HAJEE KARUTHA ROWTHER HOWDIA COLLEGE

(An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai.)
Re-Accredited with A++ Grade by NAAC (3rd Cycle)
Uthamapalayam - 625 533.

PG & RESEARCH DEPARTMENT OF PHYSICS

MASTER OF SCIENCE - PHYSICS

PART IV-SYLLABUS

Choice Based Credit System – CBCS

(As per TANSCHE)

With

Outcome Based Education (OBE)

(Academic Year 2023 -2025)

Semester - II

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23PPHSE21	Medical Physics	2	25	75	100	2

Semester - III

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23PPHSE31	Bio Physics	4	25	75	100	2
	23PPHIS31	Internship / Industrial Activity	-	-	-	-	2

Semester - IV

Course Category	Course Code	Course Title	Hrs	CIAE	TEE	Max Marks	Credits
Part – IV	23PPHSE41	Characterization of Materials	4	25	75	100	2

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23PPHSE21	MEDICAL PHYSICS	SEC	2	2	25	75	100

Pre-Requisites		
Fundamentals of physiological concepts, Basics of instruments principle,		
Learning Objectives		
L1	To understand the major applications of Physics to Medicine	
L2	To study the aid of different medical devices such as X-ray machines, gamma camera, accelerator and nuclear magnetic resonance.	
L3	To outline the principles of Physics of different medical radiation devices and their modern advances, especially in medical radiation therapy and different applications in medical physics.	
L4	To introduce the ideas of Radiography.	
L5	To form a good base for further studies like research.	
UNIT	**Contents**	**No. of Hours**
I	**X-RAYS AND TRANSDUCERS** Electromagnetic Spectrum – Production of X-Rays – X-Ray Spectrum –Bremsstrahlung – Characteristic X-Ray – X-Ray Tubes – Coolidge Tube – X-Ray Tube Design – Thermistors – photo electric transducers – Photo voltaic cells – photo emissive cells –Photoconductive cells– piezoelectric transducer	6
II	**BLOOD PRESSURE MEASUREMENTS** Introduction –□sphygmomanometer – Measurement of heart rate – basic principles of electrocardiogram (ECG) –Basic principles of electro-neurography (ENG) – Basic principles of magnetic resonance imaging (MRI).	6
III	**RADIATION PHYSICS** Radiation Units – Exposure – Absorbed Dose – Rad to Gray – Kera Relative Biological Effectiveness –Effective Dose – Sievert (Sv) – Inverse Square Law – Interaction of radiation with Matter – Linear Attenuation Coefficient – Radiation Detectors –Thimble Chamber – Condenser Chambers – Geiger Counter – Scintillation Counter	6
IV	**MEDICAL IMAGING PHYSICS** Radiological Imaging – Radiography – Filters – Grids – Cassette – X-Ray Film – Film processing – Fluoroscopy – Computed Tomography Scanner – Principal Function – Display – Mammography – Ultrasound Imaging – Magnetic Resonance Imaging – Thyroid Uptake System – Gamma Camera (Only Principle, Function and display)	6
V	**RADIATION PROTECTION** Principles of Radiation Protection – Protective Materials – Radiation Effects – Somatic – Genetic Stochastic and Deterministic Effect – Personal Monitoring Devices – TLD Film Badge – Pocket Dosimeter	6
VI	**PROFESSIONAL COMPONENTS** Expert Lectures, Online Seminars - Webinars on Industrial	

	Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.	
	Total	**30**

Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Learn the fundamentals, production and applications of X-rays.	K1,K2,K3,K4,K5
2	Understand the basics of blood pressure measurements. Learn about sphygmomanometer, EGC, ENG and basic principles of MRI.	K1,K2,K3,K4,K5
3	Apply knowledge on Radiation Physics	K1,K2,K3,K4,K5,K6
4	Analyze Radiological imaging and filters	K1,K2,K3,K4,K5,K6
5	Assess the principles of radiation protection	K1,K2,K3,K4,K5,K6

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

Textbooks

1	Dr.K.Thayalan ,*Basic Radiological Physics*, Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi, 2003.
2	Curry, Dowdey and Murry, *Christensen's Physics of Diagnostic Radiology: - Lippincot*Williams and Wilkins, 1990.
3	FM Khan, *Physics of Radiation Therapy*, William and Wilkins, 3rd ed, 2003.
4	D. J. Dewhurst, *An Introduction to Biomedical Instrumentation*, 1st ed, Elsevier Science, 2014.
5	R.S. Khandpur, *Hand Book of Biomedical Instrumentations*, 1st ed, TMG, New Delhi, 2005.

