**THIRUVALLUVAR UNIVERSITY**

**MASTER OF SCIENCE**

**M.Sc. ZOOLOGY**

**DEGREE COURSE**

**UNDER CBCS**

**(With effect from 2020-2021)**

**The Course of Study and the Scheme of Examinations**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No**   |  | | --- | |  | | | |  | | --- | | **Study Components** | | | |  | | --- | | **Ins.**  **Hrs /Week** | | |  | | --- | | **Credit** | | |  | | --- | | **Title of the paper** | | |  | | --- | | **Maximum Marks** | | | |
| |  | | --- | | **Course Title** | | |
| **SEMESTER I** | | | | | |  | **CIA** | **Uni. Exam** | **Marks** |
|  | Core Theory | | Paper-1 | 5 | 4 | Life and Diversity of Invertebrates | 25 | 75 | 100 |
|  | Core Theory | | Paper-2 | 5 | 4 | Life and Diversity of Chordates | 25 | 75 | 100 |
|  | Core Theory | | Paper-3 | 5 | 4 | Cell and Molecular biology | 25 | 75 | 100 |
|  | Core Practical | | Paper-1 | 9 | - | Life and diversity of Invertebrates, Life and diversity of Chordates and Cell and molecular Biology | - | - | - |
| **Internal Elective for same major students** | | | | | | | | | |
|  | Core Elective | | Paper-1 | 3 | 3 | **(to choose one out of 2)**   1. Aquaculture and Farm management 2. Biostatistics and Bioinformatics | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | Open Elective | | Paper-1 | 3 | 3 | **(to choose one out of 2)**   1. Apiculture 2. Public Health and Hygiene | 25 | 75 | 100 |
|  |  | |  | **30** | **18** |  | **125** | **375** | **500** |
|  |  | |  |  |  |  |  |  |  |
| **SEMESTER II** | | | | | |  | **CIA** | **Uni. Exam** | **Marks** |
|  | | Core Theory | Paper-4 | 4 | 4 | Genetics | 25 | 75 | 100 |
|  | | Core Theory | Paper-5 | 4 | 4 | Environmental Biology | 25 | 75 | 100 |
|  | | Core Theory | Paper-6 | 4 | 4 | Biotechnology | 25 | 75 | 100 |
|  | | Core Practical | Paper-I | - | 4 | Life and diversity of Invertebrates, Chordates, Cell and molecular Biology. | 25 | 75 | 100 |
|  | | Core Practical | Paper-2 | 10 | 4 | Genetics, Environmental Biology and Biotechnology | 25 | 75 | 100 |
|  | | Compulsory Paper | | 2 | 2 | Human Rights | 25 | 75 | 100 |
| **Internal Elective for same major students** | | | | | | | | | |
|  | | Core Elective | Paper-2 | 3 | 3 | **(to choose one out of 2)**   1. Endocrinology 2. Bio-Chemistry | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | | Open Elective | Paper-2 | 3 | 3 | **(to choose one out of 2)**   1. Vermiculture 2. Wild Life Management and Conservation | 25 | 75 | 100 |
|  | | \*Field Study |  |  | 2 |  | 25 | 75 | 100 |
|  | |  |  | **30** | **30** |  | **225** | **675** | **900** |
|  | |  |  |  |  |  |  |  |  |
| **SEMESTER III** | | | | | |  | **CIA** | **Uni. Exam** | **Marks** |
|  | | Core Theory | Paper-7 | 4 | 3 | Animal Physiology | 25 | 75 | 100 |
|  | | Core Theory | Paper-8 | 4 | 3 | Developmental Biology | 25 | 75 | 100 |
|  | | Core Theory | Paper-9 | 4 | 3 | Immunology | 25 | 75 | 100 |
|  | | Core Practical | Paper-3 | 12 | - | Animal Physiology, Developmental biology and Immunology | - | - | - |
| **Internal Elective for same major students** | | | | | | | | | |
|  | | Core Elective | Paper-3 | 3 | 3 | **(to choose one out of 2)**   1. Bioethics and Biosafety 2. Biophysics | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | | Open Elective | Paper-3 | 3 | 3 | **(to choose one out of 2)**   1. Aquarium fish keeping 2. Medical Laboratory Technology | 25 | 75 | 100 |
|  | | \*\*MOOC  Course |  | - | - |  | - | - | 100 |
|  | |  |  | **30** | **15** |  | **125** | **375** | **600** |
|  | |  |  |  |  |  |  |  |  |
| **SEMESTER IV** | | | | | |  |  |  |  |
|  | | Core Theory | Paper-10 | 5 | 4 | Research Methodology | 25 | 75 | 100 |
|  | | Core Theory | Paper-11 | 5 | 4 | Entomology | 25 | 75 | 100 |
|  | | Core | Project | 5 | 5 | Project with viva voce (Compulsory) | 100(75 Project+  25 Viva) | | 100 |
|  | | Core Practical | Paper-3 | - | 4 | Animal Physiology, Developmental Biology and Immunology | 25 | 75 | 100 |
|  | | Core Practical | Paper-4 | 9 | 4 | Research Methodology and Entomology | 25 | 75 | 100 |
| **Internal Elective for same major students** | | | | | | | | | |
|  | | Core Elective | Paper-4 | 3 | 3 | **(to choose one out of 2)**   1. Sericulture 2. Microbiology | 25 | 75 | 100 |
| **External Elective for other major students (Inter/multi disciplinary papers)** | | | | | | | | | |
|  | | Open Elective | Paper-4 | 3 | 3 | **(to choose one out of 2)**   1. Sericulture 2. Pearl Culture | 25 | 75 | 100 |
|  | |  |  | **30** | **27** |  | **175** | **525** | **700** |
|  | |  |  |  |  |  |  |  | **2700** |
|  | |  |  |  |  |  |  |  |  |

**\* Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registred by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department

(ii). Mentor

(iii). One faculty from other department

\*\***Mooc Courses**

Inclusion of the Massive Open Online Courses (MOOCs) with zero credits available on SWAYAM, NPTEL and other such portals approved by the University Authorities.

**SEMESTER III**

**PAPER-7**

**ANIMAL PHYSIOLOGY**

**UNIT-I: NUTRITION**

Nutrition - nutrients - digestion and absorption of proteins, carbohydrates and lipids. Role of gastrointestinal hormones in digestion. Essential Basal Metabolic Rate (BMR).

**UNIT-II: RESPIRATION AND CIRCULATION**

Physiology of respiration in Man. Respiratory Pigments, nervous and chemical control of respiration.

Circulation - types of hearts - physiology of cardiac muscle - heart beat and its regulation – Hemopoiesis, Blood coagulation.

**UNIT-III: EXCRETION AND OSMOREGULATION**

Excretion – Renal excretion in vertebrates - physiology of excretion in Man.

Osmotic and Ionic regulation in brackish water and fresh water animals (Fishes and Amphibians). Regulation of body fluids in Terrestrial animals (Crustaceans, Gastropods and Annelids).

**UNIT-IV: ANIMAL AND REPRODUCTION**

Neuro muscular co-ordination - types of neurons, transmissions of nerve impulse and reflex action. Chemical composition of muscle fiber and physiology of muscle contraction. Myoneural Junction. Endocrine glands in mammals. Physiology of mammalian reproduction - reproductive cycle - hormonal control of reproduction.

**UNIT-V: BEHAVIOURAL PHYSIOLOGY**

Bioluminescence - chemistry and functional significance. Behaviour (types - trophism, taxis, kinesis, reflex, learning). Temperature regulation: Poikilotherms, homeotherms and heterotherms - hibernation, aestivation - diapause.

**Course Objectives**

1. To acquire knowledge on different organs, organ system in detail

2. To gain knowledge about functional system.

3. To understand about nutrient.

4. To understand the function of Heart, Heart muscle and Heart beat and its function

**Unit-1: (50 to 100 contents)**

* To know about nutritional values.
* To understand different types of digestion.
* To know about absorption of proteins.
* To know about absorption of carbohydrates.
* To know about different gastro intestinal hormones.
* To know about role of hormones in digestion.

**Unit-2: (50 to 100 contents)**

* To understand clearly about physiology of respiration in man.
* To understand different respiratory pigments.
* To know about nervous control of respiration.
* To know about chemical control of respiration.
* To know about types of Heart, Heart beats and its regulation
* To gain knowledge about blood coagulation

**Unit-3: (50 to 100 contents)**

* To gain knowledge about physiology of excretion in man
* To know about the metabolic waste products in relation to the environment.
* To know about osmoionic regulation in invertebrates
* To understand about osmoionic regulation in vertebrates.

**Unit-4: (50 to 100 contents)**

* To know about neuromuscular coordination.
* Types of neurons
* To understand about nerve impulse and reflex action
* To know about chemical composition of muscle fiber.
* To know about physiology of muscle contraction.
* To know about myoneural junction.
* To know about endocrine glands in mammals.
* To know about physiology of mammalian reproduction.
* To understand about hormonal control of reproduction

**Unit-5: (50 to 100 contents)**

* To know about bioluminescence.
* To know about different behaviours of trophism, taxis, kinesis, reflex, learning.
* To know about poikilotherms, homeotherms, hibernation, aestivation and diapause.

**Text Books**

1. Herkat, P.C.and Mathur, P.N.1976. Text Book of Animal Physiology.S.Chand Co. Pvt, Ltd., New Delhi.
2. Agarwal, R.A, Anil K. Srinvastava and Kaushal Kumar, 1998. Animal Physiology and Biochemistry, S. Chand and Company Ltd, New Delhi.
3. Parameswaran, R, Ananthakrishnan, T.N, and Ananthasubramanian, K.S. 1998. Outlines of Animal Physiology, S. Viswanathan (Printers and Publishers) Pvt. Ltd.

**Reference Items: books, Journal**

1. Hoar, W.S.1991. General and Comparative Physiology. Prentice Hall of India, New Delhi.

2. Prosser, C.L. 1973. Comparative Animal Physiology, 3rd edn. W.B. Saunders & Co., Philadelphia.

3. Barrington, E.J.W.1975. An Introduction to General and Comparative Endocrinology. Clarendon Press, Oxford

4. Bentley, P.J.1971. Endocrine and osmoregulation, Springer Verlag, New York.

5. Palmen,J.D. Brown, I.R and Hastings, J.W.1970. Biological clocks, Academic Press, London.

6. Welson, A. 1979. Principles of Animal Physiology.McMillan Publishing Co. Inc. New York.

7. Schmidt Nelssen, K.1985. Animal Physiology. Adaptation and Environment Club, London.

8. Herkat, P.C.and Mathur, P.N.1976. Text Book of Animal Physiology.S.Chand Co. Pvt, Ltd., New Delhi.

9. Sobti, R.C. 2008. Animal Physiology, Narosa Publishing Home, New Delhi.

10. Parameswaran, R, Ananthakrishnan, T.N, and Ananthasubramanian, K.S. 1998. Outlines of Animal Physiology, S. Viswanathan (Printers and Publishers) Pvt. Ltd.

