Department of Zoology (UG)

SYLLABUS AND REGULATIONS

Under

OUTCOME-BASED EDUCATION2020

(Effective for the Batch of Students Admitted from 2020-2021)

AUXILIUM COLLEGE (Autonomous)

(Accredited by NAAC with A+ Grade with a CGPA of 3.55 out of 4 in the 3rd Cycle)

Gandhi Nagar, Vellore-632 006

AUXILIUM COLLEGE (Autonomous), Gandhi Nagar, Vellore-632006.

(Accredited by NAAC with A^+ Grade with a CGPA of 3.55 out of 4 in the 3rd cycle)

OUTCOME BASED EDUCATION

B.Sc. ZOOLOGY

(Effective for those admitted from the Academic Year 2020 – 2021)

Structure of the Course and Scheme of Examinations:

Sem	Part	Paper Code	Title of Subject	Hours	Exam		Credits	Marks
					Th	Pr		
I	I	ULTAA20	Tamil Paper- I	6	3	-	3	40+60
	II	UENGA20	English Paper- I	6	3	-	3	40+60
	III	UCZOA20	Invertebrata	6	3	-	6	40+60
	III	UCZOC20	Core Practical-I	3	-	-	-	-
	III	UACHA20	Allied I: Chemistry-I	4	3	-	4	40+60
	III	UACHC20	Allied Practical: Chemistry	2	-	-	-	-
	IV	-	Skill – Based Elective-I	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
			Total	**30**			**18**	**500**
II	I	ULTAB20	Tamil Paper -II	6	3	-	3	40+60
	II	UENGB20	English Paper -II	6	3	-	3	40+60
	III	UCZOB20	Chordata	6	3	-	6	40+60
	III	UCZOC20	Core Practical-I	3	-	3	4	40+60
	III	UACHB20	Allied II: Chemistry-II	4	3	-	4	40+60
	III	UACHC20	Allied Practical: Chemistry	2	-	3	2	40+60
	IV	-	Skill – Based Elective-II-	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
			Total	**30**			**24**	**700**
III	I	ULTAC20	Tamil Paper -III	5	3	-	3	40+60
	II	UENGC20	English Paper -III	6	3	-	3	40+60
	III	UCZOD20	Cellbiology& Bioinstrumentation	7	3	-	6	40+60
	II	UCZOF20	Core Practical-II	3	-	-	-	-
	III	UAPBA20	Allied III: Plant Biology-I	4	3	-	4	40+60
	III	UAPBC20	Allied Practical: Plant Biology	2	-	-	-	-
	IV	USZOC320	Skill – Based Elective-III-Sericulture	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
			Total	**30**			**18**	**500**

IV	I	ULTAD20	Tamil Paper -IV	6	3	-	3	40+60
	II	UENGD20	English Paper -IV	5	3	-	3	40+60
	III	UCZOE20	Genetics and Evolution	5	3	-	4	40+60
	II	UCZOF20	Core Practical-II	3	-	3	4	40+60
	III	UAPBB20	Allied III: Plant Biology-II	4	3	-	4	40+60
	III	UAPBC20	Allied Practical:Plant Biology	2	-	3	2	40+60
	IV	UNEVS20	Environmental Studies	2	2	-	2	40+60
	IV	USZOD420	Skill – Based Elective-IV-Poultry Keeping	2	2		2	40+60
	IV	UVEDA20	Value Education	1	-	-	-	-
			Total	**30**			**24**	**800**
V	III	UCZOG20	Developmental Biology	5	3	-	5	40+60
	III	UCZOH20	Physiology	4	3	-	4	40+60
	III	UCZOI20	Bio-statistics	4	3	-	4	40+60
	III	UCZOL20	Core Practical -III	3	-	-	-	-
	III	UCZOM20	Core Practical -IV	3	-	-	-	-
	III	UEZOA20	Elective IA: Economic Zoology	5	3	-	5	40+60
		UEZOB20	Elective IB: Vermiculture					
	IV	-	Non-Major Elective-I	3	3	-	2	40+60
	IV	USZOE520	Skill – Based Elective-V: Ornamental Fish Keeping	2	2	-	2	40+60
	IV	UVEDA15	Value Education	1	-	-	-	-
			Total	**30**			**22**	**600**
VI	III	UCZOJ20	Biotechnology	4	3	-	4	40+60
	III	UCZOK20	Environmental Biology	4	3	-	3	40+60
	III	UCZOL20	Core Practical -III	3	-	3	5	40+60
	III	UCZOM20	Core Practical -IV	3	-	3	5	40+60
	III	UEZOC20	Elective IIA: Microbiology	5	3	-	5	40+60
	III	UEZOD20	Elective IIB: Bioinstrumentation					
	III	UEZOE20	Elective IIIA: Immunology	5	3	-	5	40+60
	III	UEZOF20	Elective IIIB: Parasitology					
	IV	-	Non-Major Elective-II	3	3	-	2	40+60
	IV	USZOF620	Skill – Based Elective-VI: Animal Behaviour	2	2	-	2	40+60
	IV	UVEDA20	Value Education	1	2	-	2	40+60
			Total	**30**			**33**	**900**
	V		Extension Activities (90Hours)				1	
			Total	**120**			**140**	**4000**

PROGRAMME OBJECTIVES:

On completion of the UG Programme, students will be able to:

PO1: Attain knowledge and understand the principles and concepts in the respective discipline.

PO2: Acquire and apply analytical, critical and creative thinking, and problem-solving skills

PO3: Effectively communicate general and discipline-specific information, ideas and opinions.

PO4: Appreciate biodiversity and enhance eco-consciousness for sustainable development of the society.

PO5: Emulate positive social values and exercise leadership qualities and team work.

PO6: Pursue higher knowledge, qualify professionally, enhance entrepreneurial skills and contribute towards the needs of the society.

PROGRAMME SPECIFIC OBJECTIVES:

As Zoology graduates, students will:

PSO1: Demonstrate comprehensive knowledge on the complexity of life process, their molecular, cellular and physiological process, their genetics, evolution, behaviour and their interrelationship with the environment.

PSO2: Undertake further studies in Zoology or Multidisciplinary areas.

PSO3: Develop skills that are relevant to wage employment, self-employment and entrepreneurship.

PSO4: Technically sound in applying the Information technology and will be Lifelong learners in updating to the current advancements in their respective fields.

PSO5: Exercise leadership qualities and moral values through ethical ways with the concern for the society.

PSO6: Utilize the opportunities to conceptualize, nurture and accomplish the dream to be entrepreneur/leaders.

PSO/PO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
PSO1	H	H	M	H	M	H
PSO2	H	H	H	H	M	H
PSO3	H	M	H	M	H	H
PSO4	M	H	H	H	H	H
PSO5	M	H	H	L	H	M
PSO6	M	M	H	L	H	H

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

SEMESTER I

UCZOA20 – INVERTEBRATA

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I	I	UCZOA20	Invertebrata	Theory	Core	6	6	100

Objectives:

- To understand the systematic and functional morphology of various groups of Invertebrates.
- To study their economic importance, affinities and adaptations.

Course Outcomes:

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

CO1: Discuss general classification, binomial nomenclature and Phylum Protozoa.

CO2: Explain the classification up to class level, type study and salient features of Phylum Porifera and Coelenterata.

CO3: Elaborate the classification up to class level, type study and salient features of Phylum Platyhelminthes and Aschelminthes.

CO4: Discuss the classification up to class level, type study and salient features of Phylum Annelida and Arthropoda.

CO5: Explain the classification up to class level, type study and salient features of Phylum Mollusca and Echinodermata.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	M
CO2	H	H	H	H	M	M
CO3	H	H	H	H	M	M
CO4	H	H	H	H	M	M
CO5	H	H	H	H	M	M

CO /PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	H	M	H
CO2	H	H	M	H	M	H
CO3	H	H	M	H	M	H
CO4	H	H	M	H	M	H
CO5	H	H	M	H	M	H

Unit I: **(18 Hours)**

1.1: General character and outline classification of Invertebrata up to class level with examples - Structure, function and life cycle of all the type studies. (K1, K2).

1.2: Binomial nomenclature. (K1,K2, K3)

1.3: Phylum – Protozoa – General characters and classification. (K1, K2, K3)

1.4: Type study: *Plasmodium vivax*. (K1,K2, K3)

1.5: General essay: Nutrition in Protozoa. (K1, K2, K3)

1.6: General essay: Locomotion in Protozoa. (K1, K2, K3)

Unit II: **(18 Hours)**

2.1: Phylum – Porifera - General characters and classification. (K1, K2, K3)
2.2: Type study: Sycon. (K1, K2, K3)
2.3: General essay: Canal system in Sponges. (K1, K2, K3)
2.4: Phylum – Coelenterata - General characters and classification. (K1, K2, K3)
2.5: Type study: Obelia. (K1, K2, K3)
2.6: General essay: Corals and Coral Reef, Polymorphism. (K1, K2, K3)

Unit III: **(18 Hours)**

3.1: Phylum – Platyhelminthes- General characters and classification. (K1, K2, K3)
3.2: Type study: Tapeworm. (K1, K2, K3)
3.3: General essay: Helminth parasites in humans-*Wuchereria bancrofti*. (K1, K2, K3)
3.4: General essay: Parasitic adaptations in Helminthes. (K1, K2, K3)
3.5: Phylum: Aschelminthes - General characters and classification. (K1, K2, K3)
3.6: Type study: Ascaris. (K1, K2, K3)

Unit IV: **(18 Hours)**

4.1: Phylum: Annelida - General characters and classification. (K1, K2, K3)
4.2: Type study: Nereis. (K1, K2, K3)
4.3: General essay: Adaptive radiation in Polychaetes. (K1, K2, K3)
4.4: Phylum: Arthropoda- General characters and classification. (K1, K2, K3)
4.5: Type study: Prawn. (K1, K2, K3)
4.6: General essay: Social life in Insects, Peripatus and its affinities. (K1, K2, K3)

Unit V: **(18 Hours)**

5.1; Phylum: Mollusca- General characters and classification. (K1, K2, K3)
5.2: Type study: Freshwater Mussel. (K1, K2, K3)
5.3: General essay: Respiration in Mollusca. (K1, K2, K3)
5.4: Phylum: Echinodermata- General characters and classification.
5.5: Type study: Sea star. (K1, K2, K3)
5.6: General essay: Larval forms in Echinodermata and their significance. (K1, K2, K3)

Books for study and Reference:

Text Books:

1. Ekambaranatha Ayyar M, and T.N. Ananathakrishnan- Manual of Zoology Vol. I [Invertebrata], Parts I and II – S. Viswanathan (Printers and publishers) Pvt. Ltd; Madras, 1992.
2. Jordan, E.L and P.S Verma – Invertebrate Zoology, Revised Edition – S. Chand and Co. Ltd, New Delhi, 2013.

Reference Books:

3. Kotpal, R.L. – Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata- Rastogi Publications, Meerut, 1992.
4. Parker and Haswell, - Textbook of Zoology Vol.I (Invertebrata) – B.S. Publishers and distributers, New Delhi, 1964.
5. Barrington, E.J.W. - Invertebrate Structure and Functions- English Language Book Society, 1969.
6. Hyman L.H. - The Invertebrata, Vol I to VI. – McGraw- Hill Book Co., New York, 1951.

E-Resources:

https://www.civilserviceindia.com
www.iaszoology.com
http://www.insects.org
http://www.earthlife.net/begin.
http://faunaofindia.nic.in

SEMESTER II

UCZOB20– CHORDATA

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I	II	UCZOB20	Chordata	Theory	Core	6	6	100

Objectives:

- To understand the systematic and functional morphology of various groups of Chordates.
- To study their affinities and adaptations to different modes of life.

Course Outcomes:

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

CO1: Explain taxonomic status of vertebrates and its origin and Evolution.

CO2: Describe anatomy and functions of systems in vertebrates.

CO3: Discuss adaptive radiations in vertebrates.

CO4: Explain the salient features of chordates.

CO5: Explain the structural, functional and phylogenetic significance of chordates.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	M	M	M	M
CO4	H	H	M	M	M	M
CO5	H	H	M	H	M	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	H	M	H
CO2	H	H	M	H	M	H
CO3	H	H	M	H	M	M
CO4	H	H	M	H	M	M
CO5	H	H	M	H	M	M

Unit I: **(18 Hours)**

1.1: General character and outline classification of Chordates up to class level. (K1, K2).

1.2: Protochordata: General characters and classification. (K1, K2).

