

E.M.G. YADAVA WOMEN'S COLLEGE , MADURAI – 625 014.

(An Autonomous Institution – Affiliated to Madurai Kamaraj University)

Re-accredited (**3rd Cycle**) with Grade **A⁺** & **CGPA 3.51** by NAAC

DEPARTMENT OF ZOOLOGY



CBCS SYLLABUS

BACHELOR OF SCIENCE

PROGRAMME CODE - Z

COURSE STRUCTURE

(w.e.f. 2021 – 2022 Batch onwards)

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(w.e.f. 2021 – 2022 onwards)

COURSE STRUCTURE – SEMESTER WISE

Semester	Part	Sub Code	Title of the paper	Teaching hrs (per week)	Exam Duration (hrs)	Marks Allotted			Credits
						CIA	SE	Total	
V	III	21Z51	Core : Genetics	4	3	25	75	100	4
	III		Elective - I	4	3	25	75	100	4
	III		Elective - II	4	3	25	75	100	4
	III		Core : Lab in Genetics, Ecology & Evolution and Biochemistry.	4	-	-	-	-	-
	III		Core : Lab in Physiology Microbiology & Immunology and Biotechnology	4	-	-	-	-	-
	IV	21SEZ51	SBE: Biostatistics	2	3	25	75	100	2
	IV	214EV5	Environmental Studies	2	3	25	75	100	2
	III	21AG5	Allied II : Taxonomy of Angiosperms, & Plant Pathology	4	3	25	75	100	4
	III		Allied Lab II : Taxonomy of Angiosperms, & Plant Pathology and Applied Botany	2	-	-	-	-	-
	III	21Z61	Core : Physiology	4	3	25	75	100	4
	III	21Z62	Core : Microbiology & Immunology	4	3	25	75	100	4
	III		Elective – III	4	3	25	75	100	4
	III	21Z61P	Core : Lab in Biochemistry, Genetics, Ecology & Evolution	4	3	40	60	100	7
	III	21Z62P	Core : Lab in Physiology Microbiology & Immunology and Biotechnology	4	3	40	60	100	8

VI	IV	21SEZ61	SBE: Economic Zoology	2	3	25	75	100	2
	III	21AG6	Allied II : Applied Botany	4	3	25	75	100	4
	III	21AG6P	Allied Lab II : Taxonomy of Angiosperms, & Plant Pathology and Applied Botany	2	3	40	60	100	1
	IV	214VE6	Value Education	2	3	25	75	100	2
	V	215NS4/2 15PE4	Extension Activities NSS/Physical Education	-	3	25	75	100	1

Electives :**Semester - V****Elective – I & II – (Choose any two)**

1. Ecology & Evolution - **21ZE5A**
2. Biochemistry - **21ZE5B**
3. Fisheries Biology - **21ZE5C**

Semester- VI**Elective - III – (Choose any one)**

1. Biotechnology - **21ZE6A**
2. Poultry science - **21ZE6B**

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(w.e.f. 2021 – 2022 onwards)

Title of the Paper : Genetics

Semester : V

Contact hours : 4

Sub. Code : 21Z51

Credits : 4

Objectives:

- Understand one's own health and make healthy choices.
- Learn genetic technologies to help develop targeted medicines for certain diseases.
- Gain knowledge on the arrangement of genes, their interaction, and the influence of environment on gene expression.

Unit -I Introduction to Genetics: History of Genetics, Principles of Mendelian concept -Monohybrid and Dihybrid, Test cross & Back cross, Geneic interaction– Incomplete dominance & Co- dominance. Multiple Alleles – ABO Blood Group.

Unit- II Linkage and Crossing over : Drosophila-Morgan's experiments - Complete and Incomplete linkage, Linkage groups, Crossing over types, Mechanisms - Cytological evidence for Crossing over, Chromosomal maps & its construction.

Unit- III Sex Determination and Sex Linked Inheritance: Sex Determination in Man, Sex influenced and Sex limited genes - Non Disjunction and Gynandromorphs - Cytoplasmic inheritance - Maternal effect on *Limnaea* (Shell Coiling), Kappa Particles in *Paramecium*.