11. Agarwal, R.A, Anil K. Srinvastava and Kaushal Kumar, 1998. Animal Physiology and Biochemistry, S. Chand and Company Ltd, New Delhi.

**E- Materials**

* <https://www.researchgate.net/publication/286456096_DrPBReddy's_TEXT_BOOK_OF_ANIMAL_PHYSIOLOGY>
* <https://craftx.org/sites/all/themes/craft_blue/pdf/Anatomy_and_Physiology_of_Animals.pdf>
* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1328089/>
* <http://www.freebookcentre.net/biology-books-download/ANIMAL-PHYSIOLOGY.html>
* <https://archive.org/details/cu31924000353601>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* Able to understand clearly about the nutrient materials.
* Able to understand clearly about digestion.
* Able to understand clearly about absorption of proteins
* Able to understand clearly about carbohydrates and lipids
* Able to understand gastro intestinal hormones in digestion

**2. After studied unit-2, the student will be**

* Able to understand clearly about physiology of respiration.
* Able to understand clearly about respiratory pigments.
* Able to understand clearly about nervous, chemical and BMR
* Able to understand types of Heart, Heart beat in vertebrates
* Able to understand clearly about blood coagulation and theories.

**3. After studied unit-3, the student will be**

* Able to understand about excretion.
* Able to understand about metabolic waste products.
* Able to understand about metabolic waste products in relation to environment
* Able to understand osmoionic regulation in invertebrates and vertebrates.
* Able to understand clearly about physiology of excretion of man.

**4. After studied unit-4, the student will be**

* Able to understand about neuromuscular coordination.
* Able to understand about types of neuron, transmission of nerve impulse and reflex action.
* Able to understand about muscle fiber and physiology of muscle contraction.
* Able to understand about endocrine glands in mammals.
* Able to understand about physiology of mammalian reproduction and hormonal control of reproduction.

**5. After studied unit-5, the student will be**

* Able to understand bioluminescence.
* Able to understand the functional importance.
* Able to understand the different types of behavior.
* Able to understand the trophism, taxis, kinesis, reflex, learning.
* Able to understand poikilotherms, homeotherms and heterotherms.

**PAPER-8**

**DEVELOPMENTAL BIOLOGY**

**UNIT-I: EARLY DEVELOPMENT**

Gastrulation – Gastrulation in Amphioxus, Amphibians, Birds and Mammals – Morphogenetic movements – Chemical changes during gastrulation – Significance of gastrulation.

**UNIT-II: ORGANOGENESIS**

Development of Heart and Kidney – Differentiation – types of differentiation, Differentiation effected in the genome, Organizer, Inductive tissue interaction in developments.

**UNIT-III:NUCLEOCYTOPLASMIC INTERACTION, NUCLEAR TRANSPLANTATION AND REGENERATION**

Transplantation – Cytoplasmic influence of Nucleus – Nuclear transplantation experiments in Amphibians. Regeneration in invertebrates and vertebrates.

**UNIT-IV: REGULATION OF DEVELOPMENT**

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

**UNIIT-V: EMBRYONIC NUTRITION**

Nutritional requirements of Embryo- modes of embryonic nutrition –Food reserve and embryonic nutrition- embryonic nutrition from mother –physiology of placenta.

**Course Objectives**

1. To gain knowledge about developmental stages in experimental aspects.

2. To know the role of organisers.

3. To acquire the knowledge of interaction in tissues.

4. To understand the development of Heart and Kidney in different mammals.

5. To know the genes and development under the process of differentiation.

**Unit-1: (50 to 100 contents)**

* Knowing the details of gastrulation
* Movement of cells on the surface egg cortex
* Chemotactic induced aggregation in sponges.
* Experimental analysis in the early development of echinoderms, amphibians and birds.

**Unit-2: (50 to 100 contents)**

* Formation of organ rudiments.
* To know about differentiation.
* Development of Heart and Kidney in different mammals.
* Tissue interaction in developments.

**Unit-3: (50 to 100 contents)**

* Nuclear transplantation.
* Cellular differentiation and protein synthesis.
* Differential activation.
* Genetic defects
* Role of cell death in development.

**Unit-4: (50 to 100 contents)**

* Different morphological and biochemical changes during amphibian metamorphosis
* Hormonal control in amphibians.
* Neuro endocrine control of insect metamorphosis.
* Mechanism of hormones during metamorphosis.

**Unit-5: (50 to 100 contents)**

* Different nutritional requirements of embryo.
* Different modes of embryonic nutrition.
* Food preserve and embryonic nutrition.
* Physiology of placenta.

**Text Books**

1. Majumdar, N.M. 1988. Text Book of Vertebrate Embryology, Tata Mc-Graw – Hill Publishing Company, Ltd, New Delhi.
2. Veer Bala Rastogi and Jayaraj, M.S. 1992. Developmental Biology, Kedar Nath Ram Nath, Meerut, New Delhi.
3. Majumdar, N.M. 1988. Text Book of Vertebrate Embryology, Tata Mc-Graw – Hill Publishing Company, Ltd, New Delhi.
4. Majumdar, N.M. 1988. Text Book of Vertebrate Embryology, Tata Mc-Graw – Hill Publishing Company, Ltd, New Delhi.

**Reference Items: books, Journal**

1. Balinsky, B.I.1981 An Introduction to Embryology. W.B Saunders Co., Philadelphia.

2. Karp,G. and Berrill,N.J.1981. Development. McGraw Hill, New York.

3. Saunders, J.W.1982. Developmental Biology. MacMillan Co., London.

4. Nagabhushanam,R. and Sarojini,R.2002 Invertebrate Embryology. Oxford and IBA Publishing Co.

5. Tyagi,Rajiv and Shukla,A.N.2002. Development of Fishes. Jaya Publishing House, New Delhi.

6. Browder, W.1984.Developmental Physiology. Saunders College Publishing, Rinchert and Winston.

7. Gilbert, S.F.2003.Developmental Biology. Sinamer Associates Inc. Saunderland, Massachusets, U.S.A.

8. Oppenheimer, S.B.1980.Introduction to Embryonic Development. Allyn and Bacon,Inc. U.S.A.

9. Mitra, S.1994. Genetics, A Blueprint of Life. Tata McGraw - Hill Publishing Company Ltd., New Delhi.

10. Veer Bala Rastogi and Jayaraj, M.S. 1992. Developmental Biology, Kedar Nath Ram Nath, Meerut, New Delhi.

1. Majumdar, N.M. 1988. Text Book of Vertebrate Embryology, Tata Mc-Graw – Hill Publishing Company, Ltd, New Delhi.

**E- Materials**

* <https://epdf.pub/developmental-biology-9th-edition.html>
* <https://www.freebookcentre.net/Biology/Developmental-Biology-Books.html>
* <http://www.freebookcentre.net/medical_books_download/Developmental-Biology-Scott-F.-Gilbert.html>
* <https://www.ncbi.nlm.nih.gov/books/NBK9983/>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* Able to understand clearly about the different developmental stages.
* Able to understand gastrulation movements on the egg cortex.
* Able to understand cell communication.
* Able to understand chemotactic induced aggregation in sponges.
* Able to understand clearly development of echinoderms, amphibians and birds.

**2. After studied unit-2, the student will be**

* Able to understand Organ rudiments
* Able to understand development of Heart
* Able to understand development of Kidney in different mammals.
* Able to understand about organiser.
* Able to understand about tissue interactions in development

**3. After studied unit-3, the student will be**

* Able to understand nuclear transplantation in amphibians.
* Able to understand the results at the end of nuclear transplantation experiments.
* Able to understand role of genome in the transcription and translation levels.
* Able to understand genetic defects.
* Able to understand role of cell death during development.

**4. After studied unit-4, the student will be**

* Able to understand metamorphic changes.
* Able to understand metamorphic changes in amphibians
* Able to understand insect metamorphosis.
* Able to understand biochemistry of metamorphosis.
* Able to understand hormonal action during metamorphosis.

**5. After studied unit-5, the student will be**

* Able to understand nutritional requirements of embryo.
* Able to understand modes of embryonic nutrition.
* Able to understand transfer of food preserve from mother to embryo.
* Able to understand physiology of placenta.

**PAPER-9**

**IMMUNOLOGY**

**UNIT-I: IMMUNE BIOLOGY**

Immunity - Major Targets of Defence system, Types of Immunity, cellular constituents of the lympho reticular system-phagocytic cells-polymorpho nuclear neutrophils, mono nuclear phagocytes stem cells, eosinophils and lymphocytes. Lymphoid organs and Antigens.

**UNIT-II: IMMUNOGLOBULINS**

Immunoglobulins-structure, Properties, Function and Classes of Immunoglobulin, Isotypes and biological function. Antigenic determinant on immunoglobulin-isotype, allotype and idiotype. Immunoglobulin superfamily, monoclonal and polyconal antibodies. organization and expression of immunoglobulin genes. Synthesis of immunoglobulin and disorders of immunoglobulin synthesis.

**UNIT-III: DETECTION AND APPLICATION OF ANITGEN AND ANTIBODY REACTION**

Antigen-antibody reaction – Precipitation – Agglutination – Cytolysis – Complement Fixation – Flocculation – Opsonization \_ Immuno assay using labelled reagents – Harmful effects of Antigen – Antibody reactions.

**UNIT-IV: MECHANISM OF IMMUNE SYSTEM**

Antigen-antibody interaction, MHC- Major Histocompatibility Complex, Function, Restriction Organization and Inheritance of MHC, Antigen processing and presentation HLA, Genetics of HLA. B - cell receptors, T – cell receptors, Cytokine, Adhesion molecules, Hypersensitivity reaction and Anaphylaxis – Tumour Immunology – Tumour Antigens, Immunotheraphy of Tumour.

**UNIT-V: TRANSPLANTATION IMMUNOLOGY**

Transplantation immunology. Types of Graft, Graft acceptance and rejection. Immuno deficiency diseases. Immuno prophylaxis. Immuno techniques. Immuno haematology.

Biosynthesis of Antibody.

**Course Objectives**

1. To Understand the Structural and functional basis of immunology and immune system.

2. To understand the mechanism of antigen-antibody reaction

3. To understand the organization and expression of immunoglobulin genes

4. To understand the B - cell receptors and T – cell receptors

5. To understand the Tumour Immunology

6. To understand the Transplantation immunology

**Unit-1: (50 to 100 contents)**

* To study an d learn the Immunity,Major targets of defence system, types of Immunity, cellular constituents of the lympho reticular system-phagocytic
* To understand the cells-polymorpho nuclear neutrophils, mono nuclear phagocytes stem cells, eosinophils and lymphocytes.
* To acquire the knowledge of Lymphoid organs and Antigens.

