PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

NAAC "A++" Grade - State University – NIRF Rank 59, ARIIA- 10

M.Sc.,

BIOMEDICAL SCIENCE

SYLLABUS

FROM THE ACADEMIC YEAR 2023-2024 ONWARDS

M.Sc. BIOMEDICAL SCIENCE PROGRAMME
[Choice Base Credit System (CBCS)]
(For those admitted in the academic year 2023-2024 onwards)
OBE REGULATIONS AND SYLLABUS
(With effect from the academic year 2023-2024 onwards)

Introduction

The Master's programme in Biomedical Sciences provides a unique combination of fundamental research and clinical application, with a special focus on multidisciplinary aspect such as biochemical, molecular and patho-physiological mechanism of diseases. Investigating and understanding the diseases give the skill and knowledge to work towards discovery and development of preventive/ therapeutic drugs. There is an increasing prevalence of non-communicable diseases as a result of lifestyle changes and urbanization in India. Infectious diseases are also still persisting as major health problems in Indian population. These are the challenges that are to be tackled in the new millennium, so there is a need to understand the pathogenesis and to develop the new markers and diagnostic protocols with respect to the relevant field. The requirement for Biomedical Scientist is important because they are expected to bridge the gap between biomedical research, diagnostics and clinical applications.

Objectives

To improve the skills and critical thinking in the field of clinical research To understand the pathogenesis and to develop the new markers and diagnostic protocols with respect to the relevant field.

Learning Outcomes

Display a sound knowledge of the biology of disease and its clinical applications. Be able to discuss current knowledge in biomedical sciences, and the techniques used in their investigation. Possess skills in the selection, planning, performance and interpretation of a range of appropriate experimental techniques. Be able to analyse and interpret complex and sometimes contradictory scientific information. Be able to engage in professional and academic communication with other biomedical scientists. Develop an informed, critical and imaginative attitude to professional practice appropriate for those with responsibility in the field.

Job Opportunities

On successful completion of the course, the Biomedical Science graduates could contribute to the Private sector or National healthcare laboratories

- Testing and screening of life style disorders (Diagnostics)
- Investigating and understanding the disease mechanisms (Research fellow)
- Working towards discovery and development of treatments, which could be preventive (vaccines) and/or therapeutic (drugs and medicines-R &D)
- Working in academic institutions (Higher education)

AS PER TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION IMPLEMENTED IN PERIYAR UNIVERSITY, SALEM.	
Programme	**M.Sc., Biomedical Science**
Programme Code	
Duration	**PG-2 Years**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Demonstrate an in-depth knowledge of human biomedical sciences, from molecular to whole body systems with an interdisciplinary understanding of human function to design an experiment that functions well despite challenging parameters, or to create a new type of experiment should a first experiment fail **PO2: Decision Making Skill** Develop healthcare system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. Foster analytical and critical thinking abilities for biomedical data-based decision-making. **PO3: Ethical Value** Apply rigorous academic integrity and ethical scholarly practices to their own learning, and understand their application and importance in biomedical science and health research. **PO4: Communication Skill** Communicate and advocate for evidence-based scientific ideas and knowledge in diverse expert, non-expert and inter-disciplinary settings **PO5: Individual and Team Leadership Skill** Ability can help them coordinate with their research teams to perform experiments correctly. Many experiments require precision and teamwork.

	PO6: Employability Skill To enhance their knowledge and to develop their practical, intellectual and key skills to assist them in their career development. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Respectfully engage with Indigenous perspectives and cultures, and incorporate Indigenous ways of knowing into a broad understanding of biomedical science and health contexts. **PO 9 Multicultural competence** Work effectively and respectfully, both individually and in groups to meet a shared goal with people from diverse disciplinary, community and cultural backgrounds **PO 10: Moral and ethical awareness/reasoning** Apply knowledge of human biomedical sciences to understand societal and environmental determinants of health and disease, and their impacts at an individual, community and population level
Programme Specific Outcomes **(PSOs)**	**PSO1 – Placement** Major employment areas include diagnostic pathology and clinical laboratories, NHS Blood and Transplant laboratories, private pathology laboratories, **PSO 2 - Entrepreneur** Apply knowledge acquired to the planning and implementation of research, development and innovation projects in a biomedical research laboratory, a clinical department laboratory or the biomedical industry.

	PSO3 – Research and Development Read and critically analyse original and review papers on biomedical issues and assess and choose the appropriate methodological descriptions for biomedical laboratory research work. **PSO4 – Contribution to Business World** Biomedical technologies to the description of phenomena or problems in human or animal biology, with regard to their causes, mechanisms and treatment. **PSO 5 – Contribution to the Society** Apply logical reasoning based on the knowledge, skills, designing solutions to assess societal, health, safety issues and the responsibilities that go along with the scientific practice.

