A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609305

CBCS - FOR B.Sc., ZOOLOGY STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2015-16 ON WARDS

S.NO	Paper	Title	Code	Hours	Marks			Credit
					ESE	CIA	Total	
1	Language Course – I	LC. I - (Tamil)	11LT 101	6	75	25	100	3
	Language Course – I	ELC. I - (English)	11LE 101	6	75	25	100	3
	Core Course- I	CC. I -Invertebrata	15ZO 101	5	75	25	100	5
	Core Course- II	CC. II -Practical I – (Covering CC I)	15 ZOP 102	2	60	40	100	2
	Allied Course – I	AC. I - AL Zoology (For I Bot & I Che)	15AZO101	7	75	25	100	4
	Allied Course – I I	AC. II –AL Practical I (I Bot, Che & BT)	15AZOP102	2	60	40	100	1
	Skill Based Course - I	SBC- I -Vermiculture (For I Zoo)	15SZO101	2	75	25	100	2
II	Language Course – II	LC. II - (Tamil)	11LT 202	6	75	25	100	3
	Language Course – II	ELC. II- (English)	11 LE 202	6	75	25	100	3
	Core Course - III	CC. III- Chordata	15 ZO203	5	75	25	100	5
	Core Course –IV	CC IV -Practical - II (Covering CC III)	13 ZOP 204	2	60	40	100	2
	Allied Course – III	AC. III - (For I Bot, Che&BT)	15AZO203	7	75	25	100	4
	Allied Course – IV	AC. IV-AL Practical II (I Bot, Che&BT)	15AZOP204	2	60	40	100	1
	Skill Based Course - II	SBC. II- Apiculture (For I Zoo)	15SZO 202	2	75	25	100	2
III	Language Course – III	LC. III - (Tamil)	11LT 303	6	75	25	100	3
	Language Course – III	ELC III- (English)	11 LE 303	6	75	25	100	3
	Core Course -V	CC .V- Cell and Molecular Biology	15ZO305	5	75	25	100	5
	Core Course -VI	CC. VI- Practical – III (Covering CC V)	15 ZOP 306	2	60	40	100	2
	Allied Course – V	AC. V- Theory		7	75	25	100	4
	Allied Course – VI	AC. VI- AL Practical – II		2	60	40	100	1
	Skill Based Course -III	SBC. III - MLT (For II Zoo)	15SZO303	2	75	25	100	2
IV	Language Course – IV	LC. IV - (Tamil)	11LT 404	6	75	25	100	3
	Language Course – IV	ELC. IV- (English)	11 LE 404	6	75	25	100	3
	Core Course VII	CC .VII – Genetics	15 ZO 407	5	75	25	100	5
	Core Course VIII	CC. VIII- Practical IV (Covering CC VI)	15ZOP408	2	60	40	100	2
	Allied Course – VII	AC. VII – Theory		7	75	25	100	4
	Allied Course – VIII	AC. VIII – AL Practical II		2	60	40	100	1
	NMEC Paper – I	NMEC.- I (Eco. Zoology (For II Bot)	15NMZO 401	2	75	25	100	2
V	Core Course IX	CC. IX- Ecology and Evolution	12ZO509	4	75	25	100	4
	Core Course X	CC. X -Developmental Biology	13 ZO510	4	75	25	100	5
	Core Course XI	CC. XI- Animal Physiology	13ZO511	4	75	25	100	5
	Core Course XII	CC. XII – Practical – V	13ZOP512	8	60	40	100	6
	Elective Course - I	EC. I – Wildlife Biology	13ZOE 501	3	75	25	100	3
	Elective Course - II	EC II- Public Health and Hygiene	13 ZOE502	2	75	25	100	3
	Non-Major Elective II	NMEC II- Public Health and Hygiene (III Bot)	11NMZO 502	2	75	25	100	2
		EA -I Gender Studies	11EA501	1	75	25	100	1
		Soft Skill Development	11SSD 501	2	75	25	100	2
VI	Core Course XIII	CC. XIII -Microbiology and Immunology	13ZO613	5	75	25	100	5
	Core Course XIV	CC. XIV- Biotechnology and Bioinformatics	11ZO614	4	75	25	100	4
	Core Course XV	CC. XV – Biophysics, Biochemistry and Biostatistics	13ZO615	4	75	25	100	4
	Core Course XVI	CC. XVI -Practical – VI	13ZOP616	8	60	40	100	6
	Elective Course - III	EC.- III -Vector biology	11ZOE 603	5	75	25	100	5
		ES. - Environmental studies	08ES601	2	75	25	100	2
	Value Based Course	Human Values and Ethics	11VBC	2	75	25	100	2
		Extension Activity-II	11EA	-	75	25	100	1
		Total		**180**	**3150**	**1250**	**4400**	**140**

LC=8; CC – 16; AC-8; SBC-03;Electives -03; NMEC -02; EA - 02;ES - 01; VBC - 01 (TOTAL =44)

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL
B.Sc., ZOOLOGY
SEMESTER I – C.C.I: INVERTEBRATA

Code: 15ZO101

Objectives: To enable the students understand the classification, biology and economic values of invertebrates.

UNIT - I

Protozoa and Porifera: characteristic features and classification up to classes with two examples for each class.

Detailed study: Paramecium and Sycon.

General Topics: Protozoan diseases (Malaria, Amoebiasis, Trypanosomiasis & Leishmaniasis); Canal systems in Sponges. (15 Hrs)

UNIT - II

Coelenterata and Platyhelminthes: characteristic features and classification up to classes with two examples for each class.

Detailed study: Aurelia and Liver fluke.

General Topics: Types, Formation and Importance of Coral reef.

Parasitic adaptations in Platyhelminthes (15 Hrs)

UNIT - III

Aschelminthes and Annelida: characteristic features and classification up to classes with two examples for each class.

Detailed study: Ascaris and Earthworm

General Topics: Nematode parasites and Human diseases –Filariasis, Schistosomiasis Taeniasis and Dracunculus.

Adaptive radiations in Annelida (15 Hrs)

UNIT – IV

Arthropoda and Mollusca: characteristic features and classification up to classes with two examples for each class.

Detailed study: *Penaeus* and Freshwater Mussel

General Topics: Crustacean larvae and their biological significance.

Economic importance of Mollusca (15 Hrs)

UNIT - V

Echinodermata: characteristic features and classification up to classes with two examples for each class.

Detailed study: Starfish

General Topics: Echinoderm larvae and their significance

Minor Phyla: General characters – Classification based on coelom-Characteristics with two examples of Mesozoa, Rotifera and Chaetognatha (15 Hrs)

Text book:

1. Iyer, M.E. 1986. A Manual of Zoology. Vol.1. Invertebrates. S.Viswanathan, Madras.

References:

1. Jordon, E.L. and Verma, P.S. 1974. Invertebrate Zoology, S. Chand & Co., New Delhi.
2. Kotpal, R.L. Minor phyla, Rastogi Publications, Meerut.
3. Majpuria, T.C. 1980. Invertebrate Zoology. Pradeep Publications, Jullundar.
4. Nair, C. and N. Arumugam. 2006. A Text book of Invertebrates. Saras Publications

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL
B.Sc., ZOOLOGY
SEMESTER I – CC.II - MAJOR PRACTICAL – I (INVERTEBRATA)

Code: 15ZOP 102

I. DISSECTIONS:

Earthworm:	Digestive system and Nervous system.
Cockroach:	Digestive system and Nervous system.
Fresh water mussel:	Digestive system.
Prawn:	Nervous system.

II. MOUNTINGS:

Earthworm:	Body setae and Penial setae
Prawn:	Appendages
Fresh water mussel:	Pedal ganglion
Mouth Parts:	Honey Bee, Mosquito / House Fly

III. SPOTTERS:

(1. Draw labeled diagrams: 2. Classify giving reasons: 3. Comment on biological significance: 4.Write descriptive notes on & 5.Relate Structure and Function)

Protozoa:
Entamoeba, Paramecium, Paramecium binary fission, Paramecium conjugation, Plasmodium, Polystomella

Porifera:
Sycon sponge, Spicules of sponges, Hyalonema , Spongilla.

Coelenterata:
Aurelia, Sea anemone, Obelia colony, Gorgonia, Pleurobrachia, Obelia medusa, Physalia, Tubipora.

Platy helminthes:
Planaria, Tapeworm, Tapeworm – Scolex, Tapeworm – Proglottid
Liver fluke, Cercaria, Redia

Nematoda:
Ascaris, Wuchereria bancrofti, Dracunculus

Annelida:
Neries, Parapodium, Heteroneries, Leech, Chaetopterus

Arthropoda:
Peaneus, Peripatus, Limulus, Nauplius larva, Zoea larva,
Mysis, Daphnia, Cyclops, Balanus, Saccullina, Squilla, Palaemon,
Carcinus, Hippa, Streptocephalus, Spider, Tick, Milipede, Centipede,
Gryllotalpa,Pediculus

Mollusca:
Pila, Chiton, Dentalium, Aplysia, Mytilus, Pearl Oyster, Sepia, Octopus, Nautilus,

Echinodermata:
Asterias, Pedicellaria, Ophiothrix, Echinus, Holothuria, Antedon,
Bipinnaria, Ophiopluteus, Auricularia

IV. FIELD VISIT.

V. RECORD SUBMISSION.

A.V.C. College (Autonomous), Mannampandal, MAYILADUTHURAI-609305

B.Sc., ZOOLOGY

SEMESTER: I – SBC: I – VERMICULTURE

Code: 15 SZO 101

Objectives: To make the students understand the economic value of earthworm in enriching the soil fertility and methods of Vermicomposting.

UNIT – I

Soil: Soil types – Soil formation – Soil- physical, chemical and biological features – Soil organic matter decomposition – earthworm in soil.

Ecological groups of earthworms: humus feeders- epigeic, anecic, endogeic – Importance of Earthworm in the agriculture, fishing food, therapeutics and pollution.

UNIT- II

Earthworms: Classification - morphological and anatomical characteristics – Earthworm in India. Earthworm predators and parasites.

Composting: physical, chemical and biological characteristics - organic waste management – microorganisms in composting – composting methods: Small scale and large scale - indoor method, pit method, heap method and windrow method.

UNIT – III

Vermicomposting: vermicomposting tools - earthworm culture – preparation of vermibed – Advantages of vermicompost - applications of vermiwash – vermicast in agricultural practices – economic importance of vermiculture.

Text book:

A. Maryvioletchirsty: Vermitechnology, MJP Publishers.

References:

1. T.D. Biswas and S.K. Mukherjee (1994): Textbook of soil Science, Tata Mc Graw Hill Publication Co. New Delhi.
2. C.A. Edwards and B.J. Bohlen (1996): Biology and ecology of Earhworms, Chapman and Hall, London.
3. K.E. Lee (1985): Earthworms – Their Ecology and relationship with soil and land use, Academic press, Sydney
4. L.S. Ranganathan (2006): Vermitechnology form soil Health to Human Health, Agrobios (India) Agrohouse, Chopasani Road, Jodhpur – 342 002
5. J.E. Satchell (Ed) (1983): Earthworm Ecology – From Darwin to Vermiculture, Chapman and Hall London.
6. F.J. Stevensen (1994) : Humus chemistry, Genesis, Composition and Reaction, Johnwiley and sons Corporation, New York.
7. Sultan Ismail (1997): The Biology of Earthworm Orient Longmand Ltd., Chennai.

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A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL.

ALLIED ZOOLOGY

SEMESTER I –

AC I: ALLIED ZOOLOGY - I

(For Botany and Chemistry Students)

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CODE: 11AZO101

Objective: To make the students understand the basic characteristics and biology of animals.

UNIT – I

Characteristics of the following major invertebrate phyla: Protozoa; Porifera; Coelenterata;
Detailed study: Paramecium and Obelia
Nutrition in Protozoa
Skeleton in sponges

UNIT - II

Characteristics of the following major invertebrate phyla: Platyhelminthes; Nematoda, Annelida
Detailed study: Tape worm and Earthworm
Parasitic adaptations of Helminths
Modes of life in polychaetes

UNIT - III

Characteristics of the following major Invertebrate phyla: Arthropoda; Mollusca and Echinodermata:
Detailed study: Cockroach, Fresh water mussel
Social life in Insects
Echinoderm larvae and their significance

UNIT – IV

Characteristics of the Prochordata, Pisces and Amphibia
Detailed study: Shark and Frog
Affinities of Balanoglossus
Parental care in fishes

UNIT - V

Characteristics of the Reptiles, Birds and Mammals
Detailed study: Calotes and Rabbit
Identification of Poisonous and non poisonous snakes-
Migration in birds

Text Books:

Arumugam, N (2005). Text book of Invertebrates and Chordates. Saras Publication.

References:

P.S. Verma, and S.KAgarwal.Text book of Invertebrata and chordata
E.L. Jordan and P.S. Verma. Text book of Invertebrata and chordate. Rastogi Publication
Kotpal, R.L. 2000. Invertebrata, Rastogi Publication.

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Verified 16/7/13

Verified 26/6/13

Verified 16/7/13

Verified 30/6/14

Verified 29/6/13

Verified 20.06.13

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL

SEMESTER I – ALLIED ZOOLOGY PRACTICAL - I

(For Botany and Chemistry Students)

15 AZOP 102

I. Dissections:

1. Earthworm: Nervous system.
2. Freshwater mussel: Digestive system.
3. Cockroach: Digestive system.
4. Rat / Japanese Quail: Arterial system.

II. Mountings:

1. Earthworm: Body setae
2. Cockroach: Mouth parts
3. Shark: Placoid scale

III. Spotters:

1. Paramecium entire
2. Paramecium binary fission
3. Paramecium conjugation
4. Ascon sponge
5. Parenchymula larva
6. Obelia -entire
7. Medusa
8. Tapeworm entire
9. Proglottids
10. Tapeworm T.S.
11. Tapeworm scolex
12. Cysticercus larva
13. Pedicellaria
14. Starfish oral and aboral views.
15. Glochidium larva
16. Quill feather
17. Echeneis
18. Amphioxus
19. Balanoglossus
20. Ascidian
21. Petromyon
22. Salamander
23. Ichthyophis
24. Hyla
25. Alytes
26. Varanus
27. Chemeleon
28. Draco
29. Kingfisher
30. Merops (Bee eater)
31. Loris
32. Bat
33. Owl

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A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL

B.Sc., ZOOLOGY

SEMESTER II – CC. III : CHORDATA

Code : 15 ZO 203

OBJECTIVES:

To enable the students to acquire knowledge of organization, adaptive features and importance of Chordates.

UNIT – I (12 Hrs)

Origin of Chordates.

General Characteristics and classification of Cephalochordata , Hemichordata, Urochordata up to orders with two examples for each order.

Detailed study of Amphioxus

Distinctive features of Cyclostomes

Retrogressive metamorphosis in Ascidia

UNIT – II **(12 Hrs)**

General Characteristics and outline classification of Pisces and Amphibians up to orders with two examples per order

Migration in fishes

Economic importance of fishes

Parental care in Amphibians'

Gymnophiona – adaptations and modes of life.

UNIT – III (12 Hrs)

General Characteristics and outline classification of Reptilia and Aves up to orders with two examples for each order.

Identification of poisonous and non-poisonous snakes;

Distinctive features of Turtles and Tortoises

Flight adaptations in birds

Migration in birds.

UNIT – IV (12 Hrs)

General Characteristics and outline classification of Mammalia up to orders with two examples for each order;

Detailed study- Rat-Digestive system; Respiratory system; Urinogenital system; Heart ar Brain

Distinctive features and adaptations of Prototheria and Metatheria.

Adaptations of aquatic Mammals.

Dentition in Mammals.

Economic importance of Mammals.

UNIT – V (12 Hrs)

Comparative studies of the following classes of Pisces, Frog, Calotes, Aves and Rabbits . Digestive system; Respiratory system; Urinogenital system; Heart and Brain

Text book:

1. Kotpal.R.L.2008.Morden text book of Zoology,Vertebrates, Rastogi publications, India.
2. Agarwal, V. 2003. Chordate Zoology, S.Chand & Co., New Delhi.

References:

1. Newman, H.H. 1981. The Phylum Chordata. Biology of Vertebrates and their Kin. The Macmillan Company, New York.
2. Bhamrah, H.S., Juneja, k., Shrivastava, S. and Joshi, S.C. 1993. A Text book of Chordates. Anmal Publications, New Delhi.
3. Dhami, P.S. and Dhami, J.K. 1972. Chordate Zoology. R.Chand & Co., Delhi.
4. Renganathan, T.K. 1996. Chordate Zoology. Jayalakshmi Printers, Tuticorin.
5. Alexander, R.M. 1977. The Chordates. Cambridge University Press, Cambridge.

Verified IV 13/12/13

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305
B.Sc., ZOOLOGY

SEMESTER II – CC IV - MAJOR PRACTICAL - I1 (CHORDATA)

Hour : 2/week credit : 2 **13 ZOP 204**

I. **DISSECTIONS:** Digestive system and Reproductive system of Fish & Rat / Japanese Quail

Demonstration – Frog – Prodissector - Software

II. **MOUNTINGS:** Fish scales (Cycloid, Ctenoid and Placoid scales), Brain of Fish.

III. **SPOTTERS:**

1. Draw labeled diagrams:

Frog: Skull lower jaw, pectoral girdle, pelvic girdle, 8th vertebra, urostyle, forelimb and hind limb.

2. Classify giving reasons:

Amphioxus, Ascidian, Petromyzon, Shark, Syngnathus, Rana hexa dactyla, Calotes, Varanus, Cobra, Pigeon, Crow, Rat, Loris and Bat.

