

(Abstract)

M.Sc. Zoology Programme- Scheme (modified) and Syllabus (IIIrd and IVth semester only) under Choice Based Credit and Semester System (in Outcome Based Education system- OBE) in Affiliated Colleges -Implemented with effect from 2023 admissions - Orders issued

ACADEMIC C SECTION

ACAD C/ACAD C4/17563/2023

Dated: 14.08.2024

- Read:-1. U.O No. Acad C4/17563/2023 dtd 24.08.2023
2. Minutes of the meeting of Board of Studies in Zoology (PG), held on 23.06.2024
3. The syllabus submitted by the Chairperson, vide e-mail dtd 03.07.2024
4. XXVIII th meeting of Academic council held on 25.06.2024

ORDER

1. As per the paper read (1) above, the Scheme, Syllabus, Pattern of Question paper and Model Question papers (Ist and IInd Semesters only) of the M.Sc. Zoology programme under Choice Based Credit and Semester System (in Outcome Based Education System- OBE) in Affiliated colleges were implemented w.e.f 2023 admission vide paper read (1) above.
2. Subsequently, the Meeting of the Board of Studies in Zoology, held on 23.06.2024 finalised the Syllabi of the IIIrd and IVth Semesters of the M.Sc. Zoology programme under CBCSS in (Outcome Based Education System) to be implemented in affiliated Colleges w.e.f 2023 admission vide the paper read (2) above. The Board of Studies recommended to change the Credit distribution of the Theory papers of third and fourth semesters to 4 Credits each and the Credits for Viva voce, to 1 credit, both in IInd Semester and IVth Semester and the Credits for Personal collection in IVth Semester, to 1 credit and submitted the modified Scheme to this extent, along with the Minutes of the Meeting of the Board of Studies.
4. The Vice Chancellor after considering the matter in detail, ordered to place the Minutes before the Academic Council, for consideration.
5. Subsequently, the XXVIIIth meeting of the Academic Council held on 25.06.2024 , vide the paper read (4) above, considered the matter and approved the Scheme (Modified) and the Syllabuses of the IIIrd and IVth Semesters of the M.Sc. Zoology programme, under Choice Based Credit and Semester System (in OBE-Outcome Based Education System) in Affiliated colleges under the University w.e.f 2023 admission, in principle and accorded sanction to publish the same, considering the urgency of the matter.
6. The Minutes of the Academic Council has been approved by the Vice Chancellor and published.
7. Therefore, the Scheme (modified) and Syllabi of IIIrd and IVth Semesters of the M.Sc. Zoology programme under Choice Based Credit and Semester System (in OBE-Outcome Based Education System) in Affiliated Colleges under the University w.e.f 2023 admission is uploaded in the University website.
8. The Scheme (modified) and Syllabi of IIIrd and IVth Semesters of the M.Sc. Zoology programme are appended with this U.O.

Orders are issued accordingly.

Sd/-
ANIL CHANDRAN R
DEPUTY REGISTRAR (ACADEMIC)
For REGISTRAR

To: 1. Principals of Affiliated Colleges offering M.Sc Zoology Programme
2. Chairperson, BoS Zoology (PG).

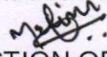
Copy To: 1. The Examination Branch (Through PA to CE)

2. PS to VC / PA to PVC / PA to R/PA to FO
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6. EP V section



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Forwarded./ By Order


SECTION OFFICER



KANNUR UNIVERSITY

കണ്ണൂർ സർവകലാശാല

Re-accredited by NAAC with 'B++' Grade

CURRICULUM

M Sc. ZOOLOGY

Credit Based Semester System

(KUCBSS-PG-2023)

2023 admission onwards

PART-1

(I & II Semester)

Kannur University

Thavakkara, Civil Station P.O. Kannur District.

Kerala 670 002, India.

SCHEME AND CREDIT DISTRIBUTION CHART OF COURSES IN THE M.Sc. ZOOLOGY PROGRAMME

Semester	Course Code	Title of Course	Marks			Credits	Hrs/Wk
			Internal	External	Total		
1	MSZGY01C01	Biochemistry	15	60	75	4	4
	MSZGY01C02	Biophysics & Biostatistics	15	60	75	4	4
	MSZGY01C03	Cell Biology & Genetics	15	60	75	4	4
	MSZGY01C04	Systematics, Evolutionary Biology & Behavioural Science	15	60	75	4	4
	MSZGY01C05	Biochemistry, Physiology, Endocrinology and Immunology - Practical					3
	MSZGY01C06	Cell Biology, Genetics, Molecular Biology, Bioinformatics and Biophysics - Practical					3
	MSZGY01C07	Systematics, Evolutionary Biology, Environmental Biology Biostatistics and Behavioural Science - Practical					3
Total Credits For semester I			60	240	300	16	25
2	MSZGY02C08	Animal Physiology & Endocrinology	15	60	75	4	4
	MSZGY02C09	Molecular Biology and Bioinformatics	15	60	75	4	4
	MSZGY02C10	Environmental Biology	15	60	75	4	4
	MSZGY02C11	Immunology	15	60	75	4	4
	MSZGY01&02C05	Biochemistry, Physiology, Endocrinology and Immunology - Practical	15	60	75	3	3
	MSZGY01&02C06	Cell Biology, Genetics, Molecular Biology, Bioinformatics and Biophysics - Practical	15	60	75	3	3
	MSZGY01&02C07	Systematics, Evolutionary Biology, Environmental Biology Biostatistics and Behavioural Science - Practical	15	60	75	3	3
	MSZGY02C12	Viva Voce	5	20	25	1	
Total Credits for Semester II			110	440	550	26	25
3	MSZGY03C13	Developmental Biology & Animal Ethics	15	60	75	4	4
	MSZGY03 O01/02	Open Elective (Multi-Disciplinary)	15	60	75	4	4
	MSZGY03 E01/02	Elective I	15	60	75	4	4
	MSZGY03 C14	Microbiology and Biotechnology - Practical					3
	MSZGY03 C15	Histology and Developmental Biology- Practical					3
	MSZGY03 E03/04	Elective - Practical					3

	MSZGY03 C16	Project					4
	Total Credits for Semester III		45	180	225	12	25
4	MSZGY04C17	Microbiology & Biotechnology	15	60	75	4	4
	MSZGY04 E05/06	Elective II	15	60	75	4	4
	MSZGY04 E07/08	Elective III	15	60	75	4	4
	MSZGY03&04 C14	Microbiology and Biotechnology- Practical	15	60	75	3	3
	MSZGY03&04 C15	Histology and Developmental Biology- Practical	15	60	75	3	3
	MSZGY03&04 E03/04	Elective - Practical	15	60	75	3	3
	MSZGY03&04C16	Project	15	60	75	3	4
	MSZGY04C18	Viva Voce	5	20	25	1	
	MSZGY04C19	Personal Collection and field study report	5	20	25	1	
	Total Credits For semester IV		115	460	575	26	25
Total Marks & Credits for Semesters I, II, III and IV							
			330	1320	1650	80	

SEMESTER III

MSZGY03C13; DEVELOPMENTAL BIOLOGY AND ANIMAL ETHICS

(72 hours, 4 Credits)

Course Objectives

CO1. Understand the basic principles of animal development (K2).

CO2. Analyse the findings from experimental embryology (K4).

CO3 Remember principles of animal ethics (K1).

CO4 Understand involvement of genetic mechanism in development (K2).

Module 1. Basic Concepts in Developmental Biology (18 hrs)

Unit .1.1. Specifying identity: (8 hrs)

1.1.1. The primary germ layers and early organs (brief account only)

1.1.2. Cell differentiation

1.1.3. Levels of commitment: specification & determination

1.1.4. Types of specification: autonomous, conditional & syncytial

1.1.5. Induction & competence: Types of induction.

1.1.6. Imprinting

1.1.7. Genomic equivalence

UNIT.1.2. Stem cells: (2hrs)

1.2.1. Stem cell concept

1.2.2. Potency

1.2.3. Stem cell niches

1.2.4. Medical applications of stem cells.

Unit. 1.3. Gametogenesis, fertilization & sex determination: (8hrs)

1.3.1. Gametogenesis in mammals-spermatogenesis and oogenesis

1.3.2. Fertilization and prevention of polyspermy in sea urchin

1.3.3. Mammalian pattern of sex determination- primary sex determination and secondary sex

determination

1.3.4. Environmental influence on sex determination.

Module 2. Early Development in Animals (18 hrs)

Unit.2.1. Drosophila development: (8hrs)

- 2. 1.1. Fertilization, cleavage, MBT, gastrulation
- 2.1.2. Axis formation- Anterior-posterior, dorsal-ventral, extremity
- 2.1.3. Segmentation genes: gap genes, pair-rule genes & segment polarity genes
- 2.1.4. Homeotic selector genes

Unit. 2.2. Amphibian development: (6hrs)

- 2.2.1. Fertilization, cortical rotation, cleavage, MBT
- 2.2.2 Gastrulation
- 2.2.3. Specification of germ layers
- 2.2.4. Formation and function of amphibian organizer.

Unit 2.3. Chick development: (4hrs)

- 2.3.1. Cleavage
- 2.3.2. Gastrulation, Primitive streak
- 2.3.3. Anterior-posterior and left-right axis formation

Module 3. Organogenesis & Post-embryonic Development (18hrs)**Unit 3.1. Organogenesis: (8hrs)**

- 3.1.1. Differentiation of neurons.
- 3.1.2. Vulval induction in *Caenorhabditis elegans*
- 3.1.3. Tetrapod limb development
- 3.1.4. Vertebrate eye development

Unit 3.2. Metamorphosis and Regeneration: (8hrs)

- 3.2.1. Metamorphosis:
 - 3.2.1.1. Insect metamorphosis
 - 3.2.1.2. Amphibian metamorphosis
- 3.2.2. Regeneration:
 - 3.2.2.1. Types of regeneration- stem cell-mediated, epimorphosis, morphallaxis, and compensatory regeneration. (Brief account)
 - 3.2.2.2. Regeneration in Hydra
 - 3.2.2.3. Vertebrate limb regeneration

Unit 3. 3. Histological techniques (2hrs)

- 3.3.1. Steps for histological preparations
- 3.3.2. Embedding and sectioning
- 3.3.3. Staining techniques used in histology

Module 4. Development in wider contexts: (18hrs)**Unit 4.1. Experimental Embryology (4hrs)**

4.1.1. Work of Hans Spemann & Hilde Mangold: constriction & transplantation experiments

4.1.2. Gradient experiments in sea urchin

4.1.3. Mutants & transgenics in the analysis of development

4.1.4. Transgenic DNA chimeras

Unit 4. 2. Development and environment (4hrs)

4.2.1. Environmental influence on normal development.

4.2.2. Teratogenesis: Influence of Alcohol, retinoic acid, DES and BPA

Unit 4.3. Animal ethics (10hrs)

4.3.1. Humans in research:

4.3.1.1. General Principles

4.3.1.2. Clinical trials of drugs and other interventions: General guidelines

4.3.1.3. Principles of research among vulnerable populations & Additional safeguards

4.3.2. Animals in research

4.3.2.1. Advantages and disadvantages of animal experimentation.

4.3.2.2. Impact of experimentation on animals.

4.3.2.3. Principle of the 4 R's: replacement, reduction, refinement and rehabilitation.

4.3.2.4. Humane Science-The Science of alternatives: In chemico, In silico, In vitro- (cultures, microphysiological systems, organoids, computer models, etc.), Volunteer studies, etc.