Candidate's eligibility for admission

Candidates who have qualified B.Sc., Biomedical Science / Animal Science / Any other Degree related to Biomedical Science / Life Sciences (B.Sc., Microbiology, Biochemistry, Biotechnology, Functional Genomics, Plant Biology and Biotechnology, Animal Science, Zoology, Advances in Zoology, Medical Biotechnology, Applied Microbiology, Medical Microbiology, Paramedical Degrees like B.Sc., Biomedical Science, Anatomy, Physiology, Pharmacy, Human Genetics etc., approved by the Syndicate of Periyar University, Salem.

Duration of the programme

The duration of the M.Sc. Biomedical Science Course shall be over a period of **Two Years** from the commencement of the course. A student shall obtain the M.Sc. Degree in Biomedical Science if he/she has registered, undergone and secured the required minimum credits for all the Core and Elective courses and completed the Project Work / Dissertation within the stipulated time.

M.Sc. Biomedical Science Programme Structure-Course work, contact hours, credits and maximum internal and external marks for the student admitted from 2023-2024 onwards

Sem	Course Code	List of Courses	Credit	Hours/ Week	Int. Mark	Ext. Mark	Total
I	**23PUBMC01**	Core Course I- Biochemistry	5	6	25	75	100
	23PUBMC02	Core Course II- Cell and Molecular Biology	5	6	25	75	100
	23PUBMC03	Core Course III- Medical Genetics	4	4	25	75	100
	23PUBMCP01	Core Course IV Lab Course -I (Biochemistry, Cell and Molecular Biology, Medical Genetics)	4	6	40	60	100
	23PUBME01	Elective Course I- Medical Microbiology/ Biosafety & Bioethics	3	4	25	75	100
	23PUBME02	Elective Course II- Biomedical Instrumentation/Bioimaging Technology	3	4	25	75	100
		Total	**24**	**30**			**600**

Examinations

Examinations are conducted in semester pattern. The examination for the Semester I&III will be held in November/December and that for the Semester II & IV will be in the month of April/May in every academic year.

Candidate failing in any subject (both theory and practical) will be permitted to appear for such failed subjects in the same syllabus structure at subsequent examinations within next 5 years. Failing which, the candidate has to complete the course in the present existing syllabus structure.

Scheme for Evaluation and Attainment Rubrics

Evaluation will be done on a continuous basis and will be evaluated four times during the course work. The first evaluation will be in the 7th week, the second in the 11th week, third in the 16th week and the end – semester examination in the 19th week. Evaluation may be by objective type questions, short answers, essays or a combination of these, but the end semester examination is a University theory examination with prescribed question paper pattern.

Attainment Rubrics for Theory Courses

Internal ***(Max. Marks - 25)***

S.No.	Approaches	Marks
1	Internal tests (Best two tests out of 3)	10
2	Attendance	5
3	Seminar	5
4	Assignment	5
Total		25

External ***(Max. Marks - 75)***

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	Objective Type (Answer all questions)	20X1 = 20 (Multiple Choice Questions)	✓	✓
B	Descriptive Type (100 to 200 words) (Answer any three out of five questions)	3X5 = 15 (Analytical type questions)	✓	✓
C	Essay Type (500 to 1000 words) (Answer all questions)	5X8 = 40 (Essay type questions)	✓	✓

Attainment Rubrics for Lab Courses

Internal ***(Max. Marks-40)***

S.No.	Approaches	Marks
1	Practical tests (Best two tests out of 3)	30
2	Attendance	5
3	Record	5
Total		40

External ***(Max. Marks - 60)***

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	Major practical	1X20 = 20	✓	✓
B	Minor practical	1X10 = 10	✓	✓
C	Spotters	4X5 = 20	✓	✓
D	Viva-voce	10	✓	✓
Total		60		

Attainment Rubrics for Research

Internal ***(Max. Marks - 40)***

S.No.	Approaches	Marks
1	Manual involvements in experiments	30
2	Attendance	10
Total		40

External ***(Max. Marks - 60)***

S.No.	Approaches	Marks
1	Project Report	40
2	Viva voce	20
Total		60

Grading System

Evaluation of performance of students is based on ten-point scale grading system as given below.

