interaction of its various components.
- study the recycling of nutrients in lieu with biogeochemical cycles
- understand about various types of ecosystems.
- make an awareness about various effects of pollution and its management
- elucidate the importance of biodiversity and need for its conservation.

COURSE OUTCOMES (COs)

On the successful completion of the course the student will be able to

CO1: recall the principles, applications and concepts of ecology and ecosystem, how biotic and abiotic factors that are related to ecosystem.

CO2: understand how the animals interact with each other and their natural environment.

CO3: analyse and compare the differences in the structure and function of different types of ecosystem.

CO4: emphasize the role of key factors responsible for changes in natural ecosystem such as pollution and urbanization and capable of pollution and other effects.

CO5: interpret the diversity of species in relation to natural process and sustenance of life.

CO6: apply the acquired knowledge in ecology to solve and manage the current environmental issues and problems.

UNIT I

ECOLOGICAL CONCEPTS

Ecosystem: concept, structure & function. Abiotic factors and its ecological role: Soil, Light, Temperature, Water- Limiting factors.

Food chain & Food web, Pyramids - Trophic levels- Energy flow.

Population Ecology – Community Ecology.

(15L)

UNIT II

NUTRIENT CYCLES & INTERACTIONS

Biogeochemical cycles: Carbon, Sulphur, Nitrogen and Phosphorous. Animal relationships: Mutualism, Commensalism, Parasitism, Competition and Predation.

(15L)

UNIT III

HABITAT ECOLOGY

Ecosystem: characteristic features and types: Freshwater - Lotic & Lentic, Marine, estuarine, mangrove, tundra, Savanna, cave, forest and desert ecosystems. Ecotone & edge effect. Ecological succession, Significance & Conservation of wetlands, Ecological effects of dams, hydroelectric projects.

(15L)

UNIT IV

POLLUTION

Types, causes, effects & management of Land, Water, Air, Thermal, Noise & Pesticide pollution. Nuclear Hazards –Management of Solid waste, Plastic waste, Medical waste and e-waste.

(15L)

UNIT V

CONSERVATION

Biodiversity– definition, loss & cause. IUCN, CITES - Brief out lines of Indian laws of conservation. Biodiversity hot spots in India. Indian Endangered species & conservation, Community reserves, Sanctuaries, National Parks and Tiger Reserves in Tamil Nadu. Afforestation & Deforestation. Human and animal conflicts.

(15L)

(Total 75L)

Books for reference

1. Arumugam N Concepts of Ecology, Saras Publication, Nagercoil.

2. Gupta PK, Cytology, Genetics & Evolution, Rastogi Publications, Meerut.

3.Verma PS,& Agarwal VK, Environmental Biology: Principles of Ecology, S Chand Publishers, New Delhi.

4. Sharma PD, Elements of Ecology, Rastogi Publications, Meerut.

5. Chapman JL & Reiss MJ, Ecology: Principles and Applications, Cambridge University Press, New Delhi.

6. Odum EP, Fundamentals of Ecology, W.B Saunders College Publishing, Philadelphi, USA..

7. Arumugam N Organic Evolution, Saras Publication, Nagercoil.

8. Caughley G, Sinclair AR. Wildlife ecology and management. Blackwell Science.

9. Divan S, Rosencranz A. Environmental law and policy in India: Cases, materials and statutes. New Delhi: Oxford University Press. Arora, M.P. Ecology. Himalaya Publishing House, Ramdoot, Dr.Bhalerao Marg, Girgaon, Mumbai- 400 004.

10. Clarke, G.L. Elements of Ecology, John Wiley & sons Inc. New York.

11. Junega, Kavita. Ecology. Anmol Publications Private Limited, 4371/4B Ansari Road,

12.Madhab, C.Dash. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Limited,No.444/1.Sri EkambaraNaicker Industrial Estate, Alapakkam,
Porur, Chennai – 600 116.

13. Purohit, S.S. A Text book of Environmental Science, Student Edition, Agrobios (India), Behind Nasrani Cinema, Chopasani Road, Jodhpur – 342 002.

14. Singh, H.R. and Neeraj Kumar. Ecology and Environmental Science, Vishal Publishing Company, Books Market, Old Railway Road, Jalandhar – 140 008.

15. Singh, S.P.Animal Ecology, 6th Edition, Rastogi Publications, Gangotri, Shivaji Road, Meerut – 250 002.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: V PART III: CORE COURSE : 5.4. ECOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	3	3	1	3	1	2	1	3	3	3	2	2	3	3	2
CO2	**K-2 Understand**	2	3	2	3	1	1	1	3	1	2	2	2	3	2	2
CO3	**K-3 Apply**	2	3	1	3	3	2	2	3	3	3	2	2	3	3	2
CO4	**K-4 Analyse**	2	2	2	2	1	2	2	3	1	3	3	2	3	2	2
CO5	**K-5 Evaluate**	-	2	1	1	2	2	1	3	1	3	3	2	2	2	2
CO6	**K-6 Create**	-	-	-	1	2	2	2	3	3	2	2	2	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

SEMESTER V

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -V /Core Practical

CORE PRACTICAL VII- ECOLOGY

L	T	P	C
--	--	3	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- determine the physicochemical parameters of the water samples.
- identify the planktons in the aquatic habitat.
- know the examples for animal associations and its ecological importance.
- illustrate the ecological adaptations with examples.