**Unit-2: (50 to 100 contents)**

* To understand the Immunoglobulins-structure, Properties, and function and Classes of Immunoglobulin, and isotypes and biological function.
* To learn and understand the antigenic determinant on immunoglobulin-isotype, allotype and idiotype.
* To describe the Immunoglobulin superfamily, monoclonal and polyconal antibodies.
* To understand the organization and expression of immunoglobulin genes.
* To study the synthesis of immunoglobulin and disorders of immunoglobulin synthesis.

**Unit-3: (50 to 100 contents)**

* To learn and understand the antigen-antibody reaction, precipitation, agglutination, cytolysis and complement Fixation.
* To study the flocculation,opsonization.
* To learn the Immuno assay using labelled reagents.
* To acquire the knowledge of Harmful effects of Antigen – Antibody reactions.

**Unit-4: (50 to 100 contents)**

* To understand the antigen-antibody interaction, MHC- Major Histocompatibility Complex, Function, Restriction Organization and Inheritance of MHC, Antigen processing and presentation HLA, Genetics of HLA.
* To learn the B - cell receptors, T – cell receptors, Cytokine, Adhesion molecules.
* To understand the Hypersensitivity reaction and Anaphylaxis.
* To study the Tumour Immunology – Tumour Antigens, Immunotheraphy of Tumour.

**Unit-5: (50 to 100 contents)**

* To understand thetransplantation immunology.
* To learn the Types of Graft, Graft acceptance and rejection.
* To understand the Immuno deficiency diseases, Immuno prophylaxis, Immuno techniques.and Immuno haematology.
* To learn and understand the Biosynthesis of Antibody.

**Text Book**

1. Roitt,I.M.1994. Essential Immunology. Blackwell Scientific, Oxford
2. Richard A.Goldsby, Thomas T.Kindt and Barbara A. Osborne. 2000. Kuby Immunology.Freeman and Co., New York
3. Stites,D.P.,Terr,A.I. and Parsloio,T.G. 1997.Medical Immunology. Prentice Hall, New Jersey
4. Paul,W.E.M.1989. Fundamentals of Immunobiology. Raven Press, New York
5. Champion,M.D. and Cooke,A.1987.Advanced Immunology. J.B.Lippincott Ltd., Philadelphia

**Reference Items: books, Journal**

1. Kuby Immunology W. H. Freeman & Company; 6th edition
2. Immunology Cancer Vaccines Experimental Methods in Immunology Goldsby RA, Kindt TK, Osborne BA and Kuby J (2003) Immunology, 5th Edition, W.H. Freeman and Company
3. Michael Behe presented with fifty-eight peer-reviewed publications, nine books, and several immunology textbook chapters about the evolution of the immune system
4. NIOSH Hazard Review: Carbonless Copy Paper/Other Publications Examined and Safety Letter, September, p. 22. American Academy of Allergy and Immunology, Executive Committee [1986]. Position statements: clinical ecology. J

**E- Materials**

* <https://onlinelibrary.wiley.com/journal/13652567>
* Journals in Immunology and Microbiology - Elsevierwww.elsevier.com › Life Sciences › Immunology and Microbiology
* http://www.elsevier.com/locate/molimm.Molecular Immunology - Journal - Elsevier
* Clinical Immunology - Journal - Elsevierwww.journals.elsevier.com › clinical-immunology
* <https://bookauthority.org/books/new-immunology-books>
* <https://home.liebertpub.com/publications/viral-immunology/57/overview>
* <https://biolympiads.com/wp-content/uploads/2018/09/Immunology-Notes.pdf>.

**Course Out Comes (five outcomes for each units should be mentioned)**

1. **After studied unit-1, the student will be able to understand**
   * + - * Major targets of defence system.
         * Phagocytic cells.
         * Polymorpho nuclear neutophils.
         * Lymphoid organs.
         * Antigens.
2. **After studied unit-2, the student will be able to understand**

* Immunoglobulins.
* Antigenic determinant.
* Isotopes and biological function.
* Monoclonal and polyconal antibodies.
* Immunoglobulin and disorders.

1. **After studied unit-3, the student will be able to understand**
   * + - * Antigen-antibody reaction.
         * Cytolysis.
         * Complement fixation.
         * Immuno assay.
         * Harmful effects of antigen.
2. **After studied unit-4, the student will be able to understand**
   * + - * Antigen-antibody interaction.
         * Major Histocompatibility Complex.
         * Genetics of HLA.
         * Hypersensitivity.
         * Tumour Immunology.
3. **After studied unit-5, the student will be able to understand**
   * + - * Transplantation immunology.
         * Graft acceptance and rejection.
         * Immuno deficiency.
         * Immuno techniques.
         * Biosynthesis of Antibody.

**CORE ELECTIVE**

**PAPER-3**

**(to Choose either A or B)**

**(A) BIO-ETHICS AND BIO-SAFETY**

**Unit-I:Introduction to Bioethics and Bio-safety**

Ethics in biotechnology- Positive effects – Negative effects - examples – Rice with Vitamin A - Slow Ripening Fruits - Saving the Banana - Virus Resistant Crops - Need for Fertilizers - Biological Pest Controls – Fast Growing Trees- Fast Growing fish - The Monarch Butterfly Story - Consumer traits – food safety- Environmental, Economic and Social Concerns.

**Unit-II:Biotechnological Applications for Human Welfare**

Production of secondary metabolites - Insulin, growth hormones and interferons. Production of biotechnological products - Food – SCP (algae, yeast, mushroom). Biofertiliser (Blue-green algae, Vesicular-arbuscular mycorrhiza) - Biopesticides (*Bascillus thruinginsis*).

**Unit-III:Regulatory Framework and Good Laboratory Practices**

Regulatory frameworks in USA and India - Good laboratory practice (GLP) - GLP authority functions - follow Good Laboratory Practices - The Aspiration – responsibility – Role of a Sponsor - Quality standards for Clinical Trials - Why is India a favorite destination for Clinical Trials world wide.

**Unit-IV:CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals) Guidelines for Laboratory Animal Handling for Various Experiments**

Veterinary care - Animal procurement - Quarantine, Sterilization and separation – Surveillance, diagnosis, treatment and control of disease - Animal care and technical personnel - Personal hygiene - Animal experimentation involving hazardous agent - Multiple surgical procedures on single animal - Duration of experiments - Physical restraint - Physical relationships of animal facilities to laboratories – Functional area - Physical facilities – Environment - Animal husbandry - Activity – Food - Bedding- Water- Sanitation and cleanliness – Waste disposal - Pest control - Emergency , weekend and holiday care.

**Unit-V: Intellectual Property Rights**

Origin of the Patent Regime – History of Indian Patent System - Indian Pharmaceutical Industry - The Present Scenario – Basis of Patentability –Patent Application Procedure in India - Patent Granted Under Convention Agreement - Who can apply for a patent - Patent Procedure – Opposition to Grant of Patent - Grant and Sealing - Exclusive Rights – Grant of Exclusive Rights - Special Provision for selling or distribution – Suits relating to infringements – Compulsory License - Termination of Compulsory License – Case study - Compulsory Licenses - Relief under Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement.

**Course Objectives**

* To acquire knowledge on the ethical applications of biological principles.
* To acquire knowledge on the regulatory frameworks and good

Laboratory practices for safety

* To Understand and make aware of the CPCSEA guidelines
* To learn the Intellectual Property Rights and patent filing.
* To learn the application of biotechnology in various fields.

**Unit-1: (50 to 100 contents)**

* To understand the Ethics, effects of the ethics.
* To learn the consumer traits.
* To acquire the knowledge about environmental, economical and social concern.

**Unit-2: (50 to 100 contents)**

* To study the secondary metabolites, growth hormones, and interferons.
* To acquire knowledge about the biotech food products.
* To learn the microbial degradation in Bioremediation process.

**Unit-3: (50 to 100 contents)**

* To study the good laboratory practical.
* To learn the quality standards of clinical trials.
* To acquire knowledge of the World Wide Clinical trials.

**Unit-4: (50 to 100 contents)**

* To study the CPCSEA guideline for handling Experimental animals.
* To learn the physical relationships of animal facilities and laboratories.

**Unit-5: (50 to 100 contents)**

* To learn the intellectual property rights and patent filing.
* To know the patent procedure in India.

**Text Books**

1. V. Srikrishna, 2007, Bioethics and Biosafety in Biotechnology, New Age

International Publisher, New Delhi

1. [Goel And Parashar](https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Goel+And+Parashar&search-alias=stripbooks), 2013, IPR, Biosafety and Bioethics, Pearson, Chennai.
2. Rajmohan Joshi, 2006, Biosafety and Bioethics, Gyan Publishing House, Delhi
3. V Sree Krishna, 2007, Bioethics and Biosfety in Biotechnology, New Age International, New Delhi.

**Reference Items: books, Journal**

1. Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational service Chennai.
2. Dubey, R. C., 2008, A text book of Biotechnology, S. Chand Co., New Delhi
3. Gupta, P.K, 2008, Biotechnology and Genomics, Rastogi Publications, Meerut, India.
4. M. K. Sateesh, 2008, Bioethics and Biosafety, I. K. International Pvt Ltd, India
5. National Bioethics Committees in Action, 2010, United Nations Educational, Scientific and Cultural Organization, rue Miollis, 75732 Paris Cedex 15, France.
6. [Henk ten Have](https://www.bookdepository.com/author/Henk-ten-Have), 2016, Encyclopedia of Global Bioethics. Springer.

**E- Materials**

* <https://books.google.co.in/books/about/Bioethics_and_Biosafety.html?id=xP9dzbSBTZQC>
* <http://access.in.pearson.com/store/store/product/896-IPR,-Biosafety-and-Bioethics?s=HigherED>

**Course Out Comes (five outcomes for each units should be mentioned)**

1. **After studied unit-1, the student will be able to understand**

* Study the positive and negative effects of Bio-ethics.
* Able to define Bio-ethics and explain the fundamental of ethical rights and principles that apply to
* Student learn the ethics in rice, vegetable, fruits, resistance crops, consumer traits.
* Environment and eco-safety makes the student to understand food school.

1. **After studied unit-2, the student will be able to understand**

* To understand the production of secondary metabolites.
* To understand the biotechnical food preparations.
* To explain the microbial degradation pesticides and bio-fertilizer.
* To know the practical use of biotechnology application medicine, agriculture, and food production.

1. **After studied unit-3, the student will be able to understand**

* To describe the regulatory frameworks in India and USA.
* To gain knowledge of the good laboratory practice.
* To understand the awareness of the clinical trials.