4.3.2.5. Legislation in animal experimentation:

4.3.2.5.1. Prevention of Cruelty to Animals Act 1960 (PCA)

4.3.2.5.2. The Breeding of and Experimentation on Animals (Control and Supervision) Rules, 1988,

4.3.2.5.3. The Committee for Control and Supervision of Experiments on Animals (CCSEA):

4.3.2.5.3.1. Ethical principles.

4.3.2.5.3.2. Function of CCSEA

4.3.2.5.3.3. CCSEA Guidelines on specific aspects regarding the use of animals in scientific experiments.

4.3.2.5.3.4. Aftercare and rehabilitation of animals after use in scientific Experiments

4.3.2.5.3.5. Situations where euthanasia of animals is permissible.

4.3.2.5.3.6. Guidelines for anaesthesia and euthanasia.

4.3.2.5.4. Institutional Animal Ethics Committee (IAEC)- functions, CCSEA Standard Operating Procedures (SOP) for IAEC, Composition of IAEC.

REFERENCES:

1. Gilbert, S.F., Barresi, M.J.F. (2018). *Developmental biology. 11thEd.* Sinauer Associates, Inc., Sunderland, Massachusetts.
2. Wolpert, L., Beddington, R., Jessell, T., Lawrence, P., Meyerowitz, E., Smith, J. (2002). *Principles of Development, 2nd*, Oxford University Press. ISBN 0-19-924939-3.
3. Kalthoff, K. (1996). *Analysis of biological development.* McGraw-Hill Book Co, Inc, New York. ISBN 0070333084/9780070333086.
4. Mandal, J., & Parija, S. C. (2013). Ethics of involving animals in research. *Tropical Parasitology*, 3(1),4–6.
5. National Ethical Guidelines For Biomedical And Health Research Involving Human Participants: Indian Council Of Medical Research, 2017.
6. Guidelines on the Regulation of Scientific Experiments on Animals: Committee for the Purpose of Control and Supervision of Experiments on Animals (CCSEA), 2021.

Websites:

1. <https://doi.org/10.4103/2229-5070.113884>
2. <https://www.niehs.nih.gov/health/topics/science/sya-iccvm>
3. <https://crueltyfreeinternational.org/about-animal-testing/alternatives-animaltesting>

**MSZGY03001; Open Elective (Multi-Disciplinary); Research methodology
Credits 4– 72 Hours**

Course Outcome

CO1: Explain the purpose of each step in tissue processing. (K3)

CO2: Troubleshoot common problems encountered during microtomy. (K4)

CO3: Explain the mechanisms and theory behind staining techniques. (K2)

CO4: Evaluate the strengths and weaknesses of different phylogenetic methods for specific research questions. (K5)

CO5: Analyze a scientific article to identify strengths and weaknesses in its structure and content. (K4)

Module 1 Histology

18 Hours

Part 1

Fixation of Histology Samples: Aims of Fixation, Tissue Changes in Fixation, Ideal fixative, Types of fixation, Mechanism of fixation, Commonly used laboratory fixatives, Mercury-salt containing fixatives,

Processing of Tissue in Histopathology Laboratory: Factors affecting tissue processing, dehydration, clearing, infiltration and embedding, tissue processing methods, precautions during tissue processing

Decalcification of Bony and Hard Tissue for Histopathology Processing

Part 2

Tissue Microtomy: Principle and Procedure: different types of microtomes, sectioning paraffin blocks (steps of sectioning), microtome knives and angles.

Frozen Section microtomy: indication of frozen sections, #Cryostat Sectioning, factors affecting good quality sections.

Module 2 Staining of microtome sections

18 Hours

Part 1

Staining Principle and General Procedure of Staining of the Tissue: Dyes Used for Staining, Mechanisms and Theory of Staining, factors affecting staining, metachromasia, Progressive and regressive staining, mordant, staining procedure.

Haematoxylin and Eosin Stain of the Tissue Section

Part 2

Special Stains for the Carbohydrate, Protein, Lipid, Nucleic Acid and Pigments

Connective Tissue Stain: Principle and Procedure (in brief)

Amyloid Staining (in brief)

Stains for the Microbial Organisms (in brief)

Immunocytochemistry in Histology and Cytology: Basic Principles, Immunocytochemistry Technique (in brief)

Flow cytometry: Principle, technique and applications. (in brief)

Fluorescent In Situ Hybridization Techniques in Pathology: Principle, Technique and Application (in brief)

Module 3 Phylogenetic trees

18 Hours

Part 1

Phylogenetic tree, parts of a phylogenetic tree, data types for preparation of phylogenetic tree (morphological data, protein data, nucleotide data).

Preparing a multiple sequence alignment, principles, free-software available for preparation of multiple sequence alignments, different algorithms (CLUSTAL, MUSCLE, MAFFT, Tcoffee)

Morphological data curation: preparation of presence-absence matrix (with two suitable examples).

Part 2

Preparation of a molecular phylogeny: free-software used to prepare a molecular phylogeny (introduce two programmes).

Methods of molecular phylogeny creation: Distance methods, parsimony methods, model-based inference (ML and Bayesian). Suitable software examples for preparation of each of these types of trees to be mentioned.

Nucleotide substitution models (only conceptual details expected), protein substitution matrices (only conceptual details expected), why model-based inference is better? Models for morphological data analysis.

Online resources for molecular phylogeny creation.

Concept of outgroup, gene-tree, species-tree, super-tree and bootstrapping.

Module 4 Preparation of a scientific publication

18 Hours

Part 1

Argument matrix & Background

Argument matrix, How to set the background of a research article

Reference management & Methods

Referencing using Zotero (or other opensource tools), How to write methods section?

Results & data sharing

formatting tables and figures properly, How to write results section? Data sharing policy, ways to share data through online databases (NCBI, ArXive, figshare, github etc.).

Discussion & Additional information

How to write a discussion? How to write a title, abstract & list keywords?

Part 2

Publication ethics

Publication ethics, plagiarism, predatory journals, paid and free journals, open-access journals

Research quality metrics

Impact factors, citation metrics (i10, h-index).

References

E. O. Wiley & Bruce S. Lieberman, 2011. *Phylogenetics: theory and practice of phylogenetic systematics*. Wiley-Blackwell, New Jersey pP 390.

Sahni, P., & Aggarwal, R. (Eds.). (2018). *Reporting and publishing research in the biomedical sciences*. Springer.

Dey, P. (2018). *Basic and advanced laboratory techniques in histopathology and cytology*. Springer Singapore.

**MSZGY03O02; Open Elective (Multi-Disciplinary); Medical and
Veterinary Entomology
Credits 4– 72 Hours**

Course Objectives

- CO1. Understand the biology and ecology of insect vectors (K2).
 CO2. Remember the techniques and practices of vector surveillance (K1).
 CO3 Explore the epidemiology of insect borne diseases and vector management strategies (K3).
 CO4 Develop practical skills in vector identification through hands on experience and field visits (K3).
 CO5 Analyze the challenges and sustainable practices in vector management (K4).

Insects of Medical and Veterinary Importance

Module I

Major Insect Borne Diseases (25 hrs)

- 1.1. Mosquito borne diseases (Causing organism, Symptoms, treatment and prophylaxis)
Filaria, Malaria, Dengue, Zika, Chikungunya, West Nile and JE Virus
- 1.2. Tick borne diseases (Causing organism, Symptoms, treatment and prophylaxis);
Lyme disease, Rocky Mountain spotted fever, Tickborne encephalitis, KFD.
- 1.3. Fly borne diseases (Causing organism, Symptoms, treatment and prophylaxis)
Leishmaniasis, Sleeping sickness, Onchocerciasis
- 1.4. Causing organism, symptoms, treatment and prophylaxis; Chagas disease and Plague
- 1.5 Insects related to Myiasis
- 1.6 Poisonous insects: Bees, wasps and ants- Anaphylaxis.

Module II

Vector Surveillance and Control (17 hrs)

- 2.1. Vector Surveillance Techniques
- 2.2. Sampling methods and identification
- 2.3. Monitoring vector populations and disease prevalence
- 2.4 Chemical Control Methods
- 2.5. Insecticides and their application
- 2.6. Resistance management and environmental impact.

Module III

Control Methods (15 hrs)

- 3.1. Biological control of predators, parasites, and pathogens
- 3.2. Genetic control and sterile insect techniques
- 3.3. Environmental and mechanical control methods
- 3.4. Habitat modification and source reduction
- 3.5. Physical barriers and traps

Module IV

Parasitic Zoonoses (15 hrs)

- 4.1. Introduction and importance of parasitic zoonoses
- 4.2. Classification of zoonoses

- 4.3. Factors influencing prevalence of zoonoses,
- 4.4. Mode of infections among parasitic zoonoses

References:

1. Kettle D.S. (1995). *Medical and Veterinary Entomology*. 2nd Ed. CAB international.
2. Jeremy Farrar et al (2015). *Manson's Tropical Diseases*, 23rd Edition. Elsevier. Pp. 1552
3. Sun, Xinjuan; Jiang, Kechun; Chen, Jingan; Wu, Liang; Lu, Hui; Wang, Aiping; Wang, Jianming (2014). A systematic review of maggot debridement therapy for chronically infected wounds and ulcers. *International Journal of Infectious Diseases* 25: 32–7
4. Mike Service (2008). *Medical Entomology for students*. 4th ed. Cambridge university Press. U K.
1. Kenneth G.V. Smith (1987). *A manual of Forensic Entomology* . Cornell Univ Pr. Pp.225.
2. Sumodan P.K. (2002). *Insect Detectives*. Resonance .
3. Gennard, D.E.(2007). *Forensic Entomology.-An Introduction*. John Wiley.
4. Wall, Richard and Shearer, David.(1998). *Veterinary Entomology*. Chapman & Hall, London.
5. Smith, K.V.G.(1986). *A Manual of Forensic Entomology*. British Museum Natural History.
6. David, B.V. and Ananthakrishnan, T.N.(2004). *General and Applied Entomology*. 2nd ed. Tata McGraw Hill publishing Co. Ltd. New Delhi.