3. Comment on biological significance:

Balanoglossus, Petromyzon, Ascidian tadpole, Tornaria larva, Anabas, Saccobranchus, Hippocampus, Uraeotyphlus, Axolottle larva, Alytes, Arius and Dryophis.

4. Explain adaptations:

Eel, Electric ray, Draco and Chameleon, Beak and feet of Parrot, Kite, Kingfisher, Loris, Bat and Hemidactylus.

5. Write descriptive notes on:

Cycloid scale and Ctenoid scale, feather types (Quill, Down and Filoplume); Carapace and Plastron. Dentition of Rabbit, Man and Cat.

6. Relate Structure and Function:

Exocoetus, Hippocampus, Ichthyophis, Draco, Carapace, Plastron, Quill Feather, Synsacrum, Baleen plate, Hedge hog.

IV. **RECORD SUBMISSION**

Field trip mandatory

Verified 5/12/13. Approved

Verified 13/2/13 MB (1)

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305

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SBC II : APICULTURE

Hour: 2/week credit: 2

UNIT –I

Species of honeybees –Dwarf bee, Rock bee, Indian honeybee and

European bee- Identification and characteristics.

Biology and life history of honeybees- Egg, larva, pupa and adult characteristics.

UNIT-II

Bee colony- Castes - Drones, Workers and Queen – structural and functional differences-

Bee foraging: Pollen and nectar yielding plants

Honeybee products- Honey - Bees wax, Propolis, Royal Jelly, Bee venom, pollen;

their characteristics and importance,

Unit III

Natural enemies of honey bees and control methods. Bee poisoning - Honeybee diseases-

Types, importance, control methods

Basic tools in apiculture- Bee hive- structure and types , advantages and disadvantages-

Hive stand.

Unit IV

Bee veil, Smoker, Gloves, Knife, Honey extractor, Drone excluder, Queen excluder, Queen gate.

Location of apiary- Care and management during dearth season- and flow seasons-

diet supplement. Swarming and Colony multiplication.

Unit V

Methods of collection and processing: Honey, Bees wax, Royal Jelly, Propolis, Pollen and Bee

venom. Honeybees and agriculture- Cross pollination- Yield increase- Economics of Apiculture.

15/12/14

PROFESSOR OF ZOOLOGY

16/12/14

References:

1) Cherian and Ramanathan, S. Bee keeping in South India
2) Sharma P.L. and Singh, S.H. and Book of Bee keeping
3) Honey - A comprehensive survey - International Bee Research Association for House - CNRC

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A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI,MANNAMPANDAL

ALLIED ZOOLOGY

SEMESTER II – AC III: ALLIED ZOOLOGY - II

(For Botany and Chemistry Students)

Code: 15 AZO 203

Objectives: To give a comprehensive idea of Cell biology, Genetics, Developmental biology, Physiology and Environmental biology.

UNIT - I

Cell biology:

Ultra structure of an Animal Cell
Plasma membrane-Fluid mosaic model and Functions.
Mitochondria-structure and Functions
Chromosomes - structure and Functions
DNA-Watson and Crick model.
RNA - Types and Functions
Cell division – Mitosis and Meiosis.

UNIT - II

Genetics:

Mendel's Laws.
Linkage and Crossing over
Sex determination in Man-XY type
Sex-linked inheritance: Colour blindness in Man and Eye colour in Drosophila
Inborn Errors of Metabolism- a) Phenylketonuria b) Alkaptonuria

UNIT - III

Developmental Biology:

Structure of Human sperm and ova
Fertilization- Physiochemical aspects
Cleavage, Blastulation, and Gastrulation in frog
Development of Eye and Heart in Frog

UNIT - IV

Physiology:

Metabolism of protein.
Metabolism of carbohydrate – Glycolysis and Kreb's cycle
Metabolism of fat – Beta oxidation
Physiology of respiration in Man-Gaseous exchange in lungs.
Physiology of excretion in Man- Formation of urine

UNIT - V

Ecology:

Pond Ecosystem
Animal Association: Mutualism, Commensalism and Parasitism

Evolution:

Theories- Lamarckism, Darwinism and De Vries

TEXT BOOK

N. Arumugam- Cell biology-Saras publications (2007).
N. Arumugam and R.P.Meyyan, Genetics and Evolution- Saras publications (2000).

N. Arumugam, Animal Physiology, -Saras publications
N. Arumugam,Ecology, -Saras publications

References

S.Verma and V.K.Agrawal (1985),Cytology S.Chand and company Ltd.,
S.Verma and V.K.Agrawal, Genetics(2000),S.Chand and company Ltd.,
S.Verma V.k.Agarwal and B.S.Tyagi (1989), S. Chand and company Ltd.,

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL

SEMESTER II – ALLIED ZOOLOGY PRACTICAL-II

(For Botany and Chemistry Students)

15 AZOP 204

I. Physiology and Ecology:

1. Analysis of urine for sugar, albumin and urea.
2. Test for carbohydrate, protein, and fat.
3. Estimation of salinity.
4. Estimation of oxygen.
5. Identification of ABO blood group in human.

II. Minor practical:

1. Determination of pH of water samples (pH paper method).
2. Squash preparation of onion root tip.
3. Squash preparation of Salivary gland Cells in Chironomous Larva

III. Spotters:

1. DNA Structure model.
2. DNA Replication model.
3. Stages of mitosis
4. Drosophila
5. Frog - egg
6. Cleavage (2-cell, 4-cell, 8-cell stages)
7. Frog - Blastula
8. Frog - Gastrula
9. Frog - Neural fold stage
10. Animal Association: Sea anemone on hermit crab, Echines (Sucker fish).
11. Parasitism – Ascaris.

IV. Record Submission:

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

B.Sc., ZOOLOGY

SEMESTER III - PAPER –V. CELL AND MOLECULAR BIOLOGY

Code: 15 ZO305

Objective:

To make the students understand the structure, functions and composition of various cell organelles and their molecular concepts.

UNIT-I (12 hrs.)

Cell: General organization of Prokaryotic and Eukaryotic cells.

Methods of cell study: Micrometry, cell culture method; cell fractionation techniques- cytochemical staining methods- immunocytochemistry – autoradiography

Cell Membrane: Ultra Structure, modifications and functions of plasma membrane.

UNIT – II (12 hrs.)

Mitochondria & Golgi complex: Structure and functions

Ultra structure and functions: Endoplasmic reticulum, Lysosome, Ribosome, Nucleus and Nucleolus.

Biology of cancer cell: Causes and theories of carcinogenesis, cell growth and ageing.

UNIT – III (12 hrs.)

Chromosome: Ultra Structure and functions of typical, Polytene and lamp brush chromosomes.

Cell Division: Mitosis; Meiosis; Role of mitotic apparatus in cell division.

Cell cycle

UNIT – IV (12 hrs.)

Nucleic acids: DNA, RNA and Micro RNA – Types, Structure and Chemical composition.

Replication of DNA: Semi conservative – Unidirectional and Bi-directional replication in eukaryotic chromosome.

Protein synthesis: Transcription and Translation in eukaryotes.

UNIT – V (12 hrs.)

Mutations: Types of mutations – Chromosomal and Gene mutation – Mutagenesis.

DNA Repair mechanism: Excision Repair mechanism.

Radiation biology: Types of radiations - Effect of radiation on cells

Text Book:

1. Gupta, P.K. 2010. Cell and Molecular Biology. Rastogi Publications. Meerut.
2. Rastogi, S.C. 2005. Cell & Molecular Biology. New Age International (P) limited. New Delhi.
3. Verma and Agarwal. 2002. Cell and Molecular Biology. S.Chand Publications. New Delhi.

References:

1. Deepak Kumar Kar and Soma Halder. 2009. Cell Biology, Genetics & Molecular Biology. New Central Book Agency (P) Ltd. Kolkata.
2. De Robertis, E.D.P. F.A., Saez, and E.M.R. De Robertis Jr. 1975. Cell Biology. W.B. Saunders Company, Philadelphia.
3. Du Praw, E.J. 1968. Cell and Molecular Biology. Academic Press New York.
4. George, M. 2008. Essentials of Molecular Biology, Narosa Publishing House.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305
DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

B.Sc., ZOOLOGY Code: 15 ZOP 306

SEMESTER III - CC –VI- MAJOR PRACTICAL –III (COVERING PAPERS- V)

1. Microscopy: Simple and compound microscope- principles, components and their applications.
2. Micrometry- stage and ocular micrometer, drum micrometer to determine nucleo-cytoplasmic ratio.
3. Squash preparation of onion root tip- to observe various stages of mitosis
4. Mounting of Polytene chromosome - Salivary gland cells of Chironomous larva, Drosophila larva.
5. Preparation and identification of various stages of meiosis from testis of Grasshopper.
6. Drumstick chromosome - blood smear.
7. Barr body - buccal epithelium.
8. Demonstration and preparation of permanent slides.
9. Preparation of 2D models of cell organelles and processes related to cell and molecular biology.
10. Spotters: Stages of mitosis and meiosis from prepared slides, models of DNA, RNAs and camera lucida.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

B.Sc., ZOOLOGY

SEMESTER III - SBC–III -MEDICAL LABORATORY TECHNIQUES

Code: 15 SZO 303

Objective: To enable the students understand the various medical techniques used for the diagnosis of human diseases.

Unit – I

General Examination: Temperature, Pulse, BP-Hypertension, Hypotension, Edema. Acute Gastroenteritis (food poisoning), cute renal failure,Amoebic dysentery,Snake bite.
Blood examination- Haemoglobin estimation and Anaemia

Unit – II

Urine analysis : Collection and preservation of urine.
Physical examination- volume, colour, odour, turbidity and reactions (pH);
Chemical examination (Albumin,Sugar,Bil salts, Bile pigments, Urobilinogen and ketone bodies (acetone, acetoacetic acid & beta-hydroxy butric acid).
Microscopic examination- urine deposits for pus cells, epithelial cells, RBCs, casts, crystals and bacteria,- Pregnancy test.

Unit -III

Stool examination: Physical examination- Colour, consistency, odour, mucus and reaction Chemical examination- Test for occult blood.Microscopic examination- study of parasitic ova and cysts.
Sputum analysis: Microscopic examination of sputum,
Semen analysis: Microscopic examination- Motility, total count and abnormality.

Text Books:

1. Gunesekaran, P. 1996. Laboratory Manual in Microbiology, New Age International, India.
2. Ochei, J. & Kothatkar. 2000. Medical Laboratory Science. Tata Mc-Graw Hill Publishing Company.
3. Ramnik Sood. 2002. Medical Laboratory Techniques Methods and Interpretation, Jaypee Brothers, Medical publishers, New Delhi.

References:

1. Zubay, G.L. 1998. Biochemistry, W.M.C. Brown Publishers, New York.
2. Richard, D.G., C.B. Slack, and J.F. Peuthere. 1996. Medical Microbiology. Churchill Livingstone, USA.
3. Gradwohls, 2000. Clinical Laboratory Methods and Diagnosis. (Ed.) Ales, C., Sonnenwirth and Leonard Jarret, M.D. B.I. Publications, New Delhi.
4. June Cella. 1994. Manual of laboratory test, AITBS publishers.
5. Ochei, J. & A. Kolhatka. 2000. Medical Laboratory Science, Theory and Practice, Tata McGraw Hill.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305
DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

B.Sc. ZOOLOGY

SEMESTER - IV - PAPER - VII- GENETICS

Objective: To enable the students understand the basic principles of inheritance.

Code: 15 ZO407

UNIT - I (15 Hours)

Mendelism: Laws of inheritance.

Interaction of genes: Non- allelic gene interactions - Epistatic genes- Dominant epistasis- Colouring pattern of plumage in domestic fowls, Complementary genes – Inheritance of flower colour in sweet pea and Supplementary genes-Inheritance of coat colour in rabbit; Allelic gene interactions - Incomplete dominance- Inheritance of flower colour in 4 O' clock plant, Codominance- Coat colour in short horn cattle and Lethal genes – Sickle cell anemia in man; Penetrance and expressivity.

UNIT - II (15 Hours)

Linkage & Crossing over: Principle, types and mechanism with *Drosophila* as example.

Mapping of Chromosomes: Principles and methods - Construction of chromosome map in *Drosophila* – Three Point Test cross experiment.

Multiple Alleles: Blood groups in man-ABO, MN and Rh types.

Polygenic inheritance: Skin colour in man.

UNIT - III (15 Hours)

Sex determination: Chromosomal, genic balance, environmental and hormonal basis.

Sex - Linked inheritance: Colour blindness and hemophilia in man.

Sex limited genes and Sex influenced genes: Definition with examples.

Cytoplasmic inheritance: Inheritance of kappa particles in *Paramecium* and Shell coiling pattern in snail.

UNIT - IV (15 Hours)

Microbial genetics: Recombination-Transformation, Conjugation, Sexduction and Transductio in bacteria.

Population genetics: Hardy-Weinberg Law, Factors affecting Hardy-Weinberg equilibrium.

Human genetics: Human chromosome, Karyotype, Idiogram, Pedigree analysis.

Chromosomal syndromes in man: Down's, Turner's and Klinefelter's syndromes.

Inborn errors of metabolism: Phenylketonuria, Alkaptonuria and Albinism.

UNIT - V (15 Hours)

Gene Concept: DNA as the genetic material.

Inbreeding, Outbreeding and Heterosis.

Genetic Code: Properties and importance.

Gene expression and regulation: Operon model- Lac operon.

Genetic Counselling: Eugenics- positive and negative, Euthenics and Euphenics.

Text book

1. Verma. P.S. & V. K. Agarwal. 2009. Genetics. S Chand & Co. New Delhi.
2. Gupta, P.K. 2007. Genetics – Classical to Modern. Rastogi Publications. Meerut.
3. Dipak Kumar Kar & Soma Halder. 2009. Cell Biology, Genetics & Molecular Biology. New Central Book Agency (P) Ltd. Kolkata.

References

1. Altenburg, E. 1970. Genetics. Oxford and IBH Publishing Company, New Delhi.
2. Gardener, E.J. & M.J. Simmons. 2009. Principles of Genetics. John Wiley & Sons. Inc. New York.
3. Lewin, B. 2005. Genes. Wiley Eastern Ltd. New Delhi.
4. Rothwell, N. V. 1978. Human Genetics. Printice Hall of India.
5. Sinnott, E.W. L.C. Dunn and T. Dobzhansky. 1959. Principles of Genetics. Tata Mc. Graw Hill, New Delhi.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305
DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

B.Sc., ZOOLOGY **Code: 15 ZOP 408**

SEMESTER IV - MAJOR PRACTICAL –IV (CORE PAPER- VII)

GENETICS

1. Culture and identification of Drosophila.
2. Dihybrid cross / Mendel's law of Independent Assortment
3. Gene interaction models- Non-allelic gene interactions- Complementary genes (9:7); Dominant epistasis (12:3:1)

   Allelic gene interactions- Co-dominance and incomplete dominance.
4. Polygenic / Quantitative genetics models.
5. Study of finger prints and their pattern of inheritance in man.
6. Calculation of gene frequency and genotype frequency for autosomal, Sex linked and sex influenced human traits.
7. Multiple alleles - Blood grouping In Man.
8. **SPOTTERS:**

i) Mendel's law of inheritance - Mendelian traits.

ii) Human karyotype -

   a) Male and female
   b) Turner's syndrome
   c) Klinefelter's syndrome
   d) Down's syndrome

iii) Preparation of human karyotype and idiogram

iv) Construction of Pedigrees charts /models on

   a) Y-linked inheritance - Hairs on pinna
   c) X linked recessive - Eye colour in Drosophila
   d) Autosomal recessive gene inheritance – Sickle cell anemia
   e) Autosomal dominant gene inheritance- Polydactyly in Man

iv) Identification of sex and mutants in Drosophila.

v). Identification of shell coiling pattern in Snail.

1. **Reference**

Jayasurya,et.al. 2013. Practical Zoology Vol.III. Saras publications Nagercoil.

2. Meyyan. R. P. 2005. Genetics. Saras publications Nagercoil.
3. Singh. H.G , Y.S. Chauhan, and R.P. Katiyar. 1988. A manual of Practical genetics. Kalyani Publishers. New Delhi, Ludhiana.
4. Verma, P.S. and Agarwal, V.K. 2013. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd, New Delhi.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305.

DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

(NMEC -1 For II B.Sc., BOTANY)

SEMESTER IV– NMEC-1: ECONOMIC ZOOLOGY

Hour : 2/week Credit : 2 Code: 15 NMZO 401

Objectives: **To make the students aware of the economic importance of various animals**

UNIT – I

Apiculture: Types of Honey bees in India
Biology of Honey bee - *Apis cerana*
Apiary: requirements and methods
Products of honey bees: Honey, Bee wax, Propolis, Royal jelly, Bee pollen, Bee venom
Economics of Apiculture

UNIT - II

Vermiculture: Types of Earth worms
Biology of Earthworm: *Lampito mauritii*
Vermiculture –requirements and methods
Importance of Vermicompost, Vermicast and Vermiwash
Economics of Vermiculture

UNIT - III

Fish culture: Freshwater Cultivable fishes
Selection, construction and management of fresh water fish farm
Natural and induced breeding; transport of seeds and breeders,
Integrated fish farming
Economics of fish culture.

Text Books:

1. Shukla, G.S. and Upadhyay, V.B. 1993. Economic Zoology. Rastogi Publications, Meerut.
2. Ahsan, J. and Sinha, S.P. 2000. A hand book on Economic Zoology. S.Chand & Company Ltd., New Delhi.
3. Jawaid Ahsan, Sinha, S. P. 2008. A Handbook of Economic Zoology. S. Chand Group Publ.