Ten Point Scale			
Grade of Marks	**Grade points**	**Letter Grade**	**Description**
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

PERIYAR UNIVERSITY
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M.Sc. Biomedical Science Programme - SEMESTER-I
(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

BIOCHEMISTRY

Core Paper-01 **Paper Code: 23PUBMC01**

Total Contact Hours: 108 **Credits: 5** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	To provide knowledge on the properties of water, acids, bases, pH and biological buffers.	
2.	To learn the concept of bioenergetics and mitochondrial respiratory chain reactions	
3.	To know the chemistry of macromolecules, functions, metabolic pathways and their control	
4.	To know the functions of biomolecules.	
Course I	**:**	**Core-I**
Course title	**:**	**BIOCHEMISTRY**
Credits	**:**	**4**
Pre-requisite:		
Students should know the biomolecules formation, metabolism, diseases and medicine		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
1.	Comprehend the structure and importance of water and physiological buffer systems.	**K1 & K2**
2.	Describe principle of bioenergetics, exergonic and endergonic	**K2 & K4**

	reactions.	
3.	Elucidate the mechanism of electron transport chain and ATP generation in living cells.	**K3 & K5**
4.	Illustrate the chemistry, properties and biological functions of macromolecules including carbohydrates, proteins, nucleic acids and lipids.	**K4 & K6**
5.	Describe the biosynthesis (anabolism) of glucose, glycogen, amino acids and nucleic acids and lipids.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Atoms:** Chemical Composition of living matter. Biological importance of water. Buffers and its Physiological properties. **Carbohydrates**: Classification, structure and function. Carbohydrate metabolism: Anabolism – Glycogenesis and Gluconeogenesis. Catabolism – Glycolysis, Kreb's cycle and Glycogenolysis. Electron transport chain. **Metabolic disorder**: Diabetes and their biomedical significance.
II	**Amino acids:** Structure and classification of amino acids. Essential amino acids and Non-essential amino acids, glycogenic and ketogenic amino acids. **Proteins:** Classification of proteins. Primary, Secondary, Tertiary and Quaternary structure of protein. Metabolism of amino acids-glucogenic and ketogenic amino acids. Transamination, deamination and decarboxylation reactions. Urea cycle and its regulation.
III	**Lipids:** Structure and Classification of Lipids. Types of fatty acid oxidation: Beta, alpha, omega and peroxysomal oxidation. Ketosis, biosynthesis of fatty acids. Triglycerides and Cholesterol: Sructure & function, Cholesterol biosynthesis. Biomedical importance of lipids in Obesity.
IV	**Nucleic acids:** Structure and functions of DNA and RNA. Synthesis and degradation of purine and pyrimidine (De novo and salvage pathways). Syndromes associated with nucleic acid metabolism: Aicardi-Goutières syndrome (AGS), Lesch-Nyhan syndrome and GOUT Disease.
V	Hormones – Peptide and Non-peptide mammalian hormones, receptors, feedback loops, signaling cascades, secondary messengers as hormones, steroid hormone receptor and gene action. Insect pheromones. The biochemistry of Learning, Memory and Thinking.
Reading list	
1	Murray, R. K., Granner, D. K., Mayes, P. A., Rodwell, V. W. (2017) Harper's Biochemistry. Prentice Hall International Inc.
2	Lehninger, A. L., Nelson, D. K., and Cox, M. M. (2015) Principles of Biochemistry.

CBS Publishers and distributors, New Delhi.

Recommended texts

1. Stryer, L. (2016) Biochemistry. W. H. Freeman and Company, New York.
2. Voet.D. Judith, G. Voet, Charlotte W. Pratt. (2017) Fundamentals of Biochemistry, John Wiley& Sons Inc. New York.
3. Satyanarayanan, U (2015). Essentials of Biochemistry, Uppala Author – Publisher Interlinks, Vijayawada.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L - Low

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M.Sc. Biomedical Science Programme - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

CELL AND MOLECULAR BIOLOGY

Core Paper-01 **Paper Code: 23PUBMC02**

Total Contact Hours: 108 **Credits: 5** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	To explain the concept of Chemical Basis of Life	
2.	Describe the internal and external structural organization of cell and its organelles	
3.	To enlighten the functional role of the cellular organelles	
4.	To know the functions of biomolecules.	
Course I	**:**	**Core II**
Course title	**:**	**CELL AND MOLECULAR BIOLOGY**
Credits	**:**	**4**
Pre-requisite:		
Students should know fundamentals of cells, structure and function and signaling pathways.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understand the cell as a basic unit of life. Understand the chemical basis of life.	**K1 & K2**
2.	Understand about different types of cells.	**K2 & K4**
3.	Understand the components aiding in cell –cell communication.	**K3 & K5**
4.	Understand the structural organization of genetic materials in prokaryotic/ eukaryotic	**K4 & K6**