Claborn, David. (2020). Introductory Chapter: Vector-Borne Diseases. 10.5772/intechopen.91761.

Claborn D, Bhattacharya S, Roy S, editors. *Vector-Borne Diseases - Recent Developments in Epidemiology and Control* [Internet]. IntechOpen; 2020. Available from: <http://dx.doi.org/10.5772/intechopen.83110>

Constantianus J.M. Koenraadt, Jeroen Spitzen and Willem Takken, (2021). *Innovative strategies for vector control*. ISBN 9789086863440 hardback
ISBN 9789086868957 e-book DOI: 10.3920/978-90-8686-895-7

Bennett JE, et al. Ticks, including tick paralysis. In: Mandell, Douglas, and Bennett's *Principles and Practice of Infectious Diseases*. 9th ed. Elsevier; 2020.

MSZGY03O03; Open Elective (Multi-Disciplinary); Medical and Forensic Entomology (Credits 4 – 72 Hours)

Course Objectives

- CO1. Understand the biology and ecology of insect vectors (K2).
 CO2. Remember the techniques and practices of vector surveillance (K1).
 CO3. Understand the epidemiology of insect borne diseases and vector management strategies (K2).
 CO4. Create practical skills in vector identification through hands on experience and field visits (K6).
 CO5. Analyze the challenges and sustainable practices in vector management (K4).

Medical and Forensic Entomology

Module 1: Major Insect Borne Diseases (25 hrs)

- 1.1. Mosquito borne diseases (Causing organism, Symptoms, treatment and prophylaxis)
 Filariasis, Malaria, Dengue, Zika, Chikungunya, West Nile and JE Virus
- 1.2. Tick borne diseases (Causing organism, Symptoms, treatment and prophylaxis);
 Lyme disease, Rocky Mountain spotted fever, Tickborne encephalitis, KFD.
- 1.3. Fly borne diseases (Causing organism, Symptoms, treatment and prophylaxis)
 Leishmaniasis, Sleeping sickness, Onchocerciasis
- 1.4. Causing organism, symptoms, treatment and prophylaxis; Chagas disease and Plague
- 1.5 Insects related to Myiasis
- 1.6 Poisonous insects: Bees, wasps and ants- Anaphylaxis.

Module 2: Vector Surveillance and Control (17 hrs)

- 2.1 Vector Surveillance Techniques
 - 2.1.1 Sampling methods and identification
 - 2.1.2 Monitoring vector populations and disease prevalence
- 2.2 Chemical Control Methods
 - 2.2.1 Insecticides and their application
 - 2.2.2 Resistance management and environmental impact

Module 3: Biological Control Methods (15 hrs)

- 3.1.1 Predators, parasites, and pathogens
- 3.1.2 Genetic control and sterile insect techniques
- 3.2 Environmental and Mechanical Control Methods
 - 3.2.1 Habitat modification and source reduction
 - 3.2.2 Physical barriers and traps

Module 4: Forensic Entomology (15 hrs.)

- 4.1: Introduction to Forensic entomology
- 4.2: Insects used in forensic entomology (Dipterans and coleopterans)
- 4.3: Succession of insect fauna on a cadaver.
- 4.4. Methods of forensic entomology: Detection of time of death, mode of death and place of death. Case histories (At least 2).

References:

Medical entomology

1. Kettle D.S. (1995). *Medical and Veterinary Entomology*. 2nd Ed. CAB international.
2. Jeremy Farrar et al (2015). *Manson's Tropical Diseases, 23rd Edition*. Elsevier. Pp. 1552

3. Sun, Xinjuan; Jiang, Kechun; Chen, Jingan; Wu, Liang; Lu, Hui; Wang, Aiping; Wang, Jianming (2014). A systematic review of maggot debridement therapy for chronically infected wounds and ulcers. *International Journal of Infectious Diseases* 25: 32–7
4. Mike Service (2008). *Medical Entomology for students.4th ed.* Cambridge university Press.U K.

Forensic Entomology

1. Kenneth G.V. Smith (1987). *A manual of Forensic Entomology* . Cornell Univ Pr. Pp.225.
2. Sumodan P.K. (2002). Insect Detectives. *Resonance* .
3. Gennard, D.E.(2007). *Forensic Entomology.-An Introduction.* John Wiley.
4. Wall, Richard and Shearer, David.(1998). *Veterinary Entomology.* Chapman & Hall, London.
5. Smith, K.V.G.(1986). *A Manual of Forensic Entomology.*British Museum Natural History.
6. David,B.V. and Ananthakrishnan,T.N.(2004).*General and Applied Entomology. 2nd ed.* Tata McGraw Hill publishing Co. Ltd. New Delhi.

**MSZGY03 E01; Elective 1; General Parasitology and Helminthology
(Credits-4- 72 hrs)**

Course Outcomes:

- CO1. Remember morphology and classification of important parasites (K1)
 CO2. Analyze the modification of structures and functions in different parasites (K4).
 CO3. Recognize of different groups of parasites (K4).
 CO4. Describe the adaptations of parasites to various environments (K2).
 CO5. Apply morphological description for identification of different parasites (K4).

A. General Parasitology (26 hrs)

MODULE I

1. Introduction to Parasitology; Parasitology and human welfare; Symbiosis and parasitism; Types of parasites and hosts; Transmission of parasites. **4 Hours**
2. Parasitic adaptations- morphological, physiological, biochemical and immunological. **4 Hours**
3. Ecology of parasites –Epidemiology, ecosystem and parasites; host demography; ecological terms in parasitology. **5 Hours**

MODULE II

4. Parasitic Zoonoses – Epidemiology of parasitic zoonoses, classification of parasitic zoonoses, host parasite relationships, modes of infections and factors influencing prevalence of zoonoses, social and economic impact of parasitic zoonoses. **8 Hours**
5. Behaviour and Parasitism – parasite effects benefitting parasites; counter measures of hosts; parasitism and altruism; parasitism and life history theory; parasite effects benefitting hosts. **5 Hours**

B. Helminthology (46hrs)

MODULE - III

1. Introduction to parasitic helminthes – Importance of helminth parasites to human and to animal welfare. **5 Hours**
2. Characters and outline classification of parasitic helminthes – Trematodes, Cestodes and Nematodes and Acanthocephala **7 Hours**

MODULE - IV

3. Taxonomy, Morphology, life cycle, pathology and prophylaxis of the following helminth parasites.

Phylum Platyhelminthes

A. Trematodes

- a) Monogenea: *Polystoma*
- b) Digenea: *Schistosoma*, *Fasciola*
Paragonimus, *Clonorchis*, *Dicrocoelium* *Echinostoma*

B. **Cestodes:** *Diphyllobothrium, Taenia, Echinococcus, Dipylidium, Hymenolepis, Stilesia, Moniezia*

Phylum **Nematoda**

Strongyloides, Ancylostoma, Haemonchus, Ascaris, Enterobius, Heterakis, Wuchereria, Brugia, Loa, Dracunculus, Trichiura, Trichinella

Phylum **Acanthocephala:** *Macracanthorhynchus*

27 Hours

4. Freshwater gastropod molluscs as intermediate hosts of trematode parasites- Classification, characters of snails, and control strategies of molluscs of veterinary importance.
5. Vaccines against helminths of veterinary importance.
6. Emerging and re-emerging helminthic diseases (Brief account).

7 Hours

References

1. Anderson, O.R, Comparative protozoology, Ecology, Physiology, Life history. SpringerVerlag, Berlin.
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9. Ramnik Sood, Parasitology, C.B.S. Publisher, New Delhi.
10. K.D. Chaterjee, Parasitology, Medical Publisher Calcutta.
11. Hobler, E.R. and Noble, G.A. Parasitology 2nd Edition, Lea & Febieger U.S.A 45
12. Smit. D.G. Introduction Animal Parasitology 2nd Edition, Johns Willey Sons, NewYork.
13. Soulsby, E.J.L. Helminthes, Arthropods & Protozoa of Domesticated Animals, ELBS Publication London Ed
14. L. S. Roberts, J. Janovy, Jr. Foundations of Parasitology 8th ed., W.C. Brown, Dubuque, IA(required).
15. Dailey, M. D. Meyer, Olsen & Schmidt's Essentials of Parasitology, 6th ed., W.C. Brown, Dubuque, IA (required).

MSZGY03 E02; Elective 1; General Entomology**(Credits 4 – 72 Hours)****Course Outcomes:**

- CO1. Remember about insect morphology and classification (K1)
- CO2. Analyze the modification of structures in different insects (K4)
- CO3. Recognize of different groups insects (K6)
- CO4. Describe the adaptations of insects to various environments (K2)
- CO5. Apply morphological description for identification of insect (K3)

MODULE 1. External morphology**(25 Hrs)****1.1. Segmentation and division of the body****1.2. General morphology of the head –**

- 1.2.1. Opisthognathous, hypognathous and prognathous
- 1.2.2. Head segmentation- theories about the segmentation of the head
- 1.2.3. Head skeleton- different sutures and sclerites
- 1.2.4. Tentorium
- 1.2.5. Modification in head capsules
- 1.2.6. Cephalic appendages
 - 1.2.6.1. Antenna: structure, function & types
 - 1.2.6.2. Gnathal appendages: types, structure & function
 - 1.2.6.3. Mouth parts of insects
- 1.2.7. Cervix

1.3. Thorax

- 1.3.1. Thoracic segmentation
- 1.3.2. Thoracic skeleton
- 1.3.3. Endothorax
- 1.3.4. Thoracic appendages
 - 1.3.4.1. Modifications of thoracic legs
 - 1.3.4.2. Wings: origin and evolution of wings, structure, venation, wing coupling apparatus, morphological variations

1.4. Abdomen

- 1.4.1. Segmentation
- 1.4.2. Skeletal composition
- 1.4.3. Pregenital and post genital segments
- 1.4.4. Abdominal appendages
- 1.4.5. External genitalia: male and female

MODULE 2. Insect classification

(17 hrs)

2.1. Introduction to classification of insects.

Mention Apterygota, Exopterygota, Endopterygota, Hemimetaboly and Holometaboly.

2.2. Apterygota

Diagnostic characteristics, biology and economic importance of the following Orders: Collembola, Protura, Diplura, Archeognata (Microcoryphia) and Thyasanura. Locomotion in Collembola.

2.3. Exopterygota: Diagnostic characteristics, biology and economic importance of the following Orders and families mentioned under each order.

