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KAKATIYA UNIVERSITY, WARANGAL - 506 009
B.Sc. PROGRAMME - Under CBCS System
Scheme wef A.Y: 2019-20

Subject: ZOOLOGY

FIRST YEAR

SEMESTER – I

Code	Course category	Title of the Paper	Credits No. of	Hrs PW	Max. Marks			Total Marks
					Internal Exam	End Exam	Lab	
BS101	AECC-1	Environmental Science	2	2	10	40	-	50
BS102	FL-1A	English	4	4	20	80	-	100
BS103	SL-1A	Second Language	4	4	20	80	-	100
BS104	DSC-1A	**Animal Diversity - Invertebrates**	4	4	20	80	25	125
		Lab -I	1	3				
BS105	DSC-2A	Optional– II	4	4	20	80	25	125
		Optional – II LAB	1	3				
BS106	DSC-3A	Optional – III	4	4	20	80	25	125
		Optional – III LAB	1	3				
		TOTAL:	**25**	**-**	**110**	**440**	**75**	**625**

SEMESTER – II

Code	Course category	Title of the Paper	Credits No. of	Hrs PW	Max. Marks			Total Marks
					Internal Exam	End Exam	Lab	
BS201	AECC-2	Basic Computer Skills (Taught by: Computer Science)	2	2	10	40	-	50
BS202	FL-2B	English	4	4	20	80	-	100
BS203	SL-2B	Second Language	4	4	20	80	-	100
BS204	DSC-1B	**Animal Diversity - Vertebrates**	4	4	20	80	25	125
		Lab	1	3				
BS205	DSC-2B	Optional– II	4	4	20	80	25	125
		Optional – II LAB	1	3				
BS206	DSC-3B	Optional – III	4	4	20	80	25	125
		Optional – III LAB	1	3				
		TOTAL:	**25**	**-**	**110**	**440**	**75**	**625**

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Subject: ZOOLOGY

SECOND YEAR

SEMESTER – III

Code	Course category	Title of the Paper	Credits No. of	Hrs PW	Max. Marks			Total Marks
					Internal Exam	End Exam	Lab	
BS301	SEC-1	Fundamentals of Nano Technology (Taught by : Physics)	2	2	10	40	-	50
BS302	SEC-2	Bio Statistics (Taught by : Statistics)	2	2	10	40	-	50
BS303	FL-3 A	English	3	3	15	60	-	75
BS304	SL-3 B	Second Language	3	3	15	60	-	75
BS305	DSC-1C	**Animal Physiology & Animal Behaviour**	4	4	20	80	25	125
		Lab	1	3				
BS306	DSC-2C	Optional– II	4	4	20	80	25	125
		Optional – II LAB	1	3				
BS307	DSC-3C	Optional – III	4	4	20	80	25	125
		Optional – III LAB	1	3				
		TOTAL:	**25**	**-**	**110**	**440**	**75**	**625**

SEMESTER – IV

Code	Course category	Title of the Paper	Credits No. of	Hrs PW	Max. Marks			Total Marks
					Internal Exam	End Exam	Lab	
BS401	SEC-3	Fundamentals of Python (Taught by: Computer Science)	2	2	10	40	-	50
BS402	SEC-4	Remedial Methods of Pollution – Drinking Water & Soil Fertility (Taught by: Chemistry)	2	2	10	40	-	50
BS403	FL-4 A	English	3	3	15	60	-	75
BS404	SL-4 B	Second Language	3	3	15	60	-	75
BS405	DSC-1D	**Cell Biology, Genetics & Developmental Biology**	4	4	20	80	25	125
		Lab	1	3				
BS406	DSC-2D	Optional– II	4	4	20	80	25	125
		Optional – II LAB	1	3				
BS407	DSC-3D	Optional – III	4	4	20	80	25	125
		Optional – III LAB	1	3				
		TOTAL:	**25**	**-**	**110**	**440**	**75**	**625**

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Scheme wef A.Y: 2019-20

Subject: ZOOLOGY

THIRD YEAR

SEMESTER – V

Code	Course category	Title of the Paper	Credits No. of	Hrs PW	Max. Marks			Total Marks
					Internal Exam	End Exam	Lab	
BS501	FL-5 A	English	3	3	15	60	-	75
BS502	SL-5 B	Second Language	3	3	15	60	-	75
BS503	G.E.	Water Resources Management (Taught by: Any Science Dept.)	4	4	20	80	-	100
BS504	DSE-1E	Optional - I : Physiological Chemistry & Endocrinology	4	4	20	80	25	125
		Optional – I Lab	1	3				
BS505	DSE-2E	Optional– II : Laboratory Animals Maintenance & Applications	4	4	20	80	25	125
		Optional – II LAB	1	3				
BS506	DSE-3E	**Optional – III : Immunology and Animal Biotechnology**	4	4	20	80	25	125
		Optional – III LAB	1	3				
		TOTAL:	**25**	**-**	**110**	**440**	**75**	**625**

SEMESTER – VI

Code	Course category	Title of the Paper	Credits No. of	Hrs PW	Max. Marks			Total Marks
					Internal Exam	End Exam	Lab	
BS601	FL-6 A	English	3	3	15	60	-	75
BS602	SL-6 B	Second Language	3	3	15	60	-	75
BS603	P.W / Optional	Optional: Public Health & Hygiene (Taught by: Zoology / Botany / Biotechnology / Micro Biology)	4	4	20	80	-	100
BS604	DSC-1F	Optional - I : Fisheries	4	4	20	80	25	125
		Optional – I Lab	1	3				
BS605	DSC-2F	Optional– II : Limnology	4	4	20	80	25	125
		Optional – II LAB	1	3				
BS606	DSC-3F	**Optional – III : Ecology, Zoogeograpy & Evolution**	4	4	20	80	25	125
		Optional – III LAB	1	3				
		TOTAL:	**25**	**-**	**110**	**440**	**75**	**625**

F.L : First Language;
S.L : Second Language;
A.E.C.C: Ability Enhancement Compulsory Course;
S.E.C : Skill Enhancement Course;
D.S.C : Discipline Specific Course;
D.S.E : Discipline Specific Effective;
G.E : Generic Elective;
P.W : Project Work;

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – I

ANIMAL DIVERSITY – INVERTEBRATES

(Core Paper –I)

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Protozoa

1.1.1 General Characters and Classification of Protozoa up to Orders with examples
1.1.2 Type Study –***Elphidium***
1.1.3 Locomotion and Reproduction
1.1.4 Epidemiology of Protozoan diseases – Amoebiasis, Giardiasis, Leishmaniasis, Malaria

1.2 Porifera

1.2.1 General characters and Classification of Porifera up to Orders with examples
1.2.2 Type study - ***Sycon***
1.2.3 Canal system in Sponges
1.2.4 Types of Cells and Spicules in Porifera.

UNIT – II

2.1 Cnidaria

2.1.1General characters and Classification of Cnidaria up to classes with examples
2.1.2 Type study -***Obelia***
2.1.3 Polymorphism in Cnidarians with examples
2.1.4 Corals and Coral Reef formation

2.2 Helminthes

2.2.1 General characters and Classification of **Platyhelminthes** up to classes with examples
2.2.2 Type study -***Schistosoma***
2.2.3 General characters and Classification of **Nemathelminthes** up to classes with examples
2.2.4 Type study –***Dracanculus;*** Parasitic Adaptations in Helminthes

UNIT– III

3.1 Annelida

3.1.1 General characters and Classification of Annelida up to classes with examples
3.1.2 Type study – ***Hirudinaria granulosa***
3.1.3 Evolutionary significance of Coelome and Coelomoducts and Metamerism
3.1.4 Economic Importance of Annelida (Polychaeta, Oligochaeta and Hirudinea)

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3.2Arthropoda

3.2.1 General characters; Classification of Arthropoda upto classes with examples
3.2.2Type study –***Palaemon***(Prawn*)*
3.2.3Crustacean Larvae; Insect metamorphosis; Useful and Harmful Insects
3.2.4***Peripatus***- Structure and affinities