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1. **After studied unit-4, the student will be able to understand**

* To understand the guide lines for laboratory animal handling.
* To know the concerns of animal welfare.
* To learn the condition and treatments which avoid mental suffering of test animals.
* To learn the facilities, provide for the experimental animals.

1. **After studied unit-5, the student will be able to understand**

* To encourage research scholarship and spirit of inquiry by generating new knowledge.
* To facilitate the transfer of knowledge and technology to intending users to promote utilizing resource for benefit of society.
* To create respect for other people IPR among the members of the institute.
* To learn the awerness on IPR through conducting seminars.

**CORE ELECTIVE**

**PAPER-3**

**B. BIOPHYSICS**

**UNIT-I: BIOMOLECULES AND BONDING**

Electron configuration of an atom and Molecule. Bonds - Covalent bond, Ionic Bond, Hydrogen bond, Disulphide bond, Peptide bonds. Forces between Molecules - Electrostatic force, Van der Waal’s forces - hydrophobic and hydrophilic - biological importance. Kinetic energy.

**UNIT-II: THERMODYNAMICS AND BIOLOGICAL OXIDATION**

Laws of Thermodynamics – First Law and Second Law - Concept of free energy and entropy - Exergonic and Endergonic reactions. Rate of reactions - Effect of sunlight and temperature on reactions. Energy of Activation - Arrhenius expression.

Diffusion - Fick’s Laws, constant laws. Osmotic coefficient - Gibbs Donnan equilibrium.

Oxidation and reduction reactions - Redox potentials in biological system, High energy phosphate group. Bioluminescence – Extra cellular, Intra cellular and Symbiotic. Bioluminescence in bacteria and Fire Fly. Function of Bioluminescence – Food collection, Protection from Predators and Sexual attractions.

**UNIT-III: MICROSCOPY**

Principle and biological application of Light microscope, Electron microscope, Polarising microscope, Fluorescent microscope, Phase contrast microscope, Dark field microscope, Interference microscope and X-ray microscope.

**UNIT-IV: PHOTO BIOPHYSICS**

Electromagnetic spectrum - visible and invisible region. Principles involved in Photoelectric colorimetry. Principle of Spectroscopy - UV & IR Spectroscopy in biological investigation. Effects of UV on biological systems. Delayed effects of radiation - Ageing, reduction in life span, cancer. Radioactive isotopes - measurements - GM tubes, Liquid Scintillation counters. Autoradiography. Effects of radiation.

**UNIT-V: BIOPHYSICAL PRINCIPLES APPLIED TO PHYSIOLOGY**

Biophysical aspects of vision, hearing, nerve conduction and muscle contraction. Application of Radioimmuno assay (RIA) Magnetic Resonance Imaging (MRI) Laser Beam in Biology. Nuclear Medicine for Therapy, Fibre – Optic Endoscopy. Heart – Lung Machine (Cardio – Pulmonary Bypass (CPB)). Mammography.

**Course Objectives**

1. To understand the principle and applications of various research instruments for Human life.

2. To understand the Biological importance of Biomolecules

3. To understand the Different types of Laws in Biophysics

4. To understand how the animals produce Bio-luminescence for food, protection and sexual attraction.

5. To understand how MRI scanner is working.

6. To understand the nuclear medicine for therapy, fiber optic endoscopy and mammography.

**Unit-1: (50 to 100 contents)**

* + To understand the basic principle of an electron configuration of an atom and Molecules.
  + To gain knowledge about Bonds - Covalent bond, Ionic bond, Hydrogen bond etc.,
  + To know the principle and biological importance of kinetic energy.

**Unit-2: (50 to 100 contents)**

* To understand the basic principle and Laws of Thermodynamics.
* To learn the concept of free energy and entropy.
* To gain knowledge about Different types of Laws in Biophysics.
* To understand how the animals, produce Bio-luminescence for food, protection and sexual attraction

**Unit-3: (50 to 100 contents)**

* To understand the basic Principle and biological application of microscopes.
* To aware the application of microscopes in biological science**s.**

**Unit-4: (50 to 100 contents)**

* To understand the principle and application of Electromagnetic spectrum.
* To know the principle and concept of Photoelctric colorimetry, Spectroscopy and its application in biological sciences.
* To learn the Effects of UV on biological system.
* To gain knowledge about radioactive isotopes.
* To understand the basic concept of Autoradiography and its application.

**Unit-5: (50 to 100 contents)**

* To understand the Biophysical aspects of vision, hearing, nerve conduction and muscle contraction.
* To understand the working principle and application of Radioimmuno assay (RIA) and Magnetic Resonance Imaging (MRI) Laser Beam in Biology.
* To know about various techniques involved in Nuclear Medicine for Therapy.
* To understand the objectives of Pulmonary Bypass ND Mammography.

**Text Books**

1. Bose, S. 1982. Elementary Biophysics. Jyoth Books
2. Bums, D.M. and MacDonald, S.G.G. 1979. Physics for Biology and Premedical students. ELBS and Addisson - Wesley Publishers Ltd., London
3. Das, D. 1982. Biophysics and Biophysical Chemistry. Academic Publishers. New Delhi.
4. Epstein, H.T. 1963. Elementary Biophysics, selected topics. Addisson - Wesley Publishing Company Inc. London
5. Palanichamy, S and Shanmugavelu, M. 1991. Priniples of Biophysics. Palani Paramount, Publication; Tamil Nadu.

**Reference Items: books, Journal**

* Rodney M. J. Cotterill (2002). Biophysics: An Introduction. Wiley. ISBN 978-0-471-48538-4.
* Sneppen K, Zocchi G (2005-10-17). Physics in Molecular Biology (1 ed.). Cambridge University Press. ISBN 978-0-521-84419-2.
* Glaser R (2004-11-23). Biophysics: An Introduction (Corrected ed.). Springer. ISBN 978-3-540-67088-9.
* Hobbie RK, Roth BJ (2006). Intermediate Physics for Medicine and Biology (4th ed.). Springer. ISBN 978-0-387-30942-2.
* Cooper WG (August 2009). "Evidence for transcriptase quantum processing implies entanglement and decoherence of superposition proton states". Bio Systems. 97 (2): 73–89. doi:10.1016/j.biosystems.2009.04.010. PMID 19427355.
* Cooper WG (December 2009). "Necessity of quantum coherence to account for the spectrum of time-dependent mutations exhibited by bacteriophage T4". Biochemical Genetics. 47 (11–12): 892–910. doi:10.1007/s10528-009-9293-8. PMID 19882244.
* Goldfarb D (2010). Biophysics Demystified. McGraw-Hill. ISBN 978-0-07-163365-9.

**E- Materials**

* https://epdf.pub/biophysics.html
* https://scholar.cu.edu.eg/?q=abdo\_elfiky/files/dillon\_p.f.\_biophysics..\_a\_physiological\_approach\_draft\_cup\_2012isbn\_1107001447314s\_b\_.pdf
* <http://www.freebookcentre.net/Physics/BioPhysics-Books-Download.html>
* <https://typeset.io/formats/springer/european-biophysics-journal/062e2ab131e74d7ab83a9eff3c450897>
* Letter from the Archives of Biochemistry and Biophysics to Joshua Lederberg - Joshua Lederberg - Profiles in Science

* <https://profiles.nlm.nih.gov/.../nlm:nlmuid-101584906X1406-doc>
* <https://profiles.nlm.nih.gov/.../nlm:nlmuid-101584906X1404-doc>
* <https://profiles.nlm.nih.gov/.../nlm:nlmuid-101584906X1408-doc>
* <https://www.cell.com/biophysj/home>
* <https://www.annualreviews.org/journal/biophys>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1.After studied unit-1, the student will be able to understand**

* + - * + Electron configuration.
        + Bonds.
        + Electrostatic force.
        + Hydrophobic and hydrophilic.
        + Kinetic energy.

**2.After studied unit-2, the student will be able to understand**

* + - * + Laws of Thermodynamics.
        + Concept of free energy.
        + Rate of reactions.
        + Bioluminescence.
        + Fick’s Laws.

**3.After studied unit-3, the student will be able to understand**

* + - * + Light microscope and Electron microscope.
        + Polarising microscope and Fluorescent microscope.
        + Phase contrast microscope and Dark field microscope.
        + Interference microscope.
        + X-ray microscope.

**4.After studied unit-4, the student will be able to understand**

* + - * + Electromagnetic spectrum.
        + Principles involved in Photoelectric colorimetry.
        + Principle of Spectroscopy and UV & IR Spectroscopy.
        + GM tubes and Liquid Scientillation counters.
        + Effects of radiation.

**5.After studied unit-5, the student will be able to understand**

* + - * + Biophysical aspects of vision, hearing and nerve.
        + Application of Radioimmuno assay.
        + Magnetic Resonance Imaging.
        + Nuclear Medicine for Therapy.
        + Mammography.

**OPEN ELECTIVE**

**PAPER-3**

**(to Choose either A or B)**

1. **AQUARIUM FISH KEEPING**

**UNIT- I**

**Scope of Aquarium Fish Industry:** Aquarium as cottage industry - Exotic and Endemic species of Aquarium fishes. Constructions of home aquarium- materials used, aerators and filters, net and other equipments.

**UNIT - II**

**General Characters and sexual dimorphism:**

Freshwater and Marine water Aquarium fishes- Guppy, Molly, Sward tail, Gold fish, Angel fish, Blue Morph, Anemone fish and Butterfly fish. Freshwater aquarium plants - Secondary sexual characters, breeding habits, spawning and parental care.

**UNIT – III**

**Food and Feeding of Aquarium Fishes:**

Different kinds of feeds - Culture of live feed organisms and separation of formulated fish feeds – feeding methods.

**UNIT – IV**

**Transportation of Aquarium fishes:**

Aquarium fish habitats, Methods of collection from the wild, Fish handling, packing and transportation techniques.

**UNIT – IV**

**Maintenance of Aquarium:** Cleaning of aquarium tank - maintenance of water quality - control of snails and algal growth in aquarium tank – disease diagnosis and treatment.

**Course Objectives**

1. To impart basic knowledge on aquarium fish keeping

2. To teach the various technology used in the aquarium fish keeping

3. To understand the characteristic features of aquarium fishes

4. To explain the biology of aquarium fishes

5. To motivate self-employment opportunity

**Unit-1: (50 to 100 contents)**

* To study the scope of aquarium fish industry and aquarium as cottage industry and exotic and endemic species of aquarium fishes.
* To understand and study the constructions of home aquarium, materials, used, aerators, filters, net and other equipment.

**Unit-2: (50 to 100 contents)**

* To learn and understand thegeneral characters and sexual dimorphism, freshwater and marine water aquarium fishes- guppy- molly- sward tail- gold fish- angel fish- blue morph-anemone fish and butterfly fish.
* To understand the freshwater aquarium plants, secondary sexual characters, breeding habits- spawning - parental care.