1.3: Type study: Amphioxus. (K1, K2, K3)

1.4: Affinities of cephalochordates. (K1, K2, K3)

1.5: Retrogressive Metamorphosis in Ascidia. (K1, K2, K3)

1.6: General essay: Origin of Chordates. (K1, K2, K3)

Unit II: Pisces **(18 Hours)**

2.1: Affinities of Cyclostomata. (K1, K2, K3)
2.2: Type study: Shark. (K1, K2, K3)
2.3: General essay: Migration in Fishes. (K1, K2, K3)
2.4: Accessory respiratory organs. (K1, K2, K3)
2.5: Parental care in Fishes. (K1, K2, K3)
2.6: Electric organs. (K1, K2, K3)

Unit 3: Amphibia **(18 Hours)**

3.1: Type study: Frog. (K1, K2, K3)
3.2: General essay: Parental care in Amphibians. (K1, K2, K3)
3.3: Adaptive radiations in Amphibians. (K1, K2, K3)
3.4: **Reptilia -** Type study: Calotes. (K1, K2, K3)
3.5: General essay: Poison apparatus and biting mechanism in snakes. (K1, K2, K3)
3.6: Identification of poisonous and non-poisonous snakes. (K1, K2, K3, K4)

Unit 4: Aves **(18 Hours)**

4.1: Type study: Pigeon. (K1, K2, K3)
4.2: General essay: Flight adaptations in birds. (K1, K2, K3)
4.3: Migration in birds. (K1, K2, K3)
4.4: Flightless birds. (K1, K2, K3)
4.5: Beaks in birds. (K1, K2, K3)
4.6: Feet in birds. (K1, K2, K3)

Unit 5: Mammals **(18 Hours)**

5.1: Type study: Rabbit. (K1, K2, K3)
5.2: General essay: Dentition in mammals. (K1, K2, K3)
5.3: Adaptive radiations in Mammals. (K1, K2, K3)
5.4: Characteristics of Prototheria with examples. (K1, K2, K3)
5.5: Characteristics of Eutheria with examples. (K1, K2, K3)
5.6: Characteristics of Metatheria with examples. (K1, K2, K3)

Books for study and Reference:

Text Books:

1. Jordan, E.L and P.S Verma – Chordate Zoology and Elements of Animal Physiology, 10^{th} Edition – S. Chand and Co. Ltd, Ram Nagar, New Delhi, 1995.
2. Ekambaranatha Ayyar M, and T.N. Ananathakrishnan- Manual of Zoology Vol. II [Chordata] – S. Viswanathan (Printers and publishers) Pvt. Ltd; Madras, 1992.

Reference Books:

3. Parker and Haswell, - Textbook of Zoology Vol.II (Chordata) – A.Z.T.B.S. Publishers and distributers, New Delhi, 1964.
4. Newman H.H.- The phylum Chordata- Satish Book Enterprise, Agra, 1981.
5. Modern Text Book of Zoology- Vertebrates-Revised Fourth Edition 2015-16 Rastogi Publications.
6. Kotpal R.L. – Moderrn Text book of Zoology, Vertebrates, 4^{th} edition. Rastogi Publication., Meerut, 2015-16.

E-Resources:

https://www.civilserviceindia.com
www.iaszoology.com
http://www.earthlife.net/begin.
http://faunaofindia.nic.in
https://www.birds.com

SEMESTER I & II

UCZOC20 – CORE PRACTICAL – I: INVERTEBRATA AND CHORDATA

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I	I &II	UCZOC20	Core Practical-I	Practical	Core	3	4	100

Objectives:

- To obtain practical skills in dissection and display of the systems.
- To learn about adaptation, biological significance of animals.
- To understand the evolutionary significance and skeletal structures of animals.

Course Outcomes:

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

CO1: Acquire knowledge about the digestive, circulatory and nervous system of arthropods and vertebrates.

CO2: Prepare mounting of the mouth parts of insects.

CO3: Analyze the biological significance of invertebrates and vertebrates.

CO4: Distinguish structure and function of invertebrates and vertebrates.

CO5: Justify the importance of evolutionary significance of animals, oesteology and dentition in mammals.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	H	M
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	M
CO4	H	H	H	H	H	M
CO5	H	H	H	H	H	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	M
CO2	H	H	H	H	H	M
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

INVERTEBRATA

1. Dissections:
    a) Major: Cockroach – Digestive and Nervous system.
    b) Prawn: Digestive and Nervous system.
2. Minor: Mouth parts - Mosquito, House fly.
   Prawn - Cephalic Appendages.
   Thoracic Appendages.
   Abdominal Appendages.
3. Study of museum specimen/ slides relevant to the types studied in theory:

a) Biological significance
b) Descriptive notes
c) Structure and function
d) Evolutionary significance

SPOTTERS LIST: INVERTEBRATA

1. ENTAMOEBA
2. VOLVOX
3. PLASMODIUM
4. TRYPANOSOMA
5. VORTICELLA
6. SYCON
7. SPONGE GEMMULE
8. EUPLECTELLA
9. HYALONEMA
10. OBELIA COLONY
11. OBELIA MEDUSA
12. ADAMSIA
13. ZOANTHUS
14. PHYSALIA
15. VELLELA
16. TAENIA SOLIUM
17. SCOLEX OF TAENIA SOLIUM
18. BLADDERWORM
19. ASCARIS MALE AND FEMALE
20. SCHISTOSOMA
21. WUCHERERIA
22. NEREIS ENTIRE
23. NEREIS PARAPODIUM
24. CHAETOPTERUS
25. ARENICOLA
26. TROCHOPHORE LARVA
27. PRAWN ENTIRE
28. PRAWN – DIGESTIVE SYSTEM
29. PRAWN – NERVOUS SYSTEM
30. PRAWN- APPENDAGES
31. NAUPLIUS LARVA
32. ZOEA LARVA
33. MEGALOPA LARVA
34. PERIPATUS
35. LIMULUS
36. COCKROACH- DIGESTIVE SYSTEM
37. COCKROACH- NERVOUS SYSTEM
38. HOUSEFLY MOUTH PARTS
39. MOSQUITO MOUTH PARTS
40. UNIO ENTIRE
41. GLOCHIDIUM LARVA
42. RADULA OF PILA
43. CHITON
44. MYTILUS

45. OCTOPUS
46. SEA STAR ENTIRE
47. PEDICELLARIA OF SEA STAR
48. BIPINNARIA LARVA
49. HOLOTHURIA
50. SEA LILY

CHORDATA:

1. Dissections:
    a) Major: Frog (Model) - Digestive, Arterial and Venous system.
    b) Minor: Shark -Placoid scales.

2. Study of museum specimen/ slides relevant to the types studied in theory:
    a) Biological significance.
    b) Descriptive notes.
    c) Structure and function.
    d) Skeletal structure / Dentition.

SPOTTERS LIST: CHORDATA

1. AMPHIOXUS ENTIRE
2. ASCIDIA ENITIRE
3. ASCIDIAN TADPOLE
4. BALANOGLOSSUS ENTIRE
5. TORNARIA LARVA
6. PETROMYZON ENTIRE
7. AMMOCETES LARVA
8. BUCCAL FUNNEL OF PETROMYZON
9. SALPA
10. SHARK ENTIRE
11. SCALES- PLACOID, CTENOID
12. NARCINE
13. SACCOBRANCHUS
14. EXOCOETUS
15. ECHENEIS
16. HIPPOCAMPUS
17. FROG ENTIRE
18. FROG-DIGESTIVE SYSTEM
19. FROG-VENOUS SYSTEM
20. FROG- ARTERIAL SYSTEM
21. FROG-BRAIN
22. FROG-HYOID
23. FROG-PECTORAL AND PELVIC GIRDLE
24. ICHTHYOPHIS
25. SALAMANDER
26. AXOLOTYL LARVA
27. NECTURUS
28. ALYTES
29. RHACOPHORUS
30. CALOTES ENTIRE
31. CALOTES- HYOID
32. CALOTES-PECTORAL AND PELVIC GIRDLE

33. DRACO
34. CHAMAELEON
35. PYTHON
36. KRAIT
37. COBRA
38. COBRA-POISON APPARATUS
39. PIGEON ENTIRE
40. PECTEN OF BIRD
41. PIGEON FORE AND HIND LIMBS
42. SYNSACRUM OF BIRD
43. OSTRICH
44. PROTOTHERIA- PLATYPUS
45. METATHERIA - OPOSSUM
46. EUTHERIA – BAT
47. RABBIT ENTIRE
48. RABBIT – PECTORAL AND PELVIC GIRDLE
49. SKULL OF RABBIT
50. SKULL OF DOG

SEMESTER III

UCZOD20 - CELL BIOLOGY AND BIOINSTRUMENTATION

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II	III	UCZOD20	Cell Biology and Bioinstrumentation.	Theory	Core	7	6	100

Objectives:

- To learn the structure and function of various cellular components.
- To learn the basic principle, working and application of instruments.

Course Outcomes:

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

CO1: Recall the cell theory, Distinguish between Prokaryotes and Eukaryotes.

CO2: Summarize the structure and functions of Cell Organelles.

CO3: Explain the structure and function of Nucleic acids.

CO4: Discuss the construction and applications of Microscopes, Centrifuges and Homogenizers.

CO5: Describe the types and applications of Chromatography and Electrophoresis.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	M	L	L
CO2	H	H	H	M	L	M
CO3	H	H	H	M	L	L
CO4	H	H	H	H	L	H
CO5	H	H	H	H	L	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	L
CO2	H	M	H	L	M	H
CO3	H	H	H	L	M	L
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

Unit 1: Cell Biology: **(21 Hours)**

1.1: Introduction to cell biology. (K1, K2)

1.2: Brief account on cell theory. (K1, K2)

1.3: Prokaryotes – PPLO. (K1, K2)

1.4: Eukaryotes- animal cell (Structure and Comparison). (K1, K2, K3)

1.5: Cell cycle. Cell division- Mitosis - Meiosis. (K1, K2, K3)

1.6: Structure and functions of Cell organelles - Cell membrane. (K1, K2, K3)

Unit 2: **(21 Hours)**

2.1: Structure and functions of Cell organelles - Mitochondria, Golgi complex.(K1, K2, K3, K4)
2.2: Structure and functions of Cell organelles- Endoplasmic reticulum, Ribosomes.(K1, K2, K3, K4)
2.3: Structure and functions of Cell organelles- Lysosome and Centriole. (K1, K2, K3, K4)
2.4: Structure and functions of Cell organelles- Nucleus and Nucleolus. (K1, K2, K3, K4)
2.5: Structure and functions of Cell organelles -Chromosomes. (K1, K2, K3, K4)
2.6: Structure and functions of Cell organelles -Giant Chromosomes-Polytene-Lamp brush chromosome. (K1, K2, K3, K4)

Unit 3: **(21 Hours)**

3.1: Nucleic acids: DNA- Ultra structure. (K1, K2, K3, K4)
3.2: DNA Replication. (K1, K2, K3, K4)
3.3: RNA – Structure and types. (K1, K2, K3, K4)
3.4: Genetic code. (K1, K2, K3, K4)
3.5: Protein synthesis. (K1, K2, K3, K4)
3.6: Gene regulation - Lac operon. (K1, K2, K3, K4)

Unit 4: Bioinstrumentation: **(21 Hours)**

4.1: Principle, construction and application of– Compound microscope. (K1, K2, K3)
4.2: Principle, construction and application of– Inverted Microscope. (K1, K2, K3)
4.3: Principle, construction and application of– TEM. (K1, K2, K3)
4.4: Principle, construction and application of– SEM. (K1, K2, K3)
4.5: Principle, construction and application of– Centrifuge-Ultracentrifuge- Differential centrifugation. (K1, K2, K3)
4.6: Cell Homogenization – Fractionation. (K1, K2, K3)

Unit 5: **(21 Hours)**

5.1: Chromatography – Paper. (K1, K2, K3)
5.2: Thin layer and Column. (K1, K2, K3)
5.3: HPLC. (K1, K2, K3, K4)
5.4: Electrophoresis – SDS PAGE Gel electrophoresis. (K1, K2, K3, K4)
5.5: Disc-gel electrophoresis. (K1, K2, K3, K4)
5.6: Immuno-electrophoresis. (K1, K2, K3)

Books for study and reference:

Textbooks:

1. Verma P.S. and V.K. Agarwal – Cytology - Chand and Co., New Delhi, Revised Edition, 2015
2. M. Prakash, C.K. Arora - Microscopical Methods - Anmol Publications Pvt. Ltd., First Edition 1998.

Reference Books:

3. Philip Sheeler, Donald E. Bianchi - Cell and Molecular Biology - John Wiley and Sons, Inc, 3rd Edition, 1987.
4. E.D.P.De Robertis, E.M.F.De Robertis Jr. - Cell and Molecular Biology – Indian Edition, B.I. Publications Pvt. Ltd. 8th Ed. 2005
5. Bruce Alberts, Julian Lewis- Molecular Biology of the Cell- Taylor and Francis 5th Edition, 2008
6. A.G.E. Pearse - Histochemistry, Theoretical and Applied, Volume One: Preparative and Optical Technology - Churchill Livingstone, 4th Edition 1980.
7. M. Prakash, C.K. Arora - Laboratory Instrumentation - Anmol Publications Pvt. Ltd. First edition, 1998.

E-Resources:

https://www.britannica.com
https://www.microscopemaster.com
https://www.ascb.org
http://www.ibiblio.org/virtualcell/index.htm

SEMESTER IV

UCZOE20 – GENETICS AND EVOLUTION

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II	IV	UCZOE20	Genetics and Evolution	Theory	Core	5	4	100

Objectives:

- To learn the basics of Genes, heredity and variations.
- To learn the evolution of life and speciation.

Course Outcomes:

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

CO1: Demonstrate the Mendelian inheritance. Understand the genetic interactions.

CO2: Discuss Linkage, Crossing over, cytoplasmic inheritance and sex determination.

CO3: Analyze the types of Gene Mutation, Chromosomal aberrations, syndromes and inborn errors in metabolism.

CO4: Explain Population Genetics

CO5: Recall the theories of Evolution, adaptations and human evolution.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	M	L
CO2	H	H	L	L	L	L
CO3	H	H	L	M	M	M
CO4	H	H	L	M	L	L
CO5	H	H	L	L	M	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	H	L
CO2	H	H	H	H	M	L
CO3	H	H	H	M	M	M
CO4	H	H	H	H	M	L
CO5	H	H	H	H	H	M

Unit 1: Genetics: (15 Hours.)