UNIT – IV

4.1 Mollusca

4.1.1 General characters; Classification of Mollusca upto classes with examples
4.1.2Type study -***Pila*** *(*Snail*)*
4.1.3 Pearl formation; Torsion and Detorsion in Gastropods
4.1.4 Molluscs as Bio-indicators, Vectors and Pests; Economic importance

4.2 Echinodermata

4.2.1 General characters and Classification of Echinodermata upto classes with examples
4.2.2 Type study- ***Star Fish***
4.2.3Echinoderm larvae and their evolutionary significance
4.2.4 Autotomy, Regeneration and Symmetry of Echinoderms

Suggested Readings:

1. **L.H. Hyman** '*The Invertebrates' Vol I, II and V.* – M.C. Graw Hill Company Ltd.
2. **Kotpal, R.L. 1988 - 1992** Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
3. **E.L. Jordan and P.S.** Verma'*Invertebrate Zoology'* S. Chand and Company.
4. **R.D. Barnes** '*Invertebrate Zoology'* by: W.B. Saunders CO., 1986.
5. **Barrington. E.J.W.**, '*Invertebrate structure and Function'* by ELBS.
6. **P.S. Dhami and J.K. Dhami.**Invertebrate Zoology. S. Chand and Co. New Delhi.
7. **Parker, T.J. and Haswell**'*A text book of Zoology'* by, W.A., Mac Millan Co. London.
8. **Barnes, R.D. (1982).***Invertebrate Zoology*, V Edition"

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – I

ANIMAL DIVERSITY - INVERTEBRATES (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

1. Study of museum slides / specimens/models (Classification of animals up to orders)

i) **Protozoa:***Amoeba, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoebahistolytica, Plasmodium vivax*

ii) **Porifera**:*Sycon, Spongilla,Euspongia, Sycon*- T.S &L.S, Spicules, Gemmule

iii) **Coelenterata:** *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula*

iv) **Platyhelminthes:***Planaria, Fasciolahepatica, Fasciola*larval forms – Miracidium, Redia, Cercaria, *Echinococcusgranulosus, Taeniasolium, Schistosomahaematobium*

v) **Nemathelminthes:***Ascaris(Male & Female), Drancunculus, Ancylostoma,Wuchereria*

vi) **Annelida:** *Nereis, Aphrodite, Chaetopteurs, Hirudinaria,* Trochophore larva

vii) **Arthropoda:** *Cancer, Palaemon,* Scorpion, *Scolopendra, Sacculina, Limulus, Peripatus,* Larvae -Nauplius, Mysis,Zoea,Mouth parts of male & female *Anopheles* and *Culex,* Mouthparts of Housefly and Butterfly.

viii) **Mollusca:** *Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus,* Glochidium larva

ix) **Echinodermata:** *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria,Antedon,* Bipinnaria larva

2. Demonstration of dissection / dissected / virtual dissection:
Prawn: Appendages, Digestive system, Nervous system, Mounting of Statocyst

3. Laboratory Record work shall be submitted at the time of practical examination

4. An **"Animal album"** containing photographs, cut outs, with appropriate write up about the abovementioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

5. Computer aided techniques should be adopted as per UGC guide lines.

Suggested manuals:

1. Practical Zoology- Invertebrates by S.S.Lal
2. Practical Zoology – Invertebrates by P.S.Verma
3. Practical Zoology –Invertebrates by K.P.Kurl

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B.Sc. ZOOLOGY I Year

SEMESTER – II

ANIMAL DIVERSITY – VERTEBRATES

(Core Paper – II)

Theory	**4 Hours/Week**	**4 Credit**	**Internal marks = 20**
Practical	**3 Hours/Week**	**1 Credit**	**External Marks = 80**

UNIT – I

1.1 Hemichordata

1.1.1 General characters and Classification of Hemichordates upto classes with examples
1.1.2*Balanoglossus*- Structure and affinities
1.1.3. Larval Significance (Tornaria)

1.2. Protochordata

1.2.1 General Characters and Classification of Chordates up to orders with examples
1.2.2 Salient features of Urochordata; Retrogressive metamorphosis in Urochordata
1.2.3 Salient features and affinities of Cephalochordata
1.2.4 General Characters of Cyclostomata; Comparison of *Petromyzon*and *Myxine*

UNIT – II

2.1 Pisces

2.1.1 General characters of and Classification of Pisces up to orders with examples
2.1.3*Scoliodon*- Digestive,Respiratory, Circulatory and Nervous system
2.1.4 Types of Scales, Types of Fins
2.1.5 Migration in Fishes

2.2 Amphibia

2.2.1 General characters and Classification of Amphibians up to orders with examples.
2.2.2***Rana tigrina***- Respiratory, Circulatory and Nervous systems
2.2.3 Parental care in Amphibians; Neoteny and Paedogenesis
2.2.4 Metamorphosis in Amphibians and its hormonal control

Unit – III

3.1 Reptilia

3.1.1 General characters and Classification of Reptilia up to orders with examples
3.1.2***Calotes***–Digestive,Respiratory, Circulatory and Nervous systems
3.1.3 Temporal fossa in Reptiles and its evolutionary importance
3.1.4 Distinguished characters of Poisonous and Non-poisonous snakes

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3.2 Aves

3.2.1 General characters and Classification of Aves upto orders with examples.
3.2.2***Columba livia***- Digestive, Respiratory,Circulatory and Nervous systems
3.2.3 Migration in Birds
3.2.4 Flight adaptation in Birds

Unit – IV

4.1 Mammalia

4.1.1 General characters and Classification of Mammalia upto orders with examples
4.1.2***Rabbit***- Digestive, Respiratory,Circulatory and Nervous systems
4.1.3Dentition in Mammals
4.1.4 Aquatic adaptations in Mammals

Suggested Readings:

1. **E.L.Jordan and P.S. Verma**'*Chordate Zoology*' -. S. Chand Publications.

2. **Mohan P.Arora**. '*Chordata – I*, Himalaya Publishing House Pvt.Ltd.

3. **Marshal, Parker and Haswell**'*Text book of Vertebrates*'. ELBS and McMillan, England.

4. **Alfred Sherwood Romer**. Thomas S. Pearson '*The Vertebrate Body*, Sixth edition, CBS CollegePublishing, Saunders College Publishing

5. **George C. Kent, Robert K. Carr**. *Comparative Anatomy of the Vertebrates*, 9th ed. McGrawHill.

6. **Kenneth Kardong***Vertebrates: Comparative Anatomy, Function and Evolution*, 4th ed,'McGraw Hill.

7. **J.W. Young**, *The Life of Vertebrates*, 3rd ed, Oxford University press.

8. **Harvey Pough F, Christine M. Janis, B. Heiser,** *Vertebrate Life,* Pearson, 6th ed, Pearson Education Inc.2002.

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY I Year

SEMESTER – II

ANIMAL DIVERSITY - VERTEBRATES (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

I. Study of museum slides / specimens / models (Classification of animals up to orders)

1. **Hemichordata:** *Balanoglossus, Tornmaria larva*
2. **Protochordata:** *Amphioxus, Amphioxus* T.S. through pharynx
3. **Cyclostomata:** *Petromyzon, Myxine, Ammocoetus larva*
4. **Pisces:** *Sphyrna, Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus,* Scales: Placoid, Cycloid, Ctenoid
5. **Amphibia:** *Ichthyophis, Amblystoma, Siren,Hyla, Rachophous,Bufo, Rana,* Axolotal larva
6. **Reptilia :** *Draco, Chemaeleon, Gecko, Uromastix, Vipera russeli, Naja, Bungarus, Enhydrina, Typhlops, Ptyas, Testudo, Trionyx, Crocodilus*
7. **Aves:** Archaeopteryx, *Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo* ,Collection and study of different types of feathers: Quill, Contour, Filoplume, Down
8. **Mammalia:** *Ornithorthynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris,* Hedgehog;
9. **Histology:**T.S. of Liver, Pancreas, Kidney, Stomach, Intestine, Lung, Artery, Vein, Bone T.S, Spinal Cord. T.S.