5.	Understand the detailed structural organization of prokaryotic and eukaryotic cells.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Discovery of cell:** Cell theory, Basic structure of prokaryotic and eukaryotic cell, Cell Cycle, and regulations. Cell division: mitosis- Stages and Significance. Meiosis -Stages and their significance. Significance of 2020 Nobel Prize for Discovery of Hepatitis C Virus and 2021 Nobel Prize for Discoveries of membrane receptor for temperature and touch.
II	**Ultra-structure and functions of Plasma membrane** – Fluid Mosaic model theory- Transport mechanism- Exocytosis, Endocytosis, Simple Diffusion. Active Transport Mechanism: Structural Components of ion channels and their functions – ATPase Dependent Na/K ion transport, Ca2+ Transport mechanism in Insulin Secretion and Neurotransmitter secretion. Micro bodies peroxisomes and Glyoxysome.
III	**Nucleus:** ultrastructure of nuclear membrane, Nucleolus, Nucleoplasm and Chromatin fibers, Microtubules, microfilaments – Cilia and Flagella,Ribosome and Golgi bodies, Lysosome, Endoplasmic reticulum. Mitochondria. Cell Signaling: Types, organization of cell signals and their receptors. Functions of Ion channel coupled receptors – secondary messengers. Amplifiers, Integrators. 2016 Nobel Prize for discovery of Autophagy and 2013 Nobel Prize for the discoveries of machinery regulating Vesicle traffic, a major transport system in our cell.
IV	**The Exosome:** Exosome Research Importance, Extracellular Vesicles – Structure and Composition, Mechanism of formation of Exosomes in cells, Circulation of Exosomes, Heterogenicity of Exosomes, Signal Transduction. Immune response and exosomes. Current scenario of Circulating DNA Research. Mechanism of cell aging and senescence. Comparison of Cell death: Necrotic and apoptotic cells.
V	**DNA replication** – semi conservative and rolling circle models. Enzymes involved in DNA Replication: types and their functions. Transcription and Translation in eukaryotes: RNA polymerase – types, properties, and functions– Transcription process in Eukaryotes. DNA to Nascent RNA and to mature RNA mediated by splicing mechanism. Protein Synthesis: mRNA serve as Template, Interaction of mRNA and rRNA, mRNA and RNA Polymerase, Participation of tRNAs in Translation and post translational modifications and their biological importance.

Reading list

1. Cooper, G.M. (2019). The Cell – Molecular Biological Approaches. ASM Press, Washington.
2. Lodish H, Kaiser CA, Brasher A, Amon A, Berk A, Kreger M, Ploegh H and Scott MP (2014) Molecular Cell Biology, 7th edition, Garland Publishing, Inc. New York.

Recommended texts

4. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P (2018) Essential Cell Biology. Garland Science, New York
5. De Robertis EDP and De Robertis EMF (2018) Cell and Molecular Biology. Lippincott Williams and Wilkins, USA.
6. Gupta PK (2019) Cell and Molecular Biology. Rastogi Publications, Meerut.
7. Karp G (2017) Cell and Molecular Biology: Concepts and Experiments. 6th edition, John Wiley and Sons Ltd. New York.
8. Lewin B (2020) Genes XIII Oxford University Press, Oxford.
9. Walker JM and Gingold EB (2013) Molecular Biology and Biotechnology. Panima University Press, Oxford Publishing Co., New Delhi.
10. Thorpe NO (2000) Cell Biology, John Wiley and Sons, New York.
11. Turner PC McLennan AG Bates AD and White MRH (2007) Instant Notes Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
12. Thomas Pollard, William Earnshaw, Jennifer Lippincottt Schwartz,Graham Johnson, (2017) Cell Biology, 3rdEdition,ElsevierPupblishing, USA,

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L – Low

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M.Sc. Biomedical Science Programme - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

MEDICAL GENETICS

Core Paper-01 **Paper Code: 23PUBMC03**

Total Contact Hours: 72 **Credits: 4** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
5.	To gain knowledge on the laws and patterns of genetic inheritance.	
6.	Understanding the methods involved in genetic analysis.	
7.	To gain insights on genetic abnormalities and their impact on diseases	
Course I	**:**	**Core III**
Course title	**:**	**MEDICAL GENETICS**
Credits	**:**	**4**
Pre-requisite:		
Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
6.	Comprehend the importance of Genetics.	**K1 & K2**
7.	Describe the principles of inheritance.	**K2 & K4**
8.	Illustrate the genetic abnormalities associated with diseases	**K3 & K5**
9.	Describe various methods of evaluating genetic diseases.	**K4 & K6**