**Unit-3: (50 to 100 contents)**

* food and feeding of aquarium fishes: different kinds of feeds and culture of live feed organisms.
* To learn the preparation of formulated fish feeds – feeding methods.

**Unit-4: (50 to 100 contents)**

* To understand the transportation of aquarium fishes: aquarium fish habitats,
* To learn the methods of collection from the wild, Fish handling, packing, transportation techniques.

**Unit-5: (50 to 100 contents)**

* To learn and study the maintenance of aquarium:cleaning of aquarium tank –and maintenance of water quality - control of snails - algal growth in aquarium tank.
* To study the disease diagnosis and treatment.

**Text Books**

1. Coffey, D.J., 1977. Encylopedia of Aquarium Fishes in Colour. Acro Publications.
2. David Justin Smith- Introduction to Aquarium Keeping
3. Jhingran, V. G. 1982. Fish and Fisheries in India. Hindustan Publishing Corporation, New Delhi.
4. Shanmugam, K. 1992. Fishery Biology and Aquaculture. Leo Pathipagam, Chennai, India.
5. Mill Dick, 1993. Aquarium Fish. D.K. Publishing Corporation, New York, USA.
6. Yadav, B.N., 1997. Fish and Fisheries (Second Edition), Daya Publishing House, Delhi, India, pp. 366.
7. Day, F. 1978. Fishes of India, Vol. I & II. William Danisan & Sons, India.
8. Mill Dick, 1993. Aquarium Fish. D.K. Publishing Corporation, New York, USA.
9. Mill Dick, 1993. Aquarium Fish. D.K. Publishing Corporation, New York, USA.
10. The transport of live fish –A review - FAO
11. Fish Pathology - Fourth Edition (Roberts, R.J., ed.), 2012. Blackwell Publishing Ltd., UK. pp. 591.

**Reference Items: books, Journal**

1. David Justin Smith- Aquarium Keeping: The Aquarium Keeping Basics.
2. David Justin Smith- Aquarium Keeping: 25 Facts Every Aquarist Should know.
3. David Justin Smith- Aquarium Keeping: The Aquarium Keeping Guide Book.
4. David Justin Smith- Aquarium Keeping: The Aquarium Keeping Essentials.
5. Coffey, D.J., 1977. Encylopedia of Aquarium Fishes in Colour. Acro Publications.
6. Fish Pathology - Fourth Edition (Roberts, R.J., ed.). 2012. Blackwell Publishing Ltd., UK. pp. 591.
7. Jhingran, V. G. 1982. Fish and Fisheries in India. Hindustan Publishing Corporation, New Delhi.
8. Shanmugam, K. 1992. Fishery Biology and Aquaculture. Leo Pathipagam, Chennai, India.
9. Mill Dick, 1993. Aquarium Fish. D.K. Publishing Corporation, New York, USA.
10. Yadav, B.N., 1997. Fish and Fisheries (Second Edition), Daya Publishing House, Delhi, India, pp. 366.
11. Day, F. 1978. Fishes of India, Vol. I & II. William Danisan & Sons, India.

**E- Materials**

* [www.fao.org](http://www.fao.org) - The transport of live fish –A review – FAO
* [www.fisheriesjournal.com](http://www.fisheriesjournal.com) – The design and construction of Aquaria.
* [www.instructable.com](http://www.instructable.com) – How to build Aquarium- 6 steps- instructable

**Course Out Comes (five outcomes for each units should be mentioned)**

1. **After studied unit-1, the student will be able to**

a) Acquire basic knowledge about aquarium

b) Learn about the exotic and endemic aquarium fish species

c) Know about the construction of home aquarium

d) Understand the materials requirement for setting up home aquarium

e) Know the usage of minor equipment used in the aquarium

**2. After studied unit-2, the student will be able to**

a) Acquire knowledge on freshwater and marine water aquarium fishes

b) Know the fresh water aquarium plants used in the tank

c) Learn their secondary sexual characters

d) Know the breeding and spawning behavior of aquarium fishes

e) Understand the parental care present in the aquarium fishes

**3. After studied unit-3, the student will be able to**

a) Know the different kinds of feeds used for aquarium fish

b) Understand how to cultivate live feed organisms?

c) Learn the techniques of preparation of formulated feed

d) Acquire knowledge on feed conversion ratio of feeds

e) Know the feeding behavior of aquarium fishes

**4. After studied unit-4, the student will be able to**

a) Understand the aquarium fish habitat

b) Know the method of collection of aquarium fishes form wild

c) How to handle the aquarium fishes?

d) Acquire knowledge on packing of aquarium fishes

e) Learn techniques used for transportation of aquarium fishes

**5. After studied unit-5, the student will be able to**

a) Know the procedure of cleaning the aquarium tank

b) Understand the water quality parameters and its importance

c) Comprehend the control of snail and algal growth in the aquarium tank

d) Acquire knowledge on disease diagnosis

e) Get an idea of treatment of disease in aquarium fishes.

**OPEN ELECTIVE**

**PAPER-3**

1. **MEDICAL LABORATORY TECHNOLOGY**

**UNIT I**

Medical Laboratory scope- general procedures- Laboratory requirements, Sterilization, Dry heat (Hot air oven), Moist heat (Autoclave, Pressure cooker), Laboratory equipments -Spectrophotometer, Incubator Refrigerator, Auto analyzer, Micro centrifuge, Automatic pipettes.

**UNIT II**

Collection of blood samples, Packed cell volume (PVC), Erythrocyte sedimentation Rate (ESR),RBC Count, WBC Count, Reticulocyte count, Total count, Differential Count, Pulse rate, Use of blood pressure Apparatus, Electrocardiogram, Echocardiogram, Estimation of Haemoglobin, Artificial pacemaker.

**UNIT III**

Blood cross matching – Hepatitis test – Haemolytic jaundice, ELISA, Estimation of blood glucose fasting two-hour post prandial – Diabetes mellitus, Estimation of blood Cholesterol, Blood Urea, Blood Uric Acid.

**UNIT IV**

Analysis of urine – Physical examination, Blood cells, Urine glucose, Urine albumin, Bile salts,

Ketone bodies, Urine culture – Antibiotic susceptibility test. Pregnancy Test (Detection of HCG). Analysis of faeces – Components of faeces their characteristics, factors affecting faeces.composition.Analysis of sputum – Pathological conditions that can be detected in sputum – their causes – Detection of Group A – Streptococcus.

**UNIT V**

Cerebrospinal fluid – Formation, Composition function, Conditions altering its composition –

their causes. Seminal fluid – Composition of seminal fluid, Sperm count, Abnormal sperms,

Common pathological conditions detected in semen – their causes. Aminotic fluid – Sex determination, Diagnosis of pathological conditions of developing foetusthrough analysis of amniotic fluid.

**Course Objectives**

* To impart awareness on clinical lab-technology
* To create knowledge on self- employment opportunity

**Unit-1: (50 to 100 contents)**

* To learn and study the laboratory equipment’s.
* To understand the principles of Spectrometer, Refrigerator.
* To acquire the knowledge of dry heat and moist heat.

**Unit-2: (50 to 100 contents)**

* To learn the blood parameters.
* To understand the medical application of the apparatus.
* To perform the routineanalysis of blood/ body fluids.

**Unit-3: (50 to 100 contents)**

* To learn the laboratory procedures of blood cross matching, Hepatitis, Haemolytic jaundice.
* To learn the estimation of Blood glucose, Blood cholesterol.
* To understand the procedure of urea, Uric acid.

**Unit-4: (50 to 100 contents)**

* To analysis the laboratory procedure for urine examination.
* To understand the knowledge of antibiotic susceptibility and detection of HCG.
* To provide basic analytical techniques.

**Unit-5: (50 to 100 contents)**

* To identify the sources of pre analytic correlate the test result with disease process.
* To diagnosis the pathological conditions of developing embryo and aminotic fluid.
* To acquire knowledge about composition of abnormality in seminal fluid.

**Text Books**

1. Biswajit Mohanty and Sharbari Basu – Fundamentals of Practical Clinical

Biochemistry, B.I. Publications PVT., LTD.,54, Janpath, New Delhi – 110001.

2. Estridge B.H. Raynold A.P and Walters N.J. Basic Medical Laboratory

Techniques,4th edition, Thomson Delmar Learning, Eastern press (Bangalore)Pvt.,

Ltd., Boommasandra Industrial Area, Hosur Road, Bangalore – 562158.

3. Kannai, L. Mukherjee, Medical Laboratory Technology Vol - I, Vol - II and Vol -

III. Tata MC Graw Hill Publishing Company Limited,No:444/1,Sri Ekambara

Naicker Industrial Estate, Alapakkam, Porur, Chennai – 600116.

**Reference Items: books, Journal**

1. Ramnik Sood, Medical Laboratory Technology, Methods and Interpretations. Jaypee

Brothers Medical Publishers (P) Ltd., New Delhi.

2. Venkadesan, O. Essential of Medical Laboratory technology, Bicobas P.G and

Research Department of Zoology, Loyola College, Madras – 60003

**E- Materials**

* <https://libguides.utoledo.edu/medlabsci/books>
* <https://guides.lib.uiowa.edu/c.php?g=131963&p=863302>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* To perform the basic analytical techniques.
* To demonstrate the appropriate use of laboratory instrumentations.
* To select the appropriate troble-shooting procedure.

**2. After studied unit-2, the student will be**

* To perform routine analysis of blood and body fluid samples.
* To demonstrate the ability to proper for the proper procedure for laboratory analysis.
* To learn and to understand the knowledge and skill in major areas of clinical laboratory diagnosis.

**3.After studied unit-3, the student will be**

* To understand and test the blood glucose estimation in diabetic patients.
* To study the process of immunohaematology trials.
* To learn and to understand the lab operations in blood culture, blood uric acid, etc.

**4.After studied unit-4, the student will be**

* To perform the analysis of Urine and blood.
* To understand the laboratory test diagnose treat the disease.
* To identify the immune haematology test.

**5.After studied unit-5, the student will be**

* To understand the clinical chemistry of CSF,SF, and amniotic fluid.
* To study the pathology conditions of the patients.
* To demonstrate a commitment to patients to the performance.

**SEMESTER IV**

**PAPER-10**

**RESEARCH METHODOLOGY**

**UNIT-I: BIOSTATISTICS & BIOINFORMATICS**

Collection and analysis of biological data - mean, median, mode, Standard deviation, Standard error, Coefficient of variation, Student ‘t’ test, Skewness,

Kurtosis, Chi - square, Correlation, Regression and ANOVA.

Internet - Worldwide Web - Search Engines - their functions. Boolean searching - file formats.