1. Ephemeroptera.
2. Odonata - mention dragon flies and damsel flies, mouthparts of naiads, mating behavior.
3. Isoptera- Castes, Termitarium, economic importance.
4. Phasmida.
5. Blattaria- mention economic importance and important species.
6. Mantoidea & Mantophasmatodea.
7. Orthoptera- Families: Acrididae, Tetrigidae, Tettigonidae, Gryllidae, Gryllotalpidae. Stridulatory organs in Orthoptera; Locusts.
8. Thysanoptera.
9. Hemiptera; Families- Cicadidae, Jassidae, Cercopidae, Membracidae, Aphididae, Nepidae, Gerridae, Pentatomidae, Reduviidae. Medical importance
of Reduviidae; Polymorphism in Aphids; Stridulation in Cicada.
10. Psocoptera.
11. Phthiraptera- mention *Pediculus humanus* and its parasitic adaptations.
12. Dermaptera- Sexual dimorphism and parental care.

13. Plecoptera.

14. Embioptera.

15. Zoraptera.

MODULE 3. Insect Classification: Endopterygota (15 Hrs)

3.1. Endopterygota : Diagnostic characteristics, biology and economic importance of the following Orders and families mentioned under each order.

1. Coleoptera- Families: Curculionidae, Scarabaeidae, Carabidae, Cerambycidae, Lampyridae, Chrysomelidae, Elateridae, Meloidae. Mention cantharidin and bioluminescence.
2. Lepidoptera. Butterflies and Moths. Families: Noctuidae, Sphingidae, Saturnidae, Pyralidae, Papilionidae, Nymphalidae, Hesperidae, Pieridae, Lycaenidae, Geometridae .
3. Hymenoptera: Families: Vespidae, Sphecidae, Megachilidae, Apidae, Eumenidae, Xylocopidae, Formicidae, Evanidae, Braconidae, Ichneumonidae, Chalcididae, Eulophidae, Eurytomidae, Pteromalidae. Parasitic hymenoptera and biological control.
4. Diptera: Suborders: Nematocera and Brachycera. Families: Muscidae, Culicidae, Calliphoridae, Sarcophagidae, Simuliidae, Tipulidae, Glossinidae, Drosophilidae, Psychodidae.
5. Siphonoptera.
6. Strepsiptera.
7. Neuroptera.
8. Mecoptera.
9. Megaloptera.
10. Raphidioptera.
11. Trichoptera.

MODULE 4. Ecology and Behaviour

(15 hrs)

4.1. Aquatic insects

- 4.1.1. Factors influencing the aquatic life
- 4.1.2. Food capture; modifications
- 4.1.3. Respiration in semi-aquatic and in truly aquatic insects
- 4.1.4. Oviposition methods
- 4.1.5. Anchorage, locomotion
- 4.1.6. Adaptations of swimming forms

4.2. Gall forming insects

- 4.2.1. Definition and features
- 4.2.2. Formation, economic importance

- 4.2.3. Common gall pests
- 4.2.4. Extent of gall making habits
- 4.2.5. Gall as dwelling place, the position of gall
- 4.2.6. Classification of galls by Orders
- 4.2.7. Adaptation for the gall making habits
- 4.2.8. Origin and types of galls (open & closed)
- 4.2.9. Physiology of gall formation

4.3. Leaf mining insects

- 4.3.1. Definition and identification
- 4.3.2. Forms of leaf mines, economic importance
- 4.3.3. Extent of the leaf mining habits
- 4.3.4. Feeding habits and frass disposal
- 4.3.5. Ecological aspects of leaf mining

4.4. Insect-plant interdependence (co-evolution)

4.5. Social insects – social organisation

- 4.5.1 Caste differentiation
- 4.5.2 Aspects of social behaviour with reference to honey bee, termite and ant
- 4.6. Communication – acoustic, visual, tactile and chemical method (pheromones)
- 4.7. Adaptations of parasitic and predatory insects

References

1. Ananthkrishnan, T.N. (1992): *Dimensions of Insect-Plant Interactions*, Oxford & IBH Publishing Co. Pvt. LTD.
2. Aswathy, V.B. (1998): *Introduction to General and Applied Entomology*. ISBN.
3. Borror, D.J. and DeLong, D.M. (1964). *An Introduction to the study of Insects*. Holt Rinehart and Winston, New York.
4. Carde, R, T. and Bell, W.J. (1995): *Chemical Ecology of Insects-2*. Chapman and Hall, New York
5. Essig, E. O. (1974): *College Entomology*. Mac Millon Co. London
6. Richard, W. and Davies, R.G.G. (1977). *Imm's general text book of Entomology, 10th edition*, Chapman & Hall.
7. Mani, M.S. (1974): *Modern classification of Insects*. Satish Book Enterprise., Agra.
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14. Gillot, C. (2005). *Entomology*. 3rd ed. Springer.
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16. Wigglesworth, V.B. (1964). *The life of Insects*. Heindenfield and Necolson, London.

SEMESTER IV

MSZGY04C17: Microbiology and Biotechnology

Credits 4 – 72 Hours

Course Objectives

CO1. Understand the importance of biotechnology and microbiology in biological studies (K2).

CO2. Remember the techniques and practices of biotechnology and microbiology (K1).

CO3 Understand intellectual property rights K2).

CO4 Develop the awareness about the guidelines of biosafety (K6).

A- Microbiology

Module 1

16 Hrs

1.1. History and scope of Microbiology - 2 Hours

1.2. Microbial Diversity: Place of microorganisms in the living world – criteria used in Microbial taxonomy; Classification of bacteria – past and present status – classification based on morphology, gram's staining and culture characteristics. Classification based on Bergey's manual of systematic bacteriology (details of sections not expected) Classification of viruses-classification based host, morphology and nucleic acid characteristics. 6 Hours

1.3. Structural organization of bacteria and viruses: Ultra structure of bacterial cell wall, cell membrane – flagella – pili – capsule and genome: Bacterial gene regulation – Operons; Structure and architecture of bacteriophages. 4 Hours

1.4 Bacterial culturing: Physical and chemical methods of sterilization – growth media mixed microbial population – selection of pure culture – physical conditions of growth – growth curve – storage and transport of microbes 6 Hours

Module 2

19 Hrs.

2.1. Microbial toxins: Exotoxins – endotoxin and other virulence factors 3 Hours

2.2. Disinfectants and antibiotics: Methods of testing antimicrobial substances – mechanism and action of important classes of disinfectants and antibiotics - drug resistance of antibiotics- 4 Hours

2.3. Microbes and diseases: Bacterial diseases – Streptococcal diseases – pneumococcal diseases- Diphtheria-Tuberculosis- Plague – Anthrax – Syphilis – Tetanus – Leprosy- UTI; Viral diseases – Chicken pox – Small pox – Rabies – Covid - AIDS – Hepatitis- HPV- KFD- 8 Hours

2.4. Microbes and Pollution: Major pollution problems – pathogens, microbial toxins, oxygen depletion, biodeterioration, eutrophication, hazardous transformation etc., and management of pollution problems using microorganisms. 4 Hours

B- Biotechnology

Module 3

20 Hrs.

3.1. Biotechnology and its applications:

- (a) Medical, Agricultural, Industrial and Environmental applications
- (b) Gene therapy and its types

- (c) RNAi and Gene silencing
- (d) Terminator genes.
- (e) Transgenic animals and plants.

3.2. Recombinant DNA Technology

- (a) Gene cloning
- (b) Enzymes: Restriction enzymes, Ligases, DNA Polymerases, Reverse transcriptase, Alkaline phosphatase, Phosphonucleotide kinase, RNase, DNase, Terminal transferase and SI Nuclease.
- (c) Cloning vectors: Plasmids (pBR 322, pUC8, pUC9 Ti-DNA plasmid), Cosmids, Phagemids, Artificial chromosomes (YAC, BAC and MAC), Shuttle vectors and Expression vectors.

3.3. Gene library and Genetic markers

- (a) Gene library: Genomic library, cDNA library and Expression libraries
- (b) Screening of Gene libraries: DNA hybridization, Immunological Assay, Screening by protein activity, Genetic complementation and Hybrid Arrest Translational systems.
- (c) Genetic markers (RFLP, AFLP, RAPD) and its applications

Module 4

17 Hrs

4.1. Gene amplification, Gene Sequencing and gene expression analysis

- (a) Gene amplification: Polymerase Chain Reaction (PCR); Types and applications
- (b) Gene Sequencing methods: Maxam and Gilbert method, Sanger method, Automated sequencing method, NGS (Sequencing by synthesis, Pyrosequencing, Ion torrent and Nanopore sequencing).
- (c) Microarray and gene expression analysis.

4.2. Biotechnology: Hazards, Biosafety and Intellectual Property Right (IPR)

- (a) Hazards of environmental engineering
- (b) Biosafety guidelines and regulations
- (c) IPR, IPP, Patenting, Copyright and Trade mark

References (Microbiology):

1. Prescott, Harley and Klein, *Microbiology*, McGraw – Hill
2. Jacquelyn G Black, *Microbiology: Principles and Exploration*, John Wiley & Sons
3. Nester *et al*, *Microbiology: A human perspective*. McGraw Hill
4. Albert G Moat *et al*, *Microbial physiology*, John Wiley & Sons
5. Kathleen Park Talaro, Arthur Talaro, *Foundations in Microbiology*, Mc Graw Hill
6. Alcamo, *Foundations of Microbiology*, Jones and Bartlett Publishers

7. Cappuccino James, *Microbiology: A Laboratory Manual*; Pearson Education
8. Tortora Gerard, Berdell R Funke and Christine L Case (2011), *Microbiology: An introduction (9th Ed.)*. Pearson education
9. Edward A I, *Microbiology*. Tata McGraw Hill
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11. Pelczar M J Jr, Chan E C S Krieg, *Microbiology*
12. Godkar, PB (1998), *A Text book of Medical Laboratory Technology*, Bhalani Publishing house, Mumbai
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References (Biotechnology):

