

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY



CIRCULAR NO.SU/Sci./M.Sc.Zoology/92/2022

It is hereby inform to all concerned that, the syllabus prepared by the Board of Studies in Zoology and recommended by the Dean, Faculty of Science & Technology the Hon'ble Vice-Chancellor has accepted the **Revised Syllabus of M.Sc. Zoology IInd semester for affiliated Colleges and University Department** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

This shall be effective from the Academic Year 2021-22 and onwards.

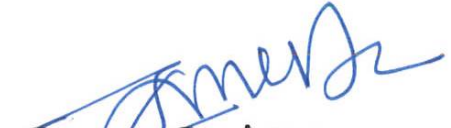
All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.

REF.NO. SU/SCI/2022/14012-21

Date:- 17.05.2022.

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Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned affiliated Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **Head of the Department, Department of Zoology,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 3] **The Director, University Network & Information Centre, UNIC,**
with a request to upload this Circular on University Website.

Copy to :-

- 1] The Director, Board of Examinations & Evaluation, Dr. BAMU, A'bad.
- 2] The Section Officer, [M.Sc. Unit] Examination Branch, Dr. BAMU, A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr. BAMU, A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr. BAMU, A'bad.
- 5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr. BAMU, A'bad.
- 6] The Public Relation Officer, Dr. BAMU, A'bad.
- 7] The Record Keeper, Dr. BAMU, A'bad.

**DR. BABASAHEB AMBEDKAR
MARATHWADA UNIVERSITY,
AURANGABAD.**



**Master of Science
Zoology**

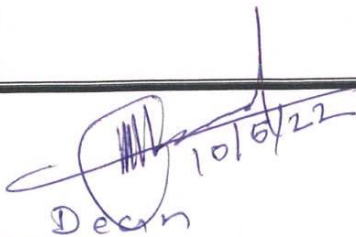
[IIInd Semester]

Under Choice Based Credit and Grading System

FACULTY OF SCIENCE & TECHNOLOGY

Effective From 2021-22 & Onwards/- for University

Department and Affiliated Colleges


Dean

faculty of Science & Tech.


Chairman
Board of studies in
Zoology

MSc Zoology Semester II Course Structure for Examination and Evaluation

Papers	Title	Ext /Term End	Int	Total Marks(Max/Min)	Time 3hrs
ZOO-201	Genetics and Bioinformatics	80	20	100/40	Do
ZOO-202	Cell and Molecular Biology	80	20	100/40	Do
ZOO-203	Biophysics	80	20	100/40	Do
ZOO-204 & ZOO-205	Instrumentation and Biological Techniques Scientific Writing	80 (Both papers included)	20	100/40	Do
Elective paper					
ZOO-206	Helminthology II	80	20	100/40	do
ZOO-207	Protozoology	80	20	100/40	do
ZOO-208	Entomology	80	20	100/40	do
ZOO-209	Endocrinology	80	20	100/40	do

M. S. H.
Chairman, BSc Zoology

Practical Based on Core and Elective

Paper code	Practical	Max/MinMarks
ZOO-210	Practical based on ZOO-201	50/20
ZOO-211	Practical based on ZOO-202	50/20
ZOO-212	Practical Based on ZOO-203	50/20
ZOO-213	Practical based on ZOO-204 and 205	50/20
Elective Practical's		
ZOO-214	Practical Based on ZOO-206	50/20
ZOO-215	Practical based on ZOO-207	50/20
ZOO-216	Practical Based on ZOO-208	50/20
ZOO-217	Practical based on ZOO-209	50/20

Mali
Chairman, BOS, Zoology.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Department of Zoology
M. Sc. First Year (Semester – II)

Course	Code	Course Title	Hours /week	Total Hours/sem	Credit	Max/Min
Core	ZOO-201	Genetics and Bioinformatics	4	60	4	100/40
	ZOO-202	Cell and Molecular biology	4	60	4	100/40
	ZOO-203	Biophysics	4	60	4	100/40
Research component	ZOO-204	Instrumentation and Biological Techniques	2	30	2	50/20
Compulsory subject	ZOO-205	Scientific Writing	2	30	2	50/20
Elective (any One)	ZOO-206	Helminthology II	4	60	4	100/40
	ZOO-207	Protozoology II	4	60	4	100/40
	ZOO-208	Entomology II	4	60	4	100/40
	ZOO-209	Endocrinology II	4	60	4	100/40
		TOTAL CREDIT	20	300	20	500/200
		Practical course				
Paper Code	Practical		Credits	Work Load in hours		
				Per week	Per term	Max/Min
ZOO-210		Practical based on ZOO-201	2	4	60	50/20
ZOO-211		Practical based on ZOO-202	2	4	60	50/20
ZOO-212		Practical based on ZOO-203	2	4	60	50/20
ZOO-213		Practical based on ZOO-204&205	2	4	60	50/20
ZOO-214		Practical based on ZOO-206	2	4	60	50/20
ZOO-215		Practical based on ZOO-207	2	4	60	50/20
ZOO-216		Practical based on ZOO-208	2	4	60	50/20
ZOO-217		Practical Based on ZOO-209	2	4	60	50/20
Total Credit			10	20	300	250/100
Total Credit for Semester II = 30						

12/5/22

① Dr. Deshpande P. A.
 ② Dr. J. D. Shaikh - *Shm*

③ Dr. Jadhav T. J.
 ④ Dr. S. K. Chavhan
 ⑤ H. S. K. Chavhan
 ⑥

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GENETICS AND BIOINFORMATICS ZOO-201

60 Hours . 4 hrs/week

credit -4

48Hours –L, 12h –T

Learning Objectives:

- To understand basic unit cell and the molecular biology of the cellular function.
- To understand the protein secretion and sorting within the cell and laws of cell division and their regulation.
- To understand the central dogma of molecular biology.