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: compare and interpret the results of estimated the physicochemical parameters of the water samples.

CO2: analyze and understand the planktonic adaptations.

CO3: develop the skill to explain the ecological adaptations with specific examples.

CO4: create awareness to conserve the natural habitat

PRACTICALS

2. Estimation of pH – ant 2 water samples
3. Estimation of total solids- any 2 water samples
4. Estimation of turbidity using Secchi disc.
5. Estimation of dissolved oxygen – any 2 water samples
6. Estimation of carbon dioxide – any 2 water samples
7. Estimation of total and phenolphthalein alkalinity- any 2 water samples
8. Identification of any two zooplanktons either fresh water or marine,
9. Visit to Sanctuaries and National Parks- Report (Mandatory)

Museum specimens, slides, models and charts

Mutualism :Hermit crab and Sea anemone; Commensalism: Echeneis and Shark;

Parasitism: Sacculina on Crab; Predation: Snake and Rat. Effect of temperature:

Cyclomolphosis- Daphnia; Effect of light: Protective Colouration - Leaf insect and

Colour changes - Chamaeleon.

Charts: Ecosystem- Pond; Food Chain –.Forest Ecosystem-; Food Web – Grass land.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: V CORE COURSE PRACTICAL: VII – ECOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-4 Analyse**	2	2	1	-	2	3	2	3	3	3	2	-	-	2	-
CO2	**K-2 Understand**	2	1	2	-	2	2	3	3	2	3	2	2	2	3	2
CO3	**K-5 Evaluate**	2	2	2	2	2	3	3	2	3	3	2	2	2	3	3
CO4	**K-6 Create**	-	2	1	-	2	3	3	2	3	3	3	2	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -VI/Core

CORE COURSE : 6.1 - EVOLUTION

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- know the origin of life with various evidences.
- study various theories of Evolution.
- elucidate the various concepts in relation to evolution
- classify mimicry, protective colouration and adaptations in relation to evolution
- portray the different phases of evolution of horse, human beings and patterns of animal distribution.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to
CO1: understand the origin of life and evidences in favour of evolution
CO2: accept the modern concept of evolution
CO3: analyse the concept of evolution especially population geneties.
CO4: learn relationship between abiotic and biotic factors adaptation in the view of evolution
CO5: get thorough knowledge of the tree diagram of evolution of various animals and patterns of distribution

UNIT I

EVIDENCES OF EVOLUTION

Origin of life: Abiogenesis, Biogenesis, Cosmic theory, Biochemical origin of life, Urey-Miller experiment. Evidences of evolution: Morphological & Anatomical, Embryological, Physiological & Biochemical and Paleontological evidences.

(15L)

UNIT II

THEORIES OF ORGANIC EVOLUTION

Lamarckism, Neo Lamarckism, Darwinism, Neo Darwinism, Mutation theory & New version of mutation theory. Modern Synthetic theory of evolution. Natural Selection. Convergent & Divergent evolution.

(15L)

UNIT III

ADAPTATION & ISOLATION

Adaptation– Colouration and Mimicry -types and significance –Non- adaptive traits –Neotony & Significance. Isolation- Mechanism & Species concept -Speciation and Variation. Hardy - Weinberg Equilibrium - Genetic drift. Basic outlines of Molecular evolution.

(15L)

UNIT IV

ANIMAL DISTRIBUTION

Zoogeographical regions – Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions -their Climatic and faunal peculiarities. Wallace line- Discontinuous distribution - Continental Drift - Geological time scale (Up to periods for Paleozoic & Mesozoic era; Up to epoch for Cenozoic era).

(15L)

UNIT V

EVOLUTION OF HIGHER FORMS

Evolutionary significance of Dipnoi– Origin of Amphibia – Golden age of Reptiles -Major types of Dinosaurs and reason for extinction, Affinities of Archaeopteryx, Outlines of evolution of Man.

(15L)

(Total 75L)

Books for references

1.Verma PS & Agarwal VK Cell Biology, Genetics, Evolution and Ecology, S Chand Publishers, New Delhi.