1. *Principles of gene manipulation- An Introduction to Genetic Engineering*. Old, RW & Primrose, S.B – 1994 5th Edn. Blackwell Sci Pub.
2. *Molecular Cloning- A Laboratory Manual*; Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989.. Second Edition. Cold Spring Harbor Laboratory Press.
3. *Recombinant DNA technology- Concepts and Biomedical Applications*; Steinberg, M., Guyden, J., Calhann, D, Staiano- Coico, L.,Coico, R,1993. Ellice Horwood Prentice Hall.
4. *Recombinant DNA*; Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992. Second Edition. Scientific American Books, WH Freeman & Co.
5. *From Genes to Clones: Introduction to Gene* - Winnacker, E. L. 1987.
6. *Molecular Biotechnology* 5th Edition Bernard R. Glick, Jack J. Pasternak, Cheryl L. Pattern ASM Press 2017
7. *Gene cloning and DNA analysis: An Introduction*; 6th Edition. T.A. Brown Wiley Blackwell 2013
8. *Modern Biotechnology: Connecting Innovations In Microbiology and Biochemistry to Engineering Fundamentals*; Nathan S. Mosier, Michael R. Ladisch Wiley 2009
9. *Biotechnology in Agriculture and Forestry*; 66: Editors: Jack M. Widholm and Toshiyuki Nagata : Springer 2012
10. *Environmental Biotechnology: New Approaches and Prospective Application*: Marian Petre (Editor) 2013
11. Beir, F.K, Crespi, R.S and Straus J: 1982 *Biotechnology and patent protection*; Oxford and IBH Publishing Co. New Delhi.
12. *Department of Biotechnology (1990) Recombinant DNA Safety guidelines*. Govt. of India, New Delhi.
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14. Narayanaswami K: 1994, *Safety and regulatory arrangements in Biotechnology in Sohal and Srivastava (eds) Environment and Biotechnology.*
15. Brown T A, *Gene Cloning and DNA Analysis*; Balackwell Science.
16. Click B R and pasternack J J *Molecular Biotechnology: principles and Applications of Reobmbinant DNA.* Panima.
17. James D Watson et al., *Recombinant DNA: A short Course.* Scientific American Books, W H Freeman & Co.
18. Old R W & Primrose S B, *Principles of Gene Manipulations*, Black Well Science
19. Winnaker E L, *From Genes to Clones: Introduction to Gene Technology.* VCH Publications. Purohit S S & Mathur S.K *Biotechnology: Fundamental and Application.* Agrobios.
20. Eric Grace, *Biotechnology Unzipped: promises and Realities.* University Press.
21. Fumento Michael, *Biotechnology demystifying the concepts.*
22. Meyers Roberts A, *Molecular Biology Biotechnology*, John Wiley

**MSZGY04E05: Protozoology and Medical & Veterinary
Entomology
(Credits-4 - 72 hrs;)**

Course Outcomes:

- CO1. Remember morphology and classification of important protozoan parasites (K1)
- CO2. Analyze the role of insects as vectors transmitting different parasites(K4)
- CO3. Recognize of different vectors of medical and veterinary importance (K6)
- CO4. Describe the arachnid and crustacean vectors (K2)
- CO5. Appley of morphological description for identification of different vectors (K3)

A. Protozoology (36 hrs)

MODULE - I

1. General characters and outline classification of parasitic protozoa
2. Morphology, life cycle, pathology and prophylaxis of the following protozoan parasites:
 - a) Phylum **Euglenozoa**- *Trypanosoma, Leishmania*
 - b) Phylum **Metamonada** - *Chilomastix, Giardia, Histomonas, Trichomonas*
 - c) Phylum **Amoebozoa** – *Entamoeba*

18 Hours

MODULE - II

- d) Phylum **Ciliophora** – *Balantidium*
- e) Phylum **Myzozoa** – *Eimeria, Toxoplasma*
- f) Phylum **Apicomplexa** - *Plasmodium, Babesia, Theileria, Sarcocystis.*
- g) Phylum **Cnidaria** – *Myxosoma cerebralis*
- h) Phylum **Microsporidia** – *Nosema bombysis*

18 Hours

B Medical and Veterinary Entomology (36 hrs)

MODULE - III

1. Introduction: - Importance of arthropods from the medical and veterinary point of view.
2. Outline classification of Phylum Arthropoda with reference to medical and veterinary importance.
3. Morphology, life cycle, pathology/ vector importance and control measures of following arthropods:

A. Insecta

- a) Diptera: *Phlebotomus, Glossina, Anopheles, Culex, Aedes, Mansonia, Tabanus, Chrysops.*
- b) Siphonaptera: *Ctenocephalides, Xenopsylla, Pules, Tunga*
- c) Phthiraptera: *Pediculus, Pthirus*, A brief account on lice of veterinary importance

d) Hemiptera: *Cimex*, Triatomine bugs

18 Hours

MODULE - IV

B. Arachnida

a) Ticks: *Argas*, *Rhipicephalus*, *Boophilus*, *Hamaphysalis*

b) Mites: *Sarcoptes*, *Knemidokoptes*, *Leptotrombidium*

C. Crustacea

Lernaea, *Sacculina*, *Caligus*

4 **Myiasis** : Definition, types, medical and veterinary importance

5 Venomous, Urticating and Allergic Arthropods

18 Hours

References

1. Anderson, O.R, Comparative protozoology, Ecology, Physiology, Life history. SpringerVerlag, Berlin.
2. Cheng T. C. General Parasitology, Academic Press.
3. Cox F.E.G., Modern Parasitology, Eds. Parasitology in focus, facts & trends, Melhorn Eds., Spriger Verlag, Beriin.
4. Piakarsky G. L., Medical Parasitology, Springer Verlag, Berlin.
5. Wyler D. J., Eds. W. H. Freeman, NY, Modern Parasitology, Cellular immunological & Immunological aspects,
6. Soulsby, E. J. L., Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London.
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11. Hobler, E.R. and Noble, G.A. Parasitology 2nd Edition, Lea & Febieger U.S.A 45
12. Smit. D.G. Introduction Animal Parasitology 2nd Edition, Johns Willey Sons, NewYork.
13. Soulsby, E.J.L. Helminthes, Arthropods & Protozoa of Domesticated Animals, ELBS Publication London Ed
14. L. S. Roberts, J. Janovy, Jr. Foundations of Parasitology 8th ed., W.C. Brown, Dubuque, IA(required).
15. Dailey, M. D. Meyer, Olsen & Schmidt's Essentials of Parasitology, 6th ed., W.C. Brown, Dubuque, IA (required).

MSZGY04E06: INSECT PHYSIOLOGY
(Credits-4 -72 Hrs-)

Course Outcomes:

- CO1. Remember about insect organ systems and their functions (K1).
- CO2. Analyze the modification of organs and functions in different insects (K4).
- CO3. Recognize of differences in physiological processes of insects (K6)
- CO4. Describe the nervous and chemical co-ordination in insects (K2)

Module 1; Integumentary and Digestive systems (18 hrs)

1.1. The Integument

- 1.1.1. Histology-basic components
- 1.1.2. Chemical and physical properties
- 1.1.3. Moulting and sclerotisation
- 1.1.4. Hormonal control and function

1.2. Digestion and Assimilation

- 1.2.1. General structure of alimentary canal: foregut, midgut, hindgut and their modifications
- 1.2.2. Digestive enzymes and physiology of digestion
- 1.2.3. Specialized digestion: Digestion of wood, keratin wax and silk, Extra-intestinal digestion
- 1.2.4. Role of micro flora/ fauna in insect digestion
- 1.2.5. Assimilation.

Module 2; Respiratory and Circulatory systems (18 hrs)

2.1. Respiratory system

- 2.1.1. Structure and modification of respiratory system
- 2.1.2. Closed and open tracheal system
- 2.1.3. Physical gill and plastron respiration
- 2.1.4. Diffusion, ventilation, control of ventilation, cyclic release of carbon dioxide

2.2. Circulatory system

- 2.2.1. Cellular elements in haemolymph

2.2.2. Composition of haemolymph

2.2.3. Dorsal vessels, accessory pumping sinuses and diaphragm

2.2.4. Heart beat rate and control of heart beat

2.2.5. Course of circulation of haemolymph

Module 3; Excretory, Nervous and Muscular systems (18 hrs)

3.1. Excretory system

3.1.1. Malpighian tubules, Nephrorectal complex and labial glands

3.1.2. Physiology of excretion

3.1.3. Synthesis of uric acid and formation of excreta

3.2. Nervous system

3.2.1. General structure and organization of central and peripheral nervous system

3.2.2. Anatomy and histology of brain, ganglia and nerves

3.2.3. Reception of stimuli and transmission of nerve impulses, transmission at synapse

3.2.4. Sense organs – anatomy, histology and physiology of mechanoreceptors, chemoreceptors and photoreceptors.

3.3. Muscular system

3.3.1 Histomorphology of insect muscles

3.3.2 Neuromuscular junctions

3.3.3 Excitation of muscle fibres, activation of muscle fibres, role of fast and slow axons

Module 4; Endocrine and exocrine glands, Reproductive system and morphogenesis and Embryogenesis (18 hrs)

4.1. Endocrine and exocrine glands

4.1.1. Histomorphology of neurosecretory cells and endocrine glands (corpora cardiaca, corpora allata and Prothoracic glands)

4.1.2. Hormones and their functions

4.1.3. Mechanism of hormone action

4.1.4. Pheromones and their function

4.2. Reproductive system and morphogenesis

4.2.1. Development of primordial germ cells

4.2.2. Reproductive system- structure-male and female

4.2.3 Fertilization and oviposition

4.2.4 Formation of blastoderm and extraembryonic membranes

4.2.5. Sex determination and parthenogenesis

4.3. Embryogenesis

4.3.1. Differentiation of germ layers

4.3.2. Segmentation, appendage formation, organogenesis

4.3.3. Polyembryony, paedogenesis, viviparity, oviparity, eclosion

4.3.4. Postembryonic development-hatching, larval development and control, polyphenism, diapause.

References

1. Beament, J.W.L., Treherne, J. E. and Wigglesworth, V.B.(1972). *Advances in Insect Physiology*, Academic press, London
2. Bursell, E (1970): *An Introduction to Insect physiology*, Academic Press
3. Chapman. R.F.(1998): *The Insects: Structure and Function*. 4th ed. ELBS, London.
4. Gilbert, L.I. & Kerkut. G.A. (1985): *Comprehensive Insect Physiology, Biochemistry and Physiology*, Vol. 1-12
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**MSZGY04E07; PHYSIOLOGY, IMMUNOLOGY, BIOCHEMISTRY &
GENETICS OF PARASITES
(4 CREDITS; 72 HOURS)**

Course Outcomes:

- CO1. Remember about parasite organ systems and their functions (K1).
CO2. Analyze the modification of organs and functions in different parasites (K4).
CO3. Recognize of differences in physiological processes of parasites (K6)
CO4. Describe the genetic and chemical co-ordination in parasites (K2)

MODULE 1: PHYSIOLOGY OF PARASITES (18hrs)

PART A

1.1 Parasitism & symbiosis

1.1.1 Types of symbiosis: Phoresis, commensalism, parasitism, mutualism, cleaning symbiosis

1.1.2 Effects of parasites on hosts:

1.1.2.1 Destruction of host's tissues

1.1.2.2 Competition for host's nutrients.

1.1.2.3 Mechanical interference

1.1.2.4 Effects of toxins, poisons and secretions

1.1.2.5 Other parasite-induced alterations- sex reversals, parasitic castration, enhanced growth

PART B

1.2 The microenvironment and the phases of parasitism:

1.2.1 The vertebrate alimentary canal

1.2.2 Mammalian blood

1.3 The phases of parasitism

1.3.1 Host-symbiont contact

1.3.2 Preparation for entry

1.3.3 Establishment of the symbiont

1.3.4 Escape of the symbiont

1.4 Neurotransmitters in *Ascaris*: acetylcholine, GABA, Glutamate, 5-HT, FMRF-related peptides

MODULE 2: IMMUNOLOGY OF PARASITES (18hrs)**PART A**

- 2.1 Host reactions
- 2.2 Invertebrate internal defense mechanisms
 - 2.2.1 Phagocytosis
 - 2.2.2 Encapsulation
 - 2.2.3 Nacrezation
 - 2.2.4 Humoral factors
 - 2.2.5 Lysosomal enzymes
 - 2.2.6 Antimicrobial molecules
- 2.3 Vertebrate immunity against parasites
 - 2.3.1 Antigenic determinants
 - 2.3.2 Antibodies & antibody synthesis
 - 2.3.3 Antigen-antibody interactions- Primary, secondary and tertiary
 - 2.3.4 Macrophages
 - 2.3.5 Granulocytes
 - 2.3.6 Plasma cells
- 2.4 Parasite evasion of hosts defenses