II. Osteology:
Rabbit – Axial Skeleton (Bones of Skull and Vertebral Column),
Varanus, Pigeon and Rabbit - Appendicular skeleton (Bones of Limbs and Girdles

III. Demonstration of dissection / dissected / virtual dissection: Labeo / Tilapia
1. Digestive system 2. Brain, Weberian Oscicles3. V, VII, IX, X cranial nerves

IV. Laboratory Record work shall be submitted at the time of practical examination

V. An **"Animal album"** containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

VI. Computer aided techniques should be adopted as per UGC guide lines.

Suggested manuals:

1. **S.S.Lal,** Practical Zoology – Vertebrata
2. **P.S.Verma,** A manual of Practical Zoology– Chordata

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – III

ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR

Theory	**4 Hours/Week**	**4 Credit**	**Internal marks = 20**
Practical	**3 Hours/Week**	**1 Credit**	**External Marks = 80**

UNIT – I

1.1 Digestion

1.1.1 **Enzymes:** Definition, Classification, Inhibition, Regulation
1.1.2 Digestion of Carbohydrates, Proteins, Lipids and Cellulose
1.1.3Absorption and Assimilation of digested food
1.1.4 Role of Gastrointestinal hormones in digestion

1.2 Excretion, Homeostasis and Osmoregulation

1.2.1 Classification of Animals on the basis of excretory products: Ammonotelic, Ureotelic, and Uricotelic; Structure and function of Nephron
1.2.2Urine formation and Counter current mechanism
1.2.3 Concept and Mechanism of Homeostasis
a) Hormone regulation of Blood Glucose levels in Human being
b) Water and Ionic Regulation by Marine and Fresh water Animals
c) Thermo regulation in Human being
1.2.4. Osmoregulation in Marine, Fresh and Brackish water Animals

UNIT – II

2.1 Respiration

2.1.1Definition of Respiration, Respiration mechanism, External, Internal and Cellular Respiration.
2.1.2 Respiratory Pigments; Transport of Oxygen, Oxygen dissociation curves, and Bohr's Effect;
2.1.3 Transport of Carbon dioxide, Chloride shift
2.1.4 Regulation of Respiration; Nervous and Chemical Mechanism

2.2 Circulation

2.2.1 Types of Circulation Open and Closed; Structure of Mammalian Heart
2.2.2 Types of Hearts: Myogenic and Neurogenic
2.2.3 Heart functions - Conduction and Regulation of Heart beat, Regulation of Heart rate; ECG
2.2.4 Tachycardia and Bradycardia; Blood Clotting mechanism

UNIT– III

3.1 Muscle Contraction

3.1.1Types of Muscles
3.1.2 Ultra structure of skeletal muscle fibre
3.1.3 Mechanism and Chemical changes during Muscle Contraction (Sliding filament theory)
3.1.4 Twitch Tetanus summation and Treppe fatigue

3.2 Nerve Impulse

3.2.1 Structure of Neuron
3.2.2 Nerve impulse - Resting potential, Threshold potential and Action potential, Conduction of Nerve impulse
3.2.3 Transmission of Nerve impulse
3.2.4 Synapse and Synaptic transmission; Neurotransmitters-EPSP, IPSP

3.3 Endocrine System

3.3.1 Endocrine glands - Structure, secretions and functions of Pituitary gland
3.3.2 Thyroid, Parathyroid, Adrenal glands and Pancreas
3.3.3 Hormone action and Concept of Secondary messengers
3.3.4 Male and Female Hormones; Hormonal control of Menstrual cycle in human beings

UNIT – IV

4.1 Animal Behaviour

4.1.1 Types of Behaviour- Innate and Acquired; Instinctive and Motivated behaviour
4.1.2 Taxes, Reflexes, Tropisms

4.2 Learning and Memory

4.2.1 **Types of Learning**: Trial and Error Learning, Imprinting, Habituation
4.2.2 **Conditioning:** Classical Conditioning; Instrumental conditioning, Examples of Conditioning, Pavlov's Experiment

4.3 Social Behaviour and Communication

4.3.1 Social behaviour of insects (Dance language of honey bees)Colonial Existence of Bees and Termites; Pheromones

4.4 Biological Rhythms

4.4.1 Biological Clocks, Circadian Rhythms; solar and lunar Rhythms; Circannual Rhythms

Suggested Readings:

1. **Gerard J. Tortora and Sandra Reynolds Garbowski** *Principles of Anatomy and Physiology*, Tenth Ed., John Wiley & Sons
2. **Arthur C. Guyton MD**, *A Text Book of Medical Physiology*, Eleventh ed., JohnE. Hall, Harcourt Asia Ltd.
3. **William F. Ganong**, *A Review of Medical Physiology*, 22 ed, McGraw Hill, 2005
4. **Sherwood, Klandrof, Yanc, Animal** *Physiology*, Thompson Brooks/Coole, 2005.
5. **Sherwood, Klandrof, Yanc,** *Human Physiology*, Thompson Brooks/Coole, 2005.
6. **Knut Scmidt-Nielson,** *Animal Physiology***,** 5th edition, Cambridge Low Price Edition.
7. **Roger Eckert and Randal,** *Animal Physiology***,** 4th ed, Freeman Co, New York**.**
8. **Singh. H.R,** Text Book of Animal Physiology and Biochemistry
9. **Nagabhushanam**, Comparative Animal Physiology
10. **Veer Bal Rastogi,** Text Book of Animal Physiology
11. **Dasmann**, "Wild Life Biology"
12. **ReenaMathur,** "Animal Behaviour"
13. **Alocock,** "Animal Behaviour- an Evolutionary Approach

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – III

ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR (PRACTICAL)

Instruction: 3 hrs per week
No. of Credits: 1

1. Qualitative tests for identification of carbohydrates, proteins and fats
2. Qualitative tests for identification of ammonia, urea and uric acid (Nitrogenous excretory products)
3. Zonation of gut in Cockroaches
4. Study on effect of pH and Temperature on salivary amylase activity
5. Study of permanent histological sections of mammalian endocrinal glands: Pituitary, Thyroid, Pancreas, Adrenal gland
6. Estimation of Haemoglobin by Sahli's method
7. Estimation of Blood Clotting time
8. Estimation of total protein by Biuret's method
9. Estimation of unit metabolism of fish

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

Suggested manuals:

Tortora, G.J. and Derrickson, B.H. (2009).*Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
Guyton, A.C. and Hall, J.E. (2011). T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).*Biochemistry*.VI Edition. W.H Freeman and Co.
Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009).*Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper'sIllustrated Biochemistry*. XXVIII Edition.Lange Medical Books/Mc Graw3Hill.

KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – IV

CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Cell Biology

1.1.1 Ultra structure of Animal cell

1.1.2 Structure (Fluid mosaic model) and Functions of Plasma membrane

1.1.3 Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Mitochondria and Nucleus

1.1.4 Chromosomes - Structure, types, Cell Division- Mitosis, Meiosis, Cell Cycle and its regulation.

UNIT – II

2.1 Molecular Biology

2.1.1 DNA (Deoxyribo Nucleic Acid) –Structure-RNA (Ribo Nucleic Acid)-Structure, types, DNA Replication

2.1.2 Protein Synthesis – Transcription, Translation.

2.1.3 Gene Expression - Genetic Code, Operon concept.

2.1.4 Molecular Biology Techniques – Polymerase Chain Reaction (PCR), Electrophoresis.

UNIT – III

3.1 Genetics

3.1.1 Mendel's laws of Inheritance and Non-Mendelian Inheritance , Linkage and Crossing over.

3.1.2 .Sex determination and Sex-linked inheritance.

3.1.3 Chromosomal Mutations- Deletion, Duplication, Inversion, Translocation; Aneuploidy and Polyploidy; Gene mutations- Induced versus Spontaneous mutations

3.1.4 Inborn errors of metabolism.

UNIT – IV

4.1 Developmental Biology

4.1.1 Gametogenesis (Spermatogenesis and Oogenesis), Fertilization, Types of eggs, Types of cleavages

4.1.2 Development of Frog upto the formation of primary germ layers

4.1.3 Formation of Foetal membrane in chick embryo and their functions

4.1.4 Types and functions of Placenta in Mammals,Regeneration in Turbellarians and Lizards

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Suggested Readings:

1. **Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell** *'Molecular Cell Biology'* W.H. Free man and company New York.