2. Gupta PK, Cytology, Genetics & Evolution, Rastogi Publications, Meerut.

3. Arumugam N Organic Evolution, Saras Publication, Nagercoil.

4. Barton NH, Briggs DEG, Eisen JA, Goldstein DB and Patel NH, Evolution. Cold Spring, Harbour Laboratory Press.

5. Hall BK &Hallgrimsson B, Evolution, Jones and Bartlett Publishers.

6. M.P. Arora Evolution

7. Moody, Introduction To Evolution.

8. Dobzhansky, Th.: Genetics And The Origin Of Species 1951,Columbia Uty. Press.

9. Dodson, Evolution – Process and Product.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI PART III- CORE COURSE : 6.1 EVOLUTION																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	3	3	2	2	2	2	3	3	3	3	2	2	1	0
CO2	**K-3 Apply**	3	3	3	2	2	1	1	3	3	3	2	2	2	1	0
CO3	**K-4 Analyse**	3	3	2	2	3	2	1	3	3	2	3	2	2	2	1
CO4	**K-5 Evaluate**	3	2	2	3	2	2	2	3	3	2	3	2	2	2	1
CO5	**K-6 Create**	3	2	2	2	2	2	1	3	2	2	1	1	2	1	o

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1);

No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -VI /Core

CORE COURSE: 6.2- ANIMAL BIOTECHNOLOGY

L	**T**	**P**	**C**
5	**--**	**--**	**4**

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- learn the fundamentals of modern Molecular techniques.
- understand the mechanism of Gene Expression and Regulation.

- give a nut shell idea of various protocols followed in Biotechnology in relation to animal science.

COURSE OUTCOMES (COs)

On successful completion of the course the student will be able to

CO1: relate the basic principles of recombinant DNA technology

CO2: explain various molecular techniques used in modern biotechnology.

CO3: categorise the cell and organ culture techniques.

CO4: make use of hybridoma technology for the production of monoclonal antibody.

CO5: compare the microbial enzyme and artificial enzymes

CO6: explain the general principles of generating genetically modified organisms and modern artificial methods in biotechnology.

UNIT I

RECOMBINANT DNA TECHNOLOGY

Scope of Biotechnology. Restriction Endonucleases. Modifying Enzymes (Reverse transcriptase, SI Nuclease, Tag DNA Polymerase, DNA Ligase). **Cloning Vectors:** pBR322, Lambda Phage & SV40. *Gene Cloning*: **Integration of Desired Gene into the Vector. Introduction of Recombinant DNA into Host cells**- Transformation, Transfection, Microinjection, Electroporation. **Screening and Selection of Recombinants** - Direct selection, Insertional inactivation, Blue-White selection, Colony Hybridization**.**

(15L)

UNIT II

MOLECULAR TECHNIQUES

Blotting techniques -Southern, Northern and Western. **Methods to isolate DNA** – PCR Types, Principle & Applications. **Electrophoresis** – Types and Principle. **DNA probes & diagnosis. Molecular Markers-** RAPD – FISH- RFLP. **DNA Library. DNA finger printing and its applications.**

(15L)

UNIT III

ANIMAL CELL AND TISSUE CULTURE

Primary culture - Applications. **Steps involved in mammalian cell culture**. *He la* &*WI38* cell lines – Maintenance of cell lines. **Hybridoma Technology** - Monoclonal antibody Production. **Organ culture** - Techniques and Application. **Animal cloning** – Dolly.

(15L)

UNIT IV

ENZYME BIOTECHNOLOGY

Microbial production- application of enzymes. **Ribozymes. Artificial enzymes. Immobilization of enzymes** - methods and its application. **Biosensors. Commercial production of Insulin. Cryobiology** – Methods of Cryopreservation.

(15L)

UNIT V

APPLICATIONS

Genetically modified Animals -Transgenic Animals (Fish, Mice, Sheep & Cow) & its significance. Applications of **r-DNA technology. Human Genome Project. Microarray, Biochips, Gene therapy, Super bug & bioremediation, Biofuels. Bioweapons, Solid and Liquid waste management. Biogas production. Biopesticides.**

(15L)

(TOTAL: 75L)

Books for reference

1. Brown TA. Gene cloning. London: Chapman & Hall; 1995.
2. Primrose SB, Twyman R. Principles of gene manipulation and genomics. John Wiley & Sons; 2013 May 28.
3. Robertis D. Cell and Molecular Biology. Lea &Febiger,U.S
4. Verma P.S & Agarwal V.K Genetic Engineering,S. Chand Publishers, New Delhi.
5. Prof.V. Kumaresan,"Animal Biotechnology", Saras Publication, A.R.P. Camp Road, Periavilai, Kottar P.O.,Nagercoil, K.K.Dist., - 629002.
6. Kumar H.D. A text book of Biotechnology, Affiliated East – West Press Ltd., NewDelhi
7. Animal Biotechnology,2006,R.Sasidhara, MJP Publishers, Chennai.
8. Dubey R.C "A text book of Biotechnology" S.Chand & Co., Ltd., NewDelhi.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER VI PART III- CORE COURSE: 6.2- ANIMAL BIOTECHNOLOGY																	
CO	**COGNITIVE LEVEL**	**PO**							**PSO**								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	3	3	3	2	2	0	3	1	2	1	3	3	3	3
CO2	**K-2 Understand**	3	3	2	3	1	1	1	3	1	1	1	2	3	2	3
CO3	**K-4 Analyse**	3	3	3	3	3	2	2	3	1	2	1	3	3	2	3
CO4	**K-3 Apply**	3	3	3	3	2	1	1	3	1	2	1	2	3	3	2
CO5	**K-5 Evaluate**	3	3	3	3	1	1	1	3	1	1	1	2	3	2	2
CO6	**K-2 Understand**	3	3	3	3	3	3	2	3	1	2	1	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1) No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -VI /Core Practical

CORE PRACTICALVIII- EVOLUTION & ANIMAL BIOTECHNOLOGY

L	T	P	C
--	--	2	2

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- understand the gene frequency distribution in a population.
- elucidate the application of probability in genetics experiments.
- know the evolutionary importance and biotechnological applications of given models and specimens.
- understand the basic techniques of biotechnology from demonstrations

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: evaluate the gene frequency in the light of Hardy- Weinberg law and Probability.