Learning Outcome

- The student will learn about the cell and cellular function at molecular level.
- The student will learn about the protein secretion, sorting and arranging the protein to different cell organelle.
- The student will learn in detail the central dogma of molecular biology in prokaryotes and Eukaryotes.

UNIT 1: Principle of genetic transmission and molecular organization of chromosomes.

Extension of Mendellian principles; allelic variations and gene function- incomplete dominance and co- dominance. Gene action, - penetrance and expressivity, gene interactions- epistasis, pleiotrophy, genomic imprinting, phenocopy.

Genome size and C value paradox, structure of eukaryotic chromosomes, nucleosome model, chromosome condensation,- euchromatin and heterochromatin, Repetitive nucleotide sequences in eukaryotic genomes. Kinetics of renaturation, Cot and Cot curve repetitive sequences. Mini and micro satellites, Molecular structure of centromere, and telomere. Polytene chromosome and lampbrush chromosome. Chromosome banding techniques.

UNIT II: Gene Fine structure

Evolution and concept of gene function and structure. The definition of gene. The standard genetic code, redundancy and wobble. DNA structure- alternate forms of Double Helix, Gene Synthesis (in vitro synthesis) – works of Khorana and Kornberg, Modern finding on the nature of gene. Interrupted genes in eukaryotes, Exons and introns- R loops, significance of introns. Genes within genes (overlapping genes) Bacteriophage phi X174

Transposable elements in Bacteria- IS elements, Composite transposons, Tn3 elements, medical significance. Transposable elements in Eukaryotes - P elements, Retro-transposons, Significance of transposons.

UNIT III: Genetic linkages, Recombination and chromosome Mapping

Chromosome theory of heredity, Linkage and recombination of genes, in a chromosomes, crossing over as the physical basis of recombination, Stern's Experiments; molecular mechanisms of recombination (Holliday model), Gene conversion, Recombination mapping with two point and three point test cross in Drosophila. Coincidence and interference.

Genetic mapping, by tetrad analysis in *Neurospora*, Mitotic recombination, Genetic recombination in Phage ϕ II locus, Complementation test. Deletion mapping, Conjugation mapping, Mapping by interrupted mating, Mapping with molecular markers, and mapping using somatic cells.

Bioinformatics

Unit IV: Scope and Data bases

Bioinformatics, scope and applications. Biological data bases- Primary data bases- Nucleotide sequence data bases; Gen Bank, EMBL, DDBI; DDBJ; Protein sequence data base, SWISSPROT, PIR; Structure data bases; PDB, NDB; secondary data bases; PROSITE, PFAM, CATH; composite databases; OWL; Literature data base; Pub Med; Data base searching – Entrez; Database sequence submission-BankIt.

Unit V Sequence analysis

Types of sequence alignment, methods of sequence alignment, scoring schemes, gaps and gap penalties, construction of phylogenetic trees. Structural genomics, functional genomics, comparative genomics, data mining in proteomics, Microarray, significance of proteomics and drug design.

REFERENCES

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 Masaru Tomita and Takaaki Nishioka, 2005. *Metabolomics. The Frontier of Systems Biology*. Springer Japan.

CELL AND MOLECULAR BIOLOGY ZOO- 202

60 Hours . 4 hrs/week

credit -4

48Hours –L , 12h –T

Learning Objectives:

- To understand basic unit cell and the molecular biology of the cellular function.
- To understand the protein secretion and sorting within the cell and laws of cell division and their regulation.
- To understand the central dogma of molecular biology.

Learning Out come

- The student will learn about the cell and cellular function at molecular level.
- The student will learn about the protein secretion, sorting and arranging the protein to different cell organelle.
- The student will learn in detail the central dogma of molecular biology in prokaryotes and Eukaryotes.

Unit 1 Introduction of cell:

Evolution of cell, From molecules to first cell , From prokaryotes to eukaryotes, Prokaryotes and eukaryotic genomes, single cell to multicellular organism.

Nature of cytoskeleton, intermediate filaments, Microtubules, Actin filaments, cilia and centrioles. Organization of cytoskeleton. Cell- cell communication and cell signaling. Cell adhesion, Cell junctions and extracellular matrix, cell – cell adhesion and communications, cell matrix adhesion, collagen the fibrous protein, of the matrix, non collagen components of the extra cellular matrix.

UNIT II: Cell growth and Division

Overview of the cell cycle and its control, The molecular mechanism for regulating mitotic and meiotic events, Amitosis , cell cycle control, Checkpoints in cell cycle regulation. Cell to cell signaling, overview of the extracellular signaling , Identification of cell surface receptors., G protein coupled receptors. and their effectors, second messengers, enzyme linked cell surface receptors, interactions and regulation of signaling pathways.

Unit III: Protein secretion and sorting :

Organelle biogenesis and protein secretion, synthesis and targeting, of mitochondria, chloroplast, peroxisomal proteins, translational modifications in the ER, intracellular traffic, vesicular traffic, in secretory pathways, protein sorting in the Golgi bodies, traffic in the endocytic pathways, exocytosis.