Reference Books

1.	Muhammad Maqbool, *An Introduction to Medical Physics*, 1st ed, Springer International Publishing, 2017.
2.	Daniel Jirák, FrantišekVítek, *Basics of Medical Physics*, 1st ed, Charles University, Karolinum Press, 2018
3.	Anders Brahme, *Comprehensive Biomedical Physics*, Volume 1, 1st ed, Elsevier Science, 2014.
4.	K. Venkata Ram, *Bio-Medical Electronics and Instrumentation*, 1st ed, Galgotia Publications, New Delhi, 2001.
5.	John R. Cameron and James G. Skofronick, 2009, Medical Physics, John Wiley Interscience Publication, Canada, 2nd edition.

Web Resources

1.	https:nptel.ac.in/courses/108/103/108103157/
2.	https://www.studocu.com/en/course/university-of-technology-sydney/medical-devices-and-diagnostics/225692
3.	https://www.technicalsymposium.com/alllecturenotes_biomed.html
4.	https://lecturenotes.in/notes/17929-note-for-biomedical-instrumentation-bi-by-deepraj-adhikary/78
5.	https://www.modulight.com/applications-medical/

Mapping with Programme Outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	1	2	3	3	1	3
CO2	3	3	3	2	1	2	3	3	1	3
CO3	3	3	3	2	1	2	3	3	1	3
CO4	3	3	3	2	1	2	3	3	1	3
CO5	3	3	3	1	1	2	3	3	1	3

Strong-3 Medium-2 Low-1

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	1	1	2	3	3	1	3
CO2	3	3	3	2	1	2	3	3	1	3
CO3	3	3	3	2	1	2	3	3	1	3
CO4	3	3	3	2	1	2	3	3	1	3
CO5	3	3	3	1	1	2	3	3	1	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23PPHSE31	BIOPHYSICS	SEC	2	4	25	75	100

Learning Objectives		
L1	To understand the physical principles involved in cell function maintenance.	
L2	To understand the fundamentals of macromolecular structures involved in propagation of life.	
L3	To understand the biophysical function of membrane and neuron.	
L4	To understand various kinds of radiation and their effects on living system and to know the hazards posed by such radiations and the required precautions.	
L5	To understand the physical principles behind the various techniques available for interrogating biological macromolecules.	
UNIT	**Contents**	**No. of Hours**
I	**CELLULAR BIOPHYSICS:** Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix - Molecular mechanisms of Vesicular traffic - Electrical activities of cardiac and neuronal cells.	12
II	**MOLECULAR BIOPHYSICS:** Macromolecular structure: Protein structure– amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation. Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.	12
III	**MEMBRANE AND NEURO BIOPHYISCS:** Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels. Nervous system: Organization of the nervous system – Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.	12
IV	**RADIATION BIO PHYSICS:** X-Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma radiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on bio-macromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.	12
V	**PHYSICAL METHODS IN BIOLOGY:** Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer	10

	chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis, polyacrylamide gel electrophoresis.	
VI	**PROFESSIONAL COMPONENTS:** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.	2
	Total	**60**
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.	K1,K2,K3,K4,K5
2	Comprehension of the role of biomolecular conformation to function.	K1,K2,K3,K4,K5
3	Conceptual understanding of the function of biological membranes and also to understand the functioning of nervous system.	K1,K2,K3,K4,K5,K6
4	To know the effects of various radiations on living systems and how to prevent ill effects of radiations.	K1,K2,K3,K4,K5,K6
5	Analyze and interpret data from various techniques viz., spectroscopy, crystallography, chromatography etc.,	K1,K2,K3,K4,K5,K6
Textbooks		
1.	The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.	
2.	Biophysics, Vasantha Pattabhi, N. Gautham, Narosa Publishing, 2009.	
3.	Biophysics, P. S. Mishra VK Enterprises, 2010.	
4.	Biophysics, M. A Subramanian, MJP Publishers, 2005.	
5.	Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.	
Reference Books		
1.	Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).	
2.	Essential cell biology by Bruce Albert et al (Garland Science).	
3.	Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).	
4.	Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).	
5.	Biological spectroscopy by Iain D. Campbell, Raymond A. Dwek.	
Web Resources		
1.	General Bio: http://www.biology.arizona.edu/DEFAULT.html	
2.	Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm	
3.	Electrophoresis: http://learn.genetics.utah.edu/content/labs/gel/	
4.	Online biophysics programs: http://mw.concord.org/modeler/	
5.	https://blanco.biomol.uci.edu/WWWResources.html	