CO2: apply the known basic techniques for their projects and future studies.

CO3: relate the evolutionary significances of the known organisms.

CO4: understand and apply the biotechnological techniques for their higher studies.

CO5: describe and evaluate the significance of the tools in biotechnology.

CO6: develop a model prescribing the applications of biotechnology in day to day life.

PRACTICALS

EVOLUTION

1. Gene Frequency : Hardy -Weinberg law- Probability Experiment.

2. Museum Specimens, **Slides**, **Models and Charts:**

Animals of evolutionary significance: Peripatus, Archaeopteryx, Limulus.
Colouration and Mimicry: Lycodon and Krait; Stick insect, Leaf insect.
Mutation: Peppered Moth, Ancon Sheep.
Variations : Variation in finger prints.

ANIMAL BIOTECHNOLOGY

1. Isolation of genomic DNA –Demonstration.
2. Isolation of Plasmid –Demonstration
3. Protoplast preparation and fusion –Demonstration
4. Estimation of Co_2 in any three- effluent / sewage water samples –(Individual)
5. Isolation of Protein by PAGE –Demonstration.
6. **Models / Charts / Photos:**

PBR 322, Ti plasmid, Lambda Phage, SV40, Restriction enzyme, recombinant DNA, Gene cloning, Electroporation, Microinjection, Southern blotting, RFLP, RAPD, Monoclonal antibody, Stem cells, Dolly- Transgenesis, Organ culture, Anaerobic Digester, Fermentor.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI PART III: CORE PRACTICAL COURSE : PRACTICAL VIII EVOLUTION AND ANIMAL BIOTECHNOLOGY																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	2	1	2	2	-	-	-	3	2	2	2	2	1	2	1
CO2	**K-2 Understand**	3	3	2	3	-	2	-	3	2	3	2	3	1	2	3
CO3	**K-3 Apply**	3	3	2	3	1	2	2	3	3	3	2	3	2	3	3
CO4	**K-4 Analyse**	3	3	3	3	2	3	2	3	3	3	2	3	2	3	3
CO5	**K-5 Evaluate**	3	3	3	3	2	-	2	3	2	3	3	3	2	3	3
CO6	**K-6 Create**	3	2	3	3	2	-	2	3	2	3	3	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

CORE COURSE: 6.3
BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- understand the mathematical principles of biological systems incorporating computer systems.
- explore the integration and application of statistics and bioinformatics in biology.
- acquire the skills and perspectives of statistics and bioinformatic tools in analysis and interpretation of data.
- gain an insight about the molecular databases.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO 1: attain an insight on statistical methods for analysis of biological data.

CO 2: undertake statistical operations in biology.

CO 3: gain basic understanding of computer hardware and software and use productive softwares effectively.

CO 4: acquire knowledge on the bioinformatic concepts for analyzing molecular data.

CO 5: analyse and use the bioinformatics tools for advanced sequence alignment, database searches, genome analysis and protein structure studies.

CO 6: understand and critically evaluate the data analysis procedures in publication of molecular biology research.

UNIT I

INTRODUCTION AND BASICS

Definition and Scope: Population and Samples – Types of variables. Collection and sources of data: Primary and secondary data – survey – census. Sampling methods & Sampling procedures.
Classification and Presentation of data: Frequency distribution. Tabulation & Diagramatic representation of data: tables - parts- types; diagrams – line diagram – bar diagram – pie diagram- histogram – graphs. Measures of Central tendency – Calculation of Mean, Mode and Median (Grouped and Ungrouped Data).
(15L)

UNIT II

MEASURES OF DISPERSION

Variance, Range, Standard Deviation and Standard Error, Coefficient of Variation. Chi – square test – Calculation and application, Student‟s-t Test. Correlation: Introduction, Types, Perfect positive and negative, Linear and Non-Linear methods; Scatter diagram, Karl Pearson‟s correlation coefficient; Interpretation of the Correlation coefficient.

(14L)

UNIT III

INTRODUCTION TO COMPUTER

Components of Computer: Input devices and Output devices – CPU – Primary and Secondary, Memory operating system. Introduction to MS Office software- covering, word processing, spread sheet and presentation software. MS Word basics: Creating word document – File, Edit, Format, Save menus, adding bullets, numbering and symbols printing. MS Excel – entering and editing cell entries – adjusting row and column height – Pie- bar- line chart preparation. Uses of Internet – Email, Internet Browsing; e-learning tools & resources, World Wide Web (WWW), MS Power point.