Reference

1. Ghosh, G.K. 1995. Bee keeping in India.Renganathan, L.S. 20006. Vermitechnology from soil health to Human health Agrobios. (India) Agro house, Jodhpur.
2. Swift, D.R. 1993. Aquaculture. Fishing New Books, London.
3. Banerjee, G.C. 1989. Poultry. Oxford & IBH Publishing Co.Pvt.Ltd., New Delhi.
4. Shukla, G.S. & Upadhyay, V.B. Economic zoology. Rastogi Publs. 2005.Pp. 487.
5. Upadhyay, V.B. 2006. Economic Zoology. Rastogi Publications. Pp488.
6. Yadav, Manju 2003. Economic Zoology. Discovery Publishing House.Pp. 356.

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Verified 5/12/17 Verified 5/12/16

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL–609 305
B.Sc., ZOOLOGY

SEMESTER V - C.C. IX PAPER 9: ECOLOGY AND EVOLUTION

Objectives: To enable the students understand the basic principles of Ecology and Evolution

Code: 12 ZO 509

UNIT – I

Introduction: Definition of Ecology; Subdivisions; Branches and Scope of ecology

Concept of ecosystem: Definition; Components- Biotic factors, Abiotic factors-Soil, light, temperature, water and gases (CO_2 & O_2).

Biotic community; Dynamics and Structure: Definition; Types of communities; Characteristic features; Ecotone and Edge effect; Ecological Niche; Ecological equivalents and Ecotypes.

UNIT – II

Animal relationships: Definition; Neutralism; Symbiosis; Commensalism- Mutualism; Antagonism- Predation, Parasitism, Competition.

Ecological Succession: Definition; Types of Succession; Patterns of succession – Hydrosere; Sere and Climax; Concept of climax; Significance of succession.

UNIT – III

Population ecology: Definition; Characteristics- Density, Birth rate, Death rate, Age-Distribution, Growth form, Population equilibrium, Biotic potential, Dispersal, Dispersion, Population fluctuations; Regulation of population size- Density independent and Density dependent factors; Population interactions.

Habitat Ecology: Pelagic fauna and their adaptations, Fauna of sandy, muddy and rocky shore and their adaptations

UNIT – IV

Evolution:

Theories of Evolution: Recapitulation theory, Lamarckism - Neo Lamarckism, DeVries theory of mutation - Modern concept of mutation; Darwin's theory - Neo Darwinism and Modern synthetic theory of evolution

Evidences of Organic Evolution-Morphological, Embryological &Physiological

Recapitulation theory and its importance

UNIT- V

Geological time scale; Fossils formation, types and dating of fossils

Mimicry & colouration – Isolation – Speciation –

Evolution of Horse- Evolution of Man and future evolution of man.

Text Book:

Arumugam, N. 1992. Concepts of ecology. Saras Pub., Nagargoil.

Arumugam, N. 2005. Organic Evolution. Saras Pub., Nagargoil.

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI,MANNAMPANDAL.

B.Sc., ZOOLOGY

SEMESTER V – C.C.X - DEVELOPMENTAL BIOLOGY

Code: 15ZO510

OBJECTIVES: To enable the students to acquire knowledge of the development of organisms and recent trends in embryological studies.

UNIT - I

Gametogenesis: Primordial germ cells, Spermatogenesis, Oogenesis ; yolk types, synthesis, transportation, importance, Structure of Human sperm and ovum-typical, frog and man -Types of eggs based on development, distribution of yolk and shell

UNIT - II

Fertilization – events in fertilization-physical, chemical and physiological changes, theories of fertilization.

Cleavage - Planes and patterns, cleavage in frog and chick

Blastulation- structure of blastula in frog and chick

UNIT - III

Morphogenetic movements –types – fate map of frog and chick

Events in gastrulation of frog and chick –structure of gastrula in frog and chick

Organogenesis- development of brain and heart in frog and chick

UNIT - IV

Foetal membranes in chick.

Placentation in mammals- types of placenta.

Organiser concept- Embryonic induction – concepts and experiments.

Nucleo- cytoplasmic interactions- Regeneration- mechanism of regeneration in amphibians

UNIT – V

Sexual cycle : Human embryology- Menstrual cycle, Menopause, pregnancy and Child birth- hormonal regulation

Causes of in-fertility in human male and female- IVF – collection and cryopreservation of gametes and embryo- Birth control-

Teratology- causes , types and events

Text Book

Verma,P.S., V.K.Agarwal and B.S.Tyagi. 1985. Chordate Embryology. S.Chand & Co Ltd. NewDelhi.

References

1. Berrill, N.J. 1974. Developmental Biology. Tata McGraw Hill Publications, New Delhi.
2. McEwen, R.S. 1973. Vertebrate Embryology. Oxford & IBH Publishing Co., Calcutta.
3. Browder, L.W. 1984. Developmental Biology. Saunders College Publishing, New York.
4. Balinsky, B.I. 1981. An Introduction to Embryology. Saunders College Publishing, New York.

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL

B.Sc., ZOOLOGY

SEMESTER V – C.C.XI: ANIMAL PHYSIOLOGY

Objectives: To acquire the basic knowledge of physiological functions of various organs.

Code: 15ZO511

UNIT – I

Nutrition: Types of nutrition - Physiology of digestion in man-peptic ulcer, malnutrition, appendicitis, liver cirrhosis

Regulation of secretion of digestive enzymes - Hormones involved in digestion.

Metabolism: Protein, carbohydrate and lipid.

UNIT - II

Respiration: Respiratory pigments, Transport of O_2 and CO_2 –pneumonia, bronchitis

Mechanism and regulation of respiration in man;

Circulation: Types of heart-Composition and functions of blood- blood coagulation;

Origin, conduction and regulation of heart beat and blood pressure- myocardial infaction, ECG, angiogram.

UNIT - III

Excretion : Types of nitrogenous wastes-Structure of kidney, nephron - formation of urine and hormonal regulation of excretion in man- Renal failure and Dialysis

Osmo and ionic regulation: Fishes, Reptiles and Birds.

Thermo-regulation in mammals.

UNIT - IV

Nervous system: Structure and types of nerve cells, propagation of nerve impulses, synaptic transmission - neurotransmitters

Effectors: Types and properties of muscles - Mechanism of muscle contraction - Biochemical analysis during contraction

Receptors: Photo (eye) and Phono-receptor (Ear).

UNIT -V

Reproductive physiology:

Histophysiology of male and female reproductive organs in man,

Endocrine system: Structure and functions of pituitary, adrenal, thyroid, gonads.

Role of hormones in spermatogenesis, lactation and parturition

Test Book

Mariyakutikan, A. and N. Arumugam. 2009. Animal physiology. Saras Pub. Nagarkoil

References

1. Hurkat, P.C., and Mathur, P.N. 1976. A Text book of Animal Physiology. S.Chand Co.,(LTD) New Delhi.
2. Wood. D.W. 1971. Principles of Animal Physiology. Edward Arnold Publishers Ltd London.
3. Tuttle, W.W. and Schottelius, B.A. 1961. Text book of Physiology. The C.V. Mosby Company, St. Louis.
4. Goel, K.A. and Sastri, K.V. 1998. A Text book of Animal Physiology. Rastogi Publications, Meerut.
5. Rastogi, S.C. 1992. Essentials of Animal Physiology. Wiley Eastern Limited, New Delhi.
6. Berry, A.K. 1989. A Text book of Animal Physiology, Emkay Publications, Delhi.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI
B.Sc. Zoology
CC XII Semester V: PRACTICAL V

Paper covering (Ecology & Evolution, Developmental Biology and Animal Physiology)

Weekly 8 Hrs
Code: 15 ZOP 512

1. Estimation of pH of water samples
2. Estimation of dissolved oxygen (Winkler's method)
3. Estimation of free carbon-di-oxide
4. Estimation of Salinity
5. Estimation of Alkalinity
6. Estimation of silicate
7. Estimation of iron
8. To study a plant community by quadrat method (frequency, density and abundance of different species)
9. Plankton analysis
10. Estimation of primary productivity – pond ecosystem (Light and Dark bottle method)
11. Chick Blastoderm mounting
12. Effects of pH and temperature on Salivary amylase activity
13. RBC & WBC estimation in human blood
14. Estimation of Haemoglobin in human blood
15. Quantitative tests for nitrogenous excretory products
16. Ciliary activity in Fresh Water Mussel
17. Oxygen consumption of Fish
18. Earthworm salt-loss and gain process

Spotters

1. Maxi-minimum thermometer, Hygrometer, Luxmeter, pH meter, Sucker Fish, Hermit crab & Sea anemone, Ascaris and Taenia solium
2. Animals of evolutionary significance –Peripatus, Archaeopteryx –Homologous organs – Forelimb modifications – Analogous organs- wings modifications – colourations – chameleon – Lycodon and Krait – Mimicry – Leaf insect, stick insect, monarch and viceroy butterfly. Fossils: Nautilus , Ammonoites
3. Embryology: Blastula types – Frog,Chick, Chick developmental stages – 16,24,48,72,96Hrs – Placenta types – Goat - Human
4. Animal Physiology – Haemoglobinometer, Haemocytometer, Cross Section of Testis and ovary.

Field trip mandatory

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI

B.Sc. ZOOLOGY

Semester V

Code: 15ZOE501

EC 1- WILDLIFE BIOLOGY

Objectives: To enable the students realize the significance of wildlife conservation

Unit: I: Definition of Wildlife: causes of wildlife depletion – need for wildlife conservation – IUCN categories - endangered species of birds and mammals in India. Social, foraging and breeding habits in birds

Unit: II: Wildlife Sanctuaries, National Parks and Biosphere Reserves – Definition and importance
Sanctuaries: Vedanthangal Bird Sanctuary - Mudumalai Wildlife Sanctuary – Point Calimere Wildlife Sanctuary
National Parks – Corbett National Park, Guindy National Park
Biosphere Reserves – Gulf of Mannar.

Unit: III: Importance of Wildlife Census - Census Techniques: Direct methods – Line Transect Method – Block count method
Indirect methods: Pug mark techniques and Pellet methods

Unit: IV: Zoos and their importance – types of enclosures – food and feeding of zoo animals – veterinary care of zoo animals – zoo education.
Case study of Aringnar Anna Zoological Park

Unit: V: Wildlife (Protection) Act 1972: Introduction – schedules – declaration of Wildlife Sanctuary and National parks.
Human wildlife conflicts with reference to Elephant.
Role of NGO's in wildlife conservation

Text book

- Saharia, V.B. 1982. Wildlife in India. Nataraj Publishers, Dehradun

References

- Dasman, R.F. 1964. Wildlife Biology. John and Wildy and sons New York. Pp 231
- Giles,R.H. Jr (Ed) 1984. Wildlife Management Techniques 3rd edition. The Wildlife Society, Washington, D.C. Natraj Publishers, Dehradun, India
- Seshadri, B. 1986. India's Wildlife reserves, Sterling Pub'rs Pvt Ltd., New Delhi.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

SEMESTER V –EC II

PUBLIC HEALTH & HYGIENE

Code: 15 ZOE502

Objectives: To create awareness among the students on health and hygiene.

UNIT – I

Scope of health and hygiene; Nutrition and Health: Classification of foods; Growth and development – Growth chart, nutritional deficiency diseases; nutritional requirements of special groups, Balanced diet.

UNIT –II

Environment and Health: Water Standards and purification of water.

Solid waste: Types of solid wastes and their management.

Noise Pollution- Effects; Sewage- Effects and treatment

UNIT –III

Communicable diseases: Respiratory infections: Small pox and Tuberculosis.

Intestinal infections: Poliomyelitis and Cholera

Arthropod borne infections: Malaria and Filariasis.

Zoonosis: Rabies and Encephalitis

UNIT – IV

Non-Communicable diseases: Cardiovascular diseases-Rheumatic heart disease, Hypertensive heart disease, Ischaemic heart disease, Chronic cor pulmonellae, congenital heart disease, Diabetic mellitus; Obesity; Blindness- accident: road, industrial, home and air craft, suicide

UNIT- V

Occupational Health: Physical, chemical, biological, and psychological hazards.

Mental health: Alcohol and drug abuses.

Health education: Health plans of India- Role of National and international organization (WHO) in the health care of the community.

Text book:

Park, K. 2006. Text book of Preventive and Social Medicine.

Reference Books

WHO (1974). Modern Management methods and the organization of Health Sciences, Public health.

WHO (1981) World Health Organization, Geneva.

Semester	Course	Credits	Hours Per Week	Code
V	EA I	02	02	11 EA 501

Gender Studies

Common to all UG courses

GENDER STUDIES

OBJECTIVES

- To make boys and girls aware of each other's strengths and weaknesses.
- To develop sensitivity towards both genders in order to lead an ethically enriched life.
- To promote attitudinal change towards a gender balanced ambience and Women empowerment.

Unit – I

Concepts of Gender : Sex – Gender - Biological Determinism - Patriarchy – Feminism – Gender Discrimination – Gender Division of Labour – Gender Stereotyping – Gender Sensitivity Gender Equity – Equality – Gender Mainstreaming – Empowerment.

Unit – II Women's Studies Vs Gender Studies : UGC's Guidelines – VII to XI Plans – Gender Studies : Beijing Conference and CEDAW – Exclusiveness and Inclusiveness.

Unit – III Areas of Gender Discrimination : Family – Sex Ratio – Literacy – Health – Governance – Religion Work Vs Employment – Market – Media – Politics – Law – Domestic Violence – Sexual Harassment – State Policies and Planning.

Unit – IV – Women Development and Gender Empowerment : Initiatives – International Women's Decade – International Women's Year – National Policy for Empowerment of Women – Women Empowerment Year 2001 – Mainstreaming Global Policies.

Unit – V

Women's Movement and Safeguarding Mechanism :- In India National / State Commission for Women (NCW). – All Women Police Station – Family Court – Domestic Violence Act – Prevention of Sexual Harassment at Work Place Supreme Court Guidelines – Maternity Benefit Act – PNDT Act – Hindu Succession Act 2005 – Eve Teasing Prevention Act – Self Help Groups – 73rd and 74th Amendment for PRIS.

Evaluation – CIA: 25 Marks & ESE : 75 Marks

Verified G. Shamila 16/07/13

Pattern of Question Paper

PROFESSOR OF ZOOLOGY

Section – A 10 Short Answer Questions (Two from each unit) 10X2=20 Verified G. Shamila 30/06/14

Section – B 5 Short Essays (either….or…type from each unit) 5X5=25

Section – C Essays 3/5 (one from each unit) 3X10=30 Verified G. Shamila 30/06/16 Verified G. Shamila

11SSD 501

MB

Bharathidasan University
Tiruchirappalli- 620 024

Candidates admitted in the Academic year 2011-2012 onwards

FOR ALL UG COURSES
Soft Skills Development

Learning Objective
Today's world is all about relationship, communication and presenting oneself, one's ideas and the company in the most positive and impactful way. This paper intends to enable students to achieve excellence in both personal and professional life.

Unit I
Know Thyself/ Understanding Self
Introduction to Soft skills-Self discovery-Developing positive attitude-Improving perceptions-Forming values

Unit II
Interpersonal Skills/ Understanding Others
Developing interpersonal relationship-Team building-group dynamics-Net working-Improved work relationship

Unit III
Communication Skills / Communication with others
Art of listening-Art of reading-Art of speaking-Art of writing-Art of writing e-mails-e mail etiquette

Unit IV
Corporate Skills / Working with Others
Developing body language-Practising etiquette and mannerism-Time management-Stress management

Unit V
Selling Self / Job Hunting
Writing resume/cv-interview skills-Group discussion- Mock interview-Mock GD – Goal setting - Career planning

Text Book

A book on development of Soft Skills Dr. K. Meena & Dr.V.Ayothi.
Soft Skills. Dr.K.Alex S.Chand & Company Ltd, Ram Nagar, New Delhi- 110 055

Reference Books

(i) Developing the leader within you John c Maxwell
(ii) Good to Great by *Jim Collins*
(iii) The seven habits of highly effective people Stephen Covey
(iv) Emotional Intelligence Daniel Goleman
(v) You can win Shive Khera
(vi) Principle centred leadership Stephen Covey

30/6/14

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29/6/15

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI

B.Sc., ZOOLOGY

SEMESTER - VI: C.C.XIII - MICROBIOLOGY AND IMMUNOLOGY

Code: 15Z0 613

Objectives: **To enable the students to understand the basics of microorganisms, immune system and immune reactions.**

UNIT – I

Microbiology

Scope and importance of microbiology. Classification of microorganisms - salient features of Bacteria, Viruses, Algae, Fungi and Protozoa.

Reproduction in Bacteria.

Classification of bacteria- based on staining, temperature and nutrition.

UNIT – II

Bacterial growth: Culture characteristics; Culture methods - Sterilization. Preparation and Preservation of culture media and maintenance of pure culture.

Control of micro organisms: physical and chemical methods.

UNIT – III

Food microbiology: sources of microorganisms, food spoilage, food poisoning.

Industrial Microbiology: Fermenter – structure; factors affecting fermentation; Production of alcohol and Penicillin.

UNIT – IV

Immunology

Immunity - Types of immunity – innate, acquired; Cells of immune system; Lymphoid organs – primary, secondary; Antigen – factors determining antigenicity; Immunoglobulins – types, structure and functions; Antigen - Antibody reactions –Precipitation, Agglutination and Cytolysis.

UNIT - V

Immune response: primary, secondary, humoral and cell mediated; Hypersensitivity– types;

Transplantation- types of grafts, mechanism of graft rejection.

Autoimmune disease - arthritis.