1.1: Mendel's work. (K1, K2, K3)

1.2: Monohybrid cross and modifications of ratio. (K1, K2, K3)

1.3: Law of segregation. Law of independent assortment. (K1, K2, K3)

1.4: Dihybrid cross and modifications of ratio. (K1, K2, K3)

1.5: Genetic interactions- Epistasis, duplicate gene, complementary gene, atavism. (K1, K2, K3,K4)

1.6: Multiple alleles, blood grouping in man. (K1, K2, K3, K4)

Unit 2: **(15 Hours)**

2.1: Linkage and Crossing over. (K1, K2, K3, K4)
2.2: Sex linkage. (K1, K2, K3, K4)
2.3: Sex limited genes and sex influenced genes in Man. (K1, K2, K3, K4)
2.4: Cytoplasmic inheritance in Snail and Paramecium. (K1, K2, K3)
2.5: Non-disjunction and Gynandromorphs. (K1, K2, K3, K4)
2.6: Sex determination - Genic balance theory, theory of heterogenesis and environmental factors. (K1, K2, K3)

Unit 3: **(15 Hours)**

3.1: Gene mutation. (K1, K2, K3, K4)
3.2: Chromosomal aberrations. (K1, K2, K3, K4)
3.3: Genetic disorders – Chromosomal – Autosomal – Down Syndrome. (K1, K2, K3, K4)
3.4: Sex chromosomal – Turner's and Klinefelter's Syndrome. (K1, K2, K3, K4)
3.5: Inborn errors in Metabolism - Phenyl alanine metabolism. (K1, K2, K3, K4)
3.6: Genetic counseling. (K1, K2, K3, K4)

Unit 4: **(15 Hours)**

4.1: Gene Pool. (K1, K2, K3, K4)
4.2: Applied genetics: Population genetics. (K1, K2, K3, K4)
4.3: Hardy Weinberg Law. (K1, K2, K3)
4.4: Gene frequency, Factors affecting gene Frequency. (K1, K2, K3)
4.5: Pedigree Analysis. (K1, K2, K3, K4)
4.6: Eugenics, Euthenics and Euphenics. (K1, K2, K3)

Unit 5: Evolution: **(15 Hours)**

5.1: Theories of Evolution – Lamark. (K1, K2, K3)
5.2: Theories of Evolution - Darwin. (K1, K2, K3)
5.3: Mimicry. (K1, K2, K3)
5.4: Isolation and Speciation. (K1, K2, K3)
5.5: Evolution of Man. (K1, K2, K3)
5.6: Geological time. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Verma P.S. and V.K.Agarwal – Genetics - Chand and Co., New Delhi, 2006
2. Gopalakrishnan T.S. - Itta Sambasivaiah and A.P.Kamalakara Rao – Introduction to Genetics - Himalaya Publishing House, Bombay, 1996.

Reference Books:

3. Gardner - Principles of Genetics - Wiley Eastern Pvt. Ltd., 8th Edition, 2013.
4. Benjamin Lewin - Genes VII- Oxford University Press, 2000.
5. Philip Sheeler, Donald E. Bianchi - Cell and Molecular Biology - John Wiley and Sons, Inc, 3rd Edition, 1987.
6. E.D.P.De Robertis, E.M.F.De Robertis Jr. - Cell and Molecular Biology - Lea and Febiger, 2005.
7. T.S Gopalakrishnan, Itta Sambasivaiah, A P Kamalakara Rao -Principles of Organic evolution- Pearl Publications, 1983.
8. Kavitha- Organic Evolution - A.I.T.B.S Publishers India, 2009.
9. N. Arumugam - Organic Evolution - Saras Publications, 2005.
10. Bernard Wood- Human Evolution- A very short Introduction, Oxford University Press, 2005.

E-Resources:

https://ghr.nlm.nih.gov
https://www.genetics.org
https://ncse.ngo
http://www.evolutionoftheweb.com
https://evolution.berkeley.edu/evolibrary/home.php

SEMESTER III & IV- CORE PRACTICAL II

UCZOF20 - CELL BIOLOGY, BIOINSTRUMENTATION AND GENETICS

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II	III &IV	UCZOF20	Core Practical-II	Practical	Core	3	4	100

Objectives:

- To obtain practical skills in preparation of slides and basic hematological techniques.
- To learn about cell organelles and nucleic acid.
- To understand the principles in genetics and bioinstrumentation.

Course Outcomes:

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

CO1: Observe the structure of different types of tissue and the stages of cell division.

CO2: Demonstrate preparation of buccal smear and squash preparation of onion root tip.

CO3: Demonstrate the skill of focusing, calibrating a microscope and learn the principle, working of laboratory instruments.

CO4: Enumerate the Differential count of WBC, total count of WBC and RBC. Identify the blood group, simple Mendelian traits and syndromes.

CO5: Observe and study the life cycle of drosophila, polytene giant chromosome and the common mutants.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	M
CO2	H	H	H	L	M	M
CO3	H	H	H	M	M	M
CO4	H	H	H	M	M	M
CO5	H	H	H	L	M	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	H	M
CO2	H	H	H	L	H	M
CO3	H	H	H	L	H	H
CO4	H	H	H	L	H	H
CO5	H	H	H	L	H	M

CELL BIOLOGY

1. Spotters: Tissue slides – T. S. of bone, striated, non – striated and cardiac muscles, Neuron, ciliated epithelium, columnar epithelium, germinal epithelium-Human sperm and ovum.
2. Mitosis: Squash preparation of Onion root tip.
3. Meiosis: Slides
4. Buccal epithelium - smear preparation.

5. Micrometry.
6. Camera Lucida.
7. Total Count of RBC.
8. Total Count of WBC.
9. Differential Count of WBC.
10. Structure of DNA – Model.
11. Structure of rRna, mRNA, tRNA- Charts.
12. Structure and function of cell organells- 80s Ribosome, Golgi Body, Centriole, Mitochondria- Chart.
13. Bioinstrumentation – Homogenizer, Centrifuge, Gel Electrophoresis, Light Microscope, TEM, SEM.

GENETICS

14. ABO blood grouping and Rh typing.
15. Study of Simple Mendelian traits in Human – Any 2 traits.
16. Karyotypic study of Syndromes: Klinefeiter's syndrome, Turners syndrome and Down syndrome- Chart.
17. Giant chromosome of Chironomous larva- Permanent Slide.
18. Drosophila mutants - vestigial wing, white eye, yellow body.
19. Drosophila medium preparation and observation of life cycle.
20. Drosophila male and female.

SEMESTER V

UCZOG20 - DEVELOPMENTAL BIOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UCZOG20	Developmental Biology	Theory	Core	5	5	100

Objectives:

- To study the process of development from germ cell to individual.
- To study the recent advancements in the reproductive biology.

Course Outcomes:

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

CO1: Discuss gametogenesis and types of eggs and egg membranes.
CO2: Explain the mechanism and physiology of Fertilization, parthenogenesis and cleavage.
CO3: Explain gastrulation and organogenesis in mammals.
CO4: Discuss human reproduction
CO5: Discuss Assisted Reproductive Technologies.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	L	L
CO2	H	H	L	M	L	L
CO3	H	H	L	M	L	L
CO4	H	H	L	M	L	L
CO5	H	H	H	H	H	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	H	M	L	M
CO2	H	M	H	M	L	M
CO3	H	M	H	M	L	M
CO4	H	M	H	M	L	M
CO5	H	M	H	L	M	M

Unit I: **(15 Hours)**

1.1: Introduction and history of Developmental Biology. (K1, K2, K3)
1.2: Spermatogenesis. (K1, K2, K3)
1.3: Oogenesis. (K1, K2, K3)
1.4: Eggs-Types of eggs. (K1, K2, K3)
1.5: Polarity and symmetry of eggs. (K1, K2, K3)
1.6: Egg membranes- Extra embryonic membranes in Chick. (K1, K2, K3)

Unit II: **(15 Hours)**

2.1: Fertilization – Mechanism. (K1, K2, K3)
2.2: Physiology of Fertilization. (K1, K2, K3)
2.3: Theories of Fertilization. (K1, K2, K3)

2.4: Experimental works of Spemann and Mangold. (K1, K2, K3)
2.5: Parthenogenesis. (K1, K2, K3)
2.6: Cleavage. (K1, K2, K3)

Unit III: **(15 Hours)**

3.1: Fate map. (K1, K2, K3,K4)
3.2: Morphogenetic movements and Gastrulation in Mammals. (K1, K2, K3)
3.3: Organogenesis in Mammal – Development of eye. (K1, K2, K3)
3.4: Development of Ear. (K1, K2, K3)
3.5: Development of Brain. (K1, K2, K3)
3.6: Development of Heart. (K1, K2, K3)

Unit IV: **(15 Hours)**

4.1: Human reproduction - Puberty, Menstrual cycle and Menopause. (K1, K2, K3)
4.2: Classification of Placenta. (K1, K2, K3)
4.3: Placenta in Mammals. (K1, K2, K3)
4.4: Hormonal changes in pregnancy. (K1, K2, K3)
4.5: Parturition and Lactation. (K1, K2, K3)
4.6: Contraception- Merits- Demerits. (K1, K2, K3)

Unit V: **(15 Hours)**

5.1: Assisted Reproductive Technology. (K1, K2, K3, K4)
5.2: Super Ovulation. Artificial insemination. (K1, K2, K3, K4)
5.3: Cryopreservation. (K1, K2, K3, K4)
5.4: In Vitro Fertilization (IVF), Test tube babies, Embryo transfer. (K1, K2, K3, K4)
5.5: Amniocentesis. (K1, K2, K3, K4)
5.6: Bio ethics. (K1, K2, K3, K4)

Books for Reference:

Textbooks:

1. P.S.Verma, V.K. Agarwal and Tyagi - Chordate Embryology, S.Chand and Co.,New Delhi 2007.
2. Arumugam N. - Developmental Biology- Saras Publication-15th edition 2014.

Reference Books:

3. Balinsky B.L - Introduction to Embryology, 5th Edition. First Indian, Reprint 2012.
4. Mohan P.Arora –Embryology- Himalaya Publishing House, 2011.
5. Veer Bala Rastogi, Jayaraj- Developmental Biology,2nd Edition, Kedar Nath Ram Nath. 1994.
6. Robert S. Mcewen- Vertebrate Embryology, 4th Edition, Oxford & IBH Publishing Co. 1949.
7. Bradley M.Patten, Bruce M. Carlson-Foundations of Embryology, 3rd Edition. Tata McGraw Hill Publishing Company Ltd. 1977.

E-Resources:

https://www.sdbonline.org
https://embryology.med.unsw.edu.au
http://www.embryology.ch
https://human-embryology.org

SEMESTER V

UCZOH20 – PHYSIOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UCZOH20	Physiology	Theory	Core	4	4	100

Objectives:

- To understand and appreciate the structure and function of organ systems.
- To study the basic physiological processes that supports life.

Course Outcomes:

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

CO1: Interpret digestion and metabolism.
CO2: Analyse the interaction between circulatory system and respiratory system.
CO3: Analyse the function of excretory system and illustrate muscle contraction.
CO4: Illustrate the structure and function of nervous system.
CO5: Compare the structure and function of endocrine system.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	M	L
CO2	H	H	L	M	M	L
CO3	H	H	L	M	M	L
CO4	H	H	L	M	M	L
CO5	H	H	L	M	M	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

Unit I: **(12 Hours)**

1.1: Introduction to Physiology. (K1, K2, K3)
1.2: Digestion- digestive system of man. (K1, K2, K3)
1.3: Process of digestion –absorption. (K1, K2, K3)
1.4: Metabolism of carbohydrate. (K1, K2, K3, K4)
1.5: Metabolism of protein. (K1, K2, K3, K4)
1.6: Metabolism of lipids. (K1, K2, K3, K4)

Unit II: **(12 Hours)**

2.1: Circulation - structure and function of heart. (K1, K2, K3)
2.2: Cardiac cycle-Cardiac rhythm- factors affecting it. (K1, K2, K3)
2.3: Properties of cardiac muscles. (K1, K2, K3)
2.4: Respiration – Respiratory system of man.(K1, K2, K3)

2.5: Mechanism of gaseous exchange. (K1, K2, K3)
2.6: Role of hemoglobin in respiration. (K1, K2, K3)

Unit III: (12 Hours)

3.1: Excretion -Structure of kidney and Nephron. (K1, K2, K3)
3.2: Physiology of urine formation. Hormonal regulation- urine formation. (K1, K2, K3)
3.3: Osmo- Iono regulation in man. (K1, K2, K3)
3.4: Muscles-Types of muscles. (K1, K2, K3)
3.5: Ultrastructure of skeletal muscle-composition. (K1, K2, K3)
3.6: Contraction – theories of contraction. (K1, K2, K3)

Unit IV: (12 Hours)

4.1: Nervous system –Components of CNS. (K1, K2, K3)
4.2: Structure of human brain. (K1, K2, K3)
4.3: Structure of neuron, nerve impulse. (K1, K2, K3)
4.4: Synaptic transmission, neurotransmitters. (K1, K2, K3, K4)
4.5: Physiology of vision. (K1, K2, K3)
4.6: Physiology of hearing. (K1, K2, K3)

Unit V: (12 Hours)

5.1: Endocrine system- Hypothalamus. (K1, K2, K3)
5.2: Structure and function of pituitary gland. (K1, K2, K3)
5.3: Structure and function of thyroid gland. (K1, K2, K3)
5.4: Structure and function of adrenal gland. (K1, K2, K3)
5.5: Structure and function of pancreas. (K1, K2, K3)
5.6: Sex hormones – estrogen and testosterone. (K1, K2, K3)

Books for Study and Reference:

Text Books:

1. P.S Verma, B.S Tyagi and VK. Agarwal- Animal Physiology -S.Chand and Co., Ltd, New Delhi, 1990.
2. Parameswaran, Anantakrishnan and Ananta subramanian - Outlines of Animal Physiology - S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1975.
3. N. Arumugam and A MariakuttikanSaras Publication; 12th edition , January 2019.