(16L)

UNIT IV

BIOINFORMATICS

Introduction: Definition of Bioinformatics – History – Scope and Application of Bioinformatics; Components of Bioinformatics - Bioinformatics in Life Science. Biological Sequence Analysis: Sequence Alignment – Pair wise Sequence Comparison – Multiple Sequence Alignment.

(15L)

UNIT V

MAJOR DATABASES IN BIOINFORMATICS

Nucleic acid sequence databases : NCBI, EMBL – Genbank; Protein sequence database – SWISS – PROT . Database similarity search Tools: BLAST, FASTA – Application of bioinformatics tools. Database Retrieval Tools: ENTREZ – Locus link – Pub Med (Publishers on Medicine); SRS - Protein structure visualizing tools – RasMol, Swiss PDB viewer.

(15L)

(TOTAL: 75L)

Books for reference

BIOSTATISTICS

1. Arora and Mathan. Bio Statistics (5thEdition). Himalaya Publishing House, Ramdoot, Dr.BhaleraoMarg,Girgaon,Mumbai – 400004.
2. Daha, T.K. Biostatitics in Theory and Practics. EMKAY Publications, Post Box No.9410, B-19, East Akrishna Nagar, Swami Dayanand Marg, Delhi-110051.
3. Gurumani. N, An Introduction to Biostatistics (computer Application included) 2nd Edition M.J.P. Publishers, Tamilnadu Book House, 47 Nallathambi street, Triplicane- 600 005.
4. Jasra, P.K.and Gurdeef Raj. Biostatistics, Krishna Prakashan Media(P) Limited, 11, Shivahi Road, Meerut – 250001
5. Parihar and Parihar. Biostatistics and biometry, Student Edition, Agrobios(India) Behind NasraniCinema,Chopasani Road,Hodhpur-342002.
6. Pranab Kumar Banergee. Introduction to Biostatistics (2nd Edition). S. chand& Company Limited, 7361, Ram nager,New Delhi-110055
7. Prasad, S. Elementa of Biostatistics. Rastogi Publications, Gangotri, ShivajiRoad, Meerut 250002.
8. Satguru Prasad – Fundamentals of Biostatistics (Biometry). EMKAY Publication,Post Box No.9410 B-19, East Akrishna Nagar, Swami Dayanand Marg, Delhi-110051.
9. Pagano, M. and K. Gauvreau. Principles of Biostatistics. Thomas Learning,Alps Building,1st floor,56,Janpath,NewDelhi.
10. Satgurau Prasad, Elements of Biostatistics, Rastogi Publications Gangotri,Shivaji Road, Meerut 250002.

COMPUTER APPLICATIONS

1. Krishnamoorthy, R. Computer Programming andapplications.
2. Rajaram, V. Fundamentals of Computers.

BIOINFORMATICS

1.Bal, H.P. Bioinformatics principles and Applications, Tata Mc Graw Hill Publishing Company Limited, No. 444/1 Sri EkambaraNaicker Industrial Estate, Alkapakkam, Porur, Chennai – 600116

2.Dan, E. Krane and Michael L. Raymer.Fundamental concepts of Bioinformatics. Pearson Education (Singapore) PTE Limited, Indian Branch, 482 FIE Patparganj, Delhi-110 092.

3. Ignacimuthu, S. Basic Bioinformatics. Narosa Publishing House Private Limited,35- 36 Greams Road, Thousand Lights, Chennai-600006
4. Ranga, M.M. Bioinformatics, Agrobios (India) Behind Nasranicinema,Chopasani Road, Hodhpur – 342002.
5. C.S.V. Murthy Bioinformatics.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER VI **PART III: CORE COURSE : 6.3 BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS**																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	2	0	2	0	0	1	3	3	1	2	3	1	3	2
CO2	**K-3 Apply**	3	2	1	2	1	2	0	2	3	1	2	3	2	3	2
CO3	**K-2 Understand K3 Apply**	1	1	2	3	0	1	3	1	2	0	2	1	1	3	2
CO4	**K-1 Remember K3 Apply**	3	3	2	3	0	1	3	3	3	1	3	3	3	3	3
CO5	**K-5 Evaluate**	3	3	1	3	0	0	3	3	3	0	2	2	2	3	3
CO6	**K-6 Create K-5 Evaluate**	3	2	3	3	0	1	3	2	3	0	2	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0).

CORE PRACTICAL - IX
BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS

L	T	P	C
--	--	2	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical courses are enabling the student to

- find the mean, mode, SD,SE and CV using neem leaves.
- calculate the correlation using height and weight of the students.
- acquire the knowledge to use the computer applications.
- get awareness about the types and applications of bioinformatic tools.

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: remember the calculation and apply the formulae in their studies.

CO2: use the technology to analyze the results of the experiments.

CO3: understand and evaluate the data in the light of of bioinformatics tools.