Unit- IV Mutation: Molecular Basis of Mutation, Types of Mutation, Chromosomal Aberrations: Autopolyploidy, Aneuploidy and Euploidy, Inborn errors of metabolism – Phenylketonuria, Parkinson's disease, Eugenics and Euthenics.

Unit- V Microbial genetics: Recombination in bacteria: Transformation- Griffith experiment, Conjugation- F Factor, H Factor, Sexduction, Transduction- Hershey and Chase experiment. Regulation of gene expression in prokaryotes.

Text Book

1. Dr. R. Meyyan ., Genetics , Saras Publication, 3rd Edition , Kanyakumari 2009

Reference Books:

1. Verma, P.S. and P.K. Agarwal, Genetics, 10th edition , S.Chand and Co. , New Delhi 2009.
2. James .D. Watson, Molecular Biology of the Gene, W. A. Benjamin Publishers, California 2008.
3. William.S. Klug, Essentials of Genetics, 7th edition, Benjamin Cummings Publisher, New York 2009.
4. Gardner, Simmond and Snustad , Principles of Genetics, John Wiley & Sons, 8th edition, New York 2006.
5. Strickberger, Genetics, 3rd edition, Macmillan Publications, New York 1985.

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(w.e.f. 2021 – 2022 onwards)

Elective - I

Title of the Paper : Ecology & Evolution

Semester : V

Contact hours: 4

Sub Code : 21ZE5A

Credits : 4

Objectives:

- Learn interdependence between people and nature that is vital for food production.
- Able to solve biological problems that impact our lives.
- Gain knowledge on the connections that exist between different species.

Unit – I Introduction to Ecology: Subdivisions of ecology – Autecology and Synecology, Ecosystem : - structure and types, Dynamics of Ecosystem – Food chain, Food web and Ecological pyramids , Concepts of Ecosystem -Limiting factors – Concepts of limiting factors- Light as a limiting factor – Pigmentation, Reproduction, Colour changes, Vision, Locomotion and Lunar Rhythm. Temperature as a limiting factor- Eurythermal and Stenothermal, Metabolism and reaction rate, Reproduction and Morphology.

Unit – II Habitat Ecology: Terrestrial habitat- Grass land ecosystem, Aquatic Habitat – Ecosystems (Lotic and lentic), Marine habitat : Characteristics, stratification, deep sea adaptations.

Unit – III Community Ecology: Characteristics of Community Ecology- structure, stratification, Ecotone and edge effect, Ecological niche, concepts of community and ecological succession-process of succession, climax, types, patterns and significance of succession.

Unit – IV Evidences of Evolution : Origin of life – Abiogenesis, Biogenesis, Cosmic theory, Biochemical origin of life – Urey –Miller experiment. Morphological and comparative anatomy- Homology & Analogy (example-forelimbs), Vestigial organs-

(Vermiform appendix, Plica semilunaris), Embryological evidences – developmental stages, Theories of evolution- Lamarkism, Neo-Darwinism - Mimicry - Batesian and Mullerian Mimicry.

Unit- V Hardy Weinberg – Gene pool, gene frequency and genetic drift, Factors affecting gene equilibrium- Natural selection - Isolating mechanisms- Speciation – Allopatric & Sympatric speciation - Human evolution - Cultural Evolution.

Text Book :

1.Arumugam ,N., *Concepts of Ecology* , Saras Publication, Kottar, Nagarkovil 2010.

Reference Books :

- 1.Dash, M.C., *Fundamentals of Ecology*, Tata Mc.Graw Hill Publishing Co.Ltd., New Delhi . ISBN: O – 07 -460103 – 2. 1996.
- 2.Gnanamuthu, C.P. *Introduction to Animal Ecology* – Higginbothams, Mount road, Chennai .1901
- 3.Kumar H.D., *Modern Concepts of zoology*, Vikas publishing House(P)Ltd. New Delhi.1995
- 4.Sambasivaya, Kamalakara Rao,& Augustine Chellapa-*Animal Ecology* S.Chand & Co.,Ram Nagar New Delhi 110055.1985
- 5.Odum, E.P. *Basic Ecology*, Saunders College Publishing, New York.1971
- 6.Odum, E.P. *Fundamentals of Ecology*, Saunders Toppan, London.1983

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Elective- II

Title of the Paper : Biochemistry

Semester : V

Sub Code : 21ZE5B

Contact hours : 4

Credits : 4

Objectives:

- Broadens our understanding of biochemical changes relating to physiological alteration in human body.
- Understand the chemical aspects of biological processes such as digestion, hormonal action and muscle contraction –relaxation.
- Application of skills in answering, critically analyzing, interpreting and presenting the results of laboratory investigations.