Reference Book:

4. Sambasivaiah, Kamalakara Rao and Augustine Chellappa - A Textbook of Animal Physiology and Ecology - S.Chand and Co., Ltd, New Delhi, 1990.
5. William S.Hoar - General and Comparative Physiology - Prentice Hall of India Pvt., Ltd., New Delhi, 1976.
6. Wood D.W. - Principles of Animal Physiology, 3rd Edition, 1983.
7. Prosser C.L. - Comparative Animal Physiology - Satish Book Enterprise, Agra, 1985.

E-Resources:

https://www.physoc.org/exPSOre-physiology
https://www.physiology.org
https://www.innerbody.com/htm

SEMESTER V

UCZOI20 – BIOSTATISTICS

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UCZOI20	Biostatistics	Theory	Core	4	4	100

Objectives:

- To understand the basic concepts and application of biostatistics
- To understand the application of biostatistics in research findings

Course Outcomes:

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

CO1: Identify and collect different types of data and select samples for biological studies

CO2: Classify and tabulate the data and present them diagrammatically and graphically

CO3: Discuss theoretical distribution. Compute mean, median and mode.

CO4: Explain and compute measures of dispersion.

CO5: Compute t-test; F-test; Chi square test for biological studies.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	H	M	H	L	L
CO2	L	H	H	H	L	M
CO3	L	H	H	H	L	L
CO4	L	H	H	H	L	L
CO5	L	H	H	H	L	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	L	M	M
CO3	H	H	H	L	M	M
CO4	H	H	H	L	M	L
CO5	H	H	H	M	M	L

Unit I: **(12 Hours)**

1.1: Biostatistics- Introduction, Definition and Scope. (K1, K2, K3)

1.2: Data Types of data- Raw data, Primary data, Secondary data. (K1, K2, K3)

1.3: Methods of collection of data. (K1, K2, K3, K4)

1.4: Constants and Variables - Discrete variables and continuous variables. (K1, K2, K3)

1.5: Sample- Need for sampling – Advantages and Disadvantages. (K1, K2, K3)

1.6: Methods of Sampling. (K1, K2, K3, K4)

Unit II: **(12 Hours)**

2.1: Classification of Data- Types of Classification- Quantitative, Qualitative, Geographical, Chronological. (K1, K2, K3)

2.2: Tabulation- Components of Table. (K1, K2, K3)

2.3: Types of Tabulation- Simple, Complex, General and Special Purpose. (K1, K2, K3)

2.4: Diagrams- Types- Line, Pie, Bar simple, subdivided, multiple, percentage bar diagrams. (K1, K2, K3, K4)

2.5: Graphs- Types- Graph of time series- Line, Range Chart, Band Graph. (K1, K2, K3, K4)

2.6: Graph of frequency distribution- Histogram, Polygon, Cumulative frequency curve, Ogive. (K1, K2, K3, K4)

Unit III: **(12 Hours)**

3.1: Theoretical (Frequency) distribution. Normal, Poisson and Binomial. (K1, K2, K3)

3.2: Measures of Central Tendency: Simple Arithmetic Mean, Median, Mode. (K1, K2, K3)

3.3: Mean-Individual and Grouped Observation, Discrete series. (K1, K2, K3, K4)

3.4: Mean-Continuous series. (K1, K2, K3, K4)

3.5: Median - Individual and Grouped Observation- Discrete series, Continuous series. (K1, K2, K3, K4)

3.6: Mode Individual Observation, Continuous series. (K1, K2, K3, K4)

Unit IV: **(12 Hours)**

4.1: Dispersion- Measures of Dispersion- Absolute and Relative measures of dispersion. (K1, K2, K3)

4.2: Methods of measuring Dispersion. (K1, K2, K3, K4)

4.3: Mean Deviation- Individual and Grouped Observation, Discrete series, Continuous series. (K1, K2, K3, K4)

4.4: Standard Deviation - Individual and Grouped Observation-Discrete series.(K1, K2, K3, K4)

4.5: Standard Deviation - Continuous series. (K1, K2, K3, K4)

4.6: Standard Error -Coefficient of Variation. (K1, K2, K3, K4)

Unit V: **(12 Hours)**

5.1: Hypothesis Testing Test for significance Small and Large samples. (K1, K2, K3)

5.2: Student's t test - Test for Significance of Means of Sample. (K1, K2, K3, K4)

5.3: Test for Significance of Difference between Two Sample mean. (K1, K2, K3, K4)

5.4: The Variance Ratio- F test (K1, K2, K3, K4)

5.5: Chi Square test and its significance. (K1, K2, K3, K4)

5.6: Contingency table – degree of freedom. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Palanichamy, S., Manoharan, M., Statistical Methods for Biologists, Palani Paramount Publications, 1999.
2. Gurumani, N., An Introduction to Biostatistics –N. 2nd edition. MJP Publishers, Chennai, 2008.

Reference Books:

3. Alwin, E. Lewis, Biostatistics, East West Press, 1971.
4. Visweswara Rao K –Biostatistics- Jaypee Publication New Delhi1996.
5. Rangaswamy, R. A Textbook of Agricultural Statistics New Age International Publishers Ltd., Wiley Eastern Ltd, 1995. .
6. Das, NG., Statistical Methods (Vol. II), Tata McGrawHill Publishing Company Ltd., 2009.
7. Pranab Kumar Banerjee, - Introduction to Biostatistics, S. Chand Revised Edition. 2015.
8. Bernard Rosner - Fundamentals of Biostatistics 5th edition – Duxbury Thomson Learning, USA 2000.
9. Clifford Blair R., Richard A. Taylor -Biostatistics for the Health Sciences – (Indian edition) Dorling Kindersley India Pvt. Ltd., New Delhi 2009.

E-Resources:

https://www.biostat.washington.edu
https://www.statistics.com
https://bms.ucsf.edu

SEMESTER VI

UCZOJ20 – BIOTECHNOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UCZOJ20	Biotechnology	Theory	Core	4	4	100

Objective:

- To learn the basics of biotechnology this is the integration of biology and technology
- To study the application of the subject in various fields

Course Outcomes:

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

CO1: Explain the scope and branches of Biotechnology and summarize Genetic Engineering.

CO2: Describe Cloning strategies.

CO3: Explain Gene transfer mechanism and Blotting Techniques.

CO4: Demonstrate Animal Cell Culture and explain the applications of cell culture.

CO5: Discuss the applications of Genetic Engineering in various fields.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	L	L
CO2	H	H	H	H	M	M
CO3	H	H	H	H	L	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	H	M
CO2	H	H	H	L	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	H	H

Unit I: **(12 Hours)**

1.1: Biotechnology – Introduction, Scope and importance. (K1, K2, K3)
1.2: Definition and Branches of Biotechnology. (K1, K2, K3)
1.3: DNA Structure and Composition. (K1, K2, K3, K4)
1.4: Introduction to Gene. (K1, K2, K3, K4)
1.5: Introduction to Genetic Engineering. (K1, K2, K3)
1.6: Methodology of Genetic Engineering. (K1, K2, K3, K4)

Unit II: **(12 Hours)**

2.1: Gene cloning – Cloning Strategies. Restriction Endonucleases. (K1, K2, K3, K4)
2.2: Cloning Vectors Plasmids – pBR322. (K1, K2, K3, K4)

2.3: Bacteriophages Lambda Phage. (K1, K2, K3, K4)
2.4: Cosmids – YAC. (K1, K2, K3, K4)
2.5: Ligases, Linkers and Adaptors, (K1, K2, K3, K4)
2.6: rDNA Technology – Construction of rDNA. (K1, K2, K3, K4)

Unit III: (12 Hours)

3.1: Gene Transfer Mechanism- Transformation, Transfection, Microinjection, Electroporation, Biolistics. Colony Hybridization, Plaque Hybridization. (K1, K2, K3, K4)
3.2: Expression of Cloned Genes. (K1, K2, K3, K4)
3.3: Sanger's Method of DNA Sequencing. (K1, K2, K3, K4)
3.4: Genomic Library; cDNA Library. (K1, K2, K3, K4)
3.5: Blotting Techniques Southern, Western, Northern Techniques. (K1, K2, K3, K4)
3.6: PCR and its Applications. (K1, K2, K3, K4)

Unit IV: (12 Hours)

4.1: Animal Cell Culture –Requirements of Cell Culture. Laboratory Equipments. (K1, K2, K3, K4)
4.2: Culture Media. (K1, K2, K3, K4)
4.3: Tissue Disaggregation; Primary and Secondary Cell Culture. (K1, K2, K3, K4)
4.4: Establishment of Cell Line –Monolayer Culture, Suspension Culture. (K1, K2, K3, K4)
4.5: Methods of Culture – Petridish, Test Tube, Flask Culture. (K1, K2, K3, K4)
4.6: Applications of Cell Culture. (K1, K2, K3, K4)

Unit V: (12 Hours)

5.1: Applications of Genetic Engineering in Medicine. (K1, K2, K3, K4)
5.2: Applications of Genetic Engineering in Agriculture. (K1, K2, K3, K4)
5.3: Applications of Genetic Engineering in Industry. (K1, K2, K3, K4)
5.4: SCP- Production of Spirullina. (K1, K2, K3, K4)
5.5: Genetically Modified Organisms- Transgenic Fish and Sheep. (K1, K2, K3, K4)
5.6: Introduction to Databases – Gen Bank, EMBL, DDBJ. (K1, K2, K3, K4)

Books for Study and Reference:

Textbooks:

1. Gupta P.K. Elements of Biotechnology Rastogi Publications, Meerut, 2001.
2. Dubey, R.C. Textbook of Biotechnology S. Chand and Co., New Delhi, 1993.

Reference Books:

3. James D. Watson, Gilman- Recombinant DNA- Scientific American Books, 2001
4. Purohit S.S., Mathur S.K. Fundamentals of Biotechnology Agrobotanical Publishers, Bikaner, India, 1990.
5. Dubey R.C.- Advanced Biotechnology, S.Chand and Company Pvt. Ltd. New Delhi, 2014.
6. Prakash S Lohar.- Textbook of Biotechnology- MJP Publishers, 2012.
7. Nicholl S.T. An Introduction to Genetic Engineering Cambridge University Press, London, 2005.
8. Satyanarayana-Biotechnology-New Delhi, Book and Allied Private Ltd.

E-Resources:

https://www.biointeractive.org
https://www.bio.org
https://www.ncbi.nlm.nih.gov

SEMESTER VI

UCZOK20- ENVIRONMENTAL BIOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UCZOK20	Environmental Biology	Theory	Core	4	3	100

Objectives:

- To understand the network of the surrounding and other organism.
- To protect the environment and to use the resources sustainably.

Course Outcomes:

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

CO1: Explain ecology its branches and abiotic and biotic components of ecosystem.
CO2: Discuss animal association, biogeochemical cycle and Ecosystem and its functions.
CO3: Discuss the structure and functions of terrestrial and aquatic ecosystems.
CO4: Describe the Characteristics of population, Community and Ecological Succession
CO5: Discuss the causes of pollution their control measures and wildlife management.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	M	M
CO2	H	H	M	H	H	M
CO3	H	H	M	H	H	M
CO4	H	H	M	H	H	M
CO5	H	H	M	H	H	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	H	H	M	M
CO2	H	H	H	H	H	M
CO3	H	H	H	H	H	M
CO4	H	H	H	H	H	M
CO5	H	H	H	H	H	H

Unit I: **(12 Hours)**

1.1: Definition, Branches- Autecology – Synecology- Integrated. (K1, K2, K3)
1.2: Abiotic factors: Temperature-Thermal stratification. Range of Temperature tolerance, Effect of temperature on Plants and animals. (K1, K2, K3)
1.3: Light-Biological effects of light on plants and animals. (K1, K2, K3)
1.4: Water-Types and properties. (K1, K2, K3)
1.5: Soil- Soil profile-Pedogenesis. (K1, K2, K3)
1.6: Atmosphere- layers and functions. (K1, K2, K3)

Unit II: **(12 Hours)**

2.1: Biotic factors: Intra and inter specific animal associations. (K1, K2, K3)

2.2: Biogeochemical cycles- Water, Carbon, Nitrogen, Phosphorus. (K1, K2, K3)
2.3: Structure of Ecosystem and functions. (K1, K2, K3, K4)
2.4: Energy flow, Productivity-primary and secondary. (K1, K2, K3, K4)
2.5: Ecological pyramids, food chain and food web. (K1, K2, K3, K4)
2.6: Decomposition and homeostasis.

Unit III: **(12 Hours)**

3.1: Terrestrial habitat-characters of biome, Tundra, Forest, Deserts. (K1, K2, K3)
3.2: Fresh water habitat-physico chemical nature. (K1, K2, K3, K4)
3.3: Adaptation of animals in lentic and lotic habitat. (K1, K2, K3)
3.4: Marine ecology-Characteristics, Zonation and stratification. (K1, K2, K3)
3.5: Inter-tidal zone (Rocky, Sandy & Muddy shore). (K1, K2, K3)
3.6: Mangroves. (K1, K2, K3)

Unit IV: **(12 Hours)**

4.1: Definition, characteristics-Density, Natality, Mortality. (K1, K2, K3)
4.2: Survivorship curves, Age pyramids. (K1, K2, K3)
4.3: Carrying capacity, Fluctuations, Equilibrium. (K1, K2, K3)
4.4: Population growth, Population dispersal, Density dependent factors. (K1, K2, K3)
4.5: Ecotone and Edge effect. (K1, K2, K3)
4.6: Ecological succession. (K1, K2, K3)

Unit V: **(12 Hours)**

5.1: Pollution- Causes and control- Air. (K1, K2, K3, K4)
5.2: Water, soil pollutions. (K1, K2, K3, K4)
5.3: Greenhouse effect, Global warming, Acid rains. (K1, K2, K3, K4)
5.4: Water treatment. (K1, K2, K3, K4)
5.5: Wild life conservation and its Management. (K1, K2, K3, K4)
5.6: Red data book, National parks and Wild life sanctuaries. (K1, K2, K3, K4)

Books for Study and Reference:

Textbooks:

1. Verma, P.S. and V.K. Agarwal- Environmental Biology, S. Chand & Co. Ltd, 1986.
2. Rastogi V.B. and M.S. Jayaraj- Animal Ecology and distribution of animals, Kedar Nath Ram Nath, Meerut-250 001, 1988-89.