Biological data bases - sequence and structure – data retrieval - searching source data bases - sequence similarity searches - FASTA and BLAST, clustral and phylip.

**UNIT-II: SPECTROSCOPY**

Absorption and Emission principles - Principles and applications of UV-visible, Spectroflurometer, flame photometer, Atomic Absorption and emission spectrophotometers, NMR and Mass spectrometer.

**UNIT-III: CHROMATOGRAPHY & ELECTROPHORESIS**

Principles and Application of Chromatography: Paper, Thin layer, column, Ion Exchange, Gel filtration, Gas Liquid, HPLC and affinity chromatography.

Principles and Application of Electrophoresis: AGE, PAGE, 2D gel and Iso-Electric focusing.

**UNIT-IV: MICROSCOPY**

Principles, construction and biological uses of phase contrast, fluorescence, scanning and transmission electron microscopes.

**UNIT-V: PREPARATION OF MANUSCRIPTS**

Preparation of index cards - Reference collection - preparation of thesis - preparation of Scientific paper for publication in a Journal. Internet and e-journals. Computer aided techniques for data analysis, data presentation and power point preparation.

**Course Objectives**

* To make the students, learning statistical and bioinformatics tools.
* To make the students, understand spectroscopic principle and application.
* To make the students, know various bio-molecule separation techniques.
* To make the students, operate various microscopes.
* To make the students, get experienced in research paper writing and publication.

**Unit-1: (50 to 100 contents)**

* Perform statistical approach for Research.
* Describe analysis of Biological data.
* Learn the World Wide Web, search engines and file formats.
* To study the biological data bases, data retrieval, sequence sources.

**Unit-2: (50 to 100 contents)**

* Study the Instrumentation of Biology.
* To under the working principles and application of Spectroscopy.

**Unit-3: (50 to 100 contents)**

* To understand chromatography and its applications.
* To acquire the knowledge in separation of serum proteins.
* To understand the principles and application of Eletrophoreis.

**Unit-4: (50 to 100 contents)**

* To understand the Immuno cyto chemical techniques.
* Recognize the SEM, TEM, techniques.
* To study the types of Microscopes.

**Unit-5: (50 to 100 contents)**

* To study the scientific research down into core argument.
* To learn the preparation of thesis.
* To study and acquire knowledge about the Publications of Journals, Internet, e- journals.
* Learn data preparation and ppt by computer aided techniques.

**Text Books**

1. Gupta, S.P. 1988. An easy approach to statistics. Chand & Co., New Delhi.
2. Gurumani, N. 2006. Research Methodology for Biological Sciences. MJP

Publishers, Chennai.

1. Veerakumari, L. 2006. Bioinstrumentation. MJP Publishers, Chennai.

**Reference Items: books, Journal**

1. Anderson, Durston and Polle.1970. Thesis and Assignment writing. Wiley Eastern Ltd., New Delhi.
2. Comir and Peter Wood Ford.1979. Writing scientific papers in English. Pitman Medical Publishing Co., London.
3. Ewing, G.W. 1988. Instrumental methods of chemical analysis, McGraw Hill Book Company.
4. Daniel, M. 1989. Basic biophysics for biologists. Agro-Botanical Publishers, India.
5. Skoog, A., Douglas, J. and Leary, J.J. 1992. Principles of Instrumental Analysis. Sanders Golden Sunberst Series, Philadelphia.
6. Day, R.A. 1994. How to write and publish a scientific paper. Cambridge University Press, London.
7. Palanichamy, S. and M. Shanmugavelu.1997. Research methods in biological sciences. Palani Paramount Publications, Tamil Nadu, India.

Wilson and Walker. 2000. Practical biochemistry - principles and techniques.

Cambridge University Press.

1. Milton, J.S. 1992. Statistical methods in Biological and Health Sciences. McGraw Hill Inc., New York.

**E- Materials**

* <https://epdf.pub/research-methodology-methods-and-techniques.html>
* <https://stuvera.com/research-methodology-books-pdf-free-download/>
* <https://groups.google.com/forum/#!topic/klubs_mba/e24oSszYJPI>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be learning statistical methods.**

* The student can able to works on Computers for Projects and Research.
* Student can able to understand search engines ,Boolean searching, file formats etc.
* By learning data base, student can analyses the sequence similarities of the FAST and BLAST etc.

**2. After studied unit-2, the student will be able to**

* understand the different types of Spectrometers.
* They learn the principles of Nuclear Magnetic Resonance to identify the atomic elements of chemicals.

**3.After studied unit-3, the student will be**

* Understand to the different types of Spectrometer.
* Able to understand the separation of protein and DNA through Elecrophoretic apparatus.

**4. After studied unit-4, the student will be**

* To understand principles, construction of different Microscope.
* Student can be able to understand the staining techniques.
* Student can be able to understand the diseases with live tissue by SEM and TEM microscopes.

**5. After studied unit-5, the student will be**

* To learn the principles of academic writing for scientific journals.
* To understand the knowledge of writing process selection of publication forum tips for writing .
* Student can be able to prepare their own scientific manuscripts.

**PAPER-11**

**ENTOMOLOGY**

**UNIT-I: CLASSIFICATION**

Classification of insects upto order with examples.

**UNIT-II: BENEFICIAL INSECTS**

Productive insects, lac insects and their management.

**UNIT-III: SERICULTURE**

Prospects of sericulture, Biology of silkworm (Nutrition, Genetics, Endocrinology, Reproduction, Pest and Diseases).

**UNIT-IV: INSECT PESTS AND THEIR CONTROL**

Insects – Pests of crops: Types of injuries and loss caused to plants in general. Factors governing the outbreak of pests.

Principles and methods of pest suppression: Natural, Cultural, mechanical, physical, chemical, Biological and Integrated pest management.

**UNIT-V: INSECTS AS VECTORS**

Vector borne diseases: Method of transmission of parasitic agents with special reference to mosquitoes and houseflies.

**Course Objectives**

1. To gain knowledge of insects and their significance

2. To understand the economic importance of insects in related to beneficial insects.

3. To acquire knowledge on classification of insects.

4. To understand insect’s pest and their control.

5. To understand different productive insects and their management

6. To understand different vector borne diseases.

**Unit-1: (50 to 100 contents)**

* To acquire knowledge on classification of insects.
* To acquire knowledge on orders.
* To gain knowledge on 26 orders of insects.
* To know about different types of insects.
* To understand morphological and physiological significance of insects

**Unit-2: (50 to 100 contents)**

* To understand about beneficial insects.
* To understand honeybee significant.
* To know lac insect significance.
* To understand the management of insects.

**Unit-3: (50 to 100 contents)**

* To understand the biology of silk worm.
* To understand silk worm nutrition.
* To understand genetical changes
* To understand pest and diseases
* To understand endocrinology of silk worm

**Unit-4: (50 to 100 contents)**

* To know about pest crops.
* To know about types of injuries.
* To know about loss of pauses to plan in general.
* To know about different pest control.
* To know about integrated pest management.

**Unit-5: (50 to 100 contents)**

* To know about different vector borne disease.
* To know about method of transmission.
* To know the mode of transmission
* To understand the different parasitic agency.
* To know about mosquitoes and housefly

**Text Books**

1. Vanantharaj David, B and Kumaraswami, T, 1975. Elements of Economic Entomology, Popular Book Depot in Madras.
2. Ananthakrishnan, T.N. 2002. Insect Plant Interactions. Oxford and I.B.H, New Delhi.
3. P.G.Fenemore, Alkaprakash. 1992. Applied Entomology, Wiley Eastern Ltd., Delhi.
4. Nayar, K.K., Ananthakrishnan, T.N. and B.V.David. 1989. General and Applied Entomology. Tata McGraw Hill Publications, New Delhi.
5. Richards, O.W. and Davies, R.G. 1997. Imm’s General Text Book of
6. Entomology Tenth Edition. Vol I and II. R.I Publications, New Delhi. Rajeev K.Upadhyay, Mukerjii K.G. Chanda, B.P. and Dubey, O.P. 1998. Integrated Pest and Disease Management. APH Publishing Corporation, New Delhi.
7. Saxena. A.B. 1996. Harmful Insects. Anmol Publications, New Delhi.
8. Patton. W.S. and Cragg F.W.1981. A Text Book of Medical Entomology. International Books and Periodicals Supply Service, New Delhi.
9. Rathinaswamy, T.K.1986. Medical Entomology. S.Viswanathan and Co., Madras.
10. Sundari, M.S.N. and Santhi, R. 2006. Entomology. MJP Publishers, Chennai.

**Reference Items: books, Journal**

1. William S. Romoser and John G. Stoffolano.W. M.1994. The Science of Entomology C.Brown Publishers, England.
2. Yataro Tazima, Kodarsha .1978. The silkworm. An important laboratory tool. Scientific Book Ltd., Japan.
3. Larry P.Pedigo. 1989. Entomology and Pest Mangement. Prentice Hall, New Jersey.
4. Metcalf, C.V. and Flint, W.P. 1979. Destructive and useful insects, their habitats and control. Tata McGraw Hill Publications, New Delhi.
5. Daniel Altman Robets. 1978. Fundamental of Plant Pest Control. C.R.S. Publishers and Distributors,Delhi,
6. Chapman, R.F.1988. The insect structure and Function. Cambridge University Press, U.K.
7. David B.V., Muralirangan M.C. and Meera Murali Rangan. 1992. Harmful and Beneficial Insects. Popular Book Depot, Chennai.
8. Ramakrishna Ayyar T.V. 1989. Handbook of Economic Entomology for South India. Books and Periodicals Supply Service, New Delhi.
9. Frost S.W.1994. General Entomology. Narendra Publishing House, Delhi.
10. Dennis S.Hill. 1993. Agricultural Insect Pests of the Tropics and their Control. Second Edition, Cambridge University Press, U.K.

**E- Materials**

* <https://www.freebookcentre.net/biology-books-download/A-Textbook-of-Entomology-(PDF-762P).html>
* <http://www.freebookcentre.net/Biology/Entomology-Books.html>
* <http://www.programamoscamed.mx/EIS/biblioteca/libros/libros/Gullan%20P.J.,%20Cranston%20P.%20The%20Insects..%20line%20of%20Entomology%202010_.pdf>
* <https://www.agrifunda.com/2018/01/fundamentals-of-entomology-free-pdf.html>
* <http://www.bio-nica.info/Biblioteca/Gillott2005ntomology.pdf>
* <https://archive.org/details/textbookofentomo00pack/page>
* <https://www.iaritoppers.com/2019/06/fundamentals-of-entomology-icar-ecourse-pdf-download.html>
* <https://feener.biology.utah.edu/courses/5445/Lecture/Bio5445%20Lecture%2001.pdf>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* Able to understand classification of insects.
* Able to understand about orders.
* Able to understand clearly about resemblances and difference between insects.
* Able to understand economic importance of insects.