Unit - I Carbohydrates: classification and biological importance - carbohydrate metabolism – Glycogenesis, Glycolysis, Citric acid cycle and Hexose Monophosphate Shunt.

Unit - II Amino acid structure and classification, Protein – Structure, classification, Configuration of protein – Primary, Secondary, Tertiary and Quaternary, and biological importance -Transamination, Decarboxylation, Transdeamination, Transmethylation, Urea cycle. Ramachandran Plot.

Unit - III Lipids: Classification and structure of cholesterol- β -oxidation of fatty acids - Biological importance of lipids–biosynthesis of fatty acids.

Unit - IV Enzymes: classification, physico-chemical nature and mechanism of enzyme action, factors affecting enzyme activity - Applications of enzymes and coenzymes.

Unit-V Bio-chemical techniques, Principle and biological application of Paper chromatography and Poly Acrylamide Gel Electrophoresis, pH meter, Spectrophotometry

Textbook:

Satyanarayana. U and Chakrapani .U *Biochemistry*, 5th Edition, Elsevier Health Sciences, India.2020. ISBN: 9788131248850

Reference Books:

1. Lehninger, Nelson& Cox , *Principles of Biochemistry*, CBS Publishers & Distributers, Delhi, CBS ISBN 81-239-0295-6 , 2004.
2. Lubert stryer, *Biochemistry* ,W.H.Freeman and company, New York.2015
3. Power.C.B & Chatwal G.R , *Biochemistry* , 5th edition ,Himalaya Publishing House.2017
4. Robert,K. Murray Daryl.K. Granner. Harper's *Biochemistry*, Peter A. Mayes & Victor W.Rodwell pRetice –Hall International.1988

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SKILL BASED ELECTIVE

Title of the Paper : Biostatistics

Semester : V

Contact hours : 2

Sub Code : 21SEZ51

Credits : 2

Objectives:

- To familiarize the students about the basic concepts of Biostatistics and its applications in biology.
- To draw valid conclusions from the obtained data.

Unit - I: Basic concepts in Biostatistics - Collection of Data-Primary and Secondary Data. Analysis and interpretations of data collection – sampling.

Unit- II Classification and Tabulation of data. - Diagrammatic presentation of data - Graphic presentation of data – Histogram and Polygon.

Unit -III Measures of Central tendency – Mean, Median, and Mode (Individual series , Discrete series and continuous series)

Unit-IV Measures of Dispersion – Range, Standard Deviation, Variance, Standard Error

Unit-V Correlation & Regression, Basic concepts of probability – Measures and Theorems. Theoretical distributions -Binomial distribution.

Text Book:

- Ramakrishnan. P., *Biostatistics*, Saras publications, 2010.

Reference Books.

1. Arumugam N, *Biostatistics and Computer application*, Saras publications, 2005.
2. Baskararao T, *Methods of Biostatistics*, PARAS Publications, Hyderabad.2001.
3. Gupta S.P, *Statistical methods*, Sulthan chand & Sons.New Delhi, 2006.
4. Khan A.S, & Khanum A., *Fundamental of Biostatistics*, Ukaas publishers,

Hyderabad. 2004.x

5. Prasad,S., *Elements of Biostatistics*, Rastogi publications, Meerut,
ISBN 81 : 7133-885-2. 2009.

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Title of the Paper : Physiology

Semester : VI

Sub Code : 21Z61

Contact hours : 4

Credits : 4

Objectives:

- Provide thorough understanding of normal body function enabling more effective treatment of abnormal or disease states.
- Provide insight into the complex nature of the human body and the countless different systems that make it up.
- Acquire knowledge of the senses, movements and needs of the human body.

Unit – I Digestion in human – Physiology of digestion - digestive glands – role of enzymes in digestion – hormonal control of digestion.