Reference Books:

3. Clarke, G.L.- Elements of Ecology, John Wiley & Sons Inc, New York, London, 1954.
4. Eugene P. Odum- Fundamentals of Ecology, Saunders International Student Edition, W. B Saunders Company, Philadelphia, London, Toronto,1971.
5. Kotpal, R.L and N.P- Basic Concepts of Ecology, Vishal Publications, Delhi,1986.
6. Biswarup Mukherjee - Environmental Biology, Tata McGraw-Hill Publishing Company Ltd. New Delhi,1997.
7. Asthana, D.K. and Asthana, M- Environmental problems and solutions. S. Chand and Co., New Delhi, 2001.

E-Resources:

http://www.enviroindia.net
http://aelsindia.com
http://environment-ecology.com

SEMESTER V

UEZOA20- MAJOR ELECTIVE I A: ECONOMIC ZOOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UEZOA20	Economic Zoology	Theory	Core Elective	5	5	100

Objectives:

- To learn the economic importance of animals
- To motivate the students to become entrepreneurs

Course Outcomes:

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

CO1: Demonstrate culture techniques of apiculture, sericulture, lac culture and vermiculture.
CO2: Illustrate the preparation and management of fish culture ponds.
CO3: Differentiate breeds of fowl and describe poultry and piggery management.
CO4: Discuss Dairy farming and tanning process.
CO5: Explain processing of wool, fur and obtains insight of pharmaceutical products from animals.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

Unit I: **(15 Hours)**

1.1: Introduction- Culture methods- equipments – Apiculture. (K1, K2, K3)
1.2: Apiculture- Products- disease and control measures. (K1, K2, K3)
1.3: Culture methods- equipments Sericulture. (K1, K2, K3)
1.4: Products- disease and control measures in Sericulture. (K1, K2, K3)
1.5: Culture methods- equipments Vermiculture. (K1, K2, K3)
1.6: Culture methods- equipments Lac culture. (K1, K2, K3)

Unit II: **(15 Hours)**

2.1: Aquaculture-fresh water fishery-farm management. Seed collection-culture techniques.(K1,K2,K3)

2.2: Edible fishes. Equipments, nets and traps. (K1, K2, K3)
2.3: Marine fish culture. (K1, K2, K3)
2.4: Prawn culture. (K1, K2, K3)
2.5: Pearl culture. (K1, K2, K3)
2.6: By products of fishing industry- Diseases of Fish and prawn. (K1, K2, K3)

Unit III: **(15 Hours)**

3.1: Poultry management – breeds of fowls - selection of breeds. (K1, K2, K3)
3.2: Fowl house – types of rearing – feeds. (K1, K2, K3)
3.3: Poultry products. (K1, K2, K3)
3.4: Preservation of eggs-by products of egg. (K1, K2, K3, K4)
3.5: Disease of fowls and control. (K1, K2, K3)
3.6: Piggery industry and byproducts. (K1, K2, K3)

Unit IV: **(15 Hours)**

4.1: Dairy farming - breeds of milch animals. (K1, K2, K3)
4.2: Housing. (K1, K2, K3)
4.3: Feeds. (K1, K2, K3)
4.4: Disease and control. (K1, K2, K3)
4.5: Leather industry -processing of leather. (K1, K2, K3)
4.6: Tanning - oil and chrome tanning - finishing. (K1, K2, K3)

Unit V: **(15 Hours)**

5.1: Wool – properties. (K1, K2, K3)
5.2: Wool- processing. (K1, K2, K3)
5.3: Fur industry – fur bearing animals. (K1, K2, K3)
5.4: Processing of fur. (K1, K2, K3)
5.5: Care of fur products. (K1, K2, K3)
5.6: Pharmaceutical products from animals. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Ahsan J., and Sinha SP- Handbook of Economic zoology, S. Chand and Co., New Delhi, 2009.
2. Shukla GS, and Upadhyay SP- Economic Zoology, Ratogi Publication, Meerut, 1994.

Reference Books:

3. Mary Violet Christy A-Vermitechnology, MJP Publication Chennai,1976.
4. Ayyar TVT- Handbook of Economic Entomology for South India, Govt press, Madras, 1963.
5. Jhinghran VG- Fish and fisheries of India, Hindustan Publishing Corp., New Delhi, 1982.
6. Jawaid Ahgan, Subhas Prasad Sinha- A Hand book on Economic Zoology, S. Chand & Co. Ltd., New Delhi, 2000.

E-Resources:

http://csb.gov.in
http://www.fao.org
http://nfdb.gov.in

SMESTER V

UEZOB20 – MAJOR ELECTIVE IB: VERMICULTURE

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UEZOB20	Vermiculture	Theory	Core Elective	5	5	100

Objectives:

- To learn the production and importance of organic fertilizers.
- To motivate students for self-employment.

Course Outcomes (CO):

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

CO1: Identify various groups of earthworms and impact of earthworm on soil.
CO2: Describe large and small scale composting methods.
CO3: Explain the factors affecting vermicomposting and preparation of vermibed.
CO4: Discuss the use of vermicompost and vermiwash in agriculture and horticulture.
CO5: Elaborate the role of earthworm in agriculture, fishing, medicine and pollution and promotion of vermiculture.

CO/PO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	H	H
CO2	H	H	H	M	H	H
CO3	H	H	H	M	H	H
CO4	H	H	H	M	H	H
CO5	H	H	H	M	H	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	M
CO2	H	H	H	H	H	M
CO3	H	H	H	H	H	M
CO4	H	H	H	H	H	M
CO5	H	H	H	H	H	M

Unit I: **(15 Hours)**

1.1: Introduction and scope of Vermiculture. (K1, K2, K3)
1.2: Ecological groups of earthworms – Epigeic, Endogeic, Anegic. (K1, K2, K3)
1.3: Varieties of Earthworm – Night crawlers – Field crawlers.(K1, K2, K3)
1.4: Manure worms – Red worms. (K1, K2, K3)
1.5: Physical and chemical effects of earthworm on soil.(K1, K2, K3)
1.6: Biological effects of earthworm on soil.(K1, K2, K3)

Unit II: **(15 Hours)**

2.1: Organic waste sources.(K1, K2, K3)
2.2: Vermi composting definition and methods.(K1, K2, K3)
2.3: Small scale Pit method.(K1, K2, K3)
2.4: Large scale pit method.(K1, K2, K3)
2.5: Four tanks method.(K1, K2, K3)
2.6: Two tank method. (K1, K2, K3)

Unit III: **(15 Hours)**

3.1: Factors affecting vermicomposting: pH.(K1, K2, K3)
3.2:Factors affecting vermicomposting Moisture, Temperature.(K1, K2, K3)
3.3: Factors affecting vermicomposting Light, location operation site.(K1, K2, K3)
3.4: Preparation of vermibed.(K1, K2, K3)
3.5: Collection of compost.(K1, K2, K3)
3.6: Separation of earthworm.(K1, K2, K3)

Unit IV: **(15 Hours)**

4.1: Application of vermicomposting in agriculture.(K1, K2, K3)
4.2: Application of vermicomposting horticulture practices.(K1, K2, K3)
4.3: Economics of Vermiculture.(K1, K2, K3)
4.4: Vermi wash.(K1, K2, K3)
4.5: Preparation of Vermiwash.(K1, K2, K3)
4.6: Uses of Vermi wash.(K1, K2, K3)

Unit V: **(15 Hours)**

5.1: Role of earthworm in agriculture.(K1, K2, K3)
5.2: Role of earthworm in fishing. (K1, K2, K3)
5.3: Role of earthworm in medicine.(K1, K2, K3)
5.4: Role of earthworm in pollution control.(K1, K2, K3)
5.5: Schemes and projects available for the promotion of Vermiculture.(K1, K2, K3)
5.6: Loans to start vermicomposting.(K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Edwards, C.A., and Bother, B.- Biology of Earthworms – Chapman Hall Publishers and Co., London, 1996.
2. Ismail, S.A.- Vermitechnology – The Biology of Earthworms- Orient Longman Publishers – India, 1997.

Reference Books:

3. Ranganathan, L.S- Vermibiotechnology from soil health to human health – Agrobios – India. 2006
4. Talashikar, S.C- Earthworms in Agriculture – Agrobios – India, 2008.
5. Gupta, P.K.- Vermicomposting for sustainable Agriculture (2nd Edition) – Agrobios – India, 2008.

E-Resources:

https://communitycrops.org
https://composting.ces.ncsu.edu
https://www.in.gov

SEMESTER VI

UEZOC20 – ELECTIVE - II A: MICROBIOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UEZOC20	Microbiology	Theory	Core Elective	5	5	100

Objectives:

- To study about the hidden world of microbes.
- To learn about the beneficial and harmful microbes.

Course Outcomes:

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

CO1: Describe the structure and function of bacteria and virus.
CO2: Apply the process of media preparation and bacterial culture.
CO3: Discuss the various sterilization techniques and chemotherapeutic agents.
CO4: Discuss the role of microbes in food production and preservation.
CO5: Discuss the disease causing microorganisms.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	L	L
CO2	H	H	H	M	L	L
CO3	M	H	H	M	M	L
CO4	H	H	H	M	L	M
CO5	H	H	L	M	L	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	L	H	M	M	M
CO2	H	H	H	M	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	L	M

Unit I: **(15 Hours)**

1.1: Introduction to Microbiology. (K1, K2, K3)

1.2: Shape and Morphological arrangements of Bacteria. (K1, K2, K3)

1.3: Structure – Cell Wall, Cytoplasmic Membrane, Flagella, Nucleoid. (K1, K2, K3)

1.4: Plasmid, Riobsomes, Capsule. (K1, K2, K3)

1.5: Gram staining positive and negative. (K1, K2, K3)

1.6: Fine structure of virus- T_4 Bacteriophage. (K1, K2, K3)

Unit II: **(15 Hours)**

2.1: Nutritional requirements of bacteria. (K1, K2, K3)

2.2: Culture Media- Agar- Blood and Beef. (K1, K2, K3)

2.3: Bacterial culture methods- Broth, Agar Plate, Agar Slant, Agar Stab, Roll Tube, Deep Media. (K1, K2, K3, K4)

2.4: Isolation of Pure culture- Serial Dilution Technique, Streak Plate Technique. (K1, K2, K3, K4)

2.5: Pour Plate Technique, Spread Plate Technique.

2.6: Maintenance of Bacterial Culture –Lyophilization, Cryopreservation by Liquid Nitrogen. (K1, K2, K3, K4)

Unit 3: **(15 Hours)**

3.1: Control of Microorganisms: Sterilization- Physical: Autoclaving; Tyndallization. (K1, K2, K3, K4)

3.2: Physical: Flaming; Filtrations; Laminar flow hood. (K1, K2, K3, K4)

3.3: Chemical methods: Acids and Alkalies. (K1, K2, K3, K4)

3.4: Halogens; Chlorine; Phenol and its derivatives. (K1, K2, K3, K4)

3.5: Alcohols; Dyes; Detergents; Heavy metals. (K1, K2, K3, K4)

3.6: Chemotherapy-Antibiotics. (K1, K2, K3, K4)

Unit 4: **(15 Hours)**

4.1: Microbiology of food: Role of microbes in food production. (K1, K2, K3, K4)

4.2: Non Dairy products - Meat and Fish Products. (K1, K2, K3, K4)

4.3: Fermented Vegetables- Bread. (K1, K2, K3, K4)

4.4: Alcoholic Beverages and Vinegar. (K1, K2, K3, K4)

4.5: Dairy Microbiology-Sources and Microorganisms in Milk, Pasteurization of milk, Dairy Products. (K1, K2, K3, K4)

4.6: Food poisoning and preservation. (K1, K2, K3, K4)

Unit 5: **(15 Hours)**

5.1: Microorganisms, pathogenesis and prophylaxis. (K1, K2, K3, K4)

5.2: Bacterial: *Mycobacterium tuberculosis* (K1, K2, K3, K4)

5.3: Bacterial: *Salmonella typhi.* (K1, K2, K3, K4)

5.4: Viral: Hepatitis B. (K1, K2, K3, K4)

5.5: Viral: H1N1. (K1, K2, K3, K4)

5.6: Fungal: *Candida albicans.* (K1, K2, K3, K4)

Books for Study and Reference:

Textbooks:

1. Powar C.B., Daginwala H.F. General Microbiology. Himlaya Publishing House. 2015.

2. Sharma P.D. - Microbiology - Rastogi Publication, 1998: 5th reprint, 2005-2006.

Reference Books:

3. Pelczar Jr. M. J. Chan E.C.S and Kreig N.R. - Microbiology - McGraw Hill Inc. New York, 2001.
4. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R. - General Microbiology - Macmillan Education Ltd, London, 1999.
5. Prescott L.M. Harley J.O Klein D.A. – Microbiology - WCB Publishers Sydney, 1990.
6. Ananthanaryanan T., Paniker J.C.K. - Textbook of Microbiology - Orient Longman Ltd., Madras, 2000.
7. Dubey, R.C., and Maheswari, D.K. - A text book of Microbiology. S.Chand and Co., New Delhi, 2007.