10.	Know the therapeutic strategies for genetic disease and elucidate the mechanism underlying mutations	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Human Genetics** - Principles - History and Impact of Genetics in Medicine - Gregor Mendel and the Laws of Inheritance - The Origins of Medical Genetics - Types of Genetic Disorders (single gene disorders, Chromosomal disorders, Polygenic disorders, Somatic cell genetics, mitochondrial disorders) - The Human Genome Project. Human Chromosomes - Cell Division- Mitosis, Meiosis, Gametogenesis -Chromosome Abnormalities- Numerical, Structural and Mosaicism - Patterns of Inheritance - Mendelian Inheritance- Autosomal dominant, Autosomal recessive, Sex linked recessive and dominant - Genomic Imprinting. Mitochondrial Inheritance - Polygenic and Multifactorial Inheritance. Polygenic Inheritance - Identifying Genes that Cause Multifactorial Disorders- Linkage analysis, Association studies, GWAS studies.
II	**Molecular Genetics & Cytogenetics:** DNA sequence polymorphisms- SNPs, VNTRs, Minisatellites, Microsatellites. Mapping and Identifying Genes for Monogenic Disorders - Position-Independent Identification of Human Disease Genes - Positional Cloning. The Human Genome Project and its Applications - Epigenetics - Microarray in research and clinical practices Cytogenetics - Methods of chromosome analysis- Karyotyping and chromosomal banding - Fluorescent In-Situ Hybridization - Comparative Genomic Hybridization - Chromosome Nomenclature - Prenatal cytogenetics - Cancer cytogenetics.
III	**Population And Mathematical Genetics** -Hardy-Weinberg Principle and its Applications - Factors that alter gene frequency- non-random mating, small populations, selection, Mutations,, Migration and gene flow. Consanguinity and its consequences - Genetic Polymorphism - Segregation Analysis - Genetic Linkage - Risk Calculation - Probability Theory - Use of Linked Markers - Bayesâ Theorem and Prenatal Screening - Empiric Risks
IV	**Genetics in Medicine:** Hemoglobin and the Hemoglobinopathies - Disorders of Hemoglobin – alpha, beta and gamma - Clinical Variation of the Hemoglobinopathies - Antenatal and Newborn Hemoglobinopathy Screening. Disorders of coagulation and bleeding - Factor VIII - Factor IX - Afibrinogenemia .Inborn Errors of Metabolism - Disorders of Amino Acid and Branched-Chain Amino Acid Metabolism - Urea Cycle Disorders - Disorders of Carbohydrate Metabolism -Disorders of Steroid Metabolism - Disorders of Lipid Metabolism - Disorders Affecting Mitochondrial Function. Prenatal Diagnosis of Inborn Errors of Metabolism

V	**Clinical Genetics:** Epigenetics and Cancer - Diabetes - Crohn Disease - Hypertension - Coronary Artery Disease - Schizophrenia - Alzheimer Disease - Hemochromatosis - Venous Thrombosis - Age-Related Macular Degeneration. Recurrent miscarriage - Xeroderma Pigmentosa - X chromosome inactivation - X-linked mental retardation and Fragile X 3 Single-Gene Disorders -Huntington Disease - Hemophilia . Preimplantation Genetic Diagnosis - Non-Invasive Prenatal Diagnosis. Stem Cell Therapy & Ethical and Legal Issues in Medical Genetics.

Reading list

1. Brooker, R.J. (2017) Genetics: analysis and principles, 6th edition. New York, NY: McGraw-Hill Education
2. Hartwell, L. et al (2017) Genetics: from genes to genomes, 6th edition. New York, NY: McGraw-Hill Education
3. Emery's Elements of Medical Genetics 12th edition, Peter Turnpeeny Sian Ellard, Elsevier publications.

Recommended texts

4. Alberts, B. et al (2015) Molecular biology of the cell 6th edition. New York, NY: Garland Science
5. Lodish, H. et al (2016) Molecular Cell Biology 8th edition. W.H.Freeman
6. Alberts, B. (2014) Essential Cell Biology 4th edition. New York, NY: Garland Science
7. Hardin, J., Bertoni, G., Kleinsmith, L.J., Becker, W.M. (2012) Becker's world of the cell 8th edition. Boston, MA: Benjamin Cummings
8. Ridley, M. (2004) Evolution 3rd Edition. Malden, MA: Blackwell
9. Steams, S.C. & Hoekstra, R.F. (2005) Evolution: an Introduction, 2nd edition. Oxford: Oxford University Press.
10. Practical Biology • Jones, A.M., Reed, R. & Weyers, J.D.B. (2016) Practical Skills in Biology, 6th edition. Harlow: Pearson Education
11. Physiology • Moyes, C.D. & Schulte, P.M. (2016) Principles of animal physiology, 3rd edition. Toronto: Pearson
12. Boron, WF & Boulpaep E.L. (2012) Medical Physiology, 2nd Edition Elsevier Saunders