**2. After studied unit-2, the student will be**

* Able to understand the biology of honeybees.
* Able to understand about lac insects
* Able to understand the management of beneficial insects.

**3. After studied unit-3, the student will be**

* Able to understand biology of silk worm
* Able to understand about nutrition of silk worm
* Able to understand the genetical importance
* Able to understand endocrinology of silk worm
* Able to understand the reproduction, pest and diseases of silk worm

**4. After studied unit-4, the student will be**

* Able to understand different pest crops.
* Able to understand types of injuries.
* Able to understand the causes of plants in general.
* Able to understand the pest control.
* Able to understand the integrated pest management.

**5. After studied unit-5, the student will be**

* Able to understand the victor borne diseases.
* Able to understand the method of transmission of parasitic agent.
* Able to understand the special reference to mosquitoes and housefly.

**PROJECT COMPULSORY**

**Objectives**

To promote original thinking, insemination of knowledge, modulation and innovation of thought, as an exercise, in order to transport the young minds to the expanding horizon of their chosen area of knowledge and transform them into knowledge generators.

**Project 75 Marks**

**Viva voce 25 Mark**

**CORE PRACTICAL 3**

**ANIMAL PHYSIOLOGY, DEVELOPMENTAL BIOLOGY AND**

**IMMUNOLOGY**

**PHYSIOLOGY**

1. Estimation of RQ in Fish with reference to Light and temperature.

2. Salt loss and salt gain in fish

3. Estimation of Proteins, Carbohydrates and Lipids in the tissues of Fish

4. Estimation of Blood Urea and Cholesterol.

5. Blood Clotting Time, Bleeding Time, Rouleaux Formation, Preparation of Haemin Crystal.

6.Principle and Application of Sphygmomanometer, Kymograph, Electrophoresis, Haemoglobinometer, ESR.

7. Estimation of Haemoglobin and ESR.

**DEVELOPMENTAL BIOLOGY**

1. Different stages in development - frog (egg, cleavage, Blastula, Gastrula, Yolk plug stage.

2. Chick embryo – primitive streak, 13 hrs, 24 hrs,48 hrs,72 hrs and 96 hrs.

3. Development of chick stage - slide showing C.S.of heart, kidney lens and limb.

4. Study of different types of placenta

5. Amphibia - identification of developmental stages.

**IMMUNOLOGY**

1. Haemagglutination - Quantitative analysis - haemagglutination titration.

2. Preparation of Antigen - RBC - Demonstration.

3. Ouchterlony technique - Demonstration.

4. Immunoelectrophoresis - Demonstration.

5. Slides showing T.S of Spleen, Thymus, lymphnodes and Bones

**CORE PRACTICAL 4**

**RESEARCH METHODOLOGY AND ENTOMOLOGY**

**RESEARCH METHODOLOGY**

1. Problems relating to test of significance (Chi - square test and t - test)

2. Problems relating to correlation, regression and ANOVA.

3. Familiarization of biological and bioinformatics web sites.

4. BLAST search for similar nucleotide sequences.

5. Spectrophotometric estimation of any biological constituent.

6. Electrophoresis - Paper / Agarose gel / PAGE

7. Preparation of index and reference cards.

**ENTOMOLOGY**

1. Study of morphology of insect (local 2 insects to be used).

2. Dissection of digestive, nervous, excretory, reproductive systems of any two insects.

3. Mounting of different types of mouthparts.

4. a. Field study of insect species

b. Identification of at least 10 insects belonging to different orders.

5. a. Field study for various methods of pest management.

b. Field visit to wearhouses and Plant protection centres.

**CORE ELECTIVE**

**PAPER-4**

**(to Choose either A or B)**

**(A) SERICULTURE**

**UNIT -I: ECONOMIC IMPORTANCE AND SILKWORM BIOLOGY**

Prospects and status of sericulture in India and other major silk producing countries. Silk producing species - their distribution.*Bombyxmori -* life cycle - organization of larvae, pupae and moth - structure and function of the silk gland.

**UNIT-II: MORICULTURE**

Mulberry - varieties - distribution - methods of cultivation and preparation - Harvest - Transport and preservation of leaves. Feeding and nutrition - specificity of diet - Factors of nutrition - Diet and growth. Pest and diseases.

**UNIT-III: SILKWORM REPRODUCTION AND GENETICS**

Reproduction: Growth and Development of silkworms - Physiology of moulting in different varieties (Uni, bi and multivoltine) - Endocrinology of reproduction and development. Genetics: mutation breeding and development of new strains.

**UNIT-IV: PATHOGENIC DISEASES AND PEST**

Pathology: Viral, bacterial, fungal and protozoan diseases - causative organisms – modes of transmission – symptoms - control mechanisms. Uzifly menace.

**UNIT-V: SILKWORM REARING AND SILK REELING**

Rearing operations - Selection and construction of rearing house - Incubation - Hatching - brooding, Harvesting. Reeling techniques - Re-reeling - Silk examination – lacing, skeining.

**Course Objectives**

1. To know the Biology of silkworm, their economic importance and methods practiced in sericulture.

To develop sericulture as a skill based curriculum.

**Unit-1: (50 to 100 contents)**

* By Learning the history of sericulture.
* Understanding the status of silk producing countries and sericulture in India.
* Basic terminologies of sericulture.
* Learning the nursery preparation and cultivating silkworms.

**Unit-2: (50 to 100 contents)**

* By learning the morphology and variety of Mulberry.
* Study the harvest, transport and preparation of Leaves.
* By learning the establishment of mulberry garden.

**Unit-3: (50 to 100 contents)**

* Study the external morphology and life cycle of silkworm.
* Learning the anatomy of physiology.
* Learning the endocrine system, hormones and it roles.
* Studying the breeding methods and importance.

**Unit-4: (50 to 100 contents)**

* Learning Viral, Bacterial, Fungal, and Protozoan Diseases.
* Understanding the mode of transmission and control mechanisms.
* Learning the Uzifly manace.

**Unit-5: (50 to 100 contents)**

* By learning the silkworm rearing techniques.
* By understanding the differentiation of young age and old age rearing methods.
* Learning the reeling techniques and examination of silk lacing and skeining.

**Text Books**

1. Ganga, G. and SulochanaChetty, J. 1997. An Introduction to Sericulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga, G. 2003. Comprehensive Sericulture Vol-I: Moriculture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Ganga, G. 2003. Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Madan Mohan Rao, M. 2019. An Introduction to Sericulture. 2nd edition, B.S. Publications. Andhra Pradesh, India.
5. Amardev Singh. 2012. Text book on Sericulture Training. Bio-Green Books. New Delhi.

**Reference Items: books, Journal**

1. HisaoAruga. 1994. Principles of Sericulture (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Veda, K., Nagai, I. and Horikomi, M. 1997. Silkworm Rearing (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Otsuki, R. and Sato, S. 1997. Silkworm Egg Production (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Eikichi Hiratsuka. 1999. Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Mahadevappa, D., Halliyal, V.G., Shankar D.G. and Bhandiwad, R., 2000. Mulberry Silk Reeling Technology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
6. Soo-Ho Lim, Young-Taek Kim, Sang-Poong Lee. 1990. Sericulture Training Manual – Published by FAO – USA. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
7. Wu Pang-Chuan and Chen Da-Chuang. 1994. Silkworm Rearing – Published by FAO – USA. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
8. Lu Yup-Lian and Liu-Fu-an. 1991. Silkworm Diseases - Published by FAO – USA. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

**E- Materials**

* <https://archive.org/details/SericultureHandbook/page/n1/mode/2up>
* <http://www.csrtimys.res.in/books-0>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* + - To know the general development of sericulture research.
    - Modern trends and Concepts in sericulture research.

**2. After studied unit-2, the student will be**

* + - The student will be involved in various aspects of egg production.

**3.After studied unit-3, the student will be**

* + - Able to understand silk health diagnosis, identification of deficiency symptoms.

**4.After studied unit-4, the student will be**

* + - The student involved in various product of silk.

**5.After studied unit-5, the student will be**

* + - The student involved in various product of silk.
    - To develops highly qualified protein and profession and manpower in silk and sericulture.

**CORE ELECTIVE**

**PAPER-4**

**(B) MICROBIOLOGY**

**UNIT-I: STRUCTURE AND CLASSIFICATION**

History and Scope of Microbiology.Structure and classification of virus, bacteria and fungi.

**UNIT-II: STERILIZATION AND CULTURE**

Sterilization: Principles - dry heat, moist heat, filtration, tyndallization, pasteurization, Radiation - disinfection.

Culture techniques - media preparation - Aerobic and anaerobic culture techniques - Wet mount, hanging drop, staining methods, dyes, simple differential and special staining techniques - acid fast stain, spore stain, capsule stain, staining for pure and mixed cultures.

**UNIT-III: ENVIRONMENTAL MICROBIOLOGY**

Microbial ecology - role of microorganisms in the productivity of ecosystems - Interactions between microorganisms- and plants and animals.Microbiology of soil, water and air.

**UNIT-IV: MEDICAL MICROBIOLOGY**

Pathogenic microbes of bacterial, viral, fungal and protozoan diseases - cure, control and prevention. Antimicrobial chemotherapy - Antibiotics - Source – Classification- Mode of action.

**UNIT-V: INDUSTRIAL MICROBIOLOGY**

Industrial uses of microbes - bioconversions – bioremediation.

Products of industrial microbiology - Penicillin, fuel ethanol, vinegar, vitamin B12, citric acid, glutamic acid, protease.

Food and Dairy microbiology. Role of microbes in food production. Dairy and non-dairy products.

**Course Objectives**

* To know the structure, function and diversity of microorganisms.
* To gain knowledge on the various techniques of microbiology.
* To acquire a basic knowledge on environmental, medical and industrial microbiology.

**Unit-1: (50 to 100 contents)**

* Understanding the different bacterial morphologies.
* By learning the structure of virus, bacteria, and fungi.
* Learning the difference between Gram negative and Gram positive bacteria.

**Unit-2: (50 to 100 contents)**

* Understanding the culture techniques of the bacteria and virus.
* Understand the sterilization techniques.
* By learning to compare sterilization and pasteurization techniques.

**Unit-3: (50 to 100 contents)**

* Understand the microbial metabolisms.
* Understand the bacterial, viral and fungal diseases.
* Study the different types of microbes.

**Unit-4: (50 to 100 contents)**

* To learn the pathogenic microbes.
* To understand the anti-microbial chemotherapy.

**Unit-5: (50 to 100 contents)**

* To learn the industrial uses of microbes.
* To understand the food and diary microbiology.