UNIT IV : DNA Model and chromatin structure

Types of DNA and RNAs, Chromosome structure, chromatin and Nucleosomes; Genome sequence, and chromosome diversity, Chromosome duplication and segregation, The nucleosome, chromatin structure. euchromatin, heterochromatin, constitutive and facultative heterochromatin , regulation of chromatin structure, and nucleosome assembly, Nucleolus. Gene and genome organization- Split genes. overlapping genes, Transposons, and retro-transposons, Gene clusters, Histones. Non histones. Nucleosomes, Chromatin, chromosomes structure, in prokaryotes and eukaryotes, Basic processes. Replication of DNA, Prokaryotes and eukaryotic DNA replication. Mechanism of DNA replication.

Enzymes and accessory proteins, involved in DNA replication, Replication errors, DNA, Damages, and their repairs.

UNIT V : Transcription and mRNA processing

Prokaryotic and Eukaryotic transcription , General and specific transcription factors, Regulatory elements, and mechanism, of transcription regulation, Transcriptional and post transcriptional gene silencing, : Initiation, elongation, and termination of transcription, capping, polyadenylation, Splicing, editing, mRNA stability, RNA interference, Microarray. Translation: Genetic code, prokaryotes and eukaryotic translation, the translation machinery, mechanisms of chain initiation, elongation, and termination, regulation of translation , co and post translation modifications of proteins, epigenetic.

REFERENCES

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- Becker,W.M.,Kleinsmith,L.J.andHardin,J.2007.*TheWorldoftheCell*.Pearson,NewDelhi.
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- Snustad, D.P. and Simmons, M.J. 2010. *Principles of Genetics*. John Wiley and Sons.
- Watson,J.D.,Baker,T.A.,Bell,S.P.,Gann,A.,Levine,M.andLosick,R.2009.*MolecularBiologyof the Gene*. Pearson.

BIOPHYSICS ZOO-203

60 Hours . 4 hrs/week

credit -4

48Hours –L , 12h –T

Learning Objectives:

- To understand universal law as applied to biological system.
- Better understanding of the concept from physical laws and application
- To understand the various physical mechanisms happening in a biological system.

Learning Outcome.

- The student will learn the application and concept of the physics in biological processes.

UNIT 1: Diffusion and Osmosis

Diffusion – Kinetics of diffusion, Fick's law of diffusion and diffusion coefficient, Biological significance in animals and plants. Electrochemical gradients, capacity and resistance, Stokes- Einstein Equation and Graham's Law, Facilitated diffusion, Gibbs- Donnan Equilibrium.

Plasma membrane:-Internal composition, cell penetration, permeability of cell membrane, permeability coefficient.

Osmosis –Osmotic concentration and osmotic pressure, Van't Hoff's Laws.

Biological significance of osmosis and animal and plants.

UNIT II: Biophysics cell Membrane

Physicochemical properties of cell membrane, conformational properties of cell membranes, Membrane transport, - endocytosis, exocytosis, nutrient transport across membranes, porins, facilitated diffusion, porter molecules, Facilitated transport:- Symport, antiport, uniport, anion porter, glucose porter, Active transport: Proton pumps, $\text{Na}^+ \text{K}^+$ pumps and Ca^{++} pumps, ionic channels. Functions of cell membrane. Artificial membranes.

UNIT III: Bioenergetics

Thermodynamics -Laws of thermodynamics, Entropy, Enthalpy, Free energy, Reversible thermodynamics, and irreversible thermodynamics; System – open, closed, and isolated Photo-bioenergetics. Photosynthesis– light and dark reactions, redox couple and redox potential. Chemo-bioenergetics; electron transport and oxidative phosphorylation, Chemiosmotic theory and binding changes mechanism of ATP synthesis.

UNIT IV: Biomechanics and Neurophysics

Striated muscle- contractile proteins, Mechanical properties of muscle, contraction mechanisms, role of calcium ions, Biomechanics of the cardiovascular system – Blood pressure, electrical activity of during the heart beat, Electrocardiography.

Nervous system–synapse, Physics of membrane potential bioelectric potential: Diffusion potential, membrane potential, muscle and nerve, voltage clamp, Sensory mechanism- The eye- visual receptor. electrical activity and visual generator potentials, Neural aspect of vision, Visual communication and bioluminance.

Hearing : Physical aspects, - the ear,, elementary acoustic, theories of hearing, Signal transduction- mode of transport, signal transduction in the cells.

UNIT V: Radiation Biophysics

Ionizing radiations, units of radioactivity, exposure and dose.

Interaction of radiation with matter: Photoelectric effect, ion pair production, absorption and scattering of electrons.

Biological effects of radiations; effect on nucleic acids, proteins, enzymes, and carbohydrates, cellular effects, of radiations, somatic and genetics,

Nuclear medicine; Internally administered radioisotopes, radioiodine in thyroid function analysis, Renal, liver, and lung function analysis.

Applications of radioactive tracers, Radiations protection and therapy.

REFERENCES

Ackerman, E (1962) Biophysical Science. Prentice Hall Inc. NJ,USA

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Weesner,F.M.1960. *General Zoological Microtechniques*. The Williams & Wilkins Co., Baltimore, USA

Instrumentation and Biological Techniques ZOO-204

30 Hours . 2 hrs/week

credit -2

30Hours –24L, 6 –T

Learning Objectives:

- To understand basic and advanced instruments employed in biological research and principles.

- To understand the different biological techniques used for reductionalist research.

Learning Out come

- The student will learn about principle and instruments used for the biological research. .
- The student will learn about use and procedure used for their practical training.