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L - Low

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M.Sc. Biomedical Science Programme - SEMESTER-I

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LAB COURSE -I

(Biochemistry, Cell and Molecular Biology, Medical Genetics)

Core Paper-04 **Paper Code: 23PUBMCP01**

Total Contact Hours: 108 **Credits: 4** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	To impart knowledge of basic techniques such as genomic DNA and plasmid DNA isolation	
2.	To gain hands on experience in gel-electrophoresis techniques.	
3.	To develop & train students with the knowledge of PCR& blotting techniques	
Course I	**:**	**Core III**
Course title	**:**	**LAB COURSE -I** (Biochemistry, Cell and Molecular Biology, Medical Genetics)
Credits	**:**	**3**
Pre-requisite:		
Students should experiment to measure and identity the molecular changes via various techniques.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Know the basic concept and principles of molecular biology techniques	**K1 & K2**
2.	Gain hands on experience in extraction of genomic & plasmid	**K2 & K4**

	DNA	
3.	Gain the practical knowledge of agarose gel electophoresis	**K3 & K5**
4.	Demonstrate practical skills in different molecular biology laboratory equipment's and their handling	**K4 & K6**
5.	Enable them to begin a career in academic research or R& D in Biotechnological& Pharmaceutical Industries.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Biochemistry** 1. Determination of glucose level in Blood 2. Effect of Temperature on salivary amylase activity 3. Identification of amino acids by paper chromatography 4. Spotters: Diabetes, Lesch-Nyhan syndrome and GOUT Disease 5. Molecular Weight Determination using SDS-PAGE
II	**Cell & Molecular Biology** 1. Micrometry for cell measurement 2. Identification of different types of cells in blood 3. Differential leukocyte count using Leishman stain 4. Observation of Mitosis (onion root tip) 5. Identification of multinucleated cells in cancer biopsy 6. Cells of vital organs spotters (Slides: Kidney, Liver, Spleen, Stomach, muscles, lung and colon)
III	**Medical Genetics** 1. Survey of Genetic Disorders in an around Periyar University Hospitals 2. Survey of Lifestyle diseases in Salem (Data Collection at Govt. Hospital) 3. Observation of Mendelian traits Among Student Volunteers 4. Identification of Human Syndromes – Voucher Specimen 5. Study on polygenic inheritance – Voucher Specimen 6. Pedigree Analysis of Genetic Disorder (Hemophilia and Night Blindness) 7. Genetic Counseling methods (Among Student Volunteers) 8. DNA Isolation and Agarose Gel Electrophoresis 9. PCR based Diagnosis of Pathogenic/ infectious diseases.

REFERENCE BOOKS:

1. Plumer HT (2012) Practical : Biochemistry , Wiley Publication, India
2. Borah D (2012) Biotechnology Lab Practices, Global Academic Publisher, India.
3. Kannan S, Krishnan M, Thirumurugan R and Achiraman S (2012) Methods in Molecular Biology, UVN Publishers, India.

4. Kannan S and N. Kayalvizhi, 2022. Cell and Molecular Biology – A Practical Approach.
5. Lal SS (2009) Practical Zoology, Rastogi Publications, New Delhi.

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L - Low

PERIYAR UNIVERSITY
DEPARTMENT OF BIOMEDICAL SCIENCE
Salem-636011, Tamil Nadu

M.Sc. Biomedical Science Programme - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

MEDICAL MICROBIOLOGY

Elective Course-01 **Paper Code: 23PUBME01A**

Total Contact Hours: 72 **Credits: 3** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	To acquire depth knowledge in medically important bacteria.	
2.	To gain information about the bacterial infection occurs in digestive, reproductive, urinary system.	
3.	To get information about the fungi and their toxins	
Course I	**:**	**Elective Course -01**
Course title	**:**	**Medical Microbiology**
Credits	**:**	**3**
Pre-requisite:		
Students should know the important of microbes and their related diseases		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understanding the basic knowledge on medically important microbes.	**K1 & K2**
2.	Acquire the information on culture collection, transportation and quality control.	**K2 & K4**
3.	Get a clear idea on Enterobacetriaceae family and its pathogenicity and acquire information on mycology, mycotoxins and medically important yeasts.	**K3 & K5**
4.	This study helps in understanding the pathogenicity of the microbes in nervous system.	**K4 & K6**