2. **Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008).** *Principles of Genetics.* VIII Edition. Wiley India.

3 **Snustad, D.P., Simmons, M.J. (2009).** *Principles of Genetics.* V Edition. John Wiley and Sons Inc.

4 **Klug, W.S., Cummings, M.R., Spencer, C.A. (2012).** *Concepts of Genetics.* X Edition. Benjamin Cummings.

5. **Russell, P. J. (2009).** *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.

6. **Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.** *Introduction to Genetic Analysis.* IX Edition.W. H. Freeman and Co.

7. **Ridley, M. (2004).** *Evolution.* III Edition. Blackwell Publishing

8.**Campbell, N. A. and Reece J. B. (2011).** *Biology.* IX Edition, Pearson, Benjamin, Cummings.

9.**James D. Watson, Nancy H. Hopkins** *'Molecular Biology of the Gene'*

10. **Gupta P.K**., 'Genetics'

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY II Year

SEMESTER – IV

CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

I. Cytology

1. Preparation and Identification of slides of Mitotic divisions with onion root tips
2. Preparation and Identification of different stages of Meiosis in Grasshopper Testes
3. Identification and study of the following slides

i). Different stages of Mitosis and Meiosis

ii) Lamp brush and polytene chromosomes

II. Genetics

1. Problems on Genetics - Mendelian inheritance, Linkage and Crossing over, Sex linked inheritance

III. Embryology

1. Study of T.S. of Testis and Ovary of a mammal
2. Study of different stages of cleavages (2, 4, 8, 16 cell stages); Morula, Blastula
3. Study of chick embryos of 18 hours, 24 hours, 33 hours and 48 hours of incubation

IV. Laboratory Record work shall be submitted at the time of practical examination

V. An **"Album"** containing photographs, cut outs, with appropriate write-up about Genetics and Embryology

- **Computer aided techniques should be adopted as per UGCguide lines.**

Suggested manuals:

1. Manual of laboratory experiments in Cell Biology by **Edward, G.**
2. Freeman and Bracegirdle – An Atlas of Embryology.

*****

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY III Year

SEMESTER – V

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Basics of Immune system

1.1.1 Cells of the Immune system and the Lymphoid organs (Primary and Secondary)
1.1.2 First line of defences-physical and chemical barriers; second line of defences – inflammation and phagocytosis.
1.1.3 Types of Immunity- Inherent (Active and Passive) and Acquired Immunity (Active and Passive) Humoral and Cell mediated immunity.
1.1.4 Major Histocompatibility complex (MHC)- structure and function of class I and Class II proteins. Significance of MHC in organ transplantation; MHC restriction

UNIT – II

2.1 Antibodies and Antigens and Immune system diseases

2.1.1 Antibodies(Immunoglobulins) – Structure, functions and classification, antibody diversity, Monoclonal antibodies and applications
2.1.2 Antigens structure, antigenic determinants/epitopes, haptens, adjuvants and antigenicity.
2.1.3 Antigen-antibody reactions; Agglutination; Precipitation, Opsonization, Cytotoxicity
2.1.4 Hypersensitivity reactions.
Autoimmunity and Immunodeficiency diseases.

Unit – III

3.1 Animal Biotechnology and Genetically modified organisms

3.1.1 Concept and Scope of Animal Biotechnology
3.1.2 Recombinant DNA Technology and its applications.
3.1.3 Cloning Vectors- Plasmids, Cosmids and shuttle vectors, Cloning methods(Cell, Animal and Gene cloning); Restriction enzymes and Ligases
3.1.4 Transgenesis – Methods of Transgenesis
Production of Transgenic animals- Sheep and Fish

Unit – IV

4.1 Applications of Biotechnology

4.1.1 In vitro fertilization and embryo transfer
4.1.2 Hybridoma technology – concepts and applications
4.1.3 Stem cells- Types and their applications
4.1.4 Recombinant insulin and human growth hormone; Polymerase Chain Reaction (PCR)
Animal Bioreactors- Concepts and Applications.

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Suggested Readings:

1. Text Book of Immunology – Ivan Riott
2. Text Book of Immunology – C.V.Rao
3. Text Book of Immunology – Nandinin Shetty
4. Text Book of Immunology – Kubey
5. Culture of Animal Cells – R. Ian Freshney, Wiley Liss
6. Biotechnology – S. Mitra
7. Animal Cell Culture - Practical Approach – Ed. John. RW. Masters, Oxford
8. Biotechnology – B.D.Singh
9. Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNAAnalysis*. II Edition, Academic Press, California, USA.
10. Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY III Year

SEMESTER – V

IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

I. Immunology

1. Identification of Blood grouping (Demonstration of Agglutination) using kit.
2. Demonstration of Precipitation (VDRL/RPR) using kit.
3. Histological study of Lymphoid organs -Spleen, Thymus, Lymph node, Bone marrow (through prepared slides).
4. Enumeration of Total RBC from a given blood sample.
5. Enumeration of Total WBC from a given blood sample.
6. Enumeration of Differential count of WBC from a given blood sample.

II. Animal Biotechnology

1. Study the following techniques through Photographs / Virtual Lab

a) Identification of Vectors
b) Identification of Transgenic animals
c) DNA sequencing (Sanger's method)
d) DNA finger printing
e) Southern blotting
f) Western blotting

2. PCR (demonstration) on site or of site demonstration.

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

Suggested manuals:

1. A Hand Book of Practical Immunology – **Ivan Riott**
2. Animal Biotechnology – **P.K. Gupta.**
3. Immunology, VI Edition. W.H. Freeman and Company **Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006).**
4. Immunology, VII Edition, Mosby, Elsevier Publication **David, M., Jonathan, B., David, R. B. and Ivan R. (2006).**
5. Cellular and Molecular Immunology. V Edition. Saunders Publication, **Abbas, K. Abul and Lechtman H. Andrew (2003.)**

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KAKATIYA UNIVERSITY

Under Graduate Courses (Under CBCS 2019 - 2022)

B.Sc. ZOOLOGY III Year

SEMESTER – VI

ECOLOGY, ZOOGEOGRAPHY AND EVOLUTION

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

UNIT – I

1.1 Ecology- I

1.1.1 Ecosystem Structure and Functions; Types of Ecosystems – Aquatic and Terrestrial
1.1.2 Bio-geo chemical nutrient cycles - Nitrogen, Carbon, Phosphorus and Water
1.1.3 Energy flow in ecosystem
1.1.4 Food chain, food web and ecological pyramids
1.1.5 Animal Associations-Mutualism; Commensalism;Parasitism; Competition, Predation

UNIT – II

2.1 Ecology – II

2.1.1 Concept of Species, Population dynamics and Growth curves
2.1.2 Community Structure and dynamics and Ecological Succession
2.1.3 Ecological Adaptations
2.1.4 Environmental Pollution- Sources, Effect and Control measures of Air, Water, Soiland Noise Pollution
2.1.5 Wildlife conservation - National Parks and Sanctuaries of India, Endangered species; Biodiversity and Hotspots of Biodiversity in India.

UNIT – III

3.1 Zoogeography

3.1.1 Zoogeographical regions
3.1.2 Climatic and faunal peculiarities of Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions
3.1.3 Wallace line, Discontinuous distribution
3.1.4 Continental Drift

Unit – IV

4.1. Evolution

4.1.1 Theories of Evolution – Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, Modern synthetic theory, Evidences of Evolution.
4.1.2 Forces of Evolution–Natural Selection, Genetic drift, Gene flow, Genetic load, Organic variations,Hardy Weinberg Equilibrium.
4.1.3. Isolation –Premating and post mating isolating mechanisms.
4.1.4 Speciation: Methods of Speciation - Allopatric and Sympatric; Causes and Role of Extinction in Evolution.