CO4: design a biological study to apply the learnt technology.

1. Find out Mean, Median, Mode, Standard deviation, Standard error and Co-efficient of variance using serrations of neem leaves.
2. Calculation of correlation from height and weight of the students..
3. Bar diagram, Histogram, Pie diagram and Frequency curve and polygon - construction.
4. **Models**, **Chart and Photos**: Computer Mouse, CPU, Keyboard, Monitor.
5. Visit to a Computer centre to learn internet browsing and email sending – Compulsory for each student.
6. Take printout from NCBI, EMBL and PubMed and keep it for spot tests.
7. Write some of the file commands and keep for spot tests.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI PART III: CORE PRACTICAL IX BIOSTATISTICS, COMPUTER APPLICATIONS AND BIOINFORMATICS																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	2	3	2	2	3	2	2	3	3	2	3	2	3	3
CO2	**K-5 Evaluate**	3	3	3	2	1	3	2	2	3	3	2	3	2	3	3
CO3	**K-3 Apply**	2	3	3	1	2	3	3	3	3	2	2	2	2	3	3
CO4	**K-6 Create**	2	3	3	1	2	3	3	2	3	2	2	2	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -VI /Core Elective

CORE ELECTIVE (GROUP- A)

(Any one)

CORE ELECTIVE COURSE: 6.4A -SERICULTURE

L	T	P	C
5	--	--	4

LEARNING OBJECTIVES (LOs)

The objectives of the courses are enabling the student to

- study the scope and importance of Sericulture for betterment of human welfare.
- introduce the concepts of sericulture and mulberry cultivation.
- get deep knowledge on diseases of silk worm and pests of mulberry plants.
- understand the methods of harvesting, and cocoon marketing.
- adopt sericulture as a vocation as it is a rural agro based cottage industry.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: understand the scope sericulture and mulberry cultivation practices.

CO2: gain knowledge on diseases of silkworms and pests of mulberry.

CO3. understand the classification, life cycle and physiology of silkworm.

CO4. apply the rearing methods, harvesting of cocoon and cocoon marketing.

CO5: examine process of reeling, producing raw silk and marketing.

CO6: decide to start sericulture unit/reeling unit in the local area and become notable entrepreneur.

UNIT I

IMPORTANCE OF SERICULTURE

Sericulture industry in India: Sericulture as cottage industry, role of Central Silk Board, Moriculture: Morphology of Mulberry plant- High yielding varieties –methods of propagation-irrigation. Manuring: Biofertilizers – Green manuring – Triacontanol for increased mulberry productivity – Seriboost. Pruning- Harvesting and storing of mulberry leaves-Package of practices for mulberry cultivation.

(15L)

UNIT II

DISEASES AND PESTS OF MULBERRY

Fungal diseases: fungal root, shoot and leaf diseases; Bacterial diseases: leaf blight disease, rot disease; Viral diseases: mulberry leaf mosaic disease, dawn disease; Dwarf disease, Nematode diseases: root knot disease; Deficiency diseases: nitrogen deficiency, phosphorus deficiency, potassium deficiency, magnesium deficiency and calcium deficiency diseases; Pests of mulberry: leaf eating insect pests and stem borer pests one example each.

(15L)

UNIT III

BIOLOGY OF SILKWORM

Classification of Mulberry silkworm- habit and habitats; Voltinism- races of silkworms; Life cycle- Structure of egg- larva- pupa and adult- Sexual dimorphism. Digestive system-circulatory system- excretory system- respiratory system, nervous system and reproductive system, endocrine and other glands of Silkworm.

(15L)

UNIT IV

REARING OF SILKWORM COCOON MARKETING

Rearing house (CSB model) - Rearing appliances. Rearing operation: Disinfection – Brushing – Maintenance of optimum conditions, Feeding – Bed cleaning – Spacing. Methods of Rearing; Young age worms – Chawki rearing - Rearing of late age larva-Types: Shelf rearing. Floor rearing, Shoot rearing- Application of Sampoorna. Mounting: Mountages- Methods – Precautions. Cocoon marketing: Characteristics of cocoon- – defective cocoons – methods of harvesting. – Shell ratio and rate fixation.

(15L)

UNIT V

DISEASES AND PESTS OF SILKWORM & REELING

Protozoan disease: Pebrine; Viral diseases: Flacherie, Gattine, Grasserie; Bacterial diseases: Flacherie, Septicemia, Sotto, Court; Fungal diseases : Muscardine; Pests: Uzy fly, Dermistid beetle of silkworm. Silk reeling: Cocoon stifling – types- storage of stifled cocoons- sorting-cocoon boiling and deflossing – brushing, Process of reeling: Different methods- silk waste and byproducts of silk reeling- Raw silk and marketing.

(15L)

(TOTAL: 75L)

Books for reference

1. Ganga, G. and I. Sulochana Chetty, An introduction to Sericulture. Oxford & IBH Publishing Company Private Limited, S -155,Panchshila Park, New Delhi.