PART B

- 2.4 Chemotherapy
 - 2.4.1 Anti-parasitic drugs:
 - 2.4.2 Drug resistance in parasites
- 2.5 Vaccines
 - 2.5.1 Vaccines against helminthes
 - 2.5.2 Vaccines against *Plasmodium*
- 2.6 Controlling parasites in future

MODULE 3: BIOCHEMISTRY OF PARASITES (18hrs)**PART A**

- 3.1 Nutrition & metabolism
 - 3.1.1 Carbohydrate metabolism
 - 3.1.2 Lipid metabolism
 - 3.1.3 Protein metabolism

PART B

3.2 Intracellular signaling

3.2.1 Role of Ca²⁺

3.2.2 Cyclic nucleotides

3.2.3 Reversal protein phosphorylation

3.3 Structure of helminth surfaces

3.3.1 Biochemistry of cestode surface

3.3.2 Biochemistry of trematode surface.

3.4 Metabolic plasticity, essentiality and therapeutic potential of ribose-5-phosphate synthesis in *Toxoplasma gondii* (Brief account)**MODULE 4: GENETICS OF PARASITES (18hrs)****PART A**

4.1 Parasitic genomics

4.2 Parasites and their genomes

4.3 Kinetoplast DNA

4.4 Antigenic Variation in African Trypanosomes

4.5 Antigenic Variation in Malaria.

PART B

4.6 RNA processing in parasitic organisms

4.6.1 Trans-splicing

4.6.2 RNA editing

4.7 Unusual mode of transcription in trypanosomatids and nematodes

4.8 Chromosome and gene mapping in parasites

4.9 tRNA modification and artemisinin resistance in *Plasmodium falciparum* (Brief account only)**REFERENCES**

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2. Loker, E.S. & Hofkin, B.V. (2015). *Parasitology- A Conceptual Approach*. Garland Science. Taylor & Francis Group. New York & London.

3. Goater, T.M., Goater, C.P., Esch, G.W. (2014). *Parasitism- The diversity & Ecology of Animal Parasites*. 2nd Edition. Cambridge University Press.
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MSZGY04E08: AGRICULTURAL ENTOMOLOGY

(4 Credits - 72 Hours)

Course Outcomes:

CO1. Remember about pest status and concepts of economic injury levels

(K1)

CO2. Identify insect pests of important crops (K4).

CO3. Recognize suitable measure to control the infestation of insect pests

(K6).

CO4. Describe the action of different types of pesticides (K2).

CO5. Remember about the side effects of pesticides (K1)

CO6. Recognize suitable pest control measures with minimum residual effect

(K6)

Module 1: Insect Pests

(12 Hrs)

1.1. Types of damage to plants by insects (Injury by chewing insects, piercing and sucking insects, internal feeders, subterranean insects, to stored products and indirect effect of feeding)

1.2. Classification of insect pests (Regular pests, Occasional pests, Seasonal pests, persistent pests, sporadic pests, major pests, minor pests, potential pests, key pests)

1.3. Causes for insect assuming pest status

1.4. Concepts of Economic levels, Economic injury levels, Economic threshold level

1.5. Pest surveillance and forecasting pest outbreak

1.6. Estimation of damage caused by insects to crops

Module 2: Insect pests of crops

(20 Hrs)

2.1. Identification, life history, damage and control of major pests of:

2.1.1. Paddy (15 major pests including stem borers, army worm, rice thrips, gall midge, mealy bug, BPH, green & white leaf hoppers, rice caseworm, rice leaf roller, rice hispa, rice earhead bug, root weevil, rice grass hoppers)

2.1.2. Sugarcane (Major pests including shoot, internode & top borers, white grub, leaf hopper, sugarcane scale, mealy bug, whiteflies)

2.1.3. Cotton (Major pests - Aphid, leaf hopper, thrips, whitefly, Pink spotted and American boll worms, stem weevil, leaf roller)

2.1.4. Coconut (7 pests - Rhinoceros beetle, red palm weevil, black-headed caterpillar, white grub, Scale insect, Lace wing bug, coconut skipper)

2.1.5. Pulses (8 pests - Gram pod borer, plume moth, red gram pod fly, pod borer, spotted pod borer, Blue butterflies, bean aphid, white fly)

2.1.6. Common vegetables

2.1.6.1. Brinjal (shoot & fruit borer, stem borer, spotted leaf beetle, grey weevil, Pumpkin beetle)

2.1.6.2. Tomato (serpentine leaf miner, fruit borer)

2.1.6.3. Gourds (fruiflies, snake gourd semilooper, spotted beetle, Pumpkin beetle)

2.1.6.4. Bhendi (Earias, leaf hopper, Red cotton bug, Grampod borer)

2.1.6.5. Cruciferous vegetables (diamond black moth, cabbage borer, leaf webber, Cabbage green semilooper, Cabbage aphid)

2.1.7. Fruit trees

2.1.7.1. Mango (hopper, flower webber, Leaf webber, gall midges, Nut weevil, stem borer, red tree ant)

2.1.7.2. Cashew (tree borers, Hairy caterpillar, Tea mosquito bug, Apoderus, Leaf miner)

2.1.7.3. Banana (rhizome weevil, banana aphid, spittle bug)

2.1.7.4. Citrus (Fruit sucking moth, citrus butterfly)

2.1.8. Spices

2.1.8.1. Pepper (pollu beetle, shoot borer, Marginal gall thrips)

2.1.8.2. Cardamom (cardamom thrips, rhizome borer, cardamom whitefly, hairy caterpillars, Eupterote and Pericallia)

2.1.8.3. Turmeric and Ginger (Leaf roller, shoot borer)

2.2. Identification, nature of damage & control of Insect pests of Stored Products: rice weevil, sweet potato weevil, tobacco beetle, drug store beetle, pulse beetle, Angoumois grain moth, potato tuber moth, Red flour beetle, rice moth)

Module 3: Principles of Insect pest management

(20 Hrs)

3.1. Prophylactic methods

3.2. Curative or direct methods

3. 2.1. Cultural methods

3. 2.2. Mechanical methods

3. 2.3. Physical methods

3. 2.4. Legal methods

3. 3. Biological control-

3. 3.1. History of biological control, Ecological basis of biological control.

3. 3. 2.Natural enemies (Parasites, Parasitoids, Predators), Feasibility of biocontrol.

3. 3. 3.Applied biological control (Conservation and Enhancement, Importation and Colonization, Mass culture and release).

3.3.4. Importance of systematics, Advantages and disadvantages of biological control.

3. 3.5. Important biocontrol projects undertaken in India by employing parasites and predators.

3. 4. Autocidal control- Sterile male technique and other methods, Chemosterilants, Methods of sterilization, Application, Dynamics, Advantages and disadvantages, Examples of autocidal control.

3.5. Insect growth regulators (IGRs) – Brief note on Insect growth hormones and mimics (JH mimic & ecdysone agonists) and chitin synthesis inhibitors as insect control agents.

3.6. Behavioural (pheromonal) control- (Brief note on Trail, Alarm, Aggregation and sex pheromones and the behaviour produced, Mode of application, Pest management with pheromones, Advantages and disadvantages, Examples).

3. 7. Insect attractants: definition, types of attractants, applications in insect pest management, examples, advantages and disadvantages.

3.8. Insect repellents: definition, desirable features of good repellent, types of repellents, applications in insect pest management, examples, advantages and disadvantages.

3.9. Insect antifeedants: definition, examples, applications in insect pest management, advantages and disadvantages

3.10. Microbial control of crop pests by employing Bacteria, Virus and Fungi
Classification of entomophagous Bacteria, Virus, Fungi, Mode of action, formulation, Application, Examples

3.11. Integrated Pest Management- Definition, IPM in Agroecosystem, Kinds of pest, (Key pests, Occasional pests, Potential pests, Migrant pests) Establishing the need to take action, Guidelines for developing IPM, Tactics in IPM, IPM of Rice.

Module 4. Chemical Control of Insect Pests

(20 Hrs)

4.1. Insecticide formulation (Brief note on Emulsifiable concentrates, Water-miscible liquids, Wettable powders, Water soluble powders, Oil solutions, Flowable powders, Aerosoles, Granulars, Fumigants, Ultra-low volume concentrates, Fogging concentrates, Dusts, Poison baits and Slow-release insecticides)

4.2. Classification of insecticides.

4.2.1. Based on mode of entry.

4.2.2. Based on mode of action.

4.2.3. Based on chemical nature

4.3. Chemistry, toxicology & mode of action of following class of insecticides; mention examples for each class.

4.3.1. Synthetic Organic compounds.

4.3.1.1. Organochlorine insecticides.

4.3.1.1.1. DDT.

4.3.1.1.2. BHC.

4.3.1.1.3. Cyclodiene group

4.3.1.2. Organophosphorous insecticides (examples: TEPP, Dichloros, monocrotophos, parathion).

4.3.1.3. Carbamates (special mention of carbofuran; examples: Carbaryl, aprocarb)

4.4. Inorganic compounds as insecticides - arsenic compounds, fluorides, sulphur compounds

4.5. Fumigants – definition, examples, methods of fumigation, hazards of fumigation, advantages and precautions

4.6. Botanical insecticides- chemical properties, mode of action and toxicity of the following: Nicotine, Rotenone, Pyrethrum and Neem

4.7. Synthetic pyrethroids – definition, uses as insecticides, mode of action (examples: Pyrethrin, allethrin)

4.8. Insecticide synergists – definition, types of synergism, mode of action & examples

4.9. Insecticide resistance -Genetic, Physiological and biochemical mechanism

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1. Ananthkrishnan, T.N. (1977): *Insect and Host Specificity*, Mc Millan Co, India Ltd.