**Text Books**

1. Ananthanaryanan, T. and Paniker, J.C.K. 2000. Text Book of Microbiology. Orient Longman Ltd., Chennai.
2. Ahmed, M. and Basumatary, S.K. 2006. Applied Microbiology. M.J.P Publishers, Chennai.
3. Pelczar, M.J., Reid, R.D. and Chan, E.C.S. 1996. Microbiology. Tata McGraw Hill Co., Ltd. New Delhi.
4. Dubey, R.C. andMaheshwari, D.K. 2006. A Text Book of Microbiology. S. Chand and Company Ltd. New Delhi.
5. Patel, A.H. 2016. Industrial Microbiology. 2nd edition. Trinity Press. New Delhi.
6. Rajan, S. 2007. Medical Microbiology. M.J.P. Publishers. Chennai.
7. Powar, C.B. and Daginawala, H.F. 2010. General Microbiology, Volume: 2. Himalaya Publishing House. Mumbai.

**Reference Items: books, Journal**

1. Tortora, G.J., Funke, R.B. and Case, C.L. 1992. Microbiology - An Introduction. The Benjamin / Cummings Publishing Co., Inc. Sydney.
2. Black, J.G. 1999. Microbiology - Principles and Explorations. John Wiley and Sons Inc. New York.
3. Atlas, R.M. 1995. Principles of Microbiology. Mosby - Year Book Inc.
4. Prescott L.M. Harley J.O. Klein D.A. 1990. Microbiology. WCB Publishers, Sydney.
5. Geo F. Brooks, Karen C. Carroll, Janet S. Butel, Stephen A. Morse. 2007. Medical Microbiology. 24th edition. Tata McGraw Hill, LANGE. New Delhi.
6. Roger Y. Stanier, John L. Ingraham, Mark L. Wheelis, Page R. Painter. 2008. General Microbiology. MacMillan Press Ltd. New York.

**E- Materials**

* <https://openstax.org/details/books/microbiology>
* <https://www.topfreebooks.org/medical-microbiology/>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1.After studied unit-1, the student will be able to**

* define the microbial organisms of the virus, bacteria, and fungi.
* Student can be able to explain the scope of microbiology.

**2.After studied unit-2, the student will be**

* Able to demonstrate the practical skill in sterilization and pasteurization techniques.
* Student can be able to explain the technical basis of tools, technological methods methodology.

**3.After studied unit-3, the student will be**

* Describe the basic concepts of legal, ethical, economical and regulatory dimention of health line and public health.
* To understand the interaction of microorganisms and organisms of soil.

**4.After studied unit-4, the student will be**

* Student will understand the anti-microbial interactions.
* Student will learn about the Pathogenic microbes and diseases.

**5.After studied unit-5, the student will be**

* Student can be able to gain knowledge in several field of applied microbiology.
* Student can work in research and development unit in microbial industries.

**OPEN ELECTIVE**

**PAPER -4**

**(to Choose either A or B)**

**(A) SERICULTURE**

**UNIT -I: ECONOMIC IMPORTANCE AND SILKWORM BIOLOGY**

Prospects and status of sericulture in India and other major silk producing countries. Silk producing species - their distribution. *Bombyxmori -* life cycle - organization of larvae, pupae and moth - structure and function of the silk gland.

**UNIT-II: MORICULTURE**

Mulberry - varieties - distribution - methods of cultivation and preparation - Harvest - Transport and preservation of leaves. Feeding and nutrition - specificity of diet - Factors of nutrition - Diet and growth. Pest and diseases.

**UNIT-III: SILKWORM REPRODUCTION AND GENETICS**

Reproduction: Growth and Development of silkworms - Physiology of moulting in different varieties (Uni, bi and multivoltine) - Endocrinology of reproduction and development. Genetics: mutation breeding and development of new strains.

**UNIT-IV: PATHOGENIC DISEASES AND PEST**

Pathology: Viral, bacterial, fungal and protozoan diseases - causative organisms – modes of transmission – symptoms - control mechanisms. Uzi fly menace.

**UNIT-V: SILKWORM REARING AND SILK REELING**

Rearing operations - Selection and construction of rearing house Incubation - Hatching - brooding, Harvesting. Reeling techniques - Re-reeling - Silk examination – lacing, skeining.

**Course Objectives**

1. To know the Biology of silkworm, their economic importance and methods practiced in sericulture.

2.To develop sericulture as a skill based curriculum.

**Unit-1: (50 to 100 contents)**

* By Learning the history of sericulture.
* Understanding the status of silk producing countries and sericulture in India.
* Basic terminologies of sericulture.
* Learning the nursery preparation and cultivating silkworms.

**Unit-2: (50 to 100 contents)**

* By learning the morphology and varieties of Mulberry.
* Study the harvest, transport and preparation of Leaves.
* By learning the establishment of mulberry garden.

**Unit-3: (50 to 100 contents)**

* Study the external morphology and life cycle of silkworm.
* Learning the anatomy of physiology.
* Learning the endocrine system, hormones and it roles.
* Studying the breeding methods and importance.

**Unit-4: (50 to 100 contents)**

* Learning Viral, Bacterial, Fungal, and Protozoan Diseases.
* Understanding the mode of transmission and control mechanisms.
* Learning the Uzifly manace.

**Unit-5: (50 to 100 contents)**

* By learning the silkworm rearing techniques.
* By understanding the differentiation of young age and old age rearing methods.
* Learning the reeling techniques and examination of silk lacing and skeining.

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Madan Mohan Rao, M. 2019. An Introduction to Sericulture. 2nd edition, B.S. Publications. Andhra Pradesh, India.

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Otsuki, R. and Sato, S. 1997. Silkworm Egg Production (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Eikichi Hiratsuka. 1999. Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Mahadevappa, D., Halliyal, V.G., Shankar D.G. and Bhandiwad, R., 2000. Mulberry Silk Reeling Technology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Soo-Ho Lim, Young-Taek Kim, Sang-Poong Lee. 1990. Sericulture Training Manual – Published by FAO – USA. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Wu Pang-Chuan and Chen Da-Chuang. 1994. Silkworm Rearing – Published by FAO – USA. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Lu Yup-Lian and Liu-Fu-an. 1991. Silkworm Diseases - Published by FAO – USA. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

**E- Materials**

* <https://archive.org/details/SericultureHandbook/page/n1/mode/2up>
* <http://www.csrtimys.res.in/books-0>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* + - To know the general and development of sericulture research.
    - Modern trends and Concepts in sericulture research.

**2. After studied unit-2, the student will be**

* + - 1. The student will be involved in various aspects of egg production.

**3.After studied unit-3, the student will be**

* + - able to understand silk health diagnosis, identification of different system.

**4.After studied unit-4, the student will be**

* + - the student involved in various product of silk.

**5.After studied unit-5, the student will be**

* + - The student involved in various product of silk.
    - To develops highly qualified protein and profession and manpower in silk and sericulture.

**OPEN ELECTIVE**

**PAPER -4**

**(B) PEARL CULTURE**

**Unit 1:**

Biology of Pearl oyster: Pearl producing molluscs. Morphology and anatomy of Pearl oyster, Life cycle of pearl oyster.

**Unit 2:**

Structure and Histology of mantle. Natural Process of Pearl formation. Chemical composition of Pearls. Economic importance of pearls.

**Unit 3:**

Pearl oyster culture: Techniques of pearl oyster culture (Fresh water and Marine water) for artificial production of pearls. Pearl culture techniques -Rafts, long lines, Pearls oyster baskets, under water platforms, mother oyster culture/Collection of oysters, rearing of oysters, Environmental parameters. Pearl Oyster surgery (Selection of Oyster, Graft tissue preparation, Nucleus insertion, Conditioning for surgery), Post-operative culture, harvesting of pearl, clearing of pearl.

**Unit 4:**

Diseases and Predators of Pearl oysters.

**Unit 5:**

Present status, prospects and problems of pearl industry in India.

**UNIT V**

Pearl Production: Overview of pearl trade, pearl oysters and mussels of commercial importance; anatomy, biology and seed production, techniques of implantation, method of rearing and harvesting of pearl, Mable pearl production, processing and quality evaluation of pearls, pearl production by tissue culture

**Course Objectives**

* Learning the natural process of pearl formation.
* Study the Environmental parameters
* Studying the predators of pearl oyster.
* Study and maintaing the genic condition of culture units and post-operative tanks.
* Learning the techniques of implantation.

**Unit-1: (50 to 100 contents)**

* Identify the pearl producing oyster.
* Learning the soil profile and water quality for culture.
* To study the life cycle of the Pearl oyster.

**Unit-2: (50 to 100 contents)**

* Study the structure and histology of mantle.
* Learning the natural process of pearl formation.
* Study the chemical composition of Pearls.

**Unit-3: (50 to 100 contents)**

* Learning the pearl culture techniques.
* Study the Environmental parameters.
* By learning to identify species capable of producing pearls.
* Learning the anatomy and theoretical basis of surgical implantation.

**Unit-4: (50 to 100 contents)**

* Learning the disease caused in pearl oyster.
* Studying the predators of pearl oyster.
* Study and maintaing the genic condition of culture units and post-operative tanks.

**Unit-5: (50 to 100 contents)**

* Learning the overview of pearl trade.
* Learning the techniques of implantation.
* Method of rearing and harvesting of pearl,

**Text Books**

* Paul Southgate, and John Lucas, 2008. The pearl oyster, Elsevier Science

**Reference Items: books, Journal**

* Paul Southgate, and John Lucas, 2008. The pearl oyster, Elsevier Science

**E- Materials**

* <http://www.ctsa.org/files/publications/CTSA_1276316728619239483681.pdf>
* <http://eprints.cmfri.org.in/3208/1/Special_Publication_No_20.pdf>
* <https://krishi.icar.gov.in/PDF/Selected_Tech/fisheries/33-FS-Fresh%20water%20pearl%20culture.pdf>
* <https://www.agrifarming.in/pearl-farming-project-report-cost-profits>
* <https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/leaflet357.pdf>

**Course Out Comes (five outcomes for each units should be mentioned)**

**1. After studied unit-1, the student will be**

* Identify the characteristics of molluscs.
* Understand the how pearls are formed.
* Understand the role of pearl culture techniques.

1. **After studied unit-2, the student will be**

* Perform implantation.
* Learning the chemical composition.
* To know about culturing of pearls.

**2.After studied unit-3, the student will be**

* Understand the how to conserve the habitat of molluscs.
* Student will be able to understand the collection of oysters, theoretical based implantation.
* The student will be able to acquire the knowledge to perform surgical procedure of implantation.

**3.After studied unit-4, the student will be**

* Monitor the health of pearl oyster by provide sampling and maintaining hygienic condition of culture.
* To understand the disease of Pearl oysters.

**4.After studied unit-5, the student will be**

* Student will understand and apply the skill needed to achieve academic success.
* Student will understand the economical and moral values.
* Student will learn the workmanship to serve the society.

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