2. Ganga,G. Comprehensive Sericulture, Volume – 2 Silkworm Rearing and Silk Realing. Oxford & IBH Publishing Company Private Limited, S -155, Panchshila Park,New Delhi.
3. Dandin, S.B, Jayant Jayaswal and K. Giridhas, Hand Book of Sericultural Technologies, Central Silk Board, Madivala, Bangalore –68.
4. Kamile Afifa. S and Masoodi M. Amin, Principles of Temperate Sericulture,Kalyani Publishers, B – 1/1292,Rajinder Nagar, Ludhians.
5. Kesary, M and M.Johnson, Sericulture, Department of Zoology, N.M.. Christian College, Marthandam.

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI
PART III: CORE ELECTIVE COURSE:6.4A- SERICULTURE

CO	COGNITIVE LEVEL	PO							PSO							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-1 Remember	3	3	3	2	3	2	2	3	3	2	2	1	1	3	3
CO2	K-2 Understand	3	3	3	2	3	3	3	3	3	2	2	1	1	3	3
CO3	K-3 Apply	3	3	3	2	3	3	3	3	3	2	2	1	1	3	3
CO4	K-4 Analyse	3	3	3	2	3	3	3	3	3	2	2	1	1	3	3
CO5	K-5 Evaluate	3	3	3	2	3	3	3	3	3	2	2	1	1	3	3
CO6	K-6 Create	3	3	3	2	2	3	3	3	3	2	2	1	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0).

CORE ELECTIVE PRACTICAL- X 6.4A
SERICULTURE

L	T	P	C
--	--	2	1

LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- observe and analyse the features of silk gland, digestive and nervous system of silkworm.
- realize the importance selection of leaves for feeding.
- examine and analyse the stages development.
- assess the mulberry varieties, rearing and mounting appliances and marketing of cocoons.
- promote sericulture industry in rural area.

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: understand the biological importance systems of the silkworm.

CO2: appreciate the importance of feeding and rearing appliances

CO3: enhance the production by applying scientific knowledge and training.

CO4: decide to have a sericulture unit with less input.

PRACTICALS

1. Dissection of silk glands, digestive and nervous systems- Silk worm
2. Dissection of male and female reproductive system- Silk worm
3. Selection of mulberry leaves according to different stages of the larva.
4. Life history Silk worm – egg, larva, pupa and adult.
5. Sexual dimorphism in larva, pupa and adult- Silk worm
6. Mulberry varieties such as MR2, S30, S36, V2. (any four)
7. Chandrika and Netrika
8. Rearing tray and rearing stand.
9. Raw silk and silk waste
10. Cocoon- Bivoltine/ Multivoltine

11. Report on field visit to Sericulture farm/ unit. (Mandatory)

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI PART III: CORE ELECTIVE PRACTICAL X: SERICULTURE																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	2	3	2	2	3	2	2	3	3	2	3	2	3	3

CO2	**K-5 Evaluate**	3	3	3	2	1	3	2	2	3	3	2	3	2	3	3
CO3	**K-3 Apply**	2	3	3	1	2	3	3	3	3	2	2	2	2	3	3
CO4	**K-6 Create**	2	3	3	1	2	3	3	2	3	2	2	2	3	2	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -VI /Core Elective

CORE ELECTIVE (GROUP B)- Any one

CORE ELECTIVE COURSE: 6.5A -APICULTURE

L	**T**	**P**	**C**
4	**--**	**--**	**4**

LEARNING OBJECTIVES (LOs)

The objectives of the course are enabling the student to

- familiarize the organization of bee colony
- know the systematic planning of apiary unit.
- get knowledge about the value of honey and harvesting techniques.
- understand the disease and enemies and behaviour of honey bees.
- examine the scope for self employment opportunities. give self-employment opportunities after their graduation
- provide rural based and welfare oriented knowledge.

COURSE OUTCOMES (COS)

On successful completion of the course the student will be able to

CO1: classify the honey bees and categorize its developmental stages and explain the principles of Apiculture and methods of Bee keeping.

CO2: construct modern hives and rear and recommeds apiary as a less expensive but profitable self employment.

CO3: make use of Honey bee products and marketing.

CO4: distinguish the enemies of bees and protect the bees from various diseases. and identify swarming, robbing and foraging behaviour of bees in an apiary.

CO5: trust the less expensive but profitable self employment.

CO6: gain confidence to establish an apiary after their graduation as a rural based

and welfare oriented venture.

UNIT I

INTRODUCTION

Definition, Scope, Classification of bees: Rock bee, Indian bee, Little bee and Dammer bee- their identification and habits, choice of species in Apiculture.

Bee colony: Distinctive features, Identification and Functions of queen, drones and workers, Structure and functions of legs, mouth parts and sting of worker bee. Development of Honey bee: egg, larva and pupa- time taken for the development of queen, drone and worker. Food of the bee: bee bread, honey and pollen- royal jelly- propolis. Artificial feeding.