2. Ananthakrishnan, T.N.(1992).*Emerging trends in Biological Control of Phytophagous Insects*. Oxford and IBH Publishing Co. Pvt. Ltd.,New Delhi.
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10. Hill, D.S., *Agricultural Entomology*
11. Hill, D.S., *Agricultural Insect Pests of the Tropics and their control C.V.P.*
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13. Metcalf. G.L.and Flint.W.P.(1962). *Destructive and Useful Insects, their Habits and Control*. Tata Mc Graw Hill Publishing.Co.Ltd. N.Y.
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15. Nair, M.R.G.K. (1975): *Insect and Mites of Crops in India*, ICAR, New Delhi.
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20. Romoser, W.S. and Stoffalano, J.G. (1994). *The Science of Entomology*. 3rd Edn. Wm. C. Brown Publishing
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25. Walter, G. (2003). *Insect Pest Management and Ecological Research*, Cambridge University Press, U K.

MSZGY03&04 C14; Microbiology and Biotechnology- Practical
(Credits 3 – 54 Hrs)

Course Outcomes:

- CO1. Remember about different parts of a microscope and their functions (K1)
- CO2. Acquire the skills for staining bacteria and fungi (K2)
- CO3. Identify the roles of different components of a microbial culturing medium (K6)
- CO4. Describe different sterilization techniques used in the laboratory (K2)
- CO5. Acquire necessary skills for extracting and quality control nucleic acids from tissue extracts and microbes (K3)

A. Microbiology

1. Microscopy; Principle, parts, handling and care
2. Staining of Bacteria; Simple staining, Gram staining and negative staining
3. Fungal staining
4. Bacterial Motility determination
5. Sterilization
6. Media preparation
7. Culture methods; Streak plate, pour plate and spread plate
8. Fungal culture
9. Antibiotic sensitivity testing
10. Applied microbiology; MBRT, mesophilic count of fish, antibiosis by soil microorganisms, water quality analysis, Isolation of bacteria from food and their identification.

B. Biotechnology

1. Isolation of DNA – bacterial, yeast, plasmid, animal
2. Isolation of total RNA from tissues
3. Separation of DNA by electrophoresis.
4. Cloning in plasmid.
5. Bacterial transformation

6. Demonstration of blotting techniques
7. PCR amplification of genes – bacterial and animal

References

Microbiology

1. Cappuccino, J. G., & Sherman, N. (2013). *Microbiology: a laboratory manual*. Pearson Higher Ed.
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3. 4. Caumette, P., Lebaron, P., Matheron, R., Normand, P. and Ngando, T. S. (2015). *Environmental Microbiology: Fundamentals and Applications*. Springer
4. 5. Claus, W.G. (1989). *Understanding microbes: A laboratory text book for Microbiology*. W.H. Freeman & Company, New York.

Biotechnology

1. Ausubel, F. M., Brent, R., Kingston, R. E., Moore, D. D., Seidman, J. G., Smith, J. A. and Struhl, K. (2002). *Short Protocols in Molecular Biology*. John Wiley and Sons Inc.
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3. Wilson Keith and Walker John (2006). *Principles and Techniques of Biochemistry and Molecular Biology 6th Ed.*, Cambridge University Press, New York.

**MSZGY03&04 C15; HISTOLOGY AND DEVELOPMENTAL BIOLOGY
PRACTICAL**

(Credits 3 – 54 Hrs)

Course Outcomes:

- CO1. Remember about culturing drosophila and identifying sexes (K1).
- CO2. Acquiring the skills for vital staining chick embryo and studying the early development (K6).
- CO3. Identify the larval forms of different animals (K4)
- CO4. Describe the changes at any stage of chick embryo (18hrs/24hrs/ 48hrs) (K2)
- CO5. Acquire necessary skills for preparing histological sections (K6)

A. Developmental Biology

1. Maintenance of *Drosophila melanogaster* culture, life cycle study, and sex determination.
2. Studies on chick embryos by vital staining using the window method.
3. Preparation of stained permanent mount of any stage of chick embryo (18hrs/24hrs/ 48hrs).
4. Preparation of whole and stained mounts of larval forms.
5. Identification of *Meloidogyne* species from root-knot using females and preparation of stained mount of males and juveniles.
6. Studies on the life cycle of mosquitoes. Identification of important mosquito species by using eggs, larvae, pupae, and adults.
7. Studies on the developmental stages of any soil mite in plastic vials based with a suitable medium.
8. Observation and mounting of developmental stages of any plant mite species [egg, larva, protonymph, deutonymph, adults (male and female)].

B. HISTOLOGY

1. Study of prepared permanent slides of animal tissue sections
2. Preparation of microscopic slides of stained sections of tissues (such as liver, kidney, lung, intestine, pancreas, testis, ovary etc.)
4. Histochemical staining for carbohydrates, proteins and DNA

References

1. Balinsky, B. I. (1981). *An introduction to Embryology 5th Ed.* Holt Saunders Publ., Philadelphia.
2. Browder, L. W., Erickson, C. A. and Jeffery, R. W. (1991). *Developmental Biology 3rd Ed.* Saunders College Publ., Philadelphia.
3. Diwan, A. P. and Dhakad, N. K. (1995). *Avian Embryology, 1st Ed.* Anmol Publ. Pvt. Ltd., New Delhi.
4. Jenkin, P. M. (1970). *Control of growth and metamorphosis, 1st Ed.* Pergamon Press, Oxford.
5. Melissa A Gibbs (2003). *A Practical guide to Developmental Biology*, Oxford University Press 118 pages, B/w illus, figs
6. Laura R. Keller, John H, Evans, Thomas C.S. Keller (1998). *Experimental Developmental Biology: A Laboratory Manual* Paperback pp 114 Spl Edition, Academic Press
7. Yolanda P Cruz (1993) *Laboratory Exercise in Developmental Biology* pp 241. Academic Press, <https://doi.org/10.1016/C2009-0-03524-7>

**MSZGY03&04E03; Elective: Parasitology Practical
(Credits – 3, 54 Hrs)**

- CO1. Remember about different morphological structures of parasites (K1).
- CO2. Acquire the skills dissecting different animals for surveying of parasites (K6).
- CO3. Identify parasites using morphological features (K3).
- CO4. Acquire skills for collection and preservation of parasites (K3).
- CO5. Acquire necessary skills for preparing whole mounts (K3).

1. Preparation and uses of blood and tissue impression smears.
2. Collection and preservation of protozoans, helminths and arthropods.
3. Collection and examination of faeces of human and domestic animals for the presence of immature stages (eggs, cysts and larvae) of parasites.
4. Collection, preservation and identification of snail hosts in local freshwater bodies.
5. Collection and study of larval parasites from snails, fish and insect larva.
6. Study of prepared permanent slides of parasites and vectors.
7. Preparation of whole mounts of parasites and vectors.
8. Preparation of dichotomous key for the identification of trematodes/ cestodes/ insects of medical and veterinary importance.
9. Survey of appropriate hosts (vertebrates and non-chordates) for helminth, protozoan, insect and acarine parasites.
10. Students are required to submit a collection of minimum of 20 specimens/whole mounts of parasites, intermediate hosts and arthropods of medical and veterinary importance.

MSZGY03&04E04; Elective; Entomology Practical

(Credit-3; 54 Hrs.)

Course Outcomes:

CO1. Remember about different morphological structures of insect (K1)

CO2. Acquire the skills dissecting different organs like mouth parts, sting apparatus and genitalia of different insects (K3).

CO3. Identify different insects using morphological features (K6).

CO4. Acquire skills for collection and preservation of insects (K3).

CO5. Acquire necessary skills for preparing histological sections (K3).

1. Dissection of different types of mouth parts.
2. Dissection and comparison of legs of different insects.
3. Study of the different types of antennae- prepare permanent slides of at least 5 types of antennae (To be submitted during practical examination)
4. Dissection of sound-producing organs of Orthopterans.
5. Mounting of stinging apparatus – Honeybee
6. Preparation of keys for identification of insects up to family level (common families of Orders Orthoptera, lepidoptera, Hemiptera and Coleoptera).
7. Use of Y-tube olfactometer to study responses to olfactory cues
8. Preparation of stained slides of insect haemolymph and identification of haemocytes.
9. Detection of digestive carbohydrases in the alimentary canal of insect.
10. Study of salient features of any 10 major insect pests.
11. Study of life histories of insect pests (at least two) and the damages caused by them.
12. Study of various insecticide appliances and their applications in the field.
13. Estimation of LD 50 values for some insect pests
14. Setting up and collection of insects with Malaise trap, Pitfall traps, Light trap, Sweep net, Yellow pan trap
15. Collection and identification of eggs/larvae of mosquitoes (Genus level).
16. Collection and preservation of insects. Students shall submit insects belonging to 15 orders and 30 families at the time of practical examination}.

17. Collection, identification and preservation of pests of local crops. The collection should include a minimum of 10 crop pests. The collection has to be submitted during the practical examination.
18. Study of histology of gut of any insect by preparing permanent histology slides.
19. Preparation of whole mounts external genital organs in different insects.
20. A study tour for the purpose of collecting insects belonging to different ecological niches other than local is required with a report of the field study which is to be included in the record.

References

1. Borror, D.J.& D.M. DeLong. (1964). *An Introduction to the Study of Insects*. 7th Edn. Holt Rinehart & Winston, New York.
2. Pedigo, L. P (2009). *Entomology & Pest Management Practice*. 6th Edn. Hall India Pvt. Ltd., New Delhi.
3. Mani, M.S. (1962). *General Entomology*. Oxford & IBH, New Delhi.
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5. Nayar, K. K., Ananthkrishnan T.N.& David B.V (1976). *General and Applied Entomology*, Tata Mac Grew Hill, New Delhi.
6. Richards, O.W. & Davies R.G.G (1977). *Imm's General Text Book of Entomology*. Chapman & Hall, London.
7. Romoser, W.S. and Stoffolano, J.G. (1994). *The Science of Entomology*. 3rd Edition. WCB Publishers, Oxford, England.

MSZNG03&04C16; Project

(3 credits-54 Hrs)

- a) Each student shall carry out a project work in one of the broad areas of zoology in the IIIrd & IVth semester under the supervision of a teacher of the department. A student may, in certain cases be permitted to do the project work in a research organization on the recommendation of the Head of the Department /Department coordinator. In such cases, one of the teachers from the department shall act as co-supervisor/internal guide.
- b) The candidate shall submit 2 copies of the dissertation based on the results of the project work at the end of the program. candidate must prepare a presentation for the viva voce.
- c) Every student has to do the project work independently. No group projects are accepted. The project should be unique with respect to title, project content and project layout. No two project report of any students should be identical, in any case as this may lead to the cancellation of project report by the university.
- d) The ESE of the project work shall be conducted by two external examiners. The evaluation of the project will be done at two stages.

i. Internal evaluation (supervising teacher/s will assess the project and award internal marks)

ii. External evaluation (by external examiners appointed by the university)

e) Pass conditions

The students shall declare to pass the project report course if she/he secures minimum 40% marks (internal and external put together). In an instance of inability of obtaining a minimum of 40% marks, project work may be redone and the report may be resubmitted along with subsequent exams through parent department. There shall be no improvement chance for the marks obtained in the project report.