E-Resources:

https://microbe.net
https://asm.org
https://medicine.uiowa.edu

SEMESTER VI

UEZOD20 – ELECTIVE - II B: BIOINSTRUMENTATION

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UEZOD20	Bioinstrumentation	Theory	Core Elective	5	5	100

Objectives:

- To understand the principle, construction and application of instruments.
- To aid the students to understand the usage of the instruments in research.

Course Outcomes (CO):

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

CO1: Apply the principle and construction of the instruments.
CO2: Demonstrate the usage of the instruments.
CO3: Illustrate the working method of various techniques.
CO4: Discuss the application of the techniques.
CO5: Apply the skill of instrumentation and micro techniques.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	L	L
CO2	H	H	M	H	L	L
CO3	H	H	M	H	L	L
CO4	H	H	M	H	L	L
CO5	H	H	M	H	L	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	M	M
CO2	H	H	H	L	M	M
CO3	H	H	H	L	M	M
CO4	H	H	H	L	M	M
CO5	H	H	H	L	M	M

Unit I: **(15 Hours)**

1.1: Introduction.(K1, K2, K3)
1.2: Scope.(K1, K2, K3)
1.3: Importance and application of Bioinstrumentation.(K1, K2, K3)
1.4:Microscopes – Compound.(K1, K2, K3)
1.5: Fluorescent Microscope.(K1, K2, K3)
1.6: U-V Microscopes.(K1, K2, K3)

Unit II: **(15 Hours)**

2.1: TEM, and SEM.(K1, K2, K3, K4)
2.2: Phase contrast.(K1, K2, K3)
2.3: Ocular and stage micrometer.(K1, K2, K3)
2.4: Camera Lucida.(K1, K2, K3)

2.5: Cell homogenization- Fractionation.(K1, K2, K3)
2.6: Centrifugation and Isolation of Cellular components.(K1, K2, K3)

Unit III: **(15 Hours)**
3.1: Laboratory instruments- Autoclave, Hot air oven.(K1, K2, K3)
3.2: Water bath, Incubator.(K1, K2, K3)
3.3: Centrifuge, pH meter.(K1, K2, K3)
3.4: Spectrophotometer.(K1, K2, K3)
3.5: Hemoglobinometer, Hemocytometer.(K1, K2, K3)
3.6: Microtome.(K1, K2, K3)

Unit IV: **(15 Hours)**
4.1: Electrophoresis- Zone.(K1, K2, K3, K4)
4.2: Immunoelectrophoresis.(K1, K2, K3)
4.3: SDS PAGE.(K1, K2, K3)
4.4: Chromatography- Paper, Thin layer.(K1, K2, K3)
4.5: Ion exchange chromatography.(K1, K2, K3)
4.6: Gas chromatogrophy.(K1, K2, K3)

Unit V: **(15 Hours)**
5.1: Micro technique.(K1, K2, K3)
5.2: Fixation.(K1, K2, K3)
5.3: Dehydration.(K1, K2, K3)
5.4: Embedding.(K1, K2, K3)
5.5: Sectioning. (K1, K2, K3)
5.6: Staining.(K1, K2, K3)

Books for Study and Reference:

Textbooks:

1.M. Prakash, C.K. Arora- Laboratory instrumentation, Anmol publications pvt ltd. First edition, 1998.
2. L. Veerakumari –Bioinstrumentation-MJP Publisher- 2019.

Reference Books:

3. Philip Sheeler, Donald E. Bianchi- Cell and molecular biology, John Wiley & Sons, Inc, third edition, 1987.
3. A.G.E. Pearse. Churchill Livingstone Histochemistry, theoretical and applied. Volume one: Preparative and optical technology, fourth edition, 1980.
4. M. Prakash, C.K. Arora- Microscopically methods, Anmol publications pvt ltd. First edition, 1998. 4. L.R. Patki, B.L. Bhalchandra, I.H. Jeevaji.
5. An introduction to micro technique, S.Chand & Company ltd, 1989.

E-Resources:

https://bioeng.berkeley.edu
https://www.vanderbilt.edu
https://worldwidescience.org

SEMESTER VI

UEZOE20 – ELECTIVE -III A: IMMUNOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UEZOE20	Immunology	Theory	Core Elective	5	5	100

Objectives:

- To study the structure and function of immune system
- To understand the application of immunology in medical field

Course Outcomes:

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

CO1: Describe the primary and secondary lymphoid organs.

CO2: Categorize types of immunity and the cells involved in immunity.

CO3: Analyse the structure and function of antigens and antibodies.

CO4: Examine the antigen antibody reaction and its role in transplantation, hypersensitivity, autoimmunity and AIDS.

CO5: Analyse immunization and its importance in prevention of diseases.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	H	L	L
CO2	H	H	L	H	L	L
CO3	H	H	L	H	L	L
CO4	H	H	L	H	L	L
CO5	H	H	L	H	L	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	L	L	H
CO2	H	H	M	L	L	H
CO3	H	H	M	L	L	H
CO4	H	H	M	L	L	H
CO5	H	H	M	H	L	H

Unit I: **(15 Hours)**

1.1: History and scope. (K1, K2, K3)

1.2: Lymphoid organs. - Primary and secondary. (K1, K2, K3)

1.3: Structure and role - Bone marrow – Thymus. (K1, K2, K3)

1.4: Structure and role - Lymph node. (K1, K2, K3)

1.5: Structure and role - Spleen. (K1, K2, K3)

1.6: Structure and role - Payer's patches and Kuffer cells. (K1, K2, K3)

Unit II: **(15 Hours)**

2.1: Immunity types - Innate Active and Passive. (K1, K2, K3, K4)

2.2: Acquired Active and Passive. (K1, K2, K3, K4)
2.3: Characteristics of Immune response. (K1, K2, K3, K4)
2.4: Humoral and Cell mediated immunity. (K1, K2, K3, K4)
2.5: Cells involved in immune response – T. (K1, K2, K3, K4)
2.6: Cells involved in immune response - B Cells and Macrophages.(K1, K2, K3, K4)

Unit 3: (15 Hours)

3.1: Antibodies – functions.(K1, K2, K3)
3.2: Immunoglobulin - structure and functions. (K1, K2, K3, K4)
3.3: Human Immunoglobulin Classes. (K1, K2, K3)
3.4: Antigens- Types. (K1, K2, K3)
3.5: Epitopes, Paratopes. (K1, K2, K3)
3.6: Adjuvants. (K1, K2, K3).

Unit 4: (15 Hours)

4.1: Antigen Antibody reactions-Precipitation. (K1, K2, K3)
4.2: Agglutination, Cytolysis, Opsonization. (K1, K2, K3)
4.3: Transplantations and Graft rejections. (K1, K2, K3)
4.4: Hypersensitivity. (K1, K2, K3)
4.5: Autoimmunity. (K1, K2, K3)
4.6: AIDS/HIV. (K1, K2, K3)

Unit 5: (15 Hours)

5.1: Viral and parasitic infections. (K1, K2, K3)
5.2: Principles and Types of vaccines used in humans. (K1, K2, K3)
5.3: Clinical Immunology – Immunization schedule for children. (K1, K2, K3)
5.4: Prevention of diseases in new born babies/children- Whooping cough. (K1, K2, K3)
5.5: Mumps. (K1, K2, K3)
5.6: Measles and Rubella. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Dulsy Fatima and Arumugam – Immunology - Saras, Nagercoil, India, 1998.
2. S.K.Gupta- Essentials of Immunology – 2nd edition- Arya Publication
3. I. Kannan- Immunology- MJP Publishers- 2019

Reference Books:

4. Tizard I.R. – Immunology: An Introduction, IV Ed. - Saunders College, Publication, Philadelphia, 1995.
5. Janis Kuby, Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, W.H. Freeman and company - Immunology - sixth edition, 2007
6. Ivan M. Riot - Essentials of Immunology - Blackwell Scientific Publications, 2000.
7. Paul W.E.M. - Fundamental Immunology - Raven Press, New York, 1998

E-Resources:

https://www.immunology.org
https://www.ncbi.nlm.nih.gov
https://www.aai.org

SEMESTER VI

UEZOF20 - ELECTIVE - III B: PARASITOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UEZOF20	Parasitology	Theory	Core Elective	5	5	100

Objectives:

- To learn the life cycle, disease and treatment of various parasites of Human
- To create awareness about health and hygiene

Course Outcomes:

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

CO1: Discuss about parasites.
CO2: Describe host parasite interaction.
CO3: Discuss pathology of protozoan parasites.
CO4: Describe the pathology of Helminth parasites.
CO5: Explain Arthropod role as parasites and vectors.

CO/PO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	H	L
CO2	H	H	L	M	H	L
CO3	H	H	L	M	H	L
CO4	H	H	L	M	H	L
CO5	H	H	L	M	H	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	M
CO2	H	H	H	M	M	M
CO3	H	H	H	M	M	M
CO4	H	H	H	M	M	M
CO5	H	H	H	M	M	M

Unit 1: **(15 Hours)**

1.1: Terminology - nature of Parasitism.(K1, K2, K3)
1.2: Parasites and food habits.(K1, K2, K3)
1.3: Origin of parasitism-kinds of parasitism.(K1, K2, K3)
1.4: General relation to hosts.(K1, K2, K3)
1.5: Definitive and intermediate hosts.(K1, K2, K3)
1.6: Parasitic adaptation.(K1, K2, K3)

Unit 2: **(15 Hours)**

2.1: Effects of parasites on hosts.(K1, K2, K3)
2.2: Immunity.(K1, K2, K3)

2.3: Age resistance.(K1, K2, K3)
2.4: Tolerance to injurious effects.(K1, K2, K3)
2.5: Spread to new hosts.(K1, K2, K3, K4)
2.6: Community spread.(K1, K2, K3, K4)

Unit 3: (15 Hours)

3.1: Morphology, Life cycle, mode of infection, pathogenesis, treatment and prophylaxsis of Protozoan parasites – *Plasmodium vivax.*(K1, K2, K3)
3.2: *Entameoba histolitica.*(K1, K2, K3)
3.3: *Balantidium.*(K1, K2, K3)
3.4: *Leshmania.*(K1, K2, K3)
3.5: *Trypanosoma.*(K1, K2, K3)
3.6:*Giardia intestinalis.* (K1, K2, K3)

Unit 4: (15 Hours)

4.1:Morphology, Life cycle, mode of infection, pathogenesis, treatment and prophylaxsis of Helminthes parasites- *Ascaris*.(K1, K2, K3)
4.2: *Ancylostoma.*(K1, K2, K3)
4.3: *Wuchereria.* (K1, K2, K3)
4.4: *Schistoma.*(K1, K2, K3)
4.5: *Taenia solium.*(K1, K2, K3)
4.6: *Trichuris trichiura.* (K1, K2, K3)

Unit 5: (15 Hours)

5.1: Parasitic Arthropods- degree of parasitism.(K1, K2, K3)
5.2: As vectors Indirect, direct and biological transmission.(K1,K2, K3)
5.3: Indirect, direct and biological transmission-Mosquitoes.(K1, K2, K3)
5.4: Indirect, direct and biological transmission- Flies.(K1, K2, K3)
5.5: Indirect, direct and biological transmission- Fleas and bugs.(K1, K2, K3)
5.6: Indirect, direct and biological transmission – Ticks and Mites. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Panicker - Textbook of Medical Parasitology, 4th edition, Jaypee Brothers, 1977.
2. Subhash Chandra Parija – Text book of Parasitology, All India Publishers and Distributors, **2000.**

Reference Books:

3. Chandler C. - ASA and Read C.P, Wiley Eastern University Ed, 10th edition, 1970.
4. Bush *et al.* – Parasitism - Cambridge University Press, 2001.
5. R.L.Ichhpujari, Rajesh Bhatia – Medical Parasitology, Jaypee Brothers, 1994.
6.Clark .P Read – Animal Parasitism , Prentice, Hall of India, 1977.
7. W. Crave- A Guide to Human Parasitology, 10th edition, the English Language Book Society and H.K.Lewis and Co, 1970.

E-Resources:

https://www.cdc.gov
https://parasite.org.au
http://www.parasitesinhumans.org

SEMESTER VI – CORE PRACTICAL III
UCZOL20 – PHYSIOLOGY, DEVELOPMENTAL BIOLOGY, AND ECONOMIC ZOOLOGY.

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V & VI	UCZOL20	Core Practical-III	Practical	Core	3	5	100

Objectives:

- To obtain practical skills physiology.
- To learn about development of animals.
- To understand the economic importance of animals.

Course Outcomes:
On completion of the course the student will be able to…
CO1: Demonstrate experiments in Physiology.
CO2: Demonstrate expertise in handling instruments.
CO3: Identify developmental stages, placenta and histology in development biology.
CO4: Apply equipments used in rearing techniques.
CO5: Discuss the economic importance of animals.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	H	L	L
CO2	H	H	H	H	L	H
CO3	H	H	H	H	L	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	M	L
CO2	H	H	M	L	M	L
CO3	H	H	H	L	M	L
CO4	H	H	H	L	M	H
CO5	H	H	H	H	M	H

PHYSIOLOGY:
1. Detection of nitrogenous waste products in Fish Tank Water, Bird's Excreta and Cow's Urine.
2. Study of Human Salivary Amylase Activity in relation to pH.
3. Study of Human Salivary Amylase Activity in relation to Temperature.
4. Oxygen Consumption in Fish with reference to Body Weight.
5. Differential Count of WBC.
6. Estimation of Haemoglobin - Sahli's Method.
7. Kymograph, Respirometer.

DEVELOPMENTAL BIOLOGY:

1. Frog – 4 cell, 8 cell and 32 celled stages, Blastula, Gastrula.
2. Chick-18, 24, 48hr Embryos.
3. T.S of Testis and Ovary.
4. Human Ovum and Sperm.
5. Placenta - Sheep, Human**,** Yolk Sac Placenta of Shark.