UNIT 1: Biological and Histological Techniques- Microscopy

10 hrs.

Cytochemical and histological methods- Microtome techniques, fixation, staining, cyto chemistry of nucleic acids, detection of carbohydrates, proteins and lipids. Principle and theory of fixation, staining and clearing agents used. Specimen preparation for TEM, SEM, Confocal Microscopy, Fluorescence Microscopy.

Electrophoresis, centrifugation and Chromatography

6 hrs.

Principle and application of Polyacrylamide gel electrophoresis (PAGE) – SDS and non SDS, Agarose gel electrophoresis, immuno- electrophoresis, isoelectric focusing. Basic principles of sedimentation. Types of centrifuges, Analytical and Preparative centrifugation, Differential and density gradient centrifugation Principle of Ion exchange chromatography, Gel permeation chromatography, Affinity chromatography, Gas chromatography High pressure liquid chromatography (HPLC).

UNIT II

pH Meter, spectroscopy and radioisotope detection, measurement and assay

Principle and working of pH Meter- types, Principle and applications of Flame emission spectroscopy, Atomic absorption spectroscopy, Nuclear Magnetic- resonance spectroscopy (NMR), Circular dichroism spectroscopy, ESR spectroscopy, Mass spectroscopy.

Principle and application of GM counter, Solid and liquid scintillation counters, Radio ImmunoAssay, Enzyme Linked Immuno Sorbant Assay (ELISA). Nanosensors

REFERENCES

- Ackerman, E. 1962. *Biophysical Science*. Prentice Hall Inc. NJ, USA
- Alonso, A., and Arrondo, J. L. R. 2006. *Advanced Techniques in Biophysics*. Springer, UK
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- Gupta A. 2009. *Instrumentation and Bio-Analytical Techniques*. Pragati Prakashan, Meerut.

Scientific writing ZOO-205

30 Hours . 2 hrs/week

30Hours -24L, 6 -T

credit -2

UNIT I :

Scientific writing begins with a question. Scientific writing in computer age, Communication channels – informal and formal, compilations, Use of internet, Difference between subject directories and search engines, emails, Use of word processing to write more effectively, Revising with word processors. Writing of the first draft- Content, matters dealing with authorship, copy right. Standard structure- Introduction, Materials and Methods, result, Discussion and conclusion. The title, references, Abstract and summary. Title page, key words, and acknowledgement

UNIT II: Text , Tables and English language

Visual aids – tables and Graphs, understanding numerical results, use of explanatory artwork, revising structure and style. Structural changes – revision for clarity, brevity, grammatical correctness, use of voices – active or passive, which is appropriate? Verb agreement, status of the work being discussed, - tenses, number clearly and sensibly.

Minimize jargon, use right word, uses of bias free language, verb choice, noun, article, principle use, prepositions, and prepositional phrases.

Punctuate for clarity, capitalize consistency, using scientific names, when and how to include trade names, foreign words and phrases.

References

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- Reubens, P (1992) Science and Technical Writing : A manual of style , New York ; Henry Holt.

Helminthology II ZOO-206

60 Hours . 4 hrs/week

48Hours -L, 12h -T

credit -4

Learning Objectives:

- To understand the phylogeny, the biology and applied aspects of helminthes parasites in disease and plant parasites.
- The role of helminthes parasites in burden of disease.
- Genomics of helminthes

Learning Out come

- The student will learn about the phylogeny , and importance of the helminthic parasites in control of disease.
- The student will learn about genomics and understand how helminthes survive in human body by manipulating the surface coat.
- The student will learn about the challenges in vaccine and drug resistance.
- The student will learn the skill to identify the plant nematodes and control measures in agricultural productivity.

Unit I

Phylogeny of the nematodes and related groups. Economic importance. Burden of helminthes disease worldwide and in India. Parasitic(plants and animal) and free or non pathogenic nematodes. *C. elegans* as model animal for genetic studies.

Unit II

Nematode ultra structure – complex system and processes

Body wall of nematodes: cuticle, Epicuticle (Hypodermis), muscle layer, Hydrostatic skeleton. Nervous system. Cephalic sense organs : Amphids, labial and cephalic papillae. Caudal sense organs– caudal papillae, plasmids. Spicules, inner body tube or digestive system – the stomadeum (foregut). The intestine (midgut), the Proctodeum (hind gut), Secretary / excretory system, Feeding and nutrition's in Nematodes. Essential foods, blood feeding by Hookworms and other nematodes. Male reproductive system, Female reproductive system. Fertilization, development and hatching of eggs. Moulting and Development in nematodes. Implications of nematodes ultra structural studies.

Unit III Nematodes as plant parasite,

Introduction and general life cycle, feeding types, symptoms of damages caused by nematodes, population dynamics, the threshold levels, nematode survival, Ecology, control of nematode disease-resistance/tolerance, crop rotation, chemical control, Biological control, organic amendments, physical control. Interaction with other organisms, classification of plant parasitic nematodes. Life cycle studies of followings -a. Root knot Nematodes (*meloidogyne*) b. Citrus Nematodes (*Tylenchulus*)c. Bud and leaf Nematodes (*Aphelenchoides*) d. Seed gall Nematodes (*Anguina*)

Unit IV: Genomic epidemiology

Genomic epidemiology of filarial nematodes- Transforming the basis of the elimination, progress decisions- Introduction, parasitic transmission, morbidity and control/elimination strategies- *Onchocerciasis volvulus*, and *Wucheria bancrofti*, Lymphatic filariasis. Parasitic population and genetics, and transmission zones, conceptual approach, understanding geographic and temporal variability in drug response, genomics tools to inform elimination program decisions.