MSZNG04C18; Viva Voce

(1 Credit)

MSZNG04C19; Personal collection with Field study report

(1 credit)

Personal collection related to Elective practical.

Model Question Paper**MSZGY03C13; DEVELOPMENTAL BIOLOGY AND ANIMAL ETHICS****Time 3 hours****Maximum Marks: 60****Part A****Answer any five of the following each question carries 3 marks**

1. What is primary inducer
2. Explain differentiation
3. What is totipotency
4. Explain cortical reaction
5. What is metamorphosis
6. What teratogenesis

Part B**Answer any three of the following each question carries 6 marks**

7. Explain gastrulation
8. Describe different types of specification
9. Explain differentiation of neurones
10. Explain the formation of primitive streak
11. Describe the advantages and disadvantages of using animal models in experiments

Part C**Answer any three questions each question carries 9 marks**

12. Explain gametogenesis in mammals
13. Describe the roles of segmentation genes in embryonic development
14. Explain different types of regeneration
15. Describe the contributions of Hans Spemann & Hilde Mangold for developmental biology
16. Explain the CPCSEA Guidelines for using animals in scientific experiments

MSZGY03O01; Open Elective (Multi-Disciplinary); Research methodology

Time 3 hours

Maximum Marks: 60

Part A

Answer any five of the following each question carries 3 marks

1. Explain the importance of fixation in histology
2. What is cryostat
3. describe Amyloid Staining
4. What is CLUSTAL
5. What is gene tree
6. Explain boot strap

Part B

Answer any three of the following each question carries 6 marks

7. Explain the use of a microtome
8. Explain Connective Tissue Staining
9. Explain Immunocytochemistry Technique
10. Describe the use of Online resources for molecular phylogeny creation
11. Explain the Reference management & Methods

Part C

Answer any three questions each question carries 9 marks

12. Explain the Processing of Tissue in Histopathology Laboratory
13. Explain the General Procedure of Staining of the Tissue
14. Explain the construction of a phylogenetic tree using morphological data
15. Describe the steps in a scientific publication
16. Explain the ethics in publication

Model Question Pattern – MSZGY03O02

**Open Elective (Multi-Disciplinary); Insects of Medical and
Veterinary Importance**

Time 3 hours

Maximum Marks: 60

Part A

Answer any five of the following each question carries 3 marks

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Part B

Answer any three of the following each question carries 6 marks

- 7.
- 8.
- 9.
- 10.
- 11.

Part C

Answer any three questions each question carries 9 marks

- 12.
- 13.
- 14.
- 15.
- 16.

Model Question Paper – MSZGY03O03**Open Elective (Multi-Disciplinary); Medical and Forensic
Entomology****Time 3 hours****Maximum Marks: 60****Part A****Answer any five of the following each question carries 3 marks**

1. Explain the infection of JE virus
2. Explain how we can control Leishmaniasis
3. Describe different vector sampling methods
4. Mention some any three physical barriers or traps used
5. Explain how forensic entomology helps to identify time of death
6. What is Lyme disease

Part B**Answer any three of the following each question carries 6 marks**

7. Explain the pathogenicity of filarial worm
8. Mention the medical importance of black fly
9. Explain the side effects of pesticide application for vector control
10. How is sterile insect technology applied in vector control
11. Explain how entomology helps in forensic science

Part C**Answer any three questions each question carries 9 marks**

12. Write an essay on different vector mosquitoes
13. Explain the lifecycle of plasmodium
14. Explain some vector surveillance techniques
15. Describe the various measures used in vector control
16. Explain the methods of forensic entomology

Model Question Pattern – MSZGY04E01

Elective 1; General Parasitology and Helminthology

Time 3 hours

Maximum Marks: 60

Part A

Answer any five of the following each question carries 3 marks

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Part B

Answer any three of the following each question carries 6 marks

- 7.
- 8.
- 9.
- 10.
- 11.

Part C

Answer any three questions each question carries 9 marks

- 12.
- 13.
- 14.
- 15.
- 16.

Model Question Pattern – MSZGY04E02

Elective 1; General Entomology

Time 3 hours

Maximum Marks: 60

Part A

Answer any five of the following each question carries 3 marks

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Part B

Answer any three of the following each question carries 6 marks

- 7.
- 8.
- 9.
- 10.
- 11.

Part C

Answer any three questions each question carries 9 marks

- 12.
- 13.
- 14.
- 15.
- 16.

**Model Question Paper – MSZGY04C17
Microbiology and Biotechnology**

Time: 3 hours

Maximum Marks: 60

Part A Answer any five of the following. Each question carries 3 marks.

1. Outline the historical development and scope of microbiology.
2. Describe the criteria used in microbial taxonomy for the classification of bacteria.
3. Explain the basic structure and function of bacterial flagella.
4. What are the physical methods of sterilization in bacterial culturing?
5. Discuss the differences between exotoxins and endotoxins.
6. Explain the mechanism of action of antibiotics

Part B

Answer any three of the following. Each question carries 6 marks.

7. Describe the morphological and nucleic acid characteristics used in the classification of viruses.
8. Explain the process of bacterial gene regulation through operons.
9. Discuss the various physical conditions required for the growth of bacteria.
10. Explain the role of microbial toxins in pollution and how microorganisms can be used to manage pollution problems.
11. Outline the steps involved in gene cloning.

Part C

Answer any three questions. Each question carries 9 marks.

12. Describe the structure and architecture of bacteriophages.
13. Explain the medical, agricultural, industrial, and environmental applications of biotechnology.
14. Discuss the various cloning vectors used in recombinant DNA technology.
15. Explain the different methods used for gene sequencing, including the Sanger method and next-generation sequencing techniques.
16. Discuss the concepts of biosafety, intellectual property rights (IPR), and the potential hazards of biotechnology.

Model Question Pattern – MSZGY04E05

Protozoology and Medical & Veterinary Entomology

Time 3 hours

Maximum Marks: 60

Part A

Answer any five of the following each question carries 3 marks

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Part B

Answer any three of the following each question carries 6 marks

- 7.
- 8.
- 9.
- 10.
- 11.

Part C

Answer any three questions each question carries 9 marks

- 12.
- 13.
- 14.
- 15.
- 16.

**Model Question Paper – MSZGY04E06
INSECT PHYSIOLOGY**

Time: 3 hours

Maximum Marks: 60

Part A Answer any five of the following. Each question carries 3 marks.

1. Describe the structure of the respiratory system in insects.
2. Discuss the chemical and physical properties of the insect integument.
3. Explain the composition of haemolymph and the course of circulation in insects.
4. Discuss the histomorphology of insect muscles
5. Discuss the role of microflora/fauna in insect digestion.
6. Explain the plastron respiration in aquatic insects

Part B

Answer any three of the following. Each question carries 6 marks.

7. Outline the hormonal control of the integument and its functions.
8. Describe the Malpighian tubules, Nephrorectal complex, and labial glands in the excretory system of insects.
9. Discuss the process of moulting and sclerotisation in insects.
10. Discuss the process of embryogenesis in insects, including differentiation of germ layers, segmentation, and appendage formation.
11. Describe the structure and organization of the nervous system in insects, detailing the anatomy and histology of brain, ganglia, and nerves.

Part C

Answer any three questions. Each question carries 9 marks.

12. Discuss the physiology of digestion in insects, focusing on digestive enzymes.
13. Outline the endocrine system in insects, focusing on the histomorphology of neurosecretory cells and the function of hormones.
14. Compare the closed and open tracheal systems in insects.
15. Discuss the reproductive system in insects, including structure, fertilization, and oviposition.
16. Explain the role of sense organs in insects, detailing the anatomy, histology, and physiology of mechanoreceptors, chemoreceptors, and photoreceptors.

Model Question Paper – MSZGY04E07

**MODEL QUESTION PAPER
PHYSIOLOGY, IMMUNOLOGY, BIOCHEMISTRY & GENETICS OF
PARASITES**

Time: 3 hours

Maximum Marks: 60

Part A

Answer any five of the following. Each question carries 3 marks. (5 x 3 =15)

1. What is kDNA?
2. What are different types of symbiosis?
3. Explain the mechanism of trans-splicing in kinetoplastids.
4. List out strategies to control parasites in the future.
5. Explain the structure of the cestode surface.
6. Write a brief account of antigen-antibody reactions in vertebrate hosts.

Part B

Answer any three of the following. Each question carries 6 marks. (3 x 6 = 18)

7. What is RNA editing.
8. Elaborate on phases of parasitism.
9. Write on the link between tRNA modification and artemisinin resistance in *Plasmodium falciparum*.
10. What are the neurotransmitters in *Ascaris*?
11. Explain the responses elicited by invertebrate hosts against parasite infection.

Part C

Answer any three of the following. Each question carries 9 marks. (3 x 9=27)

12. Write on the mechanism of antigenic variation in *Trypanosomes*.
13. Describe the role of Ca²⁺ as an intracellular signaling molecule in parasites.
14. Explain chemotherapy and drug resistance in parasites.
15. Elaborate on the vertebrate alimentary canal as a microenvironment of parasites.
16. Explain carbohydrate metabolism in parasites.

Model Question Paper – MSZGY04E08**AGRICULTURAL ENTOMOLOGY (70Hours)****Time 3 hours****Maximum Marks: 60****Part A****Answer any five of the following each question carries 3 marks**

1. Discuss the identification life history of any one major pests of coconut.
2. Describe the principles of pest surveillance and forecasting outbreaks.
3. Define and differentiate between Economic injury level (EIL) and Economic threshold level (ETL).
4. Discuss the importance and feasibility of biological control in managing insect pests, providing examples from India.
5. Explain the classification of insect pests based on their occurrence and impact.
6. Describe the pests commonly affecting cotton crops, focusing on their identification and control strategies..

Part B**Answer any three of the following each question carries 6 marks**

7. Discuss the role of insecticide synergists in enhancing the efficacy of insecticides. Provide examples and explain their mode of action.
8. Describe the pests that commonly affect sugarcane crops, focusing on their identification and nature of damage.
9. Discuss the principles and methods of Integrated Pest Management (IPM) with specific reference to its application in agroecosystems.
10. Explain the economic levels used in pest management with examples.
11. Discuss the identification, life history, and control measures of insect pests of stored products.

Part C**Answer any three questions each question carries 9 marks**

12. Describe the nature of damage caused by insect pests of vegetables, detailing their identification and control measures.
13. Discuss the methods used for estimating damage caused by insects to

crops.

14. Discuss the identification, life history, and control measures of major pests of paddy.

15. Describe the various methods of chemical control of insect pests, including their modes of action and examples.

16. Discuss the causes that lead insects to assume pest status, citing examples.