Text Books:

1. Dubey and Maheswary. 2002. Microbiology. S.Chand and Co (P) Ltd, Delhi
2. Dulsy Fatima & N. Arumugam. 2009. Immunology. Saras publications, Nagercoil.

verified G. Shanmugam 5/12/17

Verified 05/12/17

Reference Books:

1. Powar, C.B. and Daginawala. 1995. General Microbiology. Himalaya Publishing House, Bombay.
2. Tauro, P., Kapoor, K.K. and K.S. Yadav. 1997. An introduction to Microbiology. New Age International Ltd. New Delhi.
3. Pelczar, M. 2006. Microbiology. Tata Mc- Graw Hill publishing company, Delhi.
4. Prescott, L. M. 2003. Microbiology. Tata Mc- Graw Hill publishing company, Delhi.
5. Kuby, J. 2007. Immunology. Freeman, W.H. publishing company, London.
6. Roitt,I. and others.2002. Immunology. Mosby publishers, London.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI

B.Sc., ZOOLOGY

SEMESTER - VI: C.C. XIV - BIOTECHNOLOGY AND BIONFORMATICS

Code: 15Z0 6/4

Objectives: To enable the students to have a basic understanding of basic concept of biotechnology and bioinformatics

UNIT – I

Biotechnology: Definition; Scope;
Tools in genetic engineering- Restriction Enzymes and DNA ligase; Gene cloning vectors - Plasmids (pBR 322) - Cosmids (SV40).
Methodology of gene cloning.

UNIT – II

Blotting techniques – Southern, Northern and Western; PCR ; DNA finger printing ; hybridoma technology ;
Genomic library and gene therapy

UNIT – III

Applications of biotechnology in agriculture - Transgenic plants;
Applications of biotechnology in medicine – Insulin production;
Applications of biotechnology in Animal husbandry- Transgenic animals.
Biosensors and biochips: types and applications.

UNIT - IV

Introduction to bioinformatics – Scope and importance -Biological data bases – Protein and Nucleic acid data bases – pair-wise alignment technique– multiple sequence analysis.

UNIT - V

Bioinformatics Tools: BLAST, Clustal W, MEGA 6.06 - Phylogenetic analyses - human genome project

Text book:

1. Dubey, R.C. 2008. A text book of biotechnology. S. Chand & Co. New Delhi.
2. Arumugam, N. 2006. Bioinformatics. Saras Publications, Nagercoil.

Reference Books:

1. Balasubramania. D. 1996. Concepts of Biotechnology, University Press (India) Ltd., Hyderabad.
2. Dubey, R.C. 1995. Text Book of Biotechnology. S. Chand & Co. New Delhi.
3. Kumaresan,V. 2005. Biotechnology. Saras Publications, Nagercoil.

Verified by 5-12-17 Verified by 7/12/18

A.V.C. COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL
B.Sc., ZOOLOGY

SEMESTER - VI: C.C.XV- BIOPHYSICS, BIOCHEMISTRY AND BIOSTATISTICS

Code: ------ 15Z0 615

Objective:

- To enable students to understand the basic principles of biophysics, biochemistry and biostatistics.

UNIT - I

Microscopy: Principle and applications of Simple, Compound, Phase Contrast and Electron Microscope
Centrifuge: Principle, types and applications
Principles of Viscosity and Surface tension

UNIT - II

Structure, classification and functions: Carbohydrates, proteins and lipids; Calorific values;
Metabolism of Carbohydrates, proteins and lipids.

UNIT – III

Enzymes: Nomenclature, Properties, classification, mode of action.
Enzyme kinetics: Factors affecting enzyme action – pH, Temperature, Enzyme concentration, Substrate concentration; Michaelis and Menton equation; Enzyme Inhibition.

UNIT – IV

Data collection: Methods of collection, Classification and tabulation of data
Diagrammatic and graphical representation: Bar diagram, Pie diagram – Frequency polygon, frequency curve and Histogram

UNIT - V

Measures of central tendency: Arithmetic mean, median and mode
Measures of dispersion: Standard Deviation, Variance, Standard Error and Co-efficient of variation- Chi square analysis

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Text Books:

1. Daniel, M. 1989. Basic biophysics for biologists. Agro Botanical Pub., New Delhi.
2. Gurumani, N. 2002. An introduction to Biostatistics. MJP Publishers, Chennai.
3. Verma and Verma. 2002. Biochemistry. S.Chand Pub. PVT, New Delhi

References:

1. Ackerman, E. 1967. Biophysical science. Prentice Hall Inc., New Delhi.
2. Pillai, R.S.N. and V. Bagavathi. 1998. Statistics. 4th edition. S. Chand & Co., New Delhi.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W. H. Freeman. San Francisco.
4. Lehninger L. 1990. Biochemistry. W.H. Freeman & Co., New York.

Verified
K. Chitra 5/12/17

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5/12/17

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI

B.Sc., ZOOLOGY

SEMESTER - VI: C.C.XVI - PRACTICAL - VI

(Paper covering Microbiology, Immunology, Biotechnology, Bioinformatics, Biophysics, Biochemistry and Biostatistics)

6 Hrs/Week

Code: 15ZOP 6b

Microbiology

- Sterilization methods,
- Media preparations : Solid – Liquid media
- Culture techniques: Pure culture methods – Streak plate – Pour plate – serial dilution
- Staining technique: Gram staining
- Examination of milk quality - MBR test
- Spotters - Petridish, Autoclave, Innoculation loop and Laminar Air Flow.

Immunology

- Imprinting of liver and spleen.
- Lymphoid organs –Demonstration by using animal

Biotechnology

- Isolation of DNA from plant / animal sources
- Estimation of DNA from plant / animal sources
- Transgenic plants and animals through Models
- Examination of Transverse Sections of root nodule of leguminous plants
- Spotters: Electrophoresis - Vertical and Horizontal, Colorimeter.

Bioinformatics

- Demonstration of NCBI database, BLAST, Clustal W and MEGA 6.06

Biophysics

- Determination of surface tension (Drop weight method).
- Determination of viscosity (Oswald viscometer).
- Spotters: Microscope (Simple, Compound and Binocular), Centrifuge (Hand Centrifuge and Table top)

Biochemistry

- Qualitative tests of carbohydrates, proteins and lipids
- Preparation of buffers.

Biostatistics

- Leaf / Mussel shell: morphometric measurements
- Data distribution: Individual series, Discrete series and Frequency distribution.
- Calculation of mean, median, mode, SD and SE.
- Graphical representation: Histogram, frequency curve and frequency polygon.

verified 6/12/18

A.V.C.COLLEGE (AUTONOMOUS), MAYILADUTHURAI, MANNAMPANDAL
B.Sc., ZOOLOGY

SEMESTER - VI : EC II - VECTOR BIOLOGY

Code: 15ZOE 602

Total hours: 4

Objectives: To enable the students to understand the vectors and their importance in human and livestock.

Unit - I

Introduction to vectors – types; host – pathogen/ parasite; Types of disease transmission - natural, biological, mechanical - Zoonoses - epizootic and enzootic transmission.

Unit - II

Mosquitoes and their medical importance - Breeding habitats; Life cycle of *Anopheles, Culex* and *Aedes* mosquitoes; Disease transmission cycle of Malaria, Filariasis, Dengue;
Houseflies - life cycle - disease transmission – control.

Unit - III

Mites - life cycle - transmission (scabies, typhus) – control.
Fleas - life cycle - disease transmission – control.
Lice - head and body Lice - biology - disease transmission - epidemic typhus, trench fever, relapsing fever and secondary dermatitis - lice control.

Unit - IV

Sand flies and leishmaniasis - visceral and cutaneous.
Tsetse flies and African sleeping sickness; Flies control.
Vectors of minor importance and diseases: Snails *Lymnaea* sp. - Schistosomiasis; Copepods – Dracunculiasis.

Unit - V

Personal protection measures; Vector control – types- chemical (larvicides, adulticides and IGRs), biological (bio-larvicides, larvivorous fish, other predators); Insecticide resistance; National and International Agencies of vector center – ICMR, WHO; National disease control programme – NVBDCP: NFCP, NMCP, NMEP, NAMP, NRHM.

Text Books:

1. Park, K. 2007. Text book of preventive and social medicine.
2. Jayaram Panikar, C.K. 2002. Textbook of medical parasitology. Jaypee Brothers Medical publishers Pvt. Ltd, New Delhi.

Reference Books:

1. Rozendaal. 1997. Vector Control - Methods for Use by Individuals and Communities. World Health Organization, Geneva.

Verified K. Chitra 5/12/17.

Verified 5/12/18

2. Public Health significance of urban pests (WHO – Europe 2008) ISBN 978 -92-890-7188-8 pp 292.
3. Arthropods of public health significance in California, Training Manual, Edited by Richard P. Meyer, Ph.D. and Minoo B. Madon (2002) MOSQUITO and VECTOR CONTROL ASSOCIATION of CALIFORNIA, 660 J Street, Suite 480, Sacramento, CA 95814 pp 210.
4. World Health Organization. 1989. Geographical distribution of arthropod-borne disease and their principal vectors, WHO/VBC/89.967,Geneva.
5. Service, M.W. 2000. Medical entomology for students (2n ed.) Cambridge Univ. Press, Cambridge, UK.
6. Arthropods of Medical importance. 1981. Edited by Nicholas R.H. Burgess, Published by Noble Books Ltd, Hampshire. pp222.
7 Rao, T. R. 1981. The Anophelines of India. Indian Council of Medical Research, New Delhi.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI

B.Sc., ZOOLOGY

SEMESTER – VI: EC III - WILDLIFE BIOLOGY Code: 1520E 603

Total Hours: 4

Objectives: To enable the students realize the significance of wildlife conservation

Unit - I

Definition of Wildlife – Causes of wildlife depletion – need for wildlife conservation – IUCN categories – endangered species of birds and mammals in India; CITES – WWF – RSBP.

Unit - II

Importance of Wildlife Census - Census Techniques: Direct methods – Line Transect Method – Total count method;
Indirect methods: Pug mark techniques and Pellet methods;

Unit - III

In situ conservation: Wildlife sanctuaries, National parks and Biosphere Reserves - Definition and importance
Sanctuaries: Vedanthangal Bird Sanctuary - Mudumalai Wildlife Sanctuary – Point Calimere Wildlife Sanctuary
National Parks – Corbett National Park, Guindy National Park
Biosphere Reserves – Gulf of Mannar.

Unit – IV

Ex-situ conservation: Zoo and its importance – types of enclosures – food and feeding of Zoo animals – Veterinary care of Zoo animals – Zoo education
Case study of Aringnar Anna Zoological Park.

Unit – V

Wildlife (Protection) Act 1972: Introduction – schedules – declaration of Wildlife Sanctuary and National parks.
Human - wildlife problems with reference to Elephant.
Role of NGO's in wildlife conservation

Text book

1. Saharia, V.B. 1982. Wildlife in India. Nataraj Publishers, Dehradun

References

1. Dasman, R.F. 1964. Wildlife Biology. John and Wildy and sons New York.
2. Giles,R.H. Jr (Ed) 1984. Wildlife Management Techniques 3rd edition. The Wildlife Society, Washington, D.C. Natraj Publishers, Dehradun, India
3. Seshadri, B. 1986. India's Wildlife reserves, Sterling Pub'rs Pvt Ltd., New Delhi.

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(2008-2009 onwards)

11 VBC 601 /
08 VBC 601 /

A.V.C. COLLEGE (AUTONOMOUS)

VE : ~~VBE~~ VALUE ~~BASED~~ EDUCATION

(Common for ALL Under Graduate Courses)

HUMAN VALUES AND ETHICS

Weekly 2 Hours — **VI-SEMESTER** — 2 Credits

SYLLABUS

UNIT-I: **Introduction**: Value education and its Relevance to present day – Meaning of Value Education – Value education in Kural – Personal Values – Love – Compassion – Gratitude – Courage – Optimism - Friendship

UNIT-II: **Ethics**: Ethical Question for the Society – Overcoming Dilemma – Ethical and Ethics – Value System – Definition of Value – Categorization of Values – Method of Building – Value System – Desired and Desirable Values – Changing Values

UNIT-III: **War, Peace and Terrorism**: War – Avoiding wars – Terrorism – What is Terrorism – Perception of Terrorism – U.N. definition of Terrorism – Different Types of Terror Acts – Peace – Signs for an everlasting Peace.

UNIT-IV: **International Law and Human Rights:** Laws of States – International Laws - Human Rights – Implementing and Safeguarding Human Rights - The fundamentals of International law – International Law in Operation.

UNIT-V: **Happiness and Contentment:** Courage and Resilience – Love, Patience and Empathy – Relationship – Citizenship – Personal Values – Troubleshooting - Cultivating good manners – Being persuasive – Being Authentic.

Text Books:

1. Value Education - N.S. Raghunathan
   Margham Publications, Chennai – 2010

Reference Books:

1. Human Values and Professional Ethics (Value and Ethics of Profession) - Jayshree Suresh & B.S. Raghavan
   S.Chand & Company Ltd., New Delhi. 2009
2. Professional Ethics and Human Values - D.R. Kiran
   Tata McGraw-Hill Publishing Company Ltd., New Delhi - 2007

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for G. Dhanam 5/12/13

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A.V.C College (Autonomous), Mannampandal – 609 305

Choice Based Credit System (CBCS)

(For the Students Admitted from 2016 – 2017 onwards)

GENERAL INTEREST COURSE

ENVIRONMENTAL STUDIES

CREDIT: 2

HOURS:2/WEEK

SEMESTER VI

COURSE CODE: 16ES 601

Unit: 1

The Multidisciplinary nature of environmental studies

Definition, scope and importance.

Need for public awareness

(2 lectures)

Unit: 2

Natural Resources:

Renewable and non-renewable resources:

Natural resources and associated problems.

a) Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

f) Land resources: Land as a resources, land degradation, man induced Landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

(5 lectures)

Unit: 3

Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession.
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:-

- a. Forest ecosystem
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)

5 (6 lec

Unit: 4 Biodiversity and its conservation

- Introduction – Definition : Genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and values
- Biodiversity at global, National and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

5 (8 lect

Unit: 5 Environmental Pollution

Definition

Causes, effects and control measures of:

a. Air Pollution
b. Water Pollution
c. Soil Pollution
d. Marine Pollution
e. Noise Pollution
f. Thermal Pollution
g. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industri
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides.
- Ill-Effects of Fireworks: Firework and Celebrations, Health Hazards, Types of Fire, Fir Safety.

5 (8 lectures)

Unit: 6 Social Issues and the Environment

- From Unsustainable to Sustainable development.
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns.

Case studies

- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of pollution) Act.

- Water (Prevention and Control of pollution) Act.
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness.

(7 lectures)

Unit: 7 Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programmes
- Environment and human health
- Human Rights – Value Education
- HIV/ AIDS – Women and Child Welfare
- Role of Information Technology in Environment and human health
- Case studies.

Unit: 8 Field Work

(2 lectures)

- Visit to a local area to document environmental assets-river/ forest/ grassland/hill/ mountain

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21/12/2018.

References:

1. Agarwal, K.C. 2001 environmental Biology, Nidi Public Ltd Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt ltd, Ahamedabad – 380013 E-mail: mapin@icenet.net(R)
3. Brunner R.C. 1989, Hazardous Waste Incineratin, McGraw Hill Inc 480p
4. Clark R.S. Marine Pollution, Clanderson Press Oxford (TB)
5. Cunnigham, W.P.Cooper, T.H.Gorhani E & Hepworth, M.T.2001.
6. De A.K. Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Securit Stockholm Env.Institute Oxford University, Press 473p.
9. Hawkins, R.E. Encyclopedia of India Natural History, Bombay Natural History Society, Bomb
10. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University P 1140p.
11. Jadhav, H & Bhoslae, V.M. 1995. Environmental Protection and Laws Himalaya Pub. House, D 284p.
12. Mckinney, M.L. & Schoch R.M.1996.Environmental Science systems & Solutions, Web enhanc edition 639p.
13. Mhaskar A.K. Matter Hazardous, Techno-science Publications (TB)
14. Miller T.G. Jr.Environmental Science, Wadsworth Publishing Co.(TB)
15. Odum, E.P. 1971 Fundamentals of Ecology. W.B. Saunders Co. USA. 574p
16. Rao MN & Datta, A.K. 1987 Waste Water treatment, Oxford & IBH Publication Co.Pvt Ltd 345
17. Sharma B.K. 2001 Environmental chemistry Goel Publ House, Meerut.
18. Survey of the Environment, The Hindu (M)
19. Townsend C.Harper, J and Michael Begon, Essentials of Ecology, Blackwell science (TB)
20. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard I and II, Enviro Media (R).
21. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB)
22. Wagner K.D. 1998 Environmental Management. W.B. Saunders Co. Philadelphia USA 499p

(M) Magazine (R) Reference (TB) Textbook

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305.