Epidemiological biology, clinical pathology, immune response, diagnosis, treatment, pharmacotherapy, immunotherapy of *Trichenella spiralis*, *Trichuris trichura*, *Strongyloides stercoralis*.

Unit V: Chemotherapy

Drug used against helminthic infection in man, Drug resistance in human helminthes, cryopreservation of helminthes, Immunity to helminthes, trends in vaccines against helminthes and challenges.

References

1. Bird AF, Bird J (1991) The structure of nematodes, vol 2. Academic press, San Diego
2. Blaxter ML, Robertson WM (1998) The cuticle. In: Perry RN, Wright DJ (eds) The Physiology and biochemistry of free-living and plant-parasitic nematodes. CAB International, New York, pp 25–48
3. Gardner S (2001) Worms, Nematoda. In: Levin SA (ed) Encyclopedia of biodiversity. Academic Press, University of Nebraska, Lincoln
4. Lewbart G (2011) Nematodes, Nervouse system In: Invertebrate Medicine, 2nd (edn). John Wiley & Sons
5. Mehlhorn H (2008) Encyclopedia of parasitology, vol 3. Kluwer Academic Publishers, Great Britain
6. Mehlhorn H (2016) Encyclopedia of parasitology, vol 3. Kluwer Academic Publishers, Great Britain
7. Mehlhorn H (1988) Parasitology in Focus . Springer –Verlag , Berlin.
8. Brown, R.H. and Kerry, B.R. (1987). Principles and practice of Nematode control in crops. Academic Press, Sydney.
9. Dropkin, V. H. (1 980) . Introduction to plant nematologg. John Wiley & Sons, New York.
10. O'Brien, P.C. and Stirling, G.R. (1991). Plant nematology For practical nematologists. Queensland Department of Primary Industries Information Series g 1gOO23.
11. Southey, J.F. (ed.) (1986). Laboratory methods for work with plant and soil nematodes. Her Majesty's Stationery Office, London.
12. Stirling, G.R. (f 991). Biological control of plant-parasitic nematode CAB International Slough, U.K.
13. Panikar C.K.J(1988) Text book Medical Parasitology. Jaypee Brothers, - Medical Publishers, New York. - (1988)
14. Smyth J.D (1977) The Parasitology of Trematodes. Oliver and Boyd Ltd. Edinburgh -
15. Sood Pamnik (1993) Parasitology (Protozoology and Helminthology) - CBS Publication and Distrubution, Delhi.
16. Hiware, Jadhav and Mohekar Applied Parasitology
17. Solbsy E.J.W(1982) Helminth, Arthropod and Protozoa of domesticated animal . London

Protozoology II ZOO-207

60 Hours . 4 hrs/week

credit -4

48Hours –L, 12h –T

Learning Objectives:

1. To understand the genetics, nutritional and parasitic adaptation in human or in other vertebrates.
2. The students will also study the geomedical, aspects of protozoan's .

Learning out come :

1. The student will understand the genetics, and the nutritional requirements and general organization of protozoans.
2. The students will understand the genetics of the common parasites like trypanosomes and plasmodium.
3. The student will learn about the metabolic adaptation.

UNIT I Genetics of protozoa

Trypanosome- diploidy and sexual stages, chromosome number, survival in blood stream by coat changing, (Shedding). Molecular structure of the surface coat, Mechanism of variable surface glycoprotein (VSG) gene expression in telomeres, control of VSG gene activity during "Fly" stage. Discontinuous transcription of VSG genes.

Plasmodium: Chromosome size, diploid and haploid stages, and meiosis, chromosome size polymorphism, Evolutionary relatedness of plasmodium sp by comparative DNA analyses, Importance of cloning genes for surface proteins, Cloning of genes, encoding the circumsporozoite protein. Gene encoding the S- antigens of merozoites, - merozoites and sporozoites share a common epitopes, Diversity surface antigens.

UNIT II Geo medical aspect of parasites

1. Factors influencing the distribution of protozoa.

Climatic and Atmospheric factors, - temperature, humidity, precipitation, and irradiation, and edaphic

Other factors - Oxygen, Carbon dioxide, pH, Light, Food, Nutrition

2. Immunity to protozoan parasite - Host reaction, Innate and acquired defense mechanism; Antigen of zooparasites, Special manifestation of Antigen - Antibody reaction as related to protozoan parasites.

UNIT - III General organization

1. General organization and morphology of the parasitic flagellates occurring in digestive tract of man. i. *Retartomonas intestinalis*, ii. *Chilomastix mesnili*, iii. *Giardia lamblia* iv. *Trichomonas tenax*
2. General organization of the Microspora - Structure of the spore, life cycle of *Nosema*, Diseases caused by microspora in fishes and Arthropods.
3. General organization of the Myxospora - structure and development of the spore, Life cycle of *Myxobolus*, disease caused by Myxospora in fishes.
- 4 General morphology, life cycle, transmission and pathology of parasitic Amoebae of man and domestic animals. i. *Entamoeba histolytica* ii. *E. gingivalis*

UNIT -I V

1. Structure and life cycle pattern of acephaline and cephaline Gregarines.
2. Coccidia of poultry with special reference to the structure, treatment and control.
3. Parasitism in ciliophora - structure, Life cycle, Pathogenesis and control of i. *Balantidium coli* ii. *Ichthyophtherius multifiliis*

UNIT V Nutrition in Protozoa

Nutrition in Protozoa

Preferred substrate glucose, acquisition of amino acids, Metabolism in parasitic protozoans.