Unit – II Respiration in human -Types and mechanism of respiration- respiratory pigments- Oxygen transport - CO₂ transport – Respiratory Quotient (RQ). Circulation - Structure and function of human heart – coronary circulation-ischemic heart diseases- origin and conduction of heart beat – Electrocardiogram (ECG) Blood pressure (BP)- blood cholesterol.

Unit – III Osmoregulation - Mechanisms of osmoregulation – Poikilosmotic and Homeoosmotic animals. Euryhaline, Stenohaline – Osmoconfirmers, Osmoregulators, Osmoregulations in crustaceans, fishes and birds. **Excretion** -Ultra structure and function of kidney and structure of nephron – mechanism of urine formation.

Unit – IV Muscle system - Ultra structure of skeletal muscle - mechanism of muscle contraction. Sense organs: Physiology of vision .Chronobiology - Biological clock, Lunar Rhythm and Circadian Rhythm.

Unit – V Nervous system: Structure and types of neuron — conduction of nerve impulse Synapse and Neuromuscular junctions – Reflex arc. Endocrine system- Hormones of Pituitary, Thyroid, Parathyroid and Adrenal.

Textbook:

Arumugam, N. *Animal Physiology*, Saras Publications, 2012.

Reference Books:

1. Ernest Baldwin - *An Introduction to Comparative Bio - Chemistry* , Cambridge University Press.1970
2. Hoar, S.William , *General Comparative Physiology* - Printice Hall of India Pvt. Ltd. New Delhi, ISBN-0-87692-337-6.1966.
3. Rastogi. S.C., *Essentials of Animal Physiology* –Wiley Eastern Ltd,1977.
4. Byron A. Schottelius & Dorothy D. Schottelius -*Text Book of Physiology*, the C. V. Mosby Company; 17th Revised edition 1973.
5. Philip H Mitchell Textbook of General Physiology, 4th Edition , Mc Graw-Hill Company , Fourth Edition Newyork ,Toronto. London. Cat.log.No.55-9548,1948.

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Title of the Paper : Microbiology & Immunology

Semester : VI

Contact hours : 4

Sub Code : 21Z62

Credits : 4

Objectives:

- Acquire knowledge and understanding of the concepts of Microbiology in the field of medicine, industry, environment, genetics, agriculture, food and others.
- Demonstrate key practical skills/competencies in working with microbes.
- Demonstrate the basic knowledge of immunological processes at a cellular and molecular level and understand the principles governing vaccination and the mechanisms of protection against infectious diseases.

Unit – I Introduction to Microbiology -The history and scope of Microbiology – Classification of Microorganisms : Classification based on Robert H. Whittaker (Five Kingdom system). Outline classification for bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology and Classification of Fungi (Alexopoulos and Mims). Bacterial growth curves, Bacterial media-complex and selective media. Bacterial staining techniques- Control of microbes- Sterilization, disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical methods. Pure culture methods (streak plate, spread plate, Pour plate, stab culture, slant culture).

Unit – II Food Microbiology- Types of food-Food spoilage: spoilage of Milk & Milk products. Spoilage of beer & wine, Spoilage of vegetables, fruits, meat & canned food. Physical preservation methods: Asepsis, filtration & centrifugation, high & low temperature & Pasteurization, desiccation, radiation, anaerobiosis, canning and controlled atmosphere. Chemical preservation methods: Salt, Sugar, organic acid

(Benzoic acid, Sorbic acid, propionates, acetic acid & lactic acid), nitrates, nitrites, sulfur dioxide, ethylene dioxide, propylene oxide, wood smoke and antibiotics. Food poisoning: *Aspergillus flavus* & *Clostridium botulinum*. Probiotics and prebiotics – Benefits & applications.

Unit – III Role of microorganisms in Biogeochemical cycles– Nitrogen Cycle and Phosphorus Cycle - Role of microorganisms in soil fertility- Rhizobium, Blue Green Algae (BGA) Biofertilizer, Azotobacter.

Unit – IV History of Immunology: Contributions of Edward Jenner –Louis Pasteur – Elie Metchnikoff. Types of immunity: Innate-anatomic, physiologic, phagocytic, and inflammatory–Acquired or Adaptive – specificity – diversity- Immunologic memory– self/nonself recognition. Ontogeny of Lymphoid organs – Myeloid Lineage and Lymphoid Lineage. Primary and secondary Lymphoid organs – Thymus, Bone marrow, Spleen, lymph node- Specific and nonspecific immunity – B cells, T cells and sub cells - Immune response- humoral immune response & cell mediated immune response.