CBCS- FOR M.Sc., ZOOLOGY STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2015-16 ONWARDS

Sem. No.	Paper	Title of the Papers	Code	Hrs	Marks			Credit
					CIA	ESE	Total	
I	C.C. I	Functional morphology and Palaentology of Invertebrates & Chordates	**15 PZO 101**	6	25	75	100	5
	C.C.II	Developmental Biology & Immunology	11PZO 102	7	25	75	100	5
	C.C. III	Animal Physiology	11 PZO 103	7	25	75	100	5
	C.C. IV	Practical- I (Covering papers 1to 3 & Elective)	**15 PZOP 104**	6	40	60	100	3
	Elective- I	Vermiculture	11 PZOE 101	4	25	75	100	4
II	C.C. V	Cell and Molecular Biology	11 PZO 205	7	25	75	100	5
	C.C. VI	Biophysics and Biochemistry	11 PZO 206	6	25	75	100	5
	C.C. VII	Biometry and computer applications	11 PZO 207	7	25	75	100	5
	C.C. VIII	Practical- II (Covering papers 5,6 &7)	11 PZOP 208	6	40	60	100	3
	EDC - I	Medical Zoology	11 EDZO 201	4	25	75	100	2
III	C.C. IX	Genetics	11 PZO 309	5	25	75	100	5
	C.C. X	Microbiology	11 PZO 310	6	25	75	100	5
	C.C. XI	Research Methodology and Biotechniques	11 PZO 311	5	25	75	100	5
	C.C. XII	Practical- III (Covering papers 9,10 & 11)	11 PZOP 312	6	40	60	100	3
	Elective- II	Entomology	**15 PZOE 302**	4	25	75	100	4
	EDC - II	Health Education	11 EDZO 302	4	25	75	100	2
IV	C.C. XIII	Environmental Biology	11 PZO 413	7	25	75	100	5
	C.C. XIV	Biotechnology & Bioinformatics	**15 PZO 414**	7	25	75	100	5
	C.C. XV	Practical – IV (Covering papers 13 & 14)	11 PZOP 415	6	40	60	100	4
	Elective- III	Aquaculture/Toxicology	11 PZOE 403a/b	4	25	75	100	4
	C.C. XVI	Project & Viva voce	11 PZOPR 416	6	40	60	100	6
				120	600	1500	2100	90

A.V.C. COLLEGE (AUTONOMOUS)
MANNAMPANDAL - 609 305.
M.Sc. ZOOLOGY

SEMESTER I – C.C. I : FUNCTIONAL MORPHOLOGY AND PALEONTOLOGY OF INVERTEBRATES & CHORDATES

Code: 15PZO 101

Unit – I

Symmetry in animal organization- Types and significance- Asymmetry, radial, biradial and bilateral symmetry

Coelom- Evolutionary significance -Acoelomate, pseudocoelomate, coelomate groups (Schizocoel, Enterocoel, Mesenchyme)

Metamerism- Evolutionary significance - Pseudometamerism, cyclometamersim, Corn theory, embryological theory

Locomotion: Movement in Annelids, Molluscs and Echinoderms

Nutrition: Filter feeding mechanism in Polychaetes and Molluscs

Respiration: Gills and trachea in Arthropods- Respiration in Molluscs

Unit – II

Circulation: Circulation in Arthropods and Molluscs

Excretion: Different types of excretory organs in invertebrates- their structure and function

Nervous System: Primitive types- Nerve net in Coeloenterates; Advanced types- Nervous system in Annelids, Molluscs and Arthropods

Unit – III

Reproduction: Pattern of sexual and asexual reproduction- Invertebrate larval forms and their phylogenetic significance

Invertebrate Fossils: Evolutionary trends and phylogenetic importance of Trilobites, Ammonoids, Belemnoids, Nautiloids, Echinoderm fossils

Minor Phyla: Affinities of Chaetognatha, Rotifera and Phoronida

B. Chordates

Comparative study and functional morphology of vertebrates

Unit – IV

Integumentary System: Exoskeletal structures and their modifications

Digestive System: Alimentary canal and associated glands

Respiratory System: Gill respiration in cyclostomes and fishes- Pulmonary respiration in tetrapods

Circulatory System: Types & Evolution of heart and aortic arches

Excretory System: Types & Evolution of kidneys

Unit – V

Nervous System: Brain and spinal cord- cranial nerves, spinal nerves and visceral nerves- Autonomic nervous systems- Sympathetic- Parasympathetic

Reproductive System: Reproductive systems- Accessory reproductive glands

Vertebrate Fossils: Evolutionary significance of Ostracoderms, Placoderms, Crossopterygians, Labyrinthodonts, Dinosaurs, Archaeopteryx

References:

INVERTEBRATES

1. **Highnam, K.C and Hill, L** (1979). The Comparative Endocrinology of Invertebrates, ELBS & Edward Arnold (Publishers) Ltd., London.
2. **Hyman, G.H.** The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., N.Y.
3. **Kotpal, R.L.** Minor Phyla, Rastogi Publication, Meerut.
4. **Vasanthika Kashyap, AP.** (1997). Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.

CHORDATES

1. **Colbert, H. Edwin** (1989). Evolution of the Vertebrates, II Ed., Wiley Eastern Limited, New Delhi.
2. **Harrey Pouch, John B. Heisher, William N. McFarland** (1990). Vertebrate Life, Macmillan Publishing Co., N.Y.
3. **Jollie, M.** (1962). Chordate Morphology, Reinholt Publishing Corporation, N.Y.
4. **Kent, GC** (1976). Comparative anatomy of the Vertebrates, McGraw Hill Book Co., Inc., N.Y.
5. Romer, A.S. (1974). The Vertebrate Body. W.B. Saunders, London.
6. Romer, A.S. (1979). Hyman's Comparative Vertebrates Anatomy, III Ed., The University of Chicogo Press, London.

A.V.C. COLLEGE (AUTONOMOUS)
MANNAMPANDAL - 609 305.
M.Sc. ZOOLOGY
SEMESTER I – C.C. II : DEVELOPMENTAL BIOLOGY

Code:11 PZO 102

UNIT – I

Developmental Biology

Egg: Origin of egg - growth of oocyte - synthesis and accumulation of macromolecules in the oocyte - vitellogenesis

Egg as a developmental system: Organization of egg, cytoplasm before and after fertilization - polarity and symmetry of egg - morphogenetic gradients in the egg cytoplasm

Egg cortex: Nature and role in amphibian development

UNIT - II

Fertilization: Electron microscopic and bio-chemical aspects of egg activation - molecular events during fertilization.

Cleavage : Patterns - Chemical changes - role of nucleus and cytoplasm in cleavage - totipotency - Nuclear transplantation - nuclear clones.

Morphogenetic movements: selective affinity of cells - metabolism and gene activity during gastrulation

UNIT - III

Organizer concept: Primary and secondary organizers - nature of induction - mechanism - gradients in the determination. Tissue interactions: Lens development

Cell differentiation : Chemical and cellular factors - differential gene activity

Aging and alteration in developmental potentials: Gene regulation of aging

Metamorphosis in Amphibia: Change in organization - Causation - tissue reactivity

UNIT –IV

Metamorphosis - morphological and biochemical changes during amphibian metamorphosis Hormonal control of metamorphosis in amphibians - Neuro-endocrine control of insect etamorphosis - Biochemistry and mechanism of action of hormones during metamorphosis

Neoteny, Malignant growth - Neoplasia - Teratoma - Gene activation in neoplasia

Regeneration: Experiments - stimulation and suppression - histological process

UNIT – V

Embryonic nutrition

Nutritional requirement of embryo – modes of embryonic nutrition- food reserve and embryonic nutrition- embryonic nutrition from mother –physiology of placenta

References

1. Balinsky, B.I. 1975. An Introduction to Embryology. Saunders, Philadelphia.
2. Beril, N.J. 1974. Developmental Biology. Tata McGraw -Hill Publishing Company Ltd. New Delhi.
3. Ebert, J.D., 1966. Interacting systems in Development. Holt, Rinehart and Winston, New York.
4. McEwen, R.S. 1969. Vertebrate Embryology. Oxford & IBH Publishing Co., New Delhi.
5. Nelson, O.E. 1953. Comparative Embryology of the Vertebrates. The Blackston Company, New York.
6. Patten, B..M. 1958. Foundations of Embryology. McGraw - Hill Book Company Inc., New York.
7. Waddington, C.H. Principles of Development and Differentiation. The Mac Millan Company, New York.

A.V.C.COLLEGE (AUTONOMOUS)

MANNAMPANDAL - 609 305

M.Sc. ZOOLOGY

SEMESTER I- C.C.III: ANIMAL PHYSIOLOGY

Code: 15PZO103

Objectives: To enable the students acquire knowledge of Animal Physiology and its importance

UNIT- I

Nutrition: Physiological role of Carbohydrates, Protein and Lipid, Vitamins. General organization of alimentary canal in man, digestive glands, digestive enzymes, physiology of digestion; Hormonal coordination of digestive activities; concept of balanced diet.

Metabolism: Metabolic rate- determination of metabolic rate- direct and indirect calorimetric methods- standard and active metabolism- variations in the rate of metabolism- the relationship of body size- endocrine regulation of metabolism

UNIT- II

Excretion and Osmoregulation: Nitrogenous wastes- - formation of ammonia, urea and uric acid and their elimination- ammonotelism- ureotelism- uricotelism -organs of excretion- structural organization of mammalian kidney- urine formation in vertebrates- hormonal control of kidney function- rennin-angiotensin pathway- counter-current mechanism.

Osmoregulation: - Definition, types and mechanism; Osmoregulation in Invertebrates, Chordates, Fishes, Reptiles and Mammals -hormonal regulation of water and salts

UNIT- III

Respiration – Respiratory organ and their ventilation- integumentary, branchial, external gills and internal gills; organization of lungs in mammals and birds- trachaeae and its ventilation- regulation of breathing, pace makers of ventilation; respiratory pigments, transport of gases, problems in breathing in high altitudes

Circulation – Open and closed systems of circulation- vascular pumps: arthropod heart, chambered heart- composition and functions of blood; coagulation; neurogenic and myogenic heart ; cardiac cycle; cardiac output- pacemaker; Electro cardiogram (ECG)- Blood pressure (BP) and its regulation

UNIT- IV

Muscles: Types of muscles; ultra structural organization; Mechanism and energetics of muscle contraction; Physico chemical changes during muscular contraction-neuromuscular junction- nervous control of muscles

Nervous coordination – Structure and types of neurons- conduction of nerve impulse, structure of synapse and reflex action. Anatomy of Human brain- Cerebrum, Brain stem and Cerebellum

UNIT- V

Receptors – structure, mechanism and function of Chemo, Photo, Phono and Thermo receptor

Endocrine system : Organization and hormones of Pituitary, Thyroid, Parathyroid and adrenal and their functions

Reproduction –General organization of the reproductive system, histophysiology of gonads and reproductive cycles in mammals; Hormonal control of reproduction (ovulation, implantation, gestation, parturition and lactation); Birth control

Biological rhythms: circadian and lunar rhythms

References:

1. Prosser C.L. Brown, F.A. 1965. Comparative Animal physiology W.B. Sanders Company London.
2. Nagabhushnam. R, Kodarkar. M.S., and Sarojini,R. 1983. Text book of Animal Physiology. Oxford& IBH publishing co. New Delhi.
3. Bykov . K.M., 1960. Text book of physiology . Foreign languages publishing house . Moscow.
4. Hurkat, P.., Mathur. C., Abook of Animal physiology. S.Chand & co (PVT) Ltd., Ram Nagar, New Delhi

A.V.C.COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI- 609 305
M.Sc., ZOOLOGY

SEMESTER I – PRACTICAL I - C.C.IV (Covering Core Courses- 1, 2, 3 & Elective)

Code: 15 PZOP104

Spotters: Functional morphology and paleontology of invertebrates & chordates

1. Symmetry: Asymmetry – Paramecium; bilateral- Earthworm; radial- Aurelia; biradial- Echinus
2. Coelom- Acoelomate-Obelia; pseudocoelomate-Hydra; coelomate-Nereis
3. Respiration: Gills- Freshwater mussel trachea-Cockroach
4. Reproduction: Asexual-Binary-fission in paramecium; Sexual- Conjugation
5. Invertebrate fossils: Limulus; Peripatus; Trilobites, Nautiloids
6. Circulatory System: Heart of fish, Frog, Calotes, Pigeon, Rabbit

Developmental Biology:

1. Identification of unfertilized and fertilized eggs in frog
2. Study of different developmental stages of frog (using permanent slides)
3. Identification, mounting and study of chick blastoderm and 24 hrs, 48 hrs, 72 hrs chick embryos
4. Vital staining of chick embryo
5. Vaginal smear preparation from rat to study the estrous cycle

Immunology:

1. Cell imprinting of spleen and liver of rat
2. Blood grouping using anti-sera
3. Observation of Lymphoid organs in rat

Vermiculture:

1. Types of Earthworm
2. Preparation of vermicompost
3. Preparation of vermiwash
4. Preparation of vermicast

Animal Physiology:

1. Patterns of osmotic response in earthworm
2. Study of oxygen consumption in fish
3. Effect of Thyroxine on the respiratory metabolism of the fish
4. Effect of Salinity on the respiratory metabolism of the fish
5. Estimation of Blood Sugar in rat
6. Effect of pH and temperature on the activity of Salivary Amylase in man
7. Effect of temperature and Adrenalin on the rate of heart beat of Freshwater mussel

A.V.C. College (Autonomous), Mannampandal, MAYILADUTHURAI-609305

M.Sc., ZOOLOGY

SEMESTER: I – ELECTIVE: I – VERMICULTURE

Code: 11PZOE101

Objectives: To make the students understand the economic value of earthworm in enriching the soil fertility and methods of vermicomposting.

UNIT – I

Earthworms: Classification - Morphological and anatomical characteristics – reproduction – Biology of composting earthworm *Eudrilus eugeniae* and *Lampito mauritii* (15Hrs)

UNIT – II

Ecological groups of earthworms: Saprophages and geophages worms, Humus formers and humus feeders- epigeic, anecic, endogeic – Earthworm burrow - Earthworm casts – An outline of Earthworm importance on agriculture, fishing food, therapeutics and pollution (15Hrs)

UNIT- III

Soil: Soil types – Soil formation – Soil physical, chemical and biological features – Soil organic matter – organic matter decomposition – humus formation (15Hrs)

UNIT-IV

Organic wastes sources – problems in traditional composting – Vermicomposting: definition – Types, small scale and large scale – pit method, heap method, windrow method, Indoor method – Factors affecting vermicomposting: pH, moisture, temperature, nutritional value of feed, earthworm species – microbes and earthworms (15Hrs)

UNIT – V

Advantage of vermicompost-Applications of Vermiwash– Application of vermicompost in agricultural and horticulture practices – Earthworm predators and parasites-Economics of vermiculture – Nationalized Banks- KVIC supports of vermiculture (15Hrs)

Text book:

A.Maryvioletchirsty: Vermitechnology,MJP publishers, Chennai.

References:

1. T.D. Biswas and S.K. Mukherjee (1994): Textbook of soil Science, Tata Mc Graw Hill Publication Co. New Delhi.
2. C.A. Edwards and B.J. Bohlen (1996): Biology and ecology of Earhworms, Chapman and Hall, London.
3. K.E. Lee (1985): Earthworms – Their Ecology and relationship with soil and land use, Academic press, Sydney
4. L.S. Ranganathan (2006): Vermitechnology form soil Health to Human Health, Agrobios (India) Agrohouse, Chopasani Road, Jodhpur – 342 002
5. J.E. Satchell (Ed) (1983): Earthworm Ecology – From Darwin to Vermiculture, Chapman and Hall London.
6. F.J. Stevensen (1994) : Humus chemistry, Genesis, Composition and Reaction, Johnwiley and sons Corporation, New York.
7. Sultan Ismail (1997): The Biology of Earthworm Orient Longmand Ltd., Chennai.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305

M.Sc. ZOOLOGY

SEMESTER II - C.C.V – CELL AND MOLECULAR BIOLOGY

Code:11PZO205

Objectives: 1. To make the students understand the complete description of the structure, functions and compositions of various cell organelles.

2. To provide a fundamental idea of the molecular concepts and how they have been integrated into biological disciplines

UNIT – I

CELL BIOLOGY

Cell membrane: Molecular organisation- molecular models – cell permeability – cell surface differentiations and cell – cell communication – secretion and endocytic pathways.

Structure and functions of cells: Cell organelles – Mitochondria, Golgi complex, Endoplasmic reticulum, Ribosomes and Lysosomes.

UNIT - II

Nucleus: Nucleoplasm and cytoplasmic relationship-Hammeling's experiment, isolation techniques; ultrastructure of nuclear envelop and nucleoplasm.

Chromosomes:–Biochemistry – Organization of chromatin; Chromosomal types – polytene chromosome and lamp brush chromosome.

Cell division: Cell cycle and mitosis- significance of mitosis; meiosis and reproductive cycle-significance of meiosis.

UNIT – III

MOLECULAR BIOLOGY

Nucleic acid: DNA and DNA types, their topology and functions

DNA replication: Types of replication- conservative, dispersive and semiconservative methods; Process of replication - Origin, replication fork, regulation in prokaryotes and eukaryotes; Role of enzymes and other protein factors in DNA synthesis.

DNA damage: Sources and types of DNA damage; Nuclear versus mitochondrial DNA damage; Senescence and apoptosis; DNA damage and mutations.

DNA repairing mechanism: Excision repair, SOS repair and mismatch repair.

UNIT IV

RNA synthesis: Process of transcription- preinitiation, initiation, promoter clearance, elongation and termination; role of enzymes and other protein factors; Measuring and detecting transcription; reverse transcription; synthesis of mRNA in prokaryotes and eukaryotes; synthesis of rRNA; synthesis of tRNA; RNA processing- capping and polyadenylation.

UNIT V

Protein synthesis: Genetic code; process of translation – initiation, elongation and termination and post translational process; role of enzymes and proteins in protein synthesis

Gene regulation: Lac operon- Structure, genetic nomenclature, lactose analogs, regulation in cyclicAMP and uses in molecular biology; Trp operon- repression and attenuation.

protein transport: Intracellular compartments and protein sorting; vesicular traffic in secretory and endocytic pathway, transport from ER through Golgi to lysosome and endosome.

Text Books:

1. R.M.Shukla ,(2005)A Text Book of cell Biology , Dominant Phblishers and Distributers , New Delhi-110002.
2. Dipak Kumar Kan, Soma Halder, (2009), Cell biology, Genetics , Molecular Biology, New Central Book Agency , NewDelhi.