(12L)

UNIT II

PRINCIPLES OF APICULTURE

Arranging an Apiary: position- space- direction. Acquiring bees: care of newly captured colonies- handling the bees. Bee keeping: Primitive methods - their advantages and disadvantages. Different types of Modern hives: Architecture - Parts of artificial hive and its advantages – other appliances used in apiary The bee comb and its architecture-Different kinds of cells-Burr comb.

(12L)

UNIT III

HONEY BEE PRODUCTS

Honey: Collection and Extraction, Preservation and storage –Physical properties, Chemical composition, nutritive value, medicinal values- honey as daily food.

Bee wax- Production - method of extraction- characteristics and uses.

Bee venom- method of collection - composition of venom- its uses.

(12L)

UNIT IV

ENEMIES AND DISEASES OF BEES

Enemies: Greater wax moth, lesser wax moth, ants, wasps, lice, beetles, birds and their management.

Diseases of bees: adult and brood diseases- Bacterial, Fungal, Viral & Protozoan- Prevention and Control measures.

(12L)

UNIT V

SWARMING AND OTHER BEHAVIOURS

Swarming- Prevention and control. Robbing and Fighting- Prevention and control. Uniting stocks- Different methods. Queen rearing. Supersedure. Foraging, inter-relationships of plants and bees. Behaviour of bees- bee dances.

(12L)

(TOTAL: 60L)

Books for reference

1. Mishra,R.C. &R. Garg. Perspectives in Indian Apiculture. Agrobios (India)behind Nasrani Cinema, Chopasani Road, Jodhpur-342002.
2. Abrol,D.P. Bee Keeping in India. Kalyani Publishers, B-1/1292, Rajinder Nagar,Ludhiana-141 008.
3. Cherian, M.C. &Ramachandran. Bee Keeping in SouthIndia.
4. Philips, E.F. Bee Keeping,Agrobios (India) behind NasraniCinema,Chopasani Road,Jodhpur-342 002.
5. Sadar Singh, Bee Keeping in India Kar Delhi.
6. Sharma P.L and Singh, S.(controller) Hand Book of bee Keeping, printing and Stationery,Chandigarh.
7. Webb,A. Bee Keeping for profit and Pleasure, Agrobios (India), Behind Nasrani Cinema, Chopasani Road, Jodhpur-342002 .

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI PART III : CORE ELECTIVE COURSE – 6.5A: APICULTURE																
CO	**COGNITIVE LEVEL**	**PO**							**PSO**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-1 Remember**	3	3	2	2	3	2	2	3	2	2	2	2	3	2	2
CO2	**K-2 Understand**	2	3	3	2	3	2	3	3	3	3	2	2	3	2	2
CO3	**K-3 Apply**	2	3	3	2	3	2	3	3	3	3	2	3	3	2	2
CO4	**K-4 Analyse**	2	3	3	2	3	3	3	3	2	3	2	3	3	3	3
CO5	**K-5 Evaluate**	1	2	2	2	2	3	3	2	2	3	3	3	3	3	3
CO6	**K-6 Create**	1	1	2	1	2	2	3	2	2	3	1	2	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)

MSU/2021-22/UG-Colleges/Part-III (B.Sc. ZOOLOGY) SEMESTER -VI /Core Elective Practicals

CORE ELECTIVE PRACTICALS- X
6.5A APICULTURE

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LEARNING OBJECTIVES (LOs)

The objectives of the practical course are enabling the student to

- observe and mount legs, mouth parts and sting of workers to appreciate their diversified functions.
- compare the features of the colony members.
- relate the structural modifications with the functions
- practice the procedures for handling the bees and hygienic extraction of honey/
- motivate to start an apiary unit.

COURSE OUTCOMES (COs)

On successful completion of the practical course the student will be able to

CO1: identify and characterize the members of the colony.

CO2: describe the structure and management of the colony.

CO3: adopt suitable methods to handle the bees safely.

CO4: plan to develop a modern apiary and marketing honey with self involvement and interest.

PRACTICALS

1. Mountings of legs, mouth parts and sting of worker bees.
2. **Specimen**, **Model**, **Slide and Appliances**:
   Queen, Worker, Drone, Artificial hive (Newton hive), Queen excluder,
   smoker, honey extractor, honey, scraffing knife, Bee comb, Bee veil
   and Comb foundation sheet.

3. Report on field visit to Apiary farm/ unit. (Mandatory)

COs at Cognitive level and mapping with POs and PSOs

SEMESTER: VI PART III: CORE ELECTIVE PRACTICAL X : APICULTURE															
CO	**COGNITIVE LEVEL**	**PO**							**PSO**						
		1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
CO1	**K-2 Understand**	3	3	3	2	2	1	2	3	2	2	2	3	2	2	3
CO2	**K-3 Apply**	3	3	2	2	2	2	3	3	3	2	2	3	3	3	3
CO3	**K-4 Analyse**	3	3	2	2	2	3	3	3	3	3	2	3	3	3	3
CO4	**K-6 Create**	2	3	2	2	2	3	3	3	2	2	2	3	2	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1); No Correlation (0)