Bioenergetics and the role of oxygen, energy metabolism in kinetoplastid flagellates, Aerotolerant, Anaerobic protozoans, Malarial parasites.

Text Books:

1. Mehlhorn H (2008) Encyclopedia of parasitology, vol 3. Kluwer Academic Publishers, Great Britain
2. Mehlhorn H (2016) Encyclopedia of parasitology, vol 3. Kluwer Academic Publishers, Great Britain
3. Mehlhorn H (1988) Parasitology in Focus. Springer-Verlag, Berlin.

Entomology II ZOO-208

60 Hours . 4 hrs/week

48Hours –L, 12h –T

credit -4

Learning Objectives

1. To understand the role of insects especially the economic importance.
2. To Learn about the insect pests that damage our crops and to learn about their control.
3. To learn about the insect /vectors of importance in medical and veterinary science.
4. To learn the molecular tools used in entomological research and their applications.

Learning Outcome

1. The student will understand the necessity of insect in economic, of crop.
2. The students will be able to identify the pests and will be able to control the pest with appropriate control mechanism.
3. The students will learn about the molecular tools in entomological studies.

Unit I Phylogeny and classification of insect

Classification of Apterygota orders up to families. Thysanura and Collembola. Classification of Pterygota orders up to families – Exopterygota-Odonata, Orthoptera, Mallophaga Anoplura, Isoptera, and Hemiptera. Endopterygota-, Coleoptera, Hymenoptera, Neuroptera, Lepidoptera and Diptera. Insect diversity.

Unit II Agricultural Pests ; Medical and Veterinary Entomology

What are pests. Threshold of pest. Concept of pest; origin of pest; classification of pests; Identification, life cycle damage and control of crop pests- Maize- stem borer, cotton- Pink ball worm , stem weevil, sugar cane Shoot borer, root borer, top borer, stem borer, Soyabean- girdle beetle and stem fly, Vegetables- red cotton bug, Bhindi shoot and root borer, Brinjal shoot and fruit borer, Potato tuber moth, Cabbage borer, Fruit crops Mango hopper, Mango stem borer, Anar butterfly, Lemon butterfly, Fruit sucking moth Stored grains, Rice weevil, Rust red flour, Pulse beetle, Parasitic arthropods – epidemiologic of vector borne disease-Taxonomy , morphology , life history , behavior and ecology , Public health importance of – mosquitoes, lice, kissing bug, fleas, sand fly, horse fly, tse-tse fly, myiasis .

Unit III Principles of insect pest control

1. Chemical control: mode of action of insecticide, merits and demerits of chemical control. Modern trends in pest control. Biological control: Principles, procedure, Biological agents; success and limitations. Autocidal control – sterile male technique, genetic technique, the pheromone technique. Integrated pest management (IPM) Principles and application. The local dispersal and migration of insect pest and their importance in IPM strategies- example Aphids, and white flies.

Unit IV : Molecular tools use in Medical and Veterinary Entomology

Cloning genes, and genomics, cloning genes, Recombinant DNA technologies. Genomics: cataloguing an organisms complete genetic sequence, Library construction and genome assembly, Bioinformatics and data base, Genome and vector and vector borne pathogens, PCR and its applications, Diagnostic techniques: Rapid detection and quantification of pathogens in hosts and vectors, Visualization of pathogens in host and vectors. Immune based diagnosis of host infection.

Unit V: Insect plant interactions:

Events during herbivory, -plant volatile perception and recognition, Insect as microbial host, salivary production and secretions. Insect Endosymbionts in plant signaling, Digestion and nutrition. Endosymbionts- mediated insect defence, Plant metabolite detoxification and endosymbionts . Herbivory,- site of damages, activation of phyto- hormonal pathways, and role of microbes. Microbial priming, Below ground changes (Rhizospheres,) , changes in above ground, - below ground interactions.

References

Srivastava , KP (1996) Applied Entomology Vol.I & II 2nd Edition, Kalyani Publishers, New Delhi.

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- Daly, H. V., J. T. Doyen & P.R. Ehrlich (1981) " Introduction to Insect Biology & Diversity" International Student Edn. McGraw- Hill, Kogakusha, Japan.
- Romoser, W.S (1982) The Science of Entomology. 2nd edition MacMillan, New York.
- Disi, J., J. Simmons, and S. Zebelo. (2019). Plant growth-promoting rhizobacteria-induced defense against insect herbivores, pp. 385–410. *In* Field crops: sustainable management by PGPR. Springer, New York.
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- Hartley, S. E., and A. C. Gange. 2009. Impacts of plant symbiotic fungi on insect herbivores: mutualism in a multitrophic context. *Annu. Rev. Entomol.* 54: 323–342.
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- Klowden, M. J. 2013. Physiological systems in insects. Academic Press, Cambridge, MA.
- Mullen GR and Durden LA (2009) Medical and Veterinary Entomology 2nd Ed Academic Press. London
- Nautiyal, C. S., and P. Dion. 2008. Molecular mechanisms of plant and microbe coexistence. Springer, New York
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- Wardle, D. A. 2002. Communities and ecosystems: linking the aboveground and belowground components, Princeton, New Jersey, Princeton University Press.