REFERENCES

CELL BIOLOGY

1. DeRobertis, E.D.P. , F.A., Saez, and E.M.R. De Robertis Jr. 1975. Cell biology. W.B. Saunders Company, Philadelphia.
2. Du Praw, E.J. 1968. Cell and Molecular Biology. Academic Press New York.
3. Giese, A.C. 1962. Cell Physiology. W.B. Saunders Company, Philadelphia.
4. Freifelder D 1996. Molecular Biology, 2nd edition, Narosa Publishing house.
5. Lewin, B 2000. Genes VII Oxford university press.
6. Stryer, L 1995. Biochemistry. W.H. Freeman and company.
7. Voet, D and Voet, J 1995. Biochemistry, 2nd edition. John Wiley and Sons Inc.

A.V.C.COLLEGE (AUTONOMOUS),MANNAMPANDAL - 609 305

M. Sc. ZOOLOGY

SEMESTER II – C.C.VI : BIOPHYSICS AND BIOCHEMISTRY

Code: 11PZO206

Objectives: To enable the students to acquire knowledge of Biochemistry and Biophysics and their importance

UNIT – I

BIOPHYSICS

Light: visible spectrum-; Properties and application of Electromagnetic radiation – effects of ionizing radiations and UV light on cells.

Laws of Thermodynamics: Concept of free energy and enthalpy

Diffusion and Osmosis: Definition, methods of determination of Osmosis.

Colloids & Emulsions; sol-gel changes, Tyndal effect.

UNIT - II

Viscosity: Principle and application; Relative Viscosity; Specific viscosity; Browninan movement, Viscometer

Surface tension: Principle and application; Determination and uses.

Radio activity: Isotopes- half-life; types of emissions from isotopes- GM counter, Scintillation counter- principle and application.

BIOCHEMISTRY

UNIT- III

Acids, bases, pH and Buffers; Bronsted- Lowry concept of acid and bases; importance of pH in physiological activities; *In vivo* buffer system in animals.

Enzymes – Nomenclature and classification; characteristics and mechanism of enzyme action- enzyme kinetics-effects of substrate concentration- enzyme inhibition.

UNIT- IV

Carbohydrates: General account and classification- structure and properties of mono,-di and polysaccharrides- metabolism of carbohydrates-defects in carbohydrate metabolim.

Proteins: Classification- structure of aminoacids, peptides and proteins- protein metabolism.

Lipids: Structure and chemistry of simple and compound lipids- metabolism of fats and fatty acide- defects in lipid metabolism.

UNIT- V

Nucleic acid- DNA and RNA types, structure and function.

Nutrition biochemistry: Vitamins-Definition, Structure, Properties, Metabolism. Deficiency and Human Requirements of both Fat- Soluble and water Soluble Vitamins.

Hormones: Classification and mode of action.

REFERENCES

BIOCHEMISTRY

1. Jain. J.L ., Jain. S., and Jain. N. fundamentals of Biochemistry. S. Chand & company LTD, Ramsar nagar, New Delhi.
2. Saini.A.S. and Kaur.J. Text book of biochemistry . CBS Publishing and Distributors, New Delhi.

3. Boyer. R. Concept in Biochemistry. IT Publishing Company.

BIOPHYSICS

Text book

1. Subramanian, M.A., 2005. Biophysics principles and techniques, MJP Publishers.

References

1. Ackerman, E. 1967. Biophysical science, prentice Hall Inc., India.
2. Berry, A.K. 1988. A text book biophysical chemistry, EMKAY Publication, New Delhi.
3. Casey, E.J. 1969. Biophysics: Concepts and mechanics, Affiliated East Press.
4. Daniel, M. 1989. Basic Biophysics for Biologists. Agro Botanical Publishers (India), Bikaner.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

M.Sc., ZOOLOGY

SEMESTER II - C.C.VII – BIOMETRY AND COMPUTER APPLICATIONS

Code: 11PZO207

Objectives:

To learn the basic descriptive and advanced statistical tools and their applications in biology

To acquire fundamental knowledge on the computer applications

To develop expertise on statistics and computer applications for enhancing the research skills

UNIT - I

Biometry

Bio-statistics: Concepts of statistics-types of data, methods of data collection.

Sampling techniques: essentials of sampling – census methods - sampling methods – statistical laws – statistical error – test of reliability of sample.

Classification and tabulation of data.

Diagrammatic and graphical representation of data.

Measures of central tendency – mean, median and mode.

UNIT - II

Measures of dispersion: Mean deviations, standard deviation, standard error, co-efficient of variation.

Correlation analysis (Karl Pearson's and Spearman's Rank)

Regression analysis – simple linear.

UNIT - III

Probability and theoretical distributions: Normal, Binomial and Poisson

Tests of significance: 't'-test, Chi-square and Goodness of fit, 'F' test - Analysis of variance (ANOVA) - One-way. Descriptions of Two Way and Multiway ANOVA

Basic concepts of mathematical modeling: stochastic and deterministic models.

UNIT - IV

Computer Applications:

Introduction to computer: History of computer – components of a computer – block diagram – input devices – output devices-classification of computer – computer virus.

Computer Programming concepts: Algorithms, Flowchart.

Computer operating system: DOS and WINDOWS

UNIT - V

MS office application:

i) Word Processor : MS - Word

ii) Data Processor : MS - Excel

iii) Presentation : MS Power point

Computer application: Office automation: E-mail and Internet.

Applications of statistical packages: SPSS

Text Book:

1. Pillai, R.S.N. and Bagavathi. 2009. Statistics. S. Chand, New Delhi.
2. Gurumani, N. 2002. An introduction to Biostatistics. MJP Publishers, Chennai.

References:

3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.K. Freeman. San Francisco.
4. Taxali. R.K. 1997. PC Software made simple. Tata McGraw Hill Publishing Company Ltd., New Delhi.

A.V.C.COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI-609 305

M.Sc., ZOOLOGY

SEMESTER II – PRACTICAL II - C.C.VIII (Covering Core Courses - 5, 6 & 7)

Code: 11PZOP208

Cell and Molecular Biology:

1. Squash preparation of onion root tip.
2. Mounting of Polytene chromosome – salivary gland cells of Chironormous larva, Drosophila larva.
3. Preparation and identification of various stages of meiosis from testis of grasshopper.
4. Drumstick chromosome- blood smear.
5. Barr body – buccal epithelium.

Biophysics:

1. Micrometry –stage and ocular micrometer, camera lucida, drum micrometer to determine nucleo cytoplasmic ratio.
2. Surface tension of given liquid by capillary rise method.
3. Surface tension and interfacial tension by drop weight method.
4. Viscosity of liquid by capillary flow method.
5. Oswald's Viscometer.

Biochemistry:

1. Estimation of total protein in biological sample.
2. Estimation of total carbohydrate in biological sample.
3. Estimation of Amino acids in muscle & liver tissue of chick

Biometry:

1. Construction of bar diagrams, histogram, pie diagram and 'Ogives' using biological data.
2. Methods of constructing frequency distribution tables using biological data.
3. Calculation of Arithmetic mean, median, mode, standard deviation and coefficient of variation by using a biological data.
4. Calculation of Pearson's product moment correlation for biological data.
5. Fitting a simple linear regression for a biological data.
6. Test of significance using biological data-chi-square-test, 'T' test and 'F' test.

Computer Applications:

1. Flow charts.
2. MS Excel graph generation.
3. Power point presentation.
4. MS Word operations.
5. Windows operations.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

DEPARTMENT OF ZOOLOGY

Semester – II EDC –1 MEDICAL ZOOLOGY

Code: 11EDZO201

Objective: To enable the students to acquire a basic knowledge of common diseases of human being their preventive methods.

UNIT: I

Medical Protozoology: Malarial parasite – Morphology and Life cycle of *Plasmodium vivax*- Mode of transmission- Types of malaria - Disease Symptoms- treatment and preventive measures.

Brief account of Ameobiasis, Pyorrhoea, Leishmaniasis, Trichomoniasis.

UNIT: II

Medical Helminthology: Ascaris: Morphology and Life cycle - Mode of transmission-Disease Symptoms- treatment and preventive measures. Helminth diseases: Ancylostomiasis, Enterobiasis, Trichuriasis, Trichinosis and Filariasis.

UNIT: III

Medical Entomology: Morphology and Life cycle of Mosquitoes and Housefly –Role as vector- and control measures. Diseases transmitted by Flea, Louse, Bedbug Mechanism of host and parasites interactions. Zoonoses - epizootic and enzootic transmission

Control of mosquitoes - larvicides and adulticides.

UNIT: IV

Bacterial diseases: Cholera, Tuberculosis- Mode of transmission-Symptoms and diagnosis-Treatment and preventive measures.**Viral diseases:** Measles, Rabies, Plague, AIDS, SARS and Chikungunya. - Mode of transmission-Symptoms and diagnosis-Treatment and preventive measures.

UNIT: V

Methods of diagnosing parasitic diseases: Examination of stool: Direct examination-sedimentation technique, floatation technique, and egg counting technique.

Examination of blood –thick smear and thin smear methods.

Examination of urine: Bacterial examination.

Health Education: Health Plans of India –Role of World Health Organization (WHO). National Vector Borne Disease Control Programmes (NVBDCP)

Text Book:

Park, K. 2007. Social and Preventive Medicine. M/S. Banarsidas Bhanot Pub. India.

Paniker, C.K.J. 2007. Textbook of medical parasitology. 6th Ed., JAYPEE Bros., New Delhi.

References:

Asa, C. Chanler and Clark P. Read. Introduction to Parasitology. Wiley Eastern Private Ltd. New Delhi.

Manson-bahr.P.E.C. and Bell D.R. 1892. Manson's Tropical diseases. English Language Book Society Bailliere Tindoll.

Ramnik sodd. 1993. Parasitology. CBS Publishers & Distributor, Delhi

Service, M.W. (2000) Medical entomology for students (2n ed.) Cambridge Univ. Press, Cambridge, UK

World Health Organization (1989) Geographical distribution of arthropod-borne disease and their principal vectors, WHO/VBC/89.967, Geneva.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305
M. Sc. ZOOLOGY
SEMESTER III – C.C.IX – GENETICS

Code: 11PZO309

Objectives: To study the characters and their transmission from parents to the young ones.

UNIT - I

Principles of Mendelian inheritance; Interaction of genes; Multiple alleles; Polygenic inheritance; Linkage and crossing over; Gene mapping in drosophila; Somatic crossing over in Drosophila. Sex determination in animals; Sex-linked inheritance in man and Drosophila

UNIT - II

Extra-chromosomal inheritance with reference to mitochondrial DNA, plastids, kappa particles, plasmids, episomes and chloroplasts.

Fine structure of gene, eukaryotic genome organisation (Structure of euchromatin, coding and non coding sequences & satellite DNA).

Dynamics of genes: Transposable elements, Mechanism of transposition, uses of transposons - Gene amplification and rearrangement - pseudogenes.

UNIT – III

Mutation: molecular basis of spontaneous and induced mutations and their role in evolution - Environmental mutagenesis and toxicity testing -Numerical and structural changes in chromosomes - Law of DNA Constancy and C- value paradox.

Operon concept, regulatory mechanism in eukaryotes, attenuation and antitermination - Environmental regulation of gene expression.

UNIT - IV

Genes in population-Hardy Weinberg law - mutants in populations - equilibrium between mutation and opposing selection – Genetics of species, races and demes formation; Genetic load, Genetic drift – Founder's Principles – Inbreedng depresson - Selection against dominant and recessive defects- Genetic counseling.

UNIT - V

Human genetics: Human karyotype, chromosomal disorders in human; Inborn errors of metabolism

Microbial Genetics: Bacterial transformation, conjugation, transduction and sexduction, molecular recombination and host cell restriction. Gene mapping in prokaryotes.

Text Book 1) S.Verma and V.K.Agrawal, Genetics(2000),S.Chand and company Ltd.,
2) N. Arumugam, genetics and Evolution, Saras publication

References

1. Altenburg, E. 1970. Genetics. Oxford and IBH Publishing Company, New Delhi.
2. Burns, G.W. 1969. The Science of Genetics. The Mac Millan Co. New York.
3. Gardener, E.J. 1972. Principles of Genetics. John Wiley & Sons. Inc. New York.
4. Levine, R. P. 1968. Genetics. Holt, Rinehart and Winston Inc. New York.
5. Lewin, B. 1986. Genes. Wiley Eastern Ltd. New Delhi.
6. Rothwell, N. V. 1978. Human Genetics. Printice Hall of India.
7. Sinnott, E.W. L.C. Dunn and T. Dobzhansky. 1959. Principles of Genetics. Tata McGraw Hill, New Delhi.
8. Srb, M.A. and R.D. Owen. 1960. General Genetics, W.H. Freeman & Co., San Franscisco.
9. Winchester, A.M. 1967. Genetics, Oxford and IBH Pub. Co., New Delhi.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305
M.Sc., ZOOLOGY
SEMESTER III - C.C. X. MICROBIOLOGY

Code: 11PZO310

Objectives: To enable the students to acquire knowledge of Microbiology and its importance

UNIT -I

General microbiology: History and Scope-classification of microorganisms-salient features of Bacteria, Viruses, Algae, Fungi and Protozoa

Microbial morphology: Size, Shape and structure of bacterial cells, chemical composition and characteristics of cell wall (Gram +ve bacteria and Gram –ve bacteria) –Cell structure of Cyanobacteria - Mycoplasma.

Culture techniques of microorganism: Isolation, culture and staining.
Microbial physiology: Bacterial photosynthesis-Aerobic and anaerobic respiration-Nutrition-Growth and reproduction.

UNIT-II

Water microbiology: Methodology of bacterial analysis, Sewage water treatment methods-Municipal water purification.
Soil microbiology: Nitrogen and Carbon cycles-Soil microbes –organic matter decomposition-Environmental deterioration by microbes and amelioration.
Agricultural microbiology: Biofertilizer-Bacteria, Algae and Cyanobacteria-Microbial insecticides: Bacteria and virus.

UNIT-III

Aeromicrobiology: Aeromicroflora of hospitals and houses- Aero allergens- dust allergy, pollen grains and cosmetics. Bioreceptors and vaccine
Medical microbiology: Bacterial diseases: Brucellosis, Tuberculosis, Plague, Salmonellas – Viral diseases: Rabies, Pox virus, Jaundice, Japanese encephalitis, Yellow fever. Control of disease causing microbes –Physical and Chemical methods.

UNIT-IV

Food microbiology: Food spoilage –Food poisoning- Method of food preservation-prevention of food infection and food spoilage.
Dairy microbiology: Sources of microbes in milk and milk products-Milk borne diseases.

UNIT-V

Industrial microbiology: Fermentation and fermentable microbes-Basic function of fermentors-Types of fermentors - construction of fermentors–control of temperature, p^H, aeration and agitation-criteria used for the selection of microorganisms for fermentation. Microbes in the production of ethyl alcohol, antibiotics (Penicillin), lactic acid.

References:

1. Dubey, R.C. and Naheswari, D.K. Microbiology, S. Chand & Co. Ltd., New Delhi.
2. Powar, C.B. and Daginawala. H.F. 1995. General Microbiology. Himalaya Publishing House, Bombay.
3. Pelczar.M.J., Chan E.C.S., Krieg.N.R., TATA. McGraw- Hill., education.
4. Ananthanarayanan. R. and Paniker.J.C.K. Introduction to medical Microbology. Oscar Puplication- New Delhi.
5. Frazier. W.C. and Westhoff. W.C. Food microbiology. McGraw Hill.
6. Kalaiselvam. P.T. and Arulpandi.I. Bioprocess technology.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

M.Sc., ZOOLOGY

SEMESTER III -C.C. XI - RESEARCH METHODOLOGY AND BIOTECHNIQUES

Code: 11PZO311

Objectives: To provide basic knowledge about the Tools used in research.

UNIT – I

Selection of a research problem: Experimental approach and research design.
Library and research documentation: Literature review-sources of information - technical papers - peer reviewed journals – e journals - citation index – impact factor - reference collection from internet – index card and arrangement of reference collected.
Thesis writing: Components of thesis, preparation of research documents (abstracts, papers etc.).

UNIT – II

Microscopy: (Light and Electron): **Microtechnique** (only histological preparations): **Micrometry;** Principles and applications of Photomicrography- LASER techniques -Auto radiography – CT scan and MRI in biological studies

UNIT – III

Spectrophotometry: Principles and applications.
p^H Meter : Principles, types and applications.
Centrifuge: Principles, types and applications.

UNIT – IV

Electrophoresis: Principles, types (Paper, PAGE, SDS PAGE, Immunogel) and applications.
Chromatography: Principles, types (Paper, TLC, Column, Gas, HPLC, Ion exchange) and applications.

UNIT –V

Calorimetry: Principle and applications of Bomb calorimeter.
Field Equipments: Principles and applications of Refracto meter , Max-Mini thermometer, Sac chi disc, Binocular , Tally counter, Hygrometer, Pedometer , Altimeter, Nepholo turbidity meter , Lux meter and Field compass and Portable water analysis kit.

Text Book:

Gurumani, N. 2007. Research methodology for biological sciences. MJP Publishers, Chennai

References

1. Anderson, J., Durston, B., Poole, M. 1991. Thesis and Assignment Writing. New Age International Pvt. Ltd., New Delhi.
2. Conference of Biological Editors. 1972.Style Manual for Biological Journals, American Institute of Biological Science, Washington, D.C.
3. Van Norman, R.W. 1971. Experimental biology, Prentice Hall, New Delhi.
4. Veerakumari,L. 2007. Bioinstrumentation, MJP Publishers, Chennai
5. Webster, J.G. (Ed) 2005, Bioinstrumentation . John Wiley & Sons Inc., Singapore

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL, MAYILADUTHURAI-609 305
M.Sc., ZOOLOGY

SEMESTER III – PRACTICAL III - C.C.XII (Covering Core Courses - 9, 10 & 11)
Code: 11PZOP312

Genetics:

1. Blood grouping.
2. Gene interaction models.
3. Quantitative genetics models.
4. Study of finger prints and their pattern of inheritance in man.
5. Calculation of gene frequency and genotype frequency for autosomal, sex linked and sex influenced human traits.
6. Culture of Drosophila and identification of male and female; study of mutants.