Unit – V Structure and properties of antigen. Antigen – antibody reaction (precipitation & agglutination).Transplantation- MHC, HLA typing, Hypersensitivity reactions – Type I- anaphylactic reactions, Type II – cytotoxic reactions, Type III – immune complex reactions, Type IV – delayed type hypersensitivity reactions.

Text books :

1. Anantha Narayanan., *Text Book of Microbiology*, Longman, Chennai, 1986.
2. Dulsy Fatima, *Immunology*, Saras publication , 2009.

Reference Books:

1. Chakravorthy, A.K. Immunology, Tata McGraw Hill Publishing Company,
2. New Delhi. 1993
3. Dubey, R.C. and Maheswari, D.K. 2010. A Text Book of Microbiology. 3rd edition S. Chand, New Delhi.
4. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, 5th edition. McGrawHill. Book Co. Singapore
5. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th edition, Pearson Education, Singapore

6. Frobisher Martni -*Fundamentals of Microbiology* , W.B. Saunders and Co, London.1946.
7. John W.Kimball , *Introduction to Immunology*, Macmillan Publishing Company 1986.
8. David Male,,Jonathan Brostoff ,David Roth & Ivan Roitt, *Immunology*, Harcourt Brace & Company 2012.

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(w.e.f. 2021 – 2022 onwards)

Elective - III

Title of the Paper : Biotechnology

Semester : VI

Contact hours : 4

Sub.Code : 21ZE6A

Credits : 4

Objectives :

- Understand the principles of animal culture, media preparation, Invitro fertilization and embryo transfer technology.
- Aware of the applications of recombinant DNA technology in agriculture and production of therapeutic proteins.
- Knowledge of the microbial degradation of Pesticides, Bioremediation & Biofertilizers.

Unit –I Introduction & Recombinant DNA Technology –History and Scope of biotechnology, Conventional vs Modern Biotechnology. Biotechnology tree-Tools of gene cloning: Restriction Endonucleases , Linkers & adapters – vectors (E.coli) Major steps in gene cloning- Cloning of human insulin gene.

Unit – II Industrial Biotechnology: Microbial products – Production of Cyanocobalamine (Primary) and Penicillin (Secondary) - Bio Gas Production - stages of methanogenesis – uses. Industrial production and application of ethanol (green fuel)

Unit- III Environmental Biotechnology - Biopesticides – biological control of crop pest (bacterial pesticides only) – plant extracts – bt toxin production. Bioremediation of Heavy metals (e.g super bug), Bioleaching and Xenobiotics.

Unit- IV Animal Biotechnology - Animal tissue culture – Basic requirements – Culture media and its composition – Transgenesis – Transgenic Fish and Cattle - Monoclonal Antibody (Mab) - production & its application.

Unit – V Applied Biotechnology : r-DNA Proteins and their uses – Interferon, Interleukin -2, Factor VII , Urokinase , TPA , FMD Vaccine in Cattle.

Text Book:

Kumaresan V. *Book of Biotechnology*, Saras Publications, 2012.

Reference Books:

1. Alcamo. LD ., *DNA Technology – The Awesome Skill*. WCB Dubuque IA. ISBN 0-697.- 21248-3 , 1996.
2. Dharmalingam. K., *Biotechnology: principles, Practices and Prospects*, Biology Education. 7(3): 152-156. ISBN 0970-5961.1990.
3. Dubey. R.C.,-*Text Book Biotechnology*. S.Chand & Co.Ltd. 2004.
4. Gupta. P.K., *Elements of Biotechnology*, Rastogi publication, Meerut, ISBN 81-7133-412-1 Nuzhat Ahmed, Fouad M. Qureshi Obaid Y.Khan1999.
5. Nuzhat Ahmed, et al. *Industrial and Environmental Biotechnology*,2004.
6. Singh,B.D., *Biotechnology*, Kalyani publishers, New Delhi, ISBN 81 - 7096-735. 1998.

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SKILL BASED ELECTIVE

Title of the Paper : Economic Zoology

Semester : VI

Contact hours : 2

Sub Code : 21SEZ61

Credits : 2

Objective:

- To make students develop skill in different applications of Zoology.
- To make them become self-employed entrepreneur.