ECONOMIC ZOOLOGY:

1. Spotters / Charts of equipments of sericulture and apiculture- Chandraki, Rearing tray, Rearing stand, Honey extractor, Smoker, Modern Hive.
2. Egg, Honey, Lac, Silk, Pearl, Hide and Leather
3. Edible fish: Tilapia, Anabas, Shark, Catla.
4. Field Visit Report.

SEMESTER VI- COREPRACTICAL IV
UCZOM20 – ENVIRONMENTAL BIOLOGY, BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	UCZOM20	Core Practical IV	Practical	Core	3	5	100

Objectives:

- To obtain practical skills Ecology, Immunology and Biotechnology.
- To learn about adaptation of animals to their ecosystem.
- To understand the basic interpretations in medical field.

Course Outcomes:

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

CO1: Demonstrate procedures in Ecology and immunology.
CO2: Identify the adaptation of animals in the ecosystem.
CO3: Apply the principle, working and application of instruments used biotechnology.
CO4: Discuss microbes and the disease caused by them.
CO5: Describe Lymphoid organs and immunoglobulins.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	L
CO2	H	H	H	M	M	L
CO3	H	H	H	M	M	L
CO4	H	H	H	M	M	L
CO5	H	H	H	M	M	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	M	L
CO2	H	H	H	H	M	L
CO3	H	H	H	H	M	L
CO4	H	H	H	H	M	L
CO5	H	H	H	H	M	L

ENVIRONMENTAL BIOLOGY:

1. Instruments - Rain gauge, Max-Min thermometer, Hygrometer, Luxmeter, Anemometer, Aneroid barometer.
2. Estimations - Oxygen, Carbon-dioxide, Salinity, Carbonate and Bicarbonate and pH in different water samples
3. Study of museum specimen based on Benthic, Sandy shore, Rocky shore and Flying adaptations.
4. Planktons: Fresh water and Marine Planktons five each(**Spotters)**

BIOTECHNOLOGY:

1. Plasmids pBR322
2. PCR
3. DNA sequencing- Sanger Method
4. Blotting techniques-Southern, Northern and Western

MICROBIOLOGY:

1. *Mycobacterium tuberculosis,*
2. *Salmonella typhi,*
3. *COstridium tetani,*
4. *Vibrio cholerae,*
5. *Haemophilus influenzae.*

IMMUNOLOGY:

1. Blood grouping and Rh typing - Antigen and Antibody Reaction
2. Ig A, Ig G
3. Organs of immune system:TS of – Spleen, Thymus and Bone marrow

SKILL-BASED COURSE - I

USZOA120/USZOA220 - PUBLIC HEALTH AND HYGIENE

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I	I & II	USZOA120/ USZOA220	Public Health And Hygiene	Theory	Skill Based Elective	2	2	100

Objective:

- To highlight the various dimensions of human health with reference to nutrition, environment and disease.
- To gain basic knowledge about health and hygiene

Course Outcomes:

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

CO1: Impart knowledge about health and diseases.
CO2: Acquire knowledge about nutrition and classification of food.
CO3: Analyze the interaction and impact of the environment on health.
CO4: Expand knowledge about communicable diseases and its prevention.
CO5: Improve the quality of life through prevention and treatment of non-communicable disease.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO2	H	H	M	H	H	M
CO3	H	H	M	H	H	M
CO4	H	H	M	H	H	M
CO5	H	H	M	H	H	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	M
CO2	H	H	H	H	H	M
CO3	H	H	H	H	H	M
CO4	H	H	H	H	H	M
CO5	H	H	H	H	H	M

Unit 1: **(6 Hours)**

1.1: Introduction. (K1, K2, K3)
1.2: Terms and definitions. (K1, K2, K3)
1.3: Scope of Public Health and Hygiene. (K1, K2, K3)
1.4: Concepts of Health and Disease. (K1, K2, K3)
1.5: Sources and function of macro nutrients. (K1, K2, K3)
1.6: Sources and function of micro nutrients. (K1, K2, K3)

Unit 2: **(6 Hours)**

2.1: Nutrition and Health. (K1, K2, K3)
2.2: Classification of foods. (K1, K2, K3)
2.3: Carbohydrates, Proteins, fats. (K1, K2, K3)

2.4: Vitamins deficiency, food hygiene. (K1, K2, K3)
2.5: Balance diet. (K1, K2, K3)
2.6: Nutritional requirements of special groups. (K1, K2, K3, K4)

Unit 3: **(6 Hours)**

3.1: Environment and Health. (K1, K2, K3)
3.1: Pollution effect on health- Water, Air. (K1, K2, K3)
3.3: Pollution effect on health- Noise. (K1, K2, K3)
3.4: Pollution effect on health - Land. (K1, K2, K3)
3.5: Climate change. (K1, K2, K3)
3.6: Pandemic diseases. (K1, K2, K3)

Unit 4: **(6 Hours)**

4.1: Epidemiology of Communicable Diseases. (K1, K2, K3)
4.2: A brief account of respiratory infections. (K1, K2, K3)
4.3: Measles. (K1, K2, K3)
4.4: Intestinal infections- Amoebiasis. (K1, K2, K3)
4.5: Arthropod borne diseases- Malaria. (K1, K2, K3)
4.6: STD and AIDS. (K1, K2, K3)

Unit 5: **(6 Hours)**

5.1: Non – Communicable Diseases and Conditions. (K1, K2, K3)
5.2: Diabetes mellitus. (K1, K2, K3)
5.3: Obesity. (K1, K2, K3)
5.4: Mental health: Causes of mental ill-health. (K1, K2, K3)
5.5: Stress and strain. (K1, K2, K3)
5.6: Eating disorders. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Park J.E. and Park K. - A Textbook of Preventive and Social Medicine - M/S. Banarsidas Bhanot Publishers, Jabalpur, 1986.
2. Verma S. - Medical Zoology - Rastogi Publications, New Delhi, 1998.

Reference Books:

3. Group Nutrition Intervention, Management Manual - Dept. of Food, Ministry of Agriculture, Govt. of India, 1982.
4. Raven, Peter, H. and Johnson, George B. - Understanding Biology - Mosby Year Book, U.S.A., 1994.
5. Swaminathan M. - Advanced Text Book on Food and Nutrition Vol. I and Vol. II – The Bangalore Printing and Publishing Co., Ltd., Bangalore, 1993.

E-Resources:

https://www.cdcfoundation.org
https://www.publichealth.pitt.edu
https://www.tnhealth.org

SKILL-BASED ELECTIVE
USZOC320– SERICULTURE

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II	III	USZOC320	Sericulture	Theory	Skill Based Elective	2	2	100

Objectives:

- To help the non-science students to understand the life cycle and culture technique of silkworm
- To motivate the students for self-employment

Course Outcomes:

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

CO1: Enlist different variety of silkworms and their economic status
CO2: Explain about mulberry cultivation
CO3: Expand knowledge on utilizing silkworm rearing appliances.
CO4: Elucidate an indulgent of silkworm mounting, silkworm rearing, and silkworm reeling operations.
CO5: Indicate and identify diseases in silkworms and recognize their enemies to take necessary control measures.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	L	M	H
CO5	H	H	H	M	M	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	L	M	H
CO5	H	H	H	M	M	H

Unit 1: **(6 Hours)**

1.1: Scope of sericulture in India and in global market. (K1, K2, K3)
1.2: Economics; Central Silk Board (CSB). (K1, K2, K3)
1.3: Training Facilities in Sericulture. (K1, K2, K3)
1.4: Types of silk worm Mulberry, Tasar, Eri, Muga. (K1, K2, K3)
1.5: Life cycle of *Bombyx mori*. (K1, K2, K3)
1.6: Silk. (K1, K2, K3)

Unit 2: **(6 Hours)**

2.1: Varieties of Mulberry. (K1, K2, K3)

2.2: Mulberry Cultivation. (K1, K2, K3)
2.3: Propagation, Plantation. (K1, K2, K3)
2.4: Manuring, Pruning. (K1, K2, K3)
2.5: Harvesting, Storing. (K1, K2, K3)
2.6: Transporting. (K1, K2, K3)

Unit 3: **(6 Hours)**

3.1: Silkworm Rearing-Rearing House. (K1, K2, K3, K4)
3.2: Appliances used for Rearing, Feeding. (K1, K2, K3, K4)
3.3: Cleaning and Spinning. (K1, K2, K3)
3.4: Factors for rearing. (K1, K2, K3, K4)
3.5: Temperature. (K1, K2, K3)
3.6: Humidity. (K1, K2, K3)

Unit 4: **(6 Hours)**

4.1: Rearing operations – Disinfection. (K1, K2, K3)
4.2: Brushing, Feeding. (K1, K2, K3)
4.3: Bed Cleaning, Spacing. (K1, K2, K3)
4.4: Care during Moulting, Mounting. (K1, K2, K3)
4.5: Harvesting of cocoons. (K1, K2, K3)
4.6: Storing. (K1, K2, K3)

Unit 5: **(6 Hours)**

5.1: Silkworm Diseases and Control- Pebrine. (K1, K2, K3, K4)
5.2: Flacherie. (K1, K2, K3, K4)
5.3: Muscardine, Grasserie. (K1, K2, K3, K4).
5.4: Natural Enemies. (K1, K2, K3)
5.5: Cocoon Marketing. (K1, K2, K3)
5.6: Loans to start sericulture. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Sukla G.S. and Upadhyay V.B. – Economic Zoology – ISBN Rastogi Publications, Meerut, India, 1992.
2. Ganga G. and Sulochana Chetty J. An Introduction to Sericulture Oxford Publication, New Delhi, India, 1997.

Reference Books:

3. Ganga G. Comprehensive Sericulture Vol. II: Silkworm Rearing and Silk Reeling – ISBN Oxford Publication, New Delhi, India, 2003.
4. Ganga G. Comprehensive sericulture Vol. I: Moriculture – Oxford Publication, New Delhi, India, 2003.

E-resources:

http://csb.gov.in
http://www.csrtimys.res.in
https://tnsericulture.gov.in

SKILL BASED ELECTIVE
USZOD420-POULTRY KEEPING

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/ W	Credits	Marks
II	IV	USZOD420	Poultry Keeping	Theory	Skill based Elective	2	2	100

Objectives:

- To learn the types of breeds and housing methods for successful poultry keeping.
- To guide and motivate self-employment.

Course Outcomes:

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

CO1: Acquire Knowledge on different types of breeds of Fowls
CO2: Describe the essentials and maintenance of a good house
CO3: Compare the different types of rearing methods
CO4: Discuss the feeding requirements and its management
CO5: Explain the nutritive value and products of poultry. Identify Poultry diseases and vaccination Schedule.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	M	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	M	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

Unit 1: **(6 Hours)**

1.1: Introduction to Poultry Keeping- Importance. (K1, K2, K3)
1.2: Breeds of fowls- Desi Breeds. (K1, K2, K3)
1.3: Exotic Breeds- American Class. (K1, K2, K3)
1.4: Asiatic Class. (K1, K2, K3)
1.5: English Class. (K1, K2, K3)
1.6: Mediterranean Class. (K1, K2, K3)

Unit 2: **(6 Hours)**

2.1: Essentials of a good house. (K1, K2, K3)
2.2: Maintenance-Summer and Winter. (K1, K2, K3)

2.3: Management of Free –Range System, Semi-Intensive System. (K1, K2, K3, K4)
2.4: Intensive System- Deep Litter System. (K1, K2, K3, K4)
2.5: Battery System, Folding Unit System. (K1, K2, K3, K4)
2.6: Equipments- Types of Feeder and Water troughs. (K1, K2, K3)

Unit 3: (6 Hours)

3.1: Reproduction in Fowl- Male and Female Reproductive system. (K1, K2, K3)
3.2: How is egg formed? Types of Abnormal Eggs, Grading of Egg. (K1, K2, K3)
3.3: Breeding in Fowls- Cross Breeding- Selection of Best Layer. (K1, K2, K3)
3.4: Selection of Eggs, Fertility and quality of eggs. (K1, K2, K3)
3.5: Hatchery Equipment- Incubator, Egg tray, Tray Cart and Racks, Egg Candler, Chick boxes. (K1, K2, K3)
3.6: Natural and Artificial methods of Incubation and Hatching. (K1, K2, K3)

Unit 4: (6 Hours)

4.1: Poultry Feeding –Food Ration. (K1, K2, K3)
4.2: Poultry feed ingredient – Energy rich feed stuffs, Protein-rich feed stuffs, Mineral and Vitamin Sources, Feed additives. (K1, K2, K3)
4.3: Nutrient requirement of Poultry, Feed formulation for different age groups.(K1, K2, K3, K4)
4.4: Feeding systems of Poultry, Feeding Management. (K1, K2, K3, K4)
4.5: Nutritive value of Egg, Preservation of Egg, Products of Egg- Albumen flakes, Frozen Yolk, Egg Powder. (K1, K2, K3, K4)
4.6: By products of Poultry, Processing of Meat. (K1, K2, K3)

Unit 5: (6 hrs)

5.1: Care and Management of Poultry- Layer, Grower, Broiler, Pullet. (K1, K2, K3)
5.2: Symptoms, Transmission, Treatment and Control of Ranikhet, Fowl Pox, Coryza, Coccidiosis, Polyneuritis. (K1, K2, K3, K4)
5.3: Egg Drop Syndrome, Avian Influenza, Fowl Cholera. (K1, K2, K3)
5.4: Chronic Respiratory Disease. (K1, K2, K3)
5.5: Endoparasitic and Ectoparasitic diseases. (K1, K2, K3)
5.5: Vaccination Schedule. (K1, K2, K3)

Book for study and Reference:

Textbooks:

1) Jayasurya, Arumugam N. – Economic Zoology- Saras Publication, Nagercoil, 2013.
2) Nilotpal Ghosh- Poultry Science and Practice- A Textbook- CBS Publishers and Distributors Pvt. Ltd. 2015.