5.	Get information on Parasites and its pathogenicity and better understanding of laboratory techniques used in parasitology.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	General properties of medically important bacteria. Recommendation for collection, transport of specimens, Isolation of bacteria from clinical specimens- Primary media for isolation and their quality control – Antibiotic sensitivity disc, testing procedure and their quality control.
II	**Bacteriology:** Digestive system – Escherichia coli, Salmonella, Shigella and Vibrio. Urinary system – Leptospira sp., and proteus and Respiratory system – Mycobacterium tuberculosis
III	**Bacteriology:** Reproductive system – Neisseria and Treponema and Nervous system – Clostridium tetani
IV	**Virology:** General properties of viruses – Detection of viruses and antigens in clinical specimens – Serological diagnosis of virus infections. Hepatitis, Pox, Oncogenic and Human Immuno Deficiency (HIV) viruses. Viral vaccines – their preparation and Immunization schedules.
V	**Mycology and Parasitology:** Introduction to Medical Mycology – morphology of fungi. Detection and recovery of fungi from clinical specimens. Yeast of medically importance – Candida and Cryptococcus. Introduction to Medical Parasitology – Protozoan – Entamoeba – Plasmodium, Trypanosoma. Laboratory techniques in parasitology- Examination of faeces for ova and cysts

Reading list

1. Prescott, L.M., J.P. Harley and D.A.Klein.(1993). Microbiology.2nd edition. W.M.C - Brown publishers.
2. David Greenwood, Richard B Slack and John F. (2019). Medical Microbiology – Peutherer.Chirchill Livingstone (London) 16th edition.
3. Jawetz., E. J.L. Melnic and E.A. Adelberg (2000). Review of Medical Microbiology. 19th edition. Lange medical publications. U.S.A.
4. Ananthanarayan R. and C.K. Jeyaram Panikar.(1994). Text book of Microbiology. Orient Longman.

Mapping with Programme Outcomes*

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S

CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L – Low

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M.Sc. Biomedical Science Programme - SEMESTER-I

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BIOSAFETY AND BIOETHICS

Professional Competency Course-01 **Paper Code: 23PUBME01B**

Total Contact Hours: 36 **Credits: 3** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	To introduce the various aspects of biosafety and levels of biosafety in laboratory.	
2.	To study principles of bioethics and its guidelines.	
3.	To understand Good manufacturing Practice (GMP) and Good lab practices (GLP) and enable students to understand Biosafety assessment of pharmaceutical products such as drugs/vaccines	
Course I	**:**	**Professional Competency Course-01**
Course title	**:**	**Biosafety and Bioethics**
Credits	**:**	**2**
Pre-requisite:		
Students should know the significance of bioethics and biosafety		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understand the basic concepts in the laboratory biosafety.	**K1 & K2**
2.	Analyze the basic principles of bioethics and its importance in biological, biomedical, health care research.	**K2 & K4**

3.	Gain knowledge about biosafety regulations and bioethics in the context of modern biotechnology microbes.	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Biosafety:** Introduction - Laboratory associated infections and other hazards, Introduction to Biological Safety Cabinets-Assessment of biological hazards and Biological Containment- Good manufacturing Practice and Good lab practices (GMP and GLP)
II	**Bioethics:** Principles of bioethics- Social and cultural issues of Bioethics--Animal ethics; Guidelines for use of lab animals - Licensing of animal house - IAEC & CPCSEA- Ethical concerns of gene cloning- Ethical clearance norms for conducting studies on human subjects, NECRBHR, ICMR- Ethical implications of human genome project-Ethical issues in Human Cloning and stem cell research - Biopiracy
III	**Regulatory framework of Biosafety:** Biosafety guidelines and regulations (National and International) for rDNA and other biological researches. Definition of GMOs & LMOs - GM Labeling-Ecological safety assessment of GMO's (Eg. Bt cotton) and mixing up with the gene-pool- Bioterrorism and convention on biological weapons- Cartagena protocol
IV	**Pharma and Medical Sector:** Biosafety assessment of pharmaceutical products such as drugs/vaccines etc. Biosafety issues in Clinical Trials.
V	Ethical concerns related to prenatal diagnosis, Gene therapy, Organ transplantation, Xenotransplantation, Ethics in patient care, Informed consent

References

1. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed).ASM Press, Washington.
2. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
3. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers
4. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press

Mapping with Programme Outcomes*

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S

CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M -

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M.Sc. Biomedical Science Programme - SEMESTER-I

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BIOMEDICAL INSTRUMENTATION

Elective Course-02 **Paper Code: 23PUBME02A**

Total Contact Hours: 72 **Credits: 3** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	To understand the concept of Bioinstrumentations in molecular analysis	
2.	To realize the range of structure of metabolites.	
3.	To enable to find out the Nobel Prize winners in the concern subject.	
4.	To know the structure and functions of biomolecules.	
Course I	**:**	**Elective Course -02**
Course title	**:**	**Biomedical instrumentations**
Credits	**:**	**3**
Pre-requisite:		
Students should know the important functional methodology of instruments in medical applications.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**