Microbiology:

1. Preparation of culture media:
    a) Preparation of liquid medium (Broth).
    b) Preparation of solid medium (PDA medium).
    c) Preparation of Agar slant.
    d) Preparation of Agar deep tube.
2. Pure culture of microorganism:
    a) Serial dilution Agar plate method (Viable plate method).
    b) Streak plate method.
    c) Pour plate method.
    d) Spread plate method.
3. Counting of microbial colony by cubic colony counter.
4. Deduction of motility of bacteria by Hanging drop method.
5. Staining of microorganism:
    a) Preparation of bacterial smear and fixation of suspension.
    b) Gram's staining for identification of bacteria.
6. Characterization of microbial culture by Methyl red and Vogus pros kauer test.
7. Microbial contamination of milk :
    a) Enzymatic test of milk Methylene blue reductase test.
    b) Quality testing of milk by Resazurine test.
    c) Determination of Phosphatase activities of milk.

Research methodology and Biotechniques:

1. Reference collections from data bases using keywords and arrangement of reference collected.
2. Demonstration of electrophoresis and calorimeter.
3. Separation of amino acids by paper chromatography.
4. Preparation of standard curve using colorimeter.
5. Estimation of pH in different water samples.
6. Micro techniques: Preparation of histological slides.(Compulsory submission of 15 slides by each student).
7. Spotters: Field equipments Refractometer- probe thermometer-Sacchi disc-Binocular-Tally counter- Hygrometer- Pedometer- Altimeter-Nepholo turbidity meter-Lux meter-Field compass.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305
DEPARTMENT OF ZOOLOGY
SEMESTER – II EDC – II HEALTH EDUCATION
Code: 11EDZO302

Objectives: To enable the students acquire the basic knowledge of the importance of nutrition and sanitation.
To understand the sociological problems and family welfare.
To understand the human diseases and their control.

UNIT I

Nutrition:
Classification of foods.
Growth and development- growth chart.
Balanced diet- malnutrition- nutritional deficiency - special need groups.

UNIT II

Environment and Health:
Water – importance, standards and purification.
Air- ventilation and discomfort.
Effect of water, air and noise pollution.
Methods of environmental sanitation.
Global warming and its effects.

UNIT III

Family Health:
Small family- women and child heath – MCH programme in India.
Methods of birth control.
Sociological problem and large families.
Occupational hazards: physical, biological and physiological hazards of working groups.

UNIT IV

Diseases:
Communicable- TB, Polio, Encephalitis.
Non-communicable - obesity, STD, Hyper tension, Diabetes.
Genetic disorders- Down, Turner's, Kleinfelter's syndromes.

UNIT V

Health Education:
Individual and social health. - Family and community health - Role of mass media in health education - Physical exercises and health recreation.

Text Book:

- Park, K. (2007). Park's Text book of preventive and social medicine.
- Jayaram Panikar, C.K. (2002).Textbook of medical parasitology. Jaypee brothers Medical publishers Pvt. Ltd, New Delhi.

Reference:

- Chanler, A.C. and Read, C.P. Introduction to Parasitology. Wiley Eastern Private Ltd., New Delhi.
- Roy, C. Medical Zoology.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305
M.Sc., ZOOLOGY
SEMESTER III - Elective – II–BIOINFORMATICS
Code: 11PZOE302

Objectives: To understand and process the biological data using computers to resolve in analyzing the experimental data on molecular biology.

UNIT – I

Biological databases: Sequence databases – Nucleic Acid sequence Databases: Genbank; Protein Sequence Databases: Swiss Prot; Searching Sequence Databases – Non-redundant Databases – Low Annotation Databases – Specialized sequence Databases – Structural Databases – Motif Databases – Genome Databases – Proteome Databases.

UNIT – II

Tools for Bioinformatics: Pairwise alignment – Dotplots – scoring matrices – Blosum Matrices – PAM Matrix – Gap Penalty – Alignment Algorithms: Needleman – Wunsch Global Alignment Algorithm ; Smith – Waterman Local Alignment Algorithm.

UNIT - III

Pairwise Sequence Analysis Tools: BLAST– Steps involved in using BLAST – Interpreting BLAST results; FASTA – Alignment Scores -Multiple Alignment — ClustalW – Phylogenetic Tree – Sequence Analysis using EMBOSS.

UNIT – IV

Protein structure prediction: Secondary structure Prediction –PDB-FSSP-SCOP-CATH- Chou-Fasman – Jpred – Q_3 – Transmembrane protein prediction – Tertiary structure prediction – Comparative Modelling – Fold recognition – Ab initio prediction – modeller – RASMOL.

UNIT – V

Emerging Areas of Bioinformatics: DNA microarrays – Structural genomics - Functional Genomics – Proteomics Comparative Genomics - Phylogeny – Whole Cell Simulation –Human Genome Project- Systems biology - Biodiversity informatics.

Text books:

Arumugam, N. (2006). Bioinformatics, Saras Publications.

References:

1. Harshawardhan, P. (2005) Bioinformatics principles and application.Tata Mc Graw Hill Publishers.New Delhi.
2. Manikand Vijayaraj, 2002. Bioinformatics for beginners, Kalaikathir Achchagam, Coimbatore
3. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (II edition) CBS Publishers. New Delhi
4. Sundarajan. S. and R. Balaji.(2005), Introduction of Bioinformatics, Himalaya Publishing house, Mumbai.
5. Westhead, D.R, H.J. Parish and R.M. Twyman. (2003) Bioinformatics Viva books Private Ltd. New Delhi.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

M.Sc., ZOOLOGY

SEMESTER III -C.C.XIII - ENVIRONMENTAL BIOLOGY

Code 11PZO413

OBJECTIVE:

- To educate the students about the Environmental pollutants of water, air and soil and to create awareness to protect our environment.

UNIT – I

Concepts of ecology: Limiting factors- Liebig's law of minimum- Shelford's law of tolerance

Population ecology: Attributes, estimates, density, diversity indices: Factors influencing population fluctuations

Community ecology: community structure, dominance, stratification, succession and niche concept

UNIT – II

Biogeochemcial cycles: Nitrogen, Phosphorus and Nitrogen cycle

Solid Waste Management: Types of solid wastes – degradable and non-degradable wastes; Collection, segregation, transportation and disposal of solid wasts (integrated waste management, Landfill, incineration, recycling, biological reprocessing, energy recovery, avoidance and reduction).

Biomedical waste management-Components of biomedical wastes, waste management and protection from biomedical wastes.

Status of solid waste management in India.

UNIT – III

Natural resources and their conservation: Classification of natural resources-Conservation and management of natural resources-Land use and abuse-water requirements and uses- Problems and management of waters- Future needs and alternative sources of water

Wildlife Conservation: Importance of wildlife-causes of depletion-conservation methods-. Endangered species of India with special reference to mammals – The Project tiger and Elephant - Wildlife sanctuaries and National Parks of South India

UNIT – IV

Environmental Biotechnology: Sources and nature of pollution; Biological calcification to reduce atmospheric CO_2; Sewage treatment by bacteria and algae; Biological removal of phosphorus;

Bioscavenges of metals; Immobilized cells in the management of pollution

UNIT – V

Environmental education: Meaning and Scope- Objectives of Environmental education-Formal and non-formal environmental education in India- Environmental organization, Agencies and International bodies involved in environmental education - Environmental Protection Act 1986, 1990, 1997 and Environmental Protection Act – Air quality 2010.

Text Book:

Edward J. Kormondy, (2005), Concepts of Ecology,Prentice –Hall of India Pvt.Ltd.,New Delhi.

Sathyanarayana, U (2005) Biotechnology. Books and Allied P.Ltd.Kolkata

Reference:

Ananthankrishnan, T.N. 1982. Bioresources ecology, Oxford and IBH Publishing Co., New Delhi

Andrewartha, H.C. and L.C. Birch (1974). The distribution of abundance of animals. The University of Chicago Press, London

Clarke, G.C. (1954) Elements of ecology. Jhon Wiley and Sony Inc., Newyork

Kannan. K. (1991) Fundamentals of Environmental pollution. S.Chand & Co., Ltd., New Delhi

Krishanan, N.T. (1994). Environmental Biology. JJ Publication, Madurai.

Odum, E.P. (1971) Fundamentals of ecology. W.B.Saunders Co., Philadelphia.

Trivedi, P.R. Encyclopedia of ecology and environment. Vol.1-5. Published by Indian Institute of Ecology and Environment.

Verma, S.R. , Sharma, R.S. and Rani, G. (1988). Ecology and Animal behaviour. Jaiprakash Nath & Co., Meerut.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

M.Sc., ZOOLOGY

SEMESTER IV - BIOTECHNOLOGY

C.C. XI. **Code: 11PZO414**

Objectives:

. To provide a in basic knowledge on bio technology to apply it in industrial, agriculture and medical fields

UNIT - I

History of biotechnology; rDNA technology –Isolation and purification of DNA – Restriction endonucleases – DNA Ligases, DNA modifying enzymes; Cloning vectors –Plasmids, cosmids, phages, viruses and yeast; principle and applications of PCR; DNA sequencing – Sanger and Maxim Gilbert methods; Southern, Northern and Western blotting techniques.

UNIT – II

Industrial biotechnology: Types and uses of enzymes in industries – Isolation and purification of enzymes – Enzymes immobilization techniques and their advantages.
Fermenter – Design and types – Downstream processing –Recovery of fermented products Primary metabolites: Ethanol and vitamins ; Secondary metabolites: Penicillin and Streptomycin.
Production of single cell Protein (SCP).

UNIT – III

Plant tissue culture: Basic technique; choice of explant; culture media- complex mixture of salts, organic supplements, carbon sources, gelling agents, growth regulating hormones and antibiotics; types of culture – callus culture and cell culture; applications of plant tissue culture;
Gene transfer in plants- transgenic plants (disease resistance, herbicide resistance, pest resistance and drought tolerance) and their applications.

UNIT IV

Animal cell and tissue Culture: Basic technique- requirements, preservation and storage, maintenance and harvesting of cells; Culture media- Natural and artificial media; Primary & Secondary culture of animal cells; cell lines; organ culture.
Gene transfer in animals- Transgenic animals (mice, sheep and goat, chicken, pigs) and their applications.

UNIT – V

Production of recombinant insulins, interferons and vaccines.
Gene therapy- Approach, types, methods of gene transfer, problems and ethics of gene therapy.
Assisted Reproductive Technology (ART)- Artificial insemination, embryo transfer –*in vitro* fertilization, embryo cloning; cryopreservation;
Biosafety-Problems associated with GM foods, Biocontaminants, Biosafety levels and biosafety guidelines.
Intellectual Property Rights –copy right, trade marks, patents, industrial design rights and trade secrets

A.V.C. COLLEGE (AUTONOMOUS),MANNAMPANDAL – 609 305.
M.Sc., WILDLIFE BIOLOGY

SEMESTER III - CC XI : WILDLIFE MANAGEMENT TECHNIQUES

CODE: 15 PWL 311

Objectives: To make the students equipped with principles and applications of various wildlife management techniques

UNIT – I

Wildlife Management: Concepts and principles-Planning investigation and projects – Wildlife management plans.
Evaluation of Wildlife habitat: Reconnaissance survey – Vegetative analyses techniques – Forest range evaluation - Evaluation of wetland habitat.
Remote sensing: Satellite Images - NDVI - Drones and its applications in wildlife: Surveillance, Protection.

UNIT – II

Habitat manipulation: Food production -Water development - Cover improvement in terrestrial habitats – Wetland improvement.
Food habit analysis: Sampling methods, equipment, kinds of study materials, preservation and analytical procedures.
Capturing and marking techniques: Live trapping of birds and mammals – Chemical immobilization.

UNIT – III

Methods of marking wild animals: Ringing – Tagging –Clipping - Colouring
Study of tracks and signs of wild animals: Identifications of species, sex , age, and evaluation of habitat use.
Determination of age and sex: Fishes: Autolith, Body length and width, body scale. Gallinaceous birds: and water birds: Molt and Plumage Patterns, Feather wear and shape, Size and distance of Fur, Cloacal Protuberance and Brood Patch, Song. Mammals: tooth eruption, shoulder height methods, horns, antler, fur colour.
Translocation of Wildlife: Principles, Methods and Application

UNIT – IV

Population Size Estimation: Total count, Sample count. Direct count: Grid sampling, Line Transect Direct Sighting Methods, Point counts (Distance sampling). Indirect count: Line Transect Dung Count Methods, Pellet count, Call count, pugmark, camera trap and aerial photography. Mark – recapture -Peterson or Lincoln Index.

UNIT –V

Human-wildlife Conflicts Elephant, Nilgai - Wild pig, Leopard: Identification, Evaluation of various types. Their causes: habitat loss-fragmentation-degradation- increase in population - weed proliferation. Mitigation measures: habitat consolidation, corridor, invasive species management, capture and translocation, crop protection measures: physical barriers - mechanical barriers.

Text Book

1. Giles, R.H. Jr. (Ed) 1984. Wildlife Management Techniques 3rd edition. The wildlife Society, Washington. D.C. Nataraj Publishers, Dehradun. India.
2. Hosetti, B.B. 2003. Wildlife Management in India. Pointer Publication, Jaipur, India.
3. Silvi, N. J. (Ed) 2012. The wildlife Management Technique Manual I. John Hopkind University Press, Baltimore, Maryland.

REFERECNCE :

1. Paul R. Krassman and J.W. Cain. 2014. Wildlife Management and Conservation: Contemporary Principles and Practices
2. Dasmann, Rf. 1964, Wildlife Biology. John and Wiley and sons Newyork. Pp231.
3. Robinson, Wl. and Eric, G. Bolen, 1984. Wildlife Ecology and Management Mac Millan Publishing Co, Ny. Pp 478.
4. Rodgers, W.A 1991. Techniques for Wildlife census in India – A Field manual technical Manual – TM – 2Wildlife Institute of India, Dehradun.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305
DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY
M.Sc., WILDLIFE BIOLOGY
SEMESTER III - CC XII- MANAGEMENT OF ZOOS, SANCTUARIES, AND NATIONAL PARKS

Code: 15 PWL 312

Objectives:

1. To understand the management and monitoring of zoos and protected areas in India.
2. To introduce the concept of conservation biology.

UNIT-I

Traditional *In situ* conservation

Definition, declaration and management of Wildlife Sanctuaries, National Parks, Territorial Forest Divisions in India

Designing and evaluating the protected area. Evaluating the shape and size of selected protected areas in india

Territorial forest divisions: (Erode forest division and Sambalpur forest division)

Wildlife Sanctuaries: Vedanthangal, Wayanad, Kedarnath WLS.

National parks: Gir, Kazhiranga and Eravikulam.

Marine National Park: Gulf of Kutch, Gulf of Mannar.

UNIT-II

Modern *In situ* conservation

The concept of landscape scale conservation: Biosphere Reserves and Ramsar Sites in India

Wildlife Projects: Tiger – Lion- Elephant (Objectives, Salient features, Management, Areas covered under the scheme, Achievements and Research)

Tiger Reserves: Definition, formation, management and administration – Mudumalai, Corbet and Kanha Tiger Reserves.

Eco-Development and Ecotourism programmes in tiger reserves.

UNIT-III

***Ex situ* conservation**

Zoos and Zoological Parks: Definition- Aims of Zoos- Formation and Management of Zoos and Zoological Parks - Central Zoo Authority of India. Enclosures- Designing, Engineering and Enrichment. Exhibit types: Walk-through exhibits, Drive-through exhibits, Petting Zoos and Multi-species exhibits. Zoo animal nutrition: Food and feeding. Zoo sanitation: Principles and management of zoo. Diseases of Zoo animals. Zoo veterinary services. Animal restraint: principles and methods, release of restrained animals. Transport of animals Pests and parasites – nutritional disorders Zoo education: Internship techniques and Zoo research.

Captive breeding: Aims, Principles, methods and case studies (Olive Ridley turtle, Lion Tailed Macaque and Pigmy Hog).

UNIT-IV

Habitat deterioration: Pollution-Land-Air-Water-Organic pollution-BOD and COD.

Habitat Restoration and Animal Conservation: Identifying the key species, Assessment of carryin capacity, concept of corridor management: Conflict – Case studies- Sariska Tiger Reserve

Exotic and Invasive Species: Principles and Problems- Case Studies. Introduction and re-introduction of species- case studies- Lion, Tiger, Rhinoceros.

Role of Government, NGO's and Educational Institutes involved in Wildlife Conservation.

UNIT-V

Wildlife administration and legislation: Administrative set up - Advisory bodies- National Board for Wildlife –Wildlife (Protection) Act, 1972 and its Amendments. Wildlife trade and regulations, Biodiversi Act 2000

References

Text Books:

1. Saharia, V.B. 1998. Wildlife in India, Nataraj Publishers, Dehradun. Pp. 294.
2. Bawa, S.K., Primack, R.B. and M. A. Oommen. 2011. Conservation Biology A primer for South Asia. University Press, Hyderabad. Pp 589. ISBN: 978-81-7371-7246
3. Pullin, A.S. 2002. Conservation Biology, Cambridge University Press, Cambridge. Pp 340. ISBN: 978-0-521-64482-2
4. Rees, P.A. 2011. An Introduction to Zoo Biology and Management, John Wiley and Sons Ltd., West Sussex, UK. Pp 416. ISBN: 978-1-4051-9350-4.