Reference Book:

3) Gnanamani M.R. – Modern Aspects of Commercial Poultry Keeping – Ezhil offset printers, Madurai- 2010
4) Tomar B.S. and Neera Singh- Economic Zoology- Emkay publications, Delhi- 2004.
5) Shukla G.S. and Upadhyay V.B. –Economic Zoology- Rastogi Publications, Meerut- 1997.

E-Resources:

https://thepoultrysite.com
https://www.poultryworld.net
http://www.agritech.tnau.ac.in

SEMESTER V
SKILL-BASED ELECTIVE
USZOE520 -ORNAMENTAL FISH KEEPING

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	USZOE520	Ornamental Fish Keeping	Theory	Core Elective	2	2	100

Objectives:
- To learn about the rearing techniques in fish keeping
- To motivate for self-employment

Course Outcomes:
On completion of the course the student will be able to…
CO1: Discuss the importance, design and maintenance of an aquarium.
CO2: Explain the aquarium plants and usage of various accessories required for an aquarium.
CO3: Discuss the feed requirement, formulation and various live bearing fishes.
CO4: Differentiate the Egg laying fishes, marine fishes and other organisms in an aquarium.
CO5: Attain understanding on loan availability and export potential.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	H
CO2	H	H	M	H	M	M
CO3	H	M	H	H	H	H
CO4	H	H	H	H	H	M
CO5	M	H	M	M	H	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

Unit 1: **(6 Hours)**
1.1: Construction of home aquarium: Materials used- wooden and metal frames. (K1, K2, K3)
1.2: Frameless tanks- Sealants and gums. (K1, K2, K3)
1.3: Design and construction of aquarium tank. (K1, K2, K3)
1.4: Accessories used in aquarium tanks- aerators, filters. (K1, K2, K3)
1.5: Heaters, thermostat, hand nets. (K1, K2, K3)
1.6: Gravel/pebble - objects. (K1, K2, K3)

Unit 2: **(6 Hours)**
2.1: Aquarium plants. (K1, K2, K3)
2.2: Nutritional requirements. (K1, K2, K3)
2.3: Kinds of feed - live feeds - artificial feed. (K1, K2, K3)

2.4: Feed formulation - balanced diet. (K1, K2, K3, K4)
2.5: Culture of live food organisms - Chironomous, mosquito larva, tubifex. (K1, K2, K3)
2.6: Problems of over feeding. (K1, K2, K3)

Unit 3: **(6 Hours)**

3.1: Popular ornamental fish - live bearers - Red sword tail. (K1, K2, K3)
3.2: Guppy, Molly. (K1, K2, K3)
3.3: Egg layers - Gold fish, Siamese fighting fish, Gowrami. (K1, K2, K3)
3.4: Angel fish, Oscar. (K1, K2, K3)
3.5: Neon tetra, Discus. (K1, K2, K3)
3.6: Fish handling. (K1, K2, K3)

Unit 4: **(6 Hours)**

4.1: Aquarium maintenance - water quality-pH. (K1, K2, K3, K4)
4.2: O_2, CO_2, hardness. (K1, K2, K3)
4.3: Ammonia, Nitrite and Nitrate. (K1, K2, K3)
4.4: Common diseases - diagnosis – treatment. (K1, K2, K3)
4.5: Common marine fish - Anemone fish, Butterfly fish. (K1, K2, K3)
4.6: Other marine organism. (K1, K2, K3)

Unit 5: **(6 Hours)**

5.1: Budget for commercial scale. (K1, K2, K3)
5.2: Loan availability. (K1, K2, K3)
5.3: Credit policies. (K(K1, K2, K3)1, K2, K3)
5.4: Export potentials. (K1, K2, K3)
5.5: Value addition in ornamental fish culture. (K1, K2, K3)
5.6: Transportation. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. K.V. Jayashree, C.B. Thara Devi, N. Arumugam, Home Aquarium and Ornamental Fish Culture, Saras Publication,2015.
2. Dick Mills- Tropical aquarium fishes, Salamander Books Ltd, London, 1982.
3. J.D.Jameson and R.Santhanam- Manual of ornamental fishes and farming technologies- Fisheries College and Research Institute TANVASU, Tuticorin, 1996.

Reference Books:

4. R. Santhanakumar *et al*., - Manual of fresh water ornamental fish culture, Dept. of Fisheries extension, Fisheries College and research institute TANVASU, Tuticorin, 2004.
5. V.K.Venkataraman *et al*., - Biodiversity and stock assessment of marine ornamental fishes. Dept. of Fisheries biology and capture fisheries, Fisheries College and Research Institute TANVASU, Tuticorin, 2004.

E-Resources:

http://www.cifa.nic.in
http://agritech.tnau.ac.in
http://aquaculturetraining.com.au
http://www.oftri.org

SEMESTER VI
SKILLBASED ELECTIVE
USZOF620 - ANIMAL BEHAVIOUR

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	VI	USZOF620	Animal Behaviour	Theory	Core Elective	2	2	100

Objective:

- To learn the basics in behaviour of animal
- To help in designing the research work based on the behaviour of animals

Course Outcomes:

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

CO1: Familiarize with various techniques to study the animal behaviour in lab and in Wild.
CO2: Analyze the various modes of communication, locomotion foraging and Caching.
CO3: Comprehend the process of learning, memory, hormonal and neural systems.
CO4: Compute the social organization and to differentiate behaviour.
CO5: Study the adverse effects and cure for abnormal behaviour among the Wild domestic and pet animals.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	M	H	M
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	H	H	M
CO2	H	H	M	H	H	M
CO3	H	H	M	H	H	M
CO4	H	H	M	H	H	M
CO5	H	H	M	H	H	M

Unit 1: **(6 Hours)**

1.1: Introduction to Behavior. (K1, K2, K3)
1.2: Branches of Ethology. (K1, K2, K3)
1.3: Types of studying behavior- In Lab and In Wild- Ad libitum. (K1, K2, K3, K4)
1.4: Focal animal, Scan. (K1, K2, K3)
1.5: All occurrence, Sequence one Zero. (K1, K2, K3)
1.6: Constructing Ethogram, interpreting and presenting data. (K1, K2, K3, K4)

Unit II: **(6 Hours)**

2.1: Rhythm. (K1, K2, K3)
2.2: Sleep. (K1, K2, K3)
2.3: Methods and models of Communication. (K1, K2, K3)
2.4: Locomotion. (K1, K2, K3)

2.5: Foraging and Catching. (K1, K2, K3)
2.6: Nest construction. (K1, K2, K3)

Unit III: **(6 Hours)**

3.1: Homing, Migration. (K1, K2, K3)
3.2: Territorialism, Courtships. (K1, K2, K3)
3.3: Parental care. (K1, K2, K3)
3.4: Play. (K1, K2, K3)
3.5: Learning. (K1, K2, K3)
3.6: Memory. (K1, K2, K3)

Unit IV: **(6 Hours)**

4.1: Innate behavior – Neural and Hormonal control of behavior. (K1, K2, K3)
4.2: Social behavior – aggregation. Schooling in fish. (K1, K2, K3)
4.3: Flocking in birds. (K1, K2, K3)
4.4: Herding in mammals. (K1, K2, K3)
4.5: Social organization in insects. (K1, K2, K3)
4.6: Advantages of being social. (K1, K2, K3)

Unit V: **(6 Hours)**

5.1: Abnormal behavior. (K1, K2, K3)
5.2: Wild animals under natural conditions and in Zoo. (K1, K2, K3)
5.3: Domestic livestock. (K1, K2, K3)
5.4: Pets- causes of abnormal behavior. (K1, K2, K3)
5.5: Prevention of abnormal behaviour. (K1, K2, K3)
5.6: Curing of Abnormal behavior. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. V.K. Agarwal – Animal Behaviou – S. Chand Publications, New Delhi, 2018.
2. Reena Mathur - Animal Behaviour-Rastogi and Co., 1996.
3. M.M Ranga - Animal Behaviour- Saraswati Purohit for student's edition, 2007.

Reference Books:

4. Amita Sarkar - Social behaviour in animal- Discovery Publishing house, 2004.
5. Niko Tinbergen - Animal Behaviour-LIFE young readers' library, 1968.
6. Aubrey Manning, Marian Stamp Dawkins - An Introduction to Animal Behaviour 5th ed- Cambridge University press, 2008.
7. Michael J. Ryan, Walter Wilczynski - An introduction to Animal Behaviour- An integrative approach- Cold Spring Harbour Laboratory Press, 2011.

E-Resources:

https://www.animalbehaviorsociety.org
https://www.asab.org
http://www.behavecol.com/

NON MAJOR ELECTIVE

UGZOA520/UGZOA620-MATERNAL AND CHILD PSYCHOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UGZOA520/ UGZOA620	Maternal and child psychology	Theory	Core Elective	3	2	100

Objectives:

- To understand the complexity of Mother and Child psychology.
- To help the students understand the Biological and Psychological changes in child.
- To overcome the difficulty of motherhood.

Course Outcomes:

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

CO1: Comprehend the puberty, natal periods and maternal changes.
CO2: Explain the growth, developmental stages and motor skills
CO3: Gains insights on the stages of cognitive development and personality.
CO4: Familiarize different emotions, emotional development and moral development.
CO5: Identify, classify and differentiate the gifted, mentally retarded and backward children.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	M	M	H	M	M
CO2	H	M	M	H	M	H
CO3	H	M	M	M	M	M
CO4	H	M	M	H	H	H
CO5	H	M	M	L	M	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	H	M
CO2	H	H	H	L	H	M
CO3	H	H	H	L	H	M
CO4	H	H	H	L	H	M
CO5	H	H	H	L	H	M

Unit 1: BIOLOGY OF REPRODUCTION (9 Hours)

1.1: Hormonal changes of Puberty. (K1, K2, K3)
1.2: Mechanism of Genetic Transmission. (K1, K2, K3)
1.3: Prenatal period- Hazards during the prenatal period. (K1, K2, K3)
1.4: Physical – psychological- maternal stress. (K1, K2, K3)
1.5: Pregnancy – Maternal body changes. (K1, K2, K3)
1.6: Premenstrual syndrome and peri menopausal behaviour. (K1, K2, K3, K4)

Unit 2: GROWTH AND DEVELOPMENT (9 Hours)

2.1: Growth and Development- Stages. (K1, K2, K3, K4)
2.2: Influence of Heredity. (K1, K2, K3)
2.3: Influence of Environment. (K1, K2, K3)
2.4: Physical growth during Infancy. (K1, K2, K3)

2.5: Physical growth during Early Childhood. (K1, K2, K3)
2.6: Motor Development- Gross and Fine Motor skills. (K1, K2, K3)

Unit 3: COGNITIVE DEVELOPMENT (9 Hours)

3.1: Cognitive development-Sensorimotor stage. (K1, K2, K3)
3.2: Preoperational-concrete operational, formal operation. (K1, K2, K3)
3.3: Personality theories- Carl Roger's Self theory. (K1, K2, K3, K4)
3.4: Dollard and Miller's Learning theory. (K1, K2, K3)
3.5: Bandura and Walter's Social Learning theory. (K1, K2, K3)
3.6: Self – Understanding and Identity. (K1, K2, K3)

Unit 4: SOCIO-EMOTIONAL DEVELOPMENT (9 Hours)

4.1: Emotions in Babyhood- Early Childhood- Late Childhood. (K1, K2, K3)
4.2: Emotional problems of Childhood. (K1, K2, K3)
4.3: Psychosocial Development. (K1, K2, K3)
4.4: Moral Development- Pre Conventional level. (K1, K2, K3)
4.5: Conventional. (K1, K2, K3)
4.6: Post Conventional level. (K1, K2, K3)

Unit 5: EXCEPTIONAL CHILDREN (9 Hours)

5.1: Gifted Children- Needs and Problems of Gifted Children. (K1, K2, K3, K4)
5.2: Identification of Gifted children. Education of the Gifted Children. (K1, K2, K3, K4)
5.3: Mentally retarded – Identifying. (K1, K2, K3)
5.4: Classifying the Mentally retarded. (K1, K2, K3)
5.5: Causes- Clinical types of Mentally retarded- Prevention. (K1, K2, K3)
5.6: Backward children- Kinds-causes- Education. (K1, K2, K3)

Books for Study and Reference:

Textbooks:

1. Elizabeth B. Hurlock– Developmental Psychology – A Life Span approach 5th Ed.- Tata McGraw-Hill Education, 2001.
2. Laura E. Berk – Child Development- New Delhi, Pearson Prentice Hall, 2003.

Reference Books:

3. Ernest R. Hilgard, Richard C. Atkinson - Introduction to Psychology 6th Ed, 1975.
4. George Butterworth, Margaret Harris– Developmental psychology: A student's Handbook- Tata Mcgraw Hill Education Private Ltd., 2002.
5. Mangal S.K. – Advanced Educational Psychology 2nd Ed. – Phi Learning, 2010.
6. Thomas L. Crandell, Corinne Haines – Human Development 9th Ed.- Tata McGraw-Hill Education, 2012.
7. Rohall David E., Mikie Melissa A., Lucas Jeffrey W. - Social Psychology: Sociological Perspectives 2nd Ed. – Prentice Hall, 2011.

E-Resources:

https://www.who.int
https://www.mcsprogram.org
http://www.nrhmtn.gov.in
https://www.ifrc.org