3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	History, scope and advancement in biomedical instrumentation. Scales of biological organization. The needs for biomedical instrumentation: The scientific methods clinical diagnosis, feedback in measurement system. Common medical measurements and their applications. Bioelectronics, biosensor: Principle and applications. Impact of nanotechnology in development of Biomedical instruments.
II	**Instrumentation for cardiovascular measurements:** The heat and cardiovascular system, blood pressure, characteristics of blood flow, heart sounds. Principle, methods and applications of Electrocardiogram (ECG), plethysmography. **Lungs:** The physiology of respiratory system, instrumentation for the mechanics of breathing, respiratory therapy equipment. Principle of thermometer and Ultra-sonic measurements.
III	Neuronal sensory measurements-Psychophysiological measurement, Instruments for motor neuron responses, sensory neuron measurements. Equipment for behavioral analysis. **Blood:** Blood components, blood collection methods cell counts, Haemoglobinometer, Haemocytometer and Histological methods of WBC differential counts.
IV	Principle and applications of Electromyography (EMG), Electro-Oculogram (EOG), Electroretinogram (ERG), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET).
V	Biomedical Instrumentation for testing kidney clearance, creatinine, kidney Imaging (Pyelogram). Types of dialysis-Haemodialysis, Peritorial dialysis, and kidney function test. **Bone and Joints:** Analysis of bone mineral density, stress and strain, strain gage, joint friction and bone position testing. Clinical temperature measurements. Calorimetry for bode heat study. Principle and functions of Goniometer and accelerometer for body movements. Current scenario of Biotechnology and Role of Artificial Intelligence and medical informatics in biomedical sciences.
Reading list	

6. John G. Webster, 2004. Bioinstrumentation, Johnwiley and sons, Pvt.Ltd. Singapore.

7. L Cromwell, F.J.Welbell and E.A. Pfeiffer.1980. Biomedical instrumentation and measurements. Second Edition. PHI publisher, New Jersey, USA.

8. Mandeep Singh. 2010. Introduction of Biomedical Instrumentation. PHI Learning Pvt. Ltd, New Delhi

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L - Low

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M.Sc. Biomedical Science Programme - SEMESTER-I
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BIOIMAGING TECHNOLOGY

Soft Skill -01 **Paper Code: 23PUBME02B**

Total Contact Hours: 36 **Credits: 3** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	Learn the basic concepts of bioimaging techniques.	
2.	Understand the essential principles of ultrasound, X-ray imaging (CT)	
3.	To Acquired knowledge of imaging system theory and their applications	
Course I	**:**	**Ability Enhancement Compulsory Course Soft Skill-01**
Course title	**:**	**BIOIMAGING TECHNOLOGY**
Credits	**:**	**2**
Pre-requisite:		
Students should know the significance of bioethics and biosafety		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understand the imaging concepts that characterize the quality of imaging techniques	**K1 & K2**
2.	Acquired knowledge about the principles of image formation, capture and display of ultrasound and X-ray.	**K2 & K4**
3.	Understand and describe the mechanisms of tomography, MRI and NMR spectroscopy.	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	Introduction of Microscope, principles and applications of optical microscope, confocal microscope, fluorescens microscope, scanning electron microscope, transmission electron microscope, Live and dead assay with dyes
II	Ultrasound imaging, physics of ultrasound- principles of image formation, capture and display. Doppler ultrasound- pulsed and continuous.
III	Principles and production of X-rays-soft and hard, radiographic and fluoroscopic images in X-Ray systems.
IV	Introduction to emission tomography, mammography, transverse tomography, optical coherence tomography (OCT)- medical applications, CT Angiography basic physics of radioisotope imaging, Nuclear imaging.
V	Image acquisition in magnetic resonance imaging (MRI). NMR spectroscopy.

References

1. Cromwell, L., Weibell, F. J., Pfeiffer, E. A., & Usselman, L. B. (1973). Biomedical instrumentation and measurements (Book- Biomedical instrumentation and measurements.).
2. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1973. 457 p.
3. Drexler, W., & Fujimoto, J. G. (Eds.). (2008). Optical coherence tomography: technology and applications. Springer Science & Business Media.
4. Hendee, W. R., & Ritenour, E. R. (2003). Medical imaging physics. John Wiley & Sons.

Mapping with Programme Outcomes*

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	M	S	S	S
CO2	S	S	M	M	S	S	M	M	S	S
CO3	S	M	S	M	M	S	L	M	S	S
CO4	L	M	S	S	L	S	M	S	M	M
CO5	S	M	S	M	S	S	M	M	S	S

*S - Strong; M - Medium; L - Low