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Suggested Readings:

1. Ecology – Himalaya Publising company – M.P Arora
2. Environmental Biology – P.D. Sharma
3. Environmental Ecology – P.R. Trivedi and Gurdeep Raj
4. Indian Wildlife Threats and Prervation – Buddhadev Sharma and Te Kumar
5. Ecology-Principles and Application II Edn. Cambridge Univ Press, London, Champan. JL and Re.iss MJ.
6. Environmental Studies, TATA McGraw Hill Com. New Delhi, Benny Joseph.
7. Fundamentals of Ecology Third Edn., Nataraj Publishers, Dehradun, Eugene.P. Odum.
8. Ecology and Animal Distribution, Veea Bala Rastogi.
9. Text Book of Ecology and Environment, P.K. Gupta.
10. Ecology and Wildlife Biology, Bhatnagar and Bansal.
11. Evolution 3rd Edn. Blackwell Publishing, Ridley, M (2004).
12. Evolutionary Biology, Addison –Wesley; Minkoff,E(1983).
13. *Evolution*. Cold Spring, Harbour Laboratory Press Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).
14. *Evolution*. IV Edition. Jones and Bartlett Publishers; Hall, B. K. and Hallgrimsson, B. (2008).
15. *Evolution*, 2nd Edn, Oxford and IBH Publishing Co., New Delhi, Jan M. Savage.

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KAKATIYA UNIVERSITY
Under Graduate Courses (Under CBCS 2019 - 2022)
B.Sc. ZOOLOGY III Year
SEMESTER – VI

ECOLOGY, ZOOGEOGRAPHY AND EVOLUTION PRACTICAL

Instruction: 3 hrs per week
No. of Credits: 1

Ecology

1. Determination of pH of Soil and Water.
2. Estimation of Salinity (Chlorides) of water in given samples.
3. Estimation of Carbonates and Bicarbonates in the given water samples.
4. Estimation of dissolved Oxygen of Pond water, sewage, effluents.
5. Identification of Zooplankton from different water bodies.
6. Study of Pond Ecosystem / Local polluted site – Report submission.

Zoogeography

1. Study of at least 3 endangered or threatened wild animals of India through photographs/specimens/models
2. Field visit to Zoo Park to study the management, behavior and enumeration of wild animals.
3. Identification of Zoogeographical realms from the Map and identify specific fauna of respective regions.

Evolution

1. Museum Study of fossil animals: **Peripatus; Coelacanth fish, Dipnoi fishes; Sphenodon; Archaeopteryx.**
2. Study of homology and analogy from suitable specimens and pictures
3. Problems on Hardy-Weinberg Law
4. Macroevolution using Darwin finches (pictures)

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

Suggested manuals:

1. Ecology Student Lab Manual, Biology Labs – Robert Desharnais, JeffreyBell.
2. Ecology Lab manual – Darrell S Vodopich.

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Final Examination: Question Papers Pattern

B.A./B.Sc. (ZOOLOGY)

Theory Question Paper Pattern

WEF Academic Year: 2020-2021

Time: 3 hours] [Max. Marks: 80

Section - A

Answer ALL questions. All questions carry equal marks. (4Qx12m=48)

Q1. (a)		
	[OR]	From Unit-I
Q1. (b)		
Q2. (a)		
	[OR]	From Unit-II
Q2. (b)		
Q3. (a)		
	[OR]	From Unit-III
Q3. (b)		
Q4. (a)		
	[OR]	From Unit-IV
Q4. (b)		

Section – B

Answer any EIGHT questions. All questions carry equal marks. (8Qx4m=32)

Q5	From Unit-I
Q6	
Q7	
Q8	From Unit-II
Q9	
Q10	
Q11	From Unit-III
Q12	
Q13	
Q14	From Unit-IV
Q15	
Q16	

B.A./B.Sc. (ZOOLOGY)

Practical Question Paper Pattern

WEF Academic Year: 2020-2021

Time: 2 hours] [Max. Marks: 25

1 Major Experiment (10 M)

2 Minor Experiment (5 M)

3 Record (5 M)

4 Viva (5 M)

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Internal Examinations:

1. Two Internal exams are to be conducted and best of two internal marks is considered.
2. First internal exam is to be conducted after completion of Unit-I & II.
3. Second internal exam is to be conducted after completion of Unit-III & IV.
4. Internal Examination duration: 1 hr 30 min
5. Internal Theory QP consists of 20 marks.
6. 10 Short questions are to be given (5Q from each of 2 Completed units); 10Q are to be answered (10Q X 2m = 20m).

Final Exam for Other Papers

1. Each SEC QP consists of 50 marks.
   (10Q are given. 5Q from each unit, 5Q are to be answered, 5Q X 10 m = 50m)
   (Duration:2hrs)
2. GE QP consists of 100 marks. QP model is same as Core paper.
3. Project consists of 100 marks with 4 Credits. 80 Marks will be allotted for Project Evaluation and 20 marks for viva-voce.

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SYLLABUS FOR
M.Sc. COURSE IN ZOOLOGY
(With effect from the academic year 2021-22 Under CBCS system)

DEPARTMENT OF ZOOLOGY
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HANMAKONDA 506 009
TELANGANA STATE

KAKATIYA UNIVERSITY, DEPARTMENT OF ZOOLOGY
(With effect from the academic year 2021-22 Under CBCS system)

S.No	Paper Code	Title of the Paper	Instruction Hrs/Week	No. of Credits	Marks		Total Marks
					External	Internal	
SEMESTER-I							
1	101	Biosystematics, Structure & Function Of Invertebrates	4	4	80	20	100
2	102	Tools and Techniques in Biology	4	4	80	20	100
3	103	Animal Physiology and Ethology	4	4	80	20	100
4	104	Genetics and Evolution	4	4	80	20	100
5	105	Practical-I	4	4	100	--	100
6	106	Practical-II	4	4	100	--	100
7	107	Seminar	--	1	--	25	25
		Total		25	520	105	625
SEMESTER-II							
1	201	Structure and Function of Vertebrates	4	4	80	20	100
2	202	Environmental Biology	4	4	80	20	100
3	203	Biochemistry	4	4	80	20	100
4	204	Biostatistics and Computer Applications	4	4	80	20	100
5	205	Practical-I	4	4	100	--	100
6	206	Practical-II	4	4	100	--	100
7	207	Seminar	--	1	--	25	25
		Total		25	520	105	625

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S.No	Paper Code	Title of the Paper	Instruction Hrs/Week	No. of Credits	Marks		Total Marks
					External	Internal	
SEMESTER-III							
1	301	Molecular Biology	4	4	80	20	100
2	302	Immunology	4	4	80	20	100
3	303	Subject Elective – I Parasitology (OR) Subject Elective – II Clinical Science	4	4	80	20	100
4	304	Subject Elective – III Endocrinology & Reproductive Physiolgy (OR) Subject Elective – IV Bioinformatics	4	4	80	20	100
5	305	Practical – I	4	4	100	--	100
6	306	Practical – II	4	4	100	--	100
7	307	Seminar	--	1	--	25	25
		Total		25	520	105	625
SEMESTER-IV							
1	401	Cell Biology	4	4	80	20	100
2	402	Developmental Biology	4	4	80	20	100
3	403	Subject Elective – I Fisheries And Aquaculture (OR) Subject Elective – II Neurophysiology	4	4	80	20	100
4	404	Subject Elective – III Animal Biotechnology (OR) Subject Elective – IV Entomology	4	4	80	20	100
5	305	Practical – I	4	4	100	--	100
6	406	Practical – II	4	4	100	--	100
7	407	Seminar	--	1	--	25	25
		Total		25	520	105	625
GRAND TOTAL (Sem I+II+III+IV)				**100**	**2080**	**420**	**2500**

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PRACTICALS :

1. Observations of nervous system development from lower to higher invertebrates and write the indentified modifications in the record. Dissection of the following
   a) Nervous system of Leech
   b) Nervous system of Cockroach & Reproductive system
   c) Nervous system of *Aplsia*
   d) Nervous system of *Unio mytilus*
   e) Nervous system of Cabs
   f) Nervous system of Sepia
2. Modifications of Mouth parts in insects. Separate the mouth parts from the insects, mount and observe the modifications and write the adaptations – Chewing, Piercing and Sucking etc..
3. Collect 10 invertebrates and prepare permanent slides and submit in the examinations (Parasites – 5 and Non-parasites – 5).
4. Museum specimens (from each phylum not less than 10 specimens).
5. Slides and preserved animals (from each phylum not less than 5 slides).
6. Karyotype studies for Numerical Taxonomy.
7. Hemoglobin Variation in different phyla for Evolutionary Studies.
8. Species variation – Drosophila Variants.
9. Collection of Termites to observe variants.
10. Collection of Fresh Water Molluscs.
11. Collection of Endo- parasites for species variations Trypansomes from Rats

REFERENCE BOOKS

1. Invertebrate Zoology ------- EL Jordan; P.S. Verma
2. A Text Book of Zoology Vol.I ------ P.S. Dhami; Jk.Dhami.
3. A Text Book of Invertbrate zoology ----- R.L.Kotpal.
4. Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.