Unit –I Sericulture - Introduction to Sericulture – Types of silk worms – culture of Mulberry Silkworms-Diseases and enemies of silkworms – uses of silk -central silk board.

Unit –II Apiculture - Introduction to Apiculture – Types of Honey Bee – Bee Keeping – Hives– Products of Bee keeping — Economic importance of honey – enemies and diseases of bees – Bee Keeping industry.

Unit -III Aquaculture - Qualities of culturable fishes – Types of Fish farming. Fish culture – Breeding ponds – nursery ponds – rearing ponds – stocking ponds – Harvesting – Preservation of fishes-live fish feed culture – Dubifex, Chironomous larva.

Unit – IV Poultry -Commercial layers and broilers. Poultry housing- deep litter system, cage rearing, feeders & waterers. Summer management, winter management in brief. Debeaking, Poultry diseases- viral disease, bacterial disease, fungal disease and parasitic diseases (one each) Vaccination programme.

Unit- V Dairy farming –Breeds of cattles, dairy products, Marketing, Management. Diseases affecting cattle's (Any four) and mode of prevention.

Text Book:

Arumugam ,N., *Applied Zoology* , Saras Publications. 2012,

Reference Books:

1. Gnanamani. M.R., *Modern aspects of commercial Poultry Science* , GIRI Publications .1988.
2. Oxford and IBH Publishing Company Pvt.Ltd, 2008,
3. Jhingran. V.G., *Fish and fisheries of India*, Hindustan Publishing Corporation,
Delhi.
4. Krishnan. N.T., *Economic Entomology*, J.J. Publications, 2008.
5. Khanka.S.S., *Entrepreneurial Development*, S. Chand &Company Ltd.
2012.

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Title of the Paper	: Lab in Genetics, Ecology & Evolution and Biochemistry	
Semester	: V& VI	Contact hours : 4
Sub.Code	: 21Z61P	Credits : 2

Genetics:

1. Observation of simple Mendelian Traits in Man.
2. Study of probability with two coins using tossing experiments.
3. Multiple Allelic Inheritance-Rh factor
4. Observation on the study of Polygenetic inheritance of quantitative traits to be interpreted (Neem leaf serration).

Ecology

1. Detection of Transparency of water by Secchi disc.
2. Analysis of dissolved oxygen in water sample.
3. Observation of Animal association, symbiosis parasitism, predation and commensalism.
4. To study the distribution of road side species and investigate the changes in species richness.
5. Field report: Visit to a forest/ river/ wetland ecosystem

Evolution:

1. Variations – finger prints.
2. Homologous & Analogous organs.
3. Vestigial organs.
4. Connecting link- Archaeopteryx
5. Examples of evolutionary importances - Peripatus ,
Limulus & Archaeopteryx.

Bio Chemistry:

1. Principle and pH Measurements of various samples using pH meter.
2. Principle and Amino acids separations using Paper Chromatography- demonstration.
3. Qualitative tests for protein, carbohydrates & fats.
4. Principle and Electrophoresis- demonstration (PAGE).

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Title of the Paper : Lab in Physiology, Microbiology & Immunology and Biotechnology

Semester : V & VI

Contact hours : 4

Sub Code : 21Z62P

Credits : 4

Animal Physiology:

1. Effect of temperature on human salivary amylase activity.
2. Estimation of oxygen consumption by fish
3. Haemoglobinometer
4. Qualitative analysis of ammonia, urea and uric acid.
5. Demonstration of blood pressure using Sphygmomanometer.

Microbiology:

1. Simple staining.
2. Gram staining.
3. Sterilization technique (Moist heat and Dry heat technique)
4. Media preparation – Agar plate method.
4. Structure of Bacteria, HIV, TMV and Algae (Nostoc).

Immunology:

1. Structure - Bone marrow, Bursa fabricus, Spleen and Thymus
2. ABO blood groups & Rh factor
3. Immunoglobulin -IgG

Biotechnology:

1. Transgenic mice – Microinjection method
2. Super bug – *Pseudomonas putida*
3. pBR 322
4. Ti plasmid
5. Spectrophotometer
6. Genomic library – Chart