Reference books:

1. Hambler, C., 2004. Conservation, Cambridge University Press, Cambridge. Pp 368. ISBN: 978-0521-00038-3.
2. Primack, R.B. 1993. Essentials of Conservation Biology, Sinauer Associates Inc. Publishers, USA Pp 564. ISBN: 0-87893-722-6.
3. Chhapgar, B.F. 2006. Marine Life in India, Oxford University Press, New Delhi. Pp 368. ISBN: 978-0-19-568514-5.
4. Divyabhanusinha (ed). 2008. The Lions of India, Permanent Black, Ranikhet. Pp 267. ISBN: 81-7824-213-3.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305. 65
M.Sc., WILDLIFE BIOLOGY

SEMESTER: III – CC: XIII - ETHOLOGY OF WILDLIFE

Code : 15PWL313

ctives: To enable the students understand the basic behaviour of animals and their architectural

UNIT- I

duction and Scope to the study of Ani**mal behaviour:** Historical outline of Animal viour, Milestones in Ethology, Scope, Purpose and Importance of the study of Animal viour. Branches and Basic concepts of Ethology

l and laboratory methods of studying of animal behaviour - Ethogram

ysis **of behaviour:** taxes, kinesis and reflexes.

UNIT- II

nct **Behaviour:** Classical theory of Instinct – Phases of instinct behaviour, fixed action rn – Sign stimuli – Drive and motivation – models of instinct behaviour – Ritualization.

rning **Behaviour:** Types of learning (Habituation, classical conditioning I & II, trial and learning, latent learning, insight learning, imprinting) – evolution of learning – memory.

gressive **behaviour.**

UNIT- III

al **behaviour:** Social behaviour of Bees, Primates (Baboons and Chimpanzee), Elephant and

raging **behaviour:** Optimal foraging – Group foraging with special reference to birds.

UNIT- IV

behaviour: Types of Play – Play in mammals – biological effects of play.

roductive **behaviour:** Sexual behaviour and selection, mating strategy and pattern, parental and weaning in birds and mammals.

UNIT- V

al **communication:** Visual, auditory, chemical and vocalization in birds & mammals.

nobiology: Circadian, lunar, tidal and annual rhythms.

al **architectural ability:** birds.

al **navigation.**

Book

Wilson, E.O. 1978. Sociobiology. The Belknap press of Harard University Press, Cambridge.

Shukla, J.P. 2010. Fundamentals of Animal Behaviour. Atlantic Publishers, New Delhi.

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erences:

1. Leshner, A.I. 1978. An introduction to Behaviour Endocrinology, Oxford University Press, New York.
2. Ridley, M. 1968. Animal Behaviour. A concise introduction Blackwell Scientific publication, Oxford.
3. Slater, P.J.B. 1985. An introduction to Ethology, Cambridge University Press, Cambridge.

Verified G. Shanmugam 5/11/15

4.McFarland.D. (Ed) 1981. The Oxford companion to Animal Behaviour. Oxford University Press, New YorkWallace, R.A. 1979. The ecology and evolution of Animal Behaviour, Goodyear Publishing Company, Inc. Santa Monica, California.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305

DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

M.Sc., WILDLIFE BIOLOGY

SEMESTER III – CC XIV - RESEARCH METHODOLOGY

Code: 15 PWL314

Objective: To enable the students to acquire basic knowledge of experimental methods both laboratory and field in the wildlife biology and to pursue their higher studies including designing of a problem, experimental approach and report writing.

UNIT - I

Selection of a research problem: Approach and experimental design – defining the hypothesis, Law, and Theory

Library and information sources: Books, Journals, Reprints, CD Rom, Microfilm, Internet, Preparation of Index cards – in literature survey through internet

Research and Documentation: Components of a thesis and thesis writing - abstracts and research papers – preparation and submission of research paper for peer reviewed journals – citation index – h-index - impact factors – Creation and usage of googlescholar account.

UNIT – II

Making observation and records: Field diary, filing and filing systems.

Photography recording: Field Photography and Photomicrography:

Maps and Mapping techniques

Software: Application of Arc GIS and ENVI program, Steps involved in the usage of Q-GIS and its application.

UNIT – III

Audial, visual and activity recording instruments – weight and distance measuring instruments – GPS. Radio telemetry and Satellite telemetry.

Radars - Radio isotopes –Microchips in wildlife research.

UNIT – IV

Principles, types and application of Colorimetry (Spectrophotometer and Atomic Absorption Spectroscopy (AAS)), Calorimetry, pH meter, Chromatography (Paper, Column and Gas), Electrophoresis (Gel, PAGE and Immuno Electrophoresis) and Gel documentation, Centrifuge and Thermo-cycler (Polymerase Chain Reaction-PCR).

UNIT – V

Post-mortem examination: Equipments –Autopsy of birds and mammals.

Museum techniques: Wet and dry preservation – Taxidermy procedure.

Steps and stages involved in insect collection, preservation and display

Text Book

1. Gurumani, N. 2007. Research Methodology for Biological Sciences. MJP Pub. Chennai.
2. Jawahar, P. 2000. The Preservation of Zoological Specimens. Government Museum, Chennai.
3. Giles, R.H. Jr. (Ed.). 1984. Wildlife Management Techniques. 3rd edition. The Wildlife Society, Washington. D.C. (Indian Printers: Nataraj Publishers, Dehradun).

References

1. Anderson, J., Durston, B. and Poole, M. 1991. Thesis and Assignment Writing. New Age International Pvt. Ltd., New Delhi.
2. Conference of Biological Editors. 1972. Style Manual for Biological Journals. American Institute of Biological Science, Washington, D.C.
3. Kothari, C.R. 2006. Research Methodology and Research Techniques. New Age Int. Pub., New Delhi.
4. Palanivelu, P. 2004. Analytical Biochemistry and Separation Techniques. 3rd Edition, MKU Co-op, Press Ltd., Palkalai Nagar, Madurai.
5. Subramanian, M.A. 2005. Biophysics – Principles and Techniques. 1st Edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai.

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DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

M.Sc., WILDLIFE BIOLOGY

SEMESTER III - PAPER –XV (COVERING PAPERS – XI, XII, XIII & XIV)

Code: 15PWLP 315

1. Data sheets in wildlife management
   i. Collection and recording of data of capture, place of capture, weight, morphometric features etc.
   ii. Census data
   iii. Marking and recapture data.
2. Study of tracks and signs of wild animal in wildlife sanctuaries, pugmark tracing techniques and plaster casting.
3. Morphometry analysis of wild animals (Mammal/ Bird type study)
4. Collection, preservation and identification of pellets/ droppings.
5. Identification of hair of wild animals.
6. Examination of stomach and faecal contents for food habit studies.
7. Estimation of bird and squirrel population using one or more techniques.
8. Banding and marking techniques.
9. Preparation of the map of a Zoo (with reference to the location of exhibits, pathways, children's play ground etc.)
10. Recording of feeding time, kinds of food, cleaning procedures of the enclosures of Zoo animals.
11. Recording of breeding seasons and behaviour of animals.
12. Focal and scan sampling techniques on selected animals.
13. Field instruments used in wildlife studies.
14. Photographic techniques used in wildlife studies.
15. Postmortem examination.
16. Taxidermy.
17. Preparation of index cards , refence collection from data bases using key words and arrangement of relevant reference collected.
18. Demonstration of electrophoresis, chromatography, calorimeter, colorimeter.
19. Field report.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305
DEPARTMENT OF ZOOLOGY

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SEMESTER – III EDC – II HEALTH EDUCATION

Code: EDZO302

Objectives: To enable the students acquire the basic knowledge of the importance of nutrition and sanitation.
To understand the sociological problems and family welfare.
To understand the human diseases and their control.

UNIT I

Nutrition:
Classification of foods.
Growth and development- growth chart.
Balanced diet- malnutrition- nutritional deficiency - special need groups.

UNIT II

Environment and Health:
Water – importance, standards and purification.
Air- ventilation and discomfort.
Effect of water, air and noise pollution.
Methods of environmental sanitation.
Global warming and its effects.

UNIT III

Family Health:
Small family- women and child heath – MCH programme in India.
Methods of birth control.
Sociological problem and large families.
Occupational hazards: physical, biological and physiological hazards of working groups.

UNIT IV

Diseases:
Communicable- TB, Polio, Encephalitis.
Non-communicable - obesity, STD, Hyper tension, Diabetes.
Genetic disorders- Down, Turner's, Kleinfelter's syndromes.

UNIT V

Health Education:
Individual and social health. - Family and community health - Role of mass media in health education - Physical exercises and health recreation.

Text Book:

- Park, K. (2007). Park's Text book of preventive and social medicine.
- Jayaram Panikar, C.K. (2002).Textbook of medical parasitology. Jaypee brothers Medical publishers Pvt. Ltd, New Delhi.

Reference:

- Chanler, A.C. and Read, C.P. Introduction to Parasitology. Wiley Eastern Private Ltd., New Delhi.
- Roy, C. Medical Zoology.

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Reference Books:

Anderson, J. and D.L. Slater. 1981. Catalogue of Mammals, Vols. I and II. Cosmo Publications, New Delhi.

Applied Ecology and Resource Management. Cambridge University Press, Cambridge, U.K.

Austin, C.R. and R.V. Short. 1985. Reproduction in mammals. Book – 4. Reproductive fitness. Cambridge University Press. Cambridge.

Clegg, P.C. and A.G. Clegg. 1978. Biology of mammals. The ELBS and William Heinemana Medicak Books Ltd., London.

Conservation. Oxford University Press, New York.

David Macdonald. 1988. Encyclopaedia of mammals Vol. I and II, George Allend and Unerin, London.

Gadagkar, R. (1997). *Survival Strategies - Cooperation and Conflict in Animal Societies.* Harvard University Press, Cambridge, Massachusetts, USA and Universities Press, Hyderabad, India. (Complex) Chinese language edition, International Publishing Company Ltd., Taiwan (1999). Korean language edition, Purun Media Publishing Company (2001). [Extract Only]

Prater, S.H. 1988. The Books of Indian animals. Bombay Natural History Society, Bombay.

Roonwal, M.L. and S.M. Monhrot. 1977. Primates of South East Asia: Ecology, Sociobiology and Behaviour, Harvard Univ. Press, Cambridge.

Sadleir, R.M.F.S. 1969. The ecology of reproduction in wild and domestic mammals. Methuen & Co. Ltd., London.

Sukumar, R. (1989). The Asian Elephant: Ecology and Management. Cambridge Studies in

Sukumar, R. (2003). The Living Elephants: Evolutionary Ecology, Behavior and

Vivek Menon. 2009. Mammals of India. Princeton University Press.

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A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305

M.Sc., WILDLIFE BIOLOGY

SEMESTER: III – EC –III CLIMATE CHANGE AND WILDLIFE CONSERVATION

Code: 15 PWLE 303

Objectives: Upon completion of this paper students will gain the scientific knowledge on issues related to global warming and biodiversity conservation.

UNIT-I

Introduction and concepts of climate change –- Global Climate change – past and present scenario– role of IPCC – WMO (World Meterological Organization)– on climate change-significance of natural climate fluctuations

UNIT- II

Causes of climate change: Greenhouse Effects: Water vapour – CO_2 –Methane –Nitrous oxide and Chloflourooxide (CFCs) -Aerosols in the atmosphere– Land use change - Anthropogenic source of Green House gases (Fossil fuels –Deforestation –live stock – agricultural products) – Different Concerns of developed and developing Countries. Elements of climate change – Temperature – precipitation – Ice and snow – sea level rise.

UNIT- III

The Earth's Carbon Reservoirs - Biogeochemistry, Atmospheric Carbon Reservoir - Carbon Cycling: The Physical Carbon Pump -The Biological Carbon Pump -The Marine Carbon Cycle -The Terrestrial Carbon Cycle –ecological responses to climate change.

UNIT- IV

Introduction to Climate and Weather change - Earth's Climate - Wind Systems – Role of marine water current and global climate change - The significance of Monsoon: direct and indirect effects on wildlife –climate change and its effects on birds and mammals.

UNIT- V

Climate risk management: Natural disasters and Climate change – cloudburst – frequent Hurricanes and socio economic issues - El Niño and La Nino effects on climate change - Ocean acidification – anthropogenic factors – impact of natural radiation and global climate change - the Climate change and its impact on Indian wildlife. Climate change and its impact on animal behaviour.

References:

1. Weart Spencer. (2004). The Discovery of Global Warming. Harvard University Press. *Available on-line:* http://www.physicists.org/history/climate.
2. Sigh (2010). Global Warming And Climate Change, APH Publications, Pp.320.
3. Dubash. Hand Book of Climate Change and India ,Orange Books: ISBN: 9781849713580
4. Climate Change, *Velma Grover (ed.)*: Hamilton, Ontario, Canada ISBN 978-1-57808-326-8; 2004; 472 Pages.
5. Ecosystems Climate change – Bannerjee and Mishra – Neha Publishers - SBN10: 8179104257 ISBN13: 9788179104255
6. Causes of Climate change – Ashok Malik – Amazon Book House
7. Hand Book on Climate change – Amazon Publishers.
8. The Reports from Working Groups I, II and III are available at: http://www.ipcc.ch/.

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DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

M.Sc., Wildlife Biology

SEMESTER III –PAPER III - EMBRYOLOGY & EVOLUTION

Code: 12PWLS303

Objectives:
To enable the students understand the basic concepts of embryology and evolution.

UNIT I

Gametogenesis: Primordial germ cells, Spermatogenesis, Oogenesis.
Yolk: Types – synthesis – Transportation and Importance.
Structure of typical sperm and ovum.
Types of egg: Based on the development, distribution of yolk and shell.

UNIT II

Fertilization: Events in fertilization – Physical, chemical and physiological changes.
Theories of fertilization.
Cleavage: Planes and patterns.
Blastulation & Gastrulation: Structure of typical blastula and Gastrula

UNIT III

Embryonic induction: Concept of organizer – nature and mechanism of induction
Metamorphosis: Amphibian metamorphosis – ecological – morphological – physiological and biochemical changes
Regeneration: Types and events – Factors influencing regeneration

UNIT IV

Evolution:
Theories of Evolution: Recapitulation theory, Lamarckism - Neo Lamarckism, DeVries theory of mutation - Modern concept of mutation; Darwin's theory - Neo Darwinism and Modern synthetic theory of evolution
Recapitulation theory and its importance

UNIT V

Genetic drift: Mimicry & colouration – Isolation – Speciation –
Geological time scale; Fossils formation, types and dating of fossils
Evolution of Man and future evolution of man.

Text Book

Verma,P.S., V.K.Agarwal and B.S.Tyagi. 1985. Chodate Embryology. S.Chand & Co Ltd. NewDelhi.

References

1. Berrill, N.J. 1974. Developmental Biology. Tata McGraw Hill Publications, New Delhi.
2. McEwen, R.S. 1973. Vertebrate Embryology. Oxford & IBH Publishing Co., Calcutta.
3. Browder, L.W. 1984. Developmental Biology. Saunders College Publishing, New York.
4. Balinsky, B.I. 1981. An Introduction to Embryology. Saunders College Publishing, New York.
5. Arumugam, N. 2005. Organic Evolution. Saras Pub., Nagargoil.

A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL – 609 305.

DEPARTMENT OF ZOOLOGY & WILDLIFE BIOLOGY

M.Sc., Wildlife Biology

SEMESTER III –PAPER IV -PHYSIOLOGY& ECOLOGY

Code: 12PWLS304

Objectives:

To enable the students understand the basic mechanism of physiology

To enable the students understand the basic principles of ecosystem

UNIT – I

Physiology

Nutritive requirements; role of salivary glands, liver, pancreas and intestinal glands in digestion and absorption.

Composition and constituents of blood; blood groups and Rh factor in man; coagulation, factors and mechanism of coagulation; acidbase balance, thermo regulation.

Oxygen and carbon dioxide transport; haemoglobin: constituents and role in regulation.

UNIT II

Excretory products; nephron and regulation of urine formation; osmoregulation.

Types of muscles, mechanism of contraction of skeletal muscles.

Neuron, nerve impulse-its conduction and synaptic transmission; neurotransmitters.

UNIT –III

Vision, hearing and olfaction in man.

Mechanism of hormone action.

Physiology of reproduction, role of hormones and phermones.

UNIT – IV

Ecology

Biosphere: Biogeochemical cycles, green-houses effect, ozone layer and its impact; ecological succession, biomes and ecotones.

Population, characteristics, population dynamics, population stabilization.

UNIT V

Conservation of natural resources mineral mining, fisheries, acquaculture; forestry; grassland; wildlife (Project Tiger); sustainable production in agriculture-integrated pest management.

Environmental biodegradation; pollution and its impact on biosphere and its prevention

Text **book**

Mariyakutikan, A. and N. Arumugam. 2009. Animal physiology. Saras Pub. Nagarkoil
Arumugam, N. 1992. Concepts of ecology. Saras Pub., Nagargoil.

References

Hurkat, P.C., and Mathur, P.N. 1976. A Text book of Animal Physiology. S.Chand & Co.,(LTD) New Delhi.

Trivedi, P.R. Encyclopedia of ecology and environment. Vol.1-5. Published by Indian Institute of Ecology and Environment.

Tuttle, W.W. and Schottelius, B.A. 1961. Text book of Physiology. The C.V. Mosby Company, St. Louis.

Verma, S.R., Sharma, R.S. and Rani, G. 1988. Ecology and Animal behaviour. Jaiprakash Nath & Co., Meerut

Wood. D.W. 1971. Principles of Animal Physiology. Edward Arnold Publishers Ltd., London.