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PRACTICALS :

1. Separation of call organelles by Differential centrifugation.
2. Separation of protein by electrophori (Native & SDS page).
3. Separation of amino acids by paper and thin layer Chromatography Demonstration of column Chromatography.
4. Validation of Beer-lamberts law of a coloured compound ($CuSO_4$).
5. Measurement of pH meter Preparation of buffer.
6. Light microscope and its parts Observation of unstained and stained cells.
7. Demonstration of a fixation, dehydration, sectored and stand of any animal tissue.
8. Demonstration of Carbohydrates, Proteins Lipids and nuclear acids in tissue sections.
9. Preparation of chick fibroblast culture and viability testing.

REFERENCE BOOKS :

1. Principles and Techniques in biochemistry and molecular biology - Wilson & Walkes
2. Culture of animal cells - Freshuay
3. Sharma V.K. (1991), Techniques in microscopy and cell Viology, Tata-Mc Craw Hil.
4. Robert Braun Introduction to instrumental analysis - Mc.Crew.Hil
5. Bisen & Mathw. Tools and Techniques in Life Sciences,- CBS Publishers & distributors.
6. Principles of Animal Cell Culture - Basant Kumar & Rinesh Kumar, Int.Bork 2008,XXII edn.

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PRACTICALS:

1. Action of pepsin in digestion of proteins.
2. Estimation of salivary amylase activity.
3. Estimation of lipase activity.
4. Oxygen consumption d estimation in an aquatic or terrestrial animal.
5. Demonstration of fermentation.
6. Action of insulin on blood sugar level.
7. Experiments on urine analysis in human urine sample:

a) Test for urea, blood cells, bile salts, albumin, ketone bodies and sugar in human urine sample.

8. Determination of cell fragility by osmotic hemolysis experiment.
9. Identification of relation between temperature and heart beat in freshwater mussel.
10. Water and ionic regulation of freshwater animal in different osmotic media.
11. The Study of changes in the earthworm's responsiveness to the stimulus of touch.
12. Observation of an earthworm's responses in the cases of repeated stimulation and dual stimulation.
13. Observation of the response of invertebrates to different lighting conditions.

REFERENCE BOOKS :

1. Animal Physiology ----- Samson & Writy
2. Animal Physiology ----- Nelsion & Nelsion
3. Animal Physiology ----- Medical Physiology-Guiton
4. Text book of Animal Physiology ----- Nagbhushenen
5. Text book of Animal Physiology ----- Guize
6. Text book of Animal Physiology ----- A.K. Berry.

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PRACTICALS:

1. Problems based on multiple alleles – Blood groups
2. Problems based on Mendel's Laws – monohybrid and dihybrid ratios
3. Problems based on gene frequency – Hardy Weinberg Law
4. Karyotype studies
5. Haemoglobin variations
6. Insulin variations
7. Collection of termites to observe variants

REFERENCE BOOKS:

1. Genetics by Monroe W Strickberger
2. Evolution by Monroe W Strickberger
3. Genetics by Peter J Russell
4. Evolution by Dobzhansky, Ayala, Stebbins, Valentine
5. Genetics by P.K.Gupta
6. Human molecular Genetics by Tom Strachan and Andrew Rea

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PRACTICALS :

1. Cranial Nerves of Labeo (5th and 7th and 9th and 10th weberian oscicles)
2. Dissection demonstration of Brain and Heart of Fish, Calotes, Chick and Rat
3. Demonstration of flight muscles and Air Sacs in Birds.
4. Demonstration Vascular and urinogenetal system of Rat.
5. Collect 10 vertebrates and submit in the examinations
6. Museum specimens (from each Class not less than 15 specimens).
7. Slides related to vertebrate parts.
8. Mounting of Amphioxus, Doliolum and Scales of fishes.
9. Sketelation System (Vertebra , limbs, Girdles)

REFERENCE BOOKS :

1 Vertebrate Zoology ------- EL Jordan; P.S. Verma

2 A Text Book of Zoology Vol.II ------ P.S. Dhami; Jk.Dhami.

3 A Text Book of Vertbrate zoology ----- R.L.Kotpal.

4` Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.

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PRACTICALS:

1. Collection and identification of animal Biodiversity of selected ecosystem.
2. Physico-chemical analysis of soil pH, soil moisture soil , temperature, humidity estimation soil, soil organic matter.
3. Air Monitoring – Particulate Matter.
4. Water Monitoring - five important parameters from drinking water. 1) Dissolved Oxygen 2) Biological Oxygen demand (B O D) 3) Chemical Oxygen demand 4) Chlorides 5) salinity.
5. Bio remediation of waste water using soil micro organisms.
6. Bioconversion of municipal waste by vermi-composting.
7. Collection, preservation and estimation of Zooplankton.
8. Mapping of national parks and wild life sanctuaries in India with a note of important wild life fauna.
9. Estimation of LC50 or LD50 of an organo phosphorous pesticide.
10. Determination of pesticide residues in soil or water.

REFERENCE BOOKS:

1. Fundamental of Ecology. E.p.odum, G W Barrett.

2. Environmental Science . Willam .P.Cunninsham Barbora woodworth saigo.

3. The use of Earthworms in waste disposal by . Edward, C.A.

4. Introduction to Environmental Engineering & Science Gilbert M. Masters.

5. Essential of Ecology by colin R. Townsend Michael Begon John.L.Harper.

6. Environmental Biology -- A.G.Agarwal.

7. Environmental Science by G.Tyler Miller.

8. Toxicology -- Y.K.Lahir.

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PRACTICALS:

1. Estimation of muscle and liver glycogen
2. Estimation of protein by Biuret and Lowry methods
3. Estimation of amino acid by Ninhydrin method
4. Estimation of serum total cholesterol
5. Estimation of vitamin – C by 2,6- dichlorophenol indophenols method
6. Estimation of Ammonia (nesslerisation method) and uric acid
7. The effect of Ph and temperature (α-amylase) activity
8. The effect of concentration of enzyme (trypsin) activity

REFERENCE BOOKS:

1. Principles of biochemistry, by Lehninger
2. Biochemistry , by Donald Voet and Judith Voet.
3. Biochemistry , by Harper.
4. Biochemistry . Jeremy M.Berg, JohnL.Tymovzko, Lubert Stryer

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PRACTICALS:

(a) Statistics

1. Problems on Mean and Median.
2. Problems on Standard Deviation.
3. Problems related to X2 test, Student T Test . And Probuality
4. Problems on Correlation.

(b) Computers

1. Literature collection using INTERNET, search engines, websites, browsing and downloading for scientific investigation.
2. Creating an e-mail account, sending and receiving mails.
3. Application of excel sheet for data processing.
4. Preparation of power point presentation with software.
5. Representation of statistical data by Histograms and Pie diagrams.

(c) Bioinformatics

1. Study of Internet resources in Bioinformatics. E.g. NCBI and EMBL.
2. Searches on MEDLINE and PubMed bibliographic databases.
3. Multiple Sequence Alignment.
4. Construction of Phylogenetic Trees for DNA and Proteins.
5. Sequence Retrieval from Databases.
6. Building of Molecules.
7. BLAST, FASTA programs for sequence database search.

REFERENCE BOOKS:

1. Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press Biometry by W. H. Freeman and Francisco
2. Fundamentals of Biometry by L.N. Balaram (1980)
3. Biostatistics by N. Gurumani
4. Biostatistics-Arora and Malhan
5. Biostatistics- Jasraj and Gurudeep Raj
6. Biostatistics- P. Ramkrishan
7. Methods in Biostatistics-Mahajan
8. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub. New Delhi.
9. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
10. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
11. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.