Paper No. ZOO-209 Endocrinology II

60 Hours . 4 hrs/week

credit -4

48Hours –L, 12h –T

Learning Objectives:

- The students will learn about vertebrate hormones and their actions in vertebrates.
- The student will learn about hypothalamic pituitary axis and the various hormones released, their role in sex determination.
- The student will learn about the male and female reproductive endocrinology
- The students will learn about other hormones secreted by other organs- like stomach, intestines, pancreases, etc.

Learning Out come

- The students will understand about the various hormones in vertebrate and their origin and roles.
- The students will understand the role of male and female reproductive hormones.
- The students will understand the hormonal actions and other hormones involved in metabolism and homeostasis.

Unit - I The vertebrate endocrine system

Classes of hormones. Hormone synthesis and control – a general concept. General mechanisms of hormone action. Termination of hormone action. Hormone circulation and metabolism. Plasma membrane hormone receptors, second messengers of hormone action, receptor signal transduction, Multiple membrane messengers, Eicosanoids and hormone action, Cytosolic hormone receptors. Sex determination, differentiation of male and female gonads. Development and differentiation of genital ducts. Gonadal hormone synthesis. Gonadal steroids and brain differentiation.

Unit -II Hypothalamus and Pituitary gland

Structure of Hypothalamus and hypophysiostropins and their functions in brief. Control of Hypothalamo-hypophysial hormone secretion. Histomorphology of pituitary gland, hormones and their functions . Neurohypophysial hormones and their functions. Pars intermedia and role melanotropic hormones.

Hormones of pituitary, - families of pituitary hormones, Growth hormones, and prolactin, The glycoprotein hormones, Pro-Opiomelanocortin and melanocortins, Neurophysical hormones. Hypophysiotropic hormones, - thyrotropins releasing hormones, - thyrotropin – releasing hormones, Gonadotropins releasing hormones, (GnRH) , corticotropin releasing hormones(CRH) Prolactin release inhibiting Factor (PIF) , prolactin releasing factor (PRF) , MSH – release inhibiting Factor (MIF).

Neurophysical hormones - oxytocin, vasopressin , vasotocin, mode of action . Melanotropic hormones. Control of MSH secretion, - dopaminergic control , Physiological roles.

Unit - III Reproductive Endocrinology

Female Reproductive endocrinology. Pregnancy, Parturition and Lactation mechanisms

Anatomy of female reproductive system and histology of ovary, ovarian cycle and its hormonal control.

Ovarian steroid hormones and their physiological functions. Menstrual cycle in primates and its hormonal basis. Estrus cycle in rat and its hormonal basis. Role of hypothalamic, pituitary and ovarian hormones in pregnancy in mammals. Hormonal mechanism in parturition in mammals. Hormonal mechanism in lactation in mammals. Menopause.

Male Reproductive Endocrinology ;

Anatomy of male reproductive system, histology of testis, spermatogenesis; hormones of testis and their functions. Endocrine control of testicular function, GnRH and Pituitary gonadotropins- inhibin , prolactin. Role of androgens, , Spermatogenesis . Estrogen – physiological roles, fertility , male behavior. Epiphyseal fusion , cardiovascular functions.

Unit V : Hormones in homeostasis , Gastro intestinal tract, thyroid and adrenal glands.

Hormonal control of – calcium homeostasis . Parathormone, calcitonin, vitamin D.

Gastro intestinal Hormones- Gastrin, Secretin , cholecystokinin(CCK), Gastric inhibiting peptides, Vasoactive Intestinal Peptide (VIP). Substance P , Somatostatin , motilin. Pancreatic hormones – Insulin and glucagon – physiological action. Thyroid hormone and control of thyroid hormone secretion. Adrenal steroid hormones- Glucocorticoids, Mineralocorticoids, Aldosterone, Renin – Angiotensin system. Neurohormones- Endorphins.

Books Recommended

1. Hadley , M. E (2004) Endocrinology. Pearson education (Singapore)
2. Norman ,AW, Litwerck, G .(1987) Hormones. Orlando ,FL ; Academic press.
3. Larsen PR, Kronenberg ,HM, Melmed ,S and Polonsky , KS (Ed)(2003) Willams Text Book of Endocrinology , 10th . Ed. Philadelphia, Saunders,

Practical Paper No. ZOO-210 Practical based on ZOO-201(Genetics and Bioinformatics)(Min 8)

Genetics and Bioinformatics ZOO-210 (Any 8)

1. Determination of blood groups and suggestions on Medico legal problems regarding the parentage disputes using blood groups.
2. Culture of *Drosophila melanogaster* and study of its life cycle stages
3. Mutant studies in *Drosophila*.
4. Identification of blood group, a case study of multiple alleles.
5. Chromosome mounting – Onion roots,
6. Chironomous larva – Giant Chromosomes
7. Study of gene frequency using PTC tests (taster and non – tasters)
8. Database search and data retrieval-using NCBI, SWISS-PROT, PDB, Expasy. Methods of sequence alignment-BLAST and Clustal W.
9. Phylogenetic tree using PHYLIP.
10. Gene Prediction using GENSCAN/GRAI.
11. Protein structure visualization using RASMOL.