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SECOND YEAR – ZOOLOGY

SEMESTER – III
AND
SEMESTER - IV

PRACTICALS :

1. Isolation of DNA from goat spleen
2. Estimation of DNA (diphenyl method)
3. Estimation of RNA (Orcinol method)
4. UV absorption spectra of native and denatured DNA
5. Agarose gel Electrophoresis of DNA
6. DNA amplification by PCR
7. Gel Documentation

REFERENCE BOOKS:

1. Molecular Cell Biology by Lodish et al
2. Molecular Cell Biology by Alberts et al
3. Principles of Biochemistry by Lehninger
4. The Cell by Geoffrey Cooper
5. Genetics , A molecular approach by Peter J Russell
6. Biochemistry by Voet and Voet
7. Principles of Genetics by Tamarin
8. GENES VIII by Lewin
9. Biochemistry by U.Satyanarayana and U Chakrapani
10. Benjamin Lewin. GENES IX 2008. Ninth edition

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PRACTICALS:

1. Agglutination Reaction:
   a) Tube Agglutination Reaction
   b) Slide Agglutination Reaction
   c) Indirect Agglutination Inhibition Reaction
2. Precipitation Reaction
   a) Double Diffusion Reaction
   b) Single Diffusion Reaction
3. Erythrocyte Rosette-forming Cell Test.
4. Separation of Lymphocytes
5. Enzyme-Linked Immunosorbent Assay
6. Measurement of Phagocytosis by Phagocytes
7. Demonstration of Immunoectrophoresis
8. Neutralization and complement fixation
9. Collection of macrophages and their characterization
10. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymphnode and bone marrow

REFERENCE BOOKS:

1. Abul K. Abbas – Call And Molecular Immunulogy
2. Kuby. Immunology, W.H Freeman,USA
3. W.Pual,Fundamentals of immunology.
4. I.M. Roitt , Essential immunology, ELBS Edition.

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PRACTICALS:

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods
2. Smear preparation for protozoa
3. Study of life cycle, role as vector & control measures of:
    a) Ticks (*Argas, Boophilus*)
    b) Mosquito - anyone from- *Anopheles/ Aedes/ Culex*
    c) Any two flies: *Tabanus/ Phlebotomus/ Sarcophaga*. *Cyclops*
4. Ectoparasites & Endoparasites of wild rat, cattle, dog, chick & human including stages in excreta.
5. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
6. Preparation of whole mounts for helminthes
7. Collection of Parasites from digestive tract of Cockroach/gut / parasites of hen and their identification and preservation.
8. Spotters based on theory.

REFERENCE BOOKS:

1. Comparative protozoology, Ecology, Physiology, Life history, Anderson, O.R. , Springer verlag, Berlin.
2. General Parasitology, Cheng T. C., Academic Press.
3. Modem Parasitology, Cox F.E.G.,Eds.Parasitology in focus, facts & trends, Melhorn h., Eds., Spriger Verlag, Beriin.
4. Medical Parasitology, Piakarsky G. L., Springer Verlag, Berlin.
5. Modern Parasitology, Cellular immunological & immunological aspects, Wyler D. J., Eds., W. H. Freeman, NY
6. Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London. Soulsby, E. J. L. (1982).
7. A Text book of Parasitology, Bombay popular prakashan – by S.S. Kelkar and Rohini S. Kelkar.
8. Parasitology – by Chandler and Chands
9. Parasitology, Medical Pulisher Calcutta, 1987. K.D. Chaterjee.
10. Parasitology – By Ramnik sood, C.B.S. Publisher, New Delhi – 1993.

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PRACTICALS:

1. Histological slides pertaining to endocrine glands.
2. Alloxan diabetes induction and insulinization study by blood glucose and liver glycogen estimation.
3. Effect of thyroids and anti-thyroidal agents on O_2 Consumption in the rat./ crab
4. Effect of oxytocin on uterine contractility.
5. Estrogen bioassay using immature female rats / mice.
6. Study of male and female reproductive systems in some reproductive animals.
7. Histology of ovary and testes.
8. Study of estrus cycle (Rat).
9. Diagnosis of pregnancy by the presence of HCG in urine (Acheim Zondek test)
10. Sperm morphology, motility, count and effect of some antifertility agents.
11. Models pertaining to ART(Assisted reproductive techniques), Transgenic techniques. STDs contraception, teratogenesis.
12. Visit to Veterinary Institutes to learn breeding techniques.

REFERENCE BOOKS :

1. E.J.W. Barington , General and comparative Endocrinology.
2. P.J.Bentley , Comparative Vertebrate Endocrinology.
3. R.H. Williams, Text book of Endocrinology.
4. A.Gorbman *et.al*., Comparative Endocrinology.
5. Austen,C.R. and Short R.V. Reproduction
6. R.G.Edwards, Human Reproduction
7. E. Knobil and J.D Neill,The physiology of Reproduction volume I & II
8. E.S.E .Hafeez, Reproduction and breeding techniques for laboratory animals
9. Vander and Sherman, Human Physiology.
10. Kamini A.Rao, The infertility manual
11. A.V.Nalbondov, Reproduction Physiology.
12. K.Murray and K. Granner, Harper Biochemistry
13. J.Farris and John Griffith, The rat in laboratory investigation.
14. R.Mathur and S.Shukla ,Reproductive Biology.
15. B.P.Setchell, The mammalian testis.
16. S.F.Gilbert, Developmental Biology.
17. Vinod K. Sharma., Sexually Transmitted Diseases and ADIS
18. Gayathri Prakash, Reproductive Biology.

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PRACTICALS

1. Introduction of National Center for Biotechnology Information (NCBI).
2. Introduction of biological search engine- Entrez.
3. Analysis of 3D structure of protein using RasMol through command line.
4. Pair-wise sequence alignment by using ClustalW.
5. Multiple sequence alignment by using ClustalW
6. Similarity search using the Blast and interpretation of the results.
7. Downloading and analysis of the pdb file of the biomolecules.
8. Molecular Docking of protein and ligand by Autodock.
9. Protein Structure Prediction (Homology Modeling) using SPDBV.
10. Molecular dynamics (MD) simulation using Gromacs.

Reference Books:

1. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub.
2. New Delhi.
3. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer
4. Science+BusinessMedia, 2007.
5. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the
6. analysis of genes and proteins. John-Wiley and Sons Publications, New York.
7. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and
8. Bioinformatics, 2nd Edition. Benjamin Cummings.
9. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, structure and
10. databanks. Oxford University Press.
11. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological
12. Science and Medicine, CRC Press, London.
13. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills:
14. Shroff Publishersand Distributors Pvt. Ltd. (O'Reilly), Mumbai

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PRACTICALS:

1. Observation of a Eukaryotic cell under higher microscope.
2. Preparation of mitotic chromosomes from roots tips.
3. Preparation of mitotic Chromosomes from testis of grasshopper.
4. Membrane fragility as a measure of osmotic tolerenance
5. Lysosome isolation in isotonic sucroses.
6. Isolation & determination of number of micrchondrice
7. Extraction of nuclear Chromate
8. Extraction of membrane lipids and observation of lipid bilayer formation

REFERENCE BOOKS:

1. Molecular all biology : Lodish, etal.
2. Molecular all biology : Bruce Alberts, etsl.
3. Cell Biology : DeRoberts.
4. Cell and molecular biology, :Gerad karp
5. Molecular cell biology : David Baltimoe.
6. Cell Biology :Sc Rostogi.

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PRACTICALS:

1. Observation of living Chick embryo.
2. Dissection and Morphology observation of the 4-14 somite chick embryo (24-34 hours).
3. Dissection and Morphology observation of the 24-38 somite chick embryo (48-85 hours).
4. Culture of Early chick embryo *in vitro*.
5. Mounting of 72 and 96 hours chick embryo.
6. Chorio-Allantoic Membrane Grafting.
7. Various patterns of Cleavage and development in freshwater Snail.
8. Larval Developmental stages of Drosophila.
9. Chromosome squash preparation from Drosophila larval salivary glands.
10. Patterns of regeneration in the Planarian/Regeneration in the Tail of Frog Tadpoles.

REFERENCE BOOKS:

1. Gilbert, S.F. Developmental Biology. 10th Edition, Sinauer Associated Inc., Massachusetts
2. Balinsky, B.I. Introduction to Embryology. Saunders, Philedelphia
3. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
4. Hamburger V and Hamilton HL. Handbook of chick developmental stages. Saunders Publications. 1965.
5. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
6. Embryology-An Introduction to Developmental Biology—Stanley Shostak
7. Muthukaruppan and Pitchappan. Animal development – a laboratory guide.CoSIP-ULP Publicatiions, India. First Edition, 1979.

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PRACTICALS:

1. Visit to local Fresh water bodies to study their Ecology.
2. Collection, Identification and Screening of fish for Ecto and Endo parasites
3. Morphometric and Meristic data of Fishes (At least 3 types).
4. Estimation of Productivity of local Fresh water bodies.
5. Collection and preservation of Water and Soil from water bodies.
6. Collection, Preservation and Identification of plankton.
7. Estimation of PH, Temperature, Chlorides, Dissolved Oxygen from water samples.
8. Estimation of Organic matter of bottom soil.
9. Visit to local fish seed production centre.
10. Visit to local fish farms.

REFERENCE BOOKS:

1. Business Management in Fisheries and Aquaculture, Fishing News, Chaston, I (Books) Ltd., 1984.
2. Aquaculture Management, Meade, J.W. Van Nostrand, New York, 1989.
3. Aquaculture principles and practices, Pillay, T.V. R. Fishes News (Books) Ltd., London, 1990.
4. Water Quality Management for Pond Fish culture, Boyd, C.E. Elsevier Scientific publishing company, 1982.
5. Principles of Fresh Water Aquaculture, Stickney, R.R. John, Wiley & Sons, New York, 1979
6. Aquaculture – The Farming and Husbandry of fresh water and marine organisms, Bardach, et al., John Wiley & Sons, New York, 1979.
7. A manual of Freshwater Aquaculture, Santhanan, R. et al., Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
8. Advances in Aquaculture, Pillay, T.V.R. & M.A., DIII. Fish News (Books) Ltd., England, 1979.
9. Limnology, Welch, P.S, Mc. Grew Hill, New York, 1952.
10. Text book of Limnology, Cole, C.A., The C.V. Mosby Co., 1983.
11. Fundamentals of Limnology, Ruttner, F, Translated by D.G. Frey and F.E. Fry, University of Toronto Press, 1968.
12. The Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka, Hand Book , Jayaram , K.C., (1981), Z oological survey of India, Calcutta.
13. Fishes, An Introduction of Ichthyology, Moyle Peterb, Prentice Hall, (1979).
14. Principles of Systematic Zoology, Mayer and Ashok..
15. Fish and Fisheries of India, Jhingran, V.G. Hindustan Publishing Co., Calcutta, (1975).
16. Fish and Fisheries, Yadav, B.N. Daya Publishing House,
17. The Biology of Animal Parasites, Chang. T.C. Saunders, Philadelphia, (1964).
18. Text book of Fish Diseases. Conroy. D.A. and R.C. Heanean, (1968).
19. Fish Diseases Vol. I & II, Schauperclaus,
20. Methods for assessment of Fish Production in Fresh Water, Ricker, W.K. (1984), Blackwell Publications.

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PRACTICALS

1 Tail flick test for measurement of pain.
2 Spinal reflexes in decerebrated animal.
3 Preparation of neuromuscular system for electrophysiological recording.
4 Biochemical differentiation of fast and slow muscles – SDH, LDH activities, glycogen and lactatate content in altered neurobiological conditions.
5 Effect of ankle sprain on muscle metabolism.
6 Determination of contractile properties of muscle in pathological condition.
7 Determination of conduction velocity in nerve.
8 Induction of stress and estimation of on glycogen, lactate, AChE and Na-K ATPase activities.
9 Experimental studies on atrophy, hypertrophy of muscles and nerve degeneration as well as regeneration.
10 Moto rod test for motor coordination.

Suggested Books

1 Physiology and biophysics – Ruch and Patten
2 A text book of muscle physiology – D. A. Jones and J. M. Round
3 Neurobiology – Gorden M Sheperd
4 Principles of neural science – E. Kandel and others
5 Essentials of neural science and behaviour – E. Kandel and others
6 Behavioral neuroscience – Cottman
7 From Neuron to Brain – Nichollas, J. G. others
8 Neuroscience – A. Longstaff
9 Elements of molecular Neurobiology – C U M Smith
10 Physiology of excitable cells – D. J. Aidley
11 Text book of medical physiology – Guyton

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PRACTICALS:

1. Laboratory demonstration on safe handling of microorganisms.
2. Isolation of plasmid DNA from E-Coli .
3. Isolation of yeast DNA and Transformation of E-Coli.
4. Qualitative assay of B.Galactosidese in yeast Colonies/cell extracts.
5. Propagation & maintenance of tissue culture.
6. Isolation of Bone marrow and culture of mesenc hymel stem cells from isoleted murine/sleep/rat bone marrow.
7. Try pan blue exclusion method for cell viability estimation.
8. Mycoplasma detection method using PCR.
9. Production of penicillin and testing of antimicrobial activity.
10. Production of monoclonal of tissue culture.

REFERENCE BOOKS:

1. Culture of Animal cells – manual of basic Technique by R. Iam Freshney published by
2. Molecular Biotechnology by john Wiley & Sons Primrose Published by parima publishing corporation.
3. Principles and practice of Animal tissue culture by Sudha Gangal Published by University Pren
4. Laboratory procedures in Biotechnology--- Alam Doyle ,J.Bryan Griffiths.wiley publisher
5. Animal Biotechnology- A Laboratory course, --- Jeddrey M.Beeker. Elsevien IInd edition,2007.
6. Tools & Techniques in Biotechnology – Mousami Debnath, pointer publishers,2002
7. Principles & techniques of Biotechnology & Muecular Biology-- 6th edition, keith Wilson& John Walker
8. Gene cloning & manipulation, Christopher howe, Combridge Publications.
9. A manual of Laboratory Practices. Good

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PRACTICALS

1. Insect Collection and Preservation methods.
2. Collection of medically important Insects and identification up to genus level.
3. Maintenance and study the stages life cycle of Cockroach / house fly / mosquito.
4. Preparation of permanent mounts of mosquito respiratory siphon and trumpet.
5. Preparation of permanent mounts of Insect leg and antennae.
6. Preparation of permanent mounts of wings of Cockroach / house fly / mosquito.
7. Dissection, mounting and preparation of permanent slides of Insect mouth parts.
8. Dissection of salivary glands of Cockroach / house fly / mosquito.
9. Dissection of Digestive system, nervous system and reproductive system of Cockroach / House fly / mosquito.
10. Dissecting and mounting of male and female genitalia of Cockroach / house fly / mosquito.
11. Collection of venomous Arthropods and identification.
12. Maintenance of Insect / venomous arthropod collection box. (**Submission of Insect / venomous arthropod collection box is must during the practical examination)

REFERENCES:

1. Biology of Disease Vectors, 2nd Ed., William C. Marquardt, 2004, Elsevier Academic Press.
2. Medical and Veterinary Entomology, 2nd Ed., Gary Mullen & Lance Durden.
3. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods, Revised Edition. by Bruce Eldridge & John Edman.
4. Medical Toxicology by Richard C. Dart. Pub: Lippincott Williams & Wilkin.
5. Manual of Medical Entomology by Deane P. Furman & Paul Catts.
6. Infectious Diseases of Arthropods by Goddard.
7. Medical Entomology for Students 5th edition by Mike Service.
8. General and Applied Entomology by David and Ananthakrishnan.
9. Destructive and Useful Insects by R. L. Metcalf.
10. Ecology of Insects by Martin R. Speight Pub: Wiley-Blackwell.
11. Insect ecology by Timothy D. Schowalter 3rd Edition. Pub: Elsevier, 2011.

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