Practical Paper No. ZOO-211 Practical based on ZOO-202(Cell and Molecular biology ZOO- 211(Any 8)

Cell and Molecular biology ZOO- 211(Any 8)

1. Stages of Mitosis and Meiosis (permanent slides)
2. Squash preparation of grasshopper testis to study meiotic stages.
3. Determination of mitotic index in the squash preparation of onion root tip. Effect of drugs on cell division (Colchicine or any other inhibitor)
4. Study of mitochondria by vital staining technique.
5. Fulgen reaction- Staining of DNA.
6. Micronuclei test.
7. Induction of puff and study of puffing pattern in polytene chromosomes.
8. Preparation of different cell types as hepatocytes/ parenchymal cells
9. Study of tumor and cancerous cell (Use permanent slides)
10. Preparation of Microtome section, spreading.
11. Histochemical staining of carbohydrates (PAS), Protein (Bromophenol blue), lipids (Sudan Black), DNA (Fuelgen stain).

Practical Paper No. ZOO-212 Practical based on ZOO-203(Biophysics ZOO- 212(Any 8)

Biophysics ZOO- 212(Any 8)

1. To study the ECG cycle for signals and the corresponding cardiac functions.
2. To study the measurement of blood pressure.
3. To study the ingestion of dye in Paramecium.
4. To study the osmotic relation in animals.
5. To study the osmotic hemolysis of erythrocytes in different concentration of salt solutions.
6. To study the muscle excitation by using Kymograph apparatus.
7. To study the effect of calcium ion on heart beat of rat/ crab by using kymograph.
8. Demonstration of Geiger Muller counter.
9. Cell fractionation and Differential Centrifugation to isolate mitochondria and nuclei

Practical Paper No. ZOO-213 Practical based on ZOO-204 and 205(Instrumentation Biological Techniques and Scientific Writing ZOO- 213) (Any 8)

Instrumentation Biological Techniques and Scientific Writing ZOO- 213 (Any 8 , Practical 11 and 12 compulsory)

1. Preparation of microtome section, spreading.
2. Histochemical staining of carbohydrates (PAS), Protein (Bromophenol blue), lipids (Sudan Black), DNA (Fuelgen stain).
3. Demonstration of SDS-PAGE
4. Study of pH meter , adjusting pH and standardization of pH meter.
5. Study of ion exchange chromatography.
6. Study of gel permeation chromatography.
7. Isolation of Plasmids
8. Isolation of genomic DNA using Agarose gel electrophoresis.
9. Calculation of Molecular mass of protein after SDS-PAGE or DNA by Agarose Gel Electrophoresis
10. Study of thin layer chromatography using amino acid, or lipids or any biological materials.
11. Making appropriate corrections in table and figures in scientific paper.
12. Revision of manuscript using word processor.

Practical Paper No. ZOO-214 Practical based on ZOO-206(Helminthology II) (Min 8)

1. Collections of Nematodes from locally available animals
2. Basic techniques of preservation and mounting of Nematodes
3. Identification of collected Nematodes
4. Fecal sample analysis for collection and identification of ova.
5. Study of permanent slides (At least 8).
6. Collection and identification of Phytonema.
7. Techniques of collection, fixation, mounting and preparation of permanent slides.
8. Submission of permanent slides at the time of examinations.

Practical Paper No. ZOO-215 Practical based ZOO-207(Protozoology II) (Any 8)

1. Classification of parasitic protozoa.
2. Study of ciliates in alimentary canal of vertebrates and invertebrates.
3. Impregnation of ciliates with dry silver nitrate for study of kinetic structure.
4. Study of haemoflagellates from vertebrate blood.
5. Preparation of blood smear, staining and identification of staining of haemosporina.
6. Histopathology of host tissue caused by Apicomplexan parasites.
7. Examination of fecal sample of vertebrate host for oocyst of coccidia.
8. Collection of coccidian oocysts by centrifugation method.
9. Observation of oocysts for sporulation.
10. Study of different mosquito vectors of protozoan parasites.
11. Collection of Myxozoa from fishes.
12. Study of binary fission and conjugation in ciliates.

Practical Paper No. ZOO-216 Practicals based on ZOO-208 (Entomology- II) (All 5)

1. Collection, preservation, sketching, identification and classification of insects of following orders- Thysanura, Collembola, Odonata, Orthoptera, Mallophaga, Anopleura, Isoptera, Hemiptera, Coleoptera, Neuroptera, Hymenoptera, Lepidoptera, and Diptera and insects from Marathwada,
2. Identification damage symptoms, and management practices of pests of Jowar, Cotton, Sugarcane, soybean, Vegetables, Fruit Crops, Stored grains.
3. Collection and study of paratatic, Predatory, pollinator insects & biological control Agents, forensic insects
4. Study of insect vectors like mosquito, bed bug, flea, body louse, rat flea.
5. Field visit for demonstration of pest damage/ to entomology Department of Agricultural University . farm.

Practical Paper No. ZOO-217 Practical based on ZOO 209 (Endocrinology II) (Any 8)

1. *In situ* demonstration of endocrine glands in rat or by demonstration using visual aids.
2. Histological study of endocrine glands in different vertebrate representatives
3. Anatomical studies of reproductive system in and rat
4. Study of estrous cycle in rat
5. Endocrine gland removal in rat- a) Orchidectomy b) Ovaryectomy
c) Adrenalectomy d) Thyroidectomy
6. Effect of thyroxin on oxygen consumption in fish
7. Chromatophores and colour changes in fish (a) Effect of back ground and (b) Effect of MSH injection.
8. Determination of cholesterol in the adrenal gland of rat.
9. Effect of insulin on blood glucose levels in fish / rat
10. Histological techniques : preparation of permanent slides for histological structure of endocrine glands of rat (at least 5 be submitted)