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	3	3	2	1	2	1	3	3	2
CO 2	3	3	3	2	1	2	1	3	3	2
CO 3	3	3	3	3	1	1	2	3	3	2
CO 4	3	3	3	2	1	1	2	3	3	3
CO 5	3	3	3	3	1	1	2	3	3	3

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	2	1	2	1	3	3	2
CO 2	3	3	3	2	1	2	1	3	3	2
CO 3	3	3	3	3	1	1	2	3	3	2
CO 4	3	3	3	2	1	1	2	3	3	3
CO 5	3	3	3	3	1	1	2	3	3	3

Strong-3 Medium-2 Low-1

Course Code	Course Title	Category	Credits	Hours	Marks		
					CIAE	TEE	Total
23PPHSE41	CHARACTERIZATION OF MATERIALS	SEC	2	4	25	75	100

Learning Objectives		
L1	To make the students learn some important thermal analysis techniques namely TGA, DTA, DSC and TMA.	
L2	To make the students understand the theory of image formation in an optical microscope and to introduce other specialized microscopic techniques.	
L3	To make the students learn and understand the principle of working of electron microscopes and scanning probe microscopes.	
L4	To make the students understand some important electrical and optical characterization techniques for semiconducting materials.	
L5	To introduce the students, the basics of x-ray diffraction techniques and some important spectroscopic techniques.	
UNIT	**Contents**	**No. of Hours**
I	**THERMAL ANALYSIS:** Introduction – thermogravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves – differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermo mechanical parameters.	12
II	**MICROSCOPIC METHODS:** Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy – Dispersion staining microscopy - phase contrast microscopy –differential interference contrast microscopy - fluorescence microscopy - confocal microscopy - - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.	12
III	**ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPY:** SEM, EDAX, EPMA, TEM: working principle and Instrumentation – sample preparation –Data collection, processing and analysis- Scanning tunnelling microscopy (STEM) - Atomic force microscopy (AFM) - Scanning new field optical microscopy.	12
IV	**ELECTRICAL METHODS AND OPTICAL CHARACTERISATION:** Two probe and four probe methods-van der Pauw method – Hall probe and measurement – scattering mechanism – C-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations. Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.	12

V	**X-RAY AND SPECTROSCOPIC METHODS:** Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, XPS, AES and SIMS-proton induced X-ray Emission spectroscopy (PIXE) –Rutherford Back Scattering (RBS) analysis-application - Powder diffraction – Powder diffractometer -interpretation of diffraction patterns - indexing - phase identification - residual stress analysis - Particle size, texture studies - X-ray fluorescence spectroscopy - uses.	10
VI	**PROFESSIONAL COMPONENTS:** Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.	2
	Total	**60**
Course Outcomes		**Knowledge Level**
CO	**On completion of this course, students will**	
1	Describe the TGA, DTA, DSC and TMA thermal analysis techniques and make interpretation of the results.	K1,K2,K3,K4,K5
2	The concept of image formation in Optical microscope, developments in other specialized microscopes and their applications.	K1,K2,K3,K4,K5
3	The working principle and operation of SEM, TEM, STM and AFM.	K1,K2,K3,K4,K5,K6
4	Understood Hall measurement, four –probe resistivity measurement, C-V, I-V, Electrochemical, Photoluminescence and electroluminescence experimental techniques with necessary theory.	K1,K2,K3,K4,K5,K6
5	The theory and experimental procedure for x- ray diffraction and some important spectroscopic techniques and their applications.	K1,K2,K3,K4,K5,K6
Textbooks		
1.	R. A. Stradling and P. C. Klipstain. ***Growth and Characterization of semiconductors.*** Adam Hilger, Bristol, 1990.	
2.	J. A. Belk. ***Electron microscopy and microanalysis of crystalline materials***. Applied Science Publishers, London, 1979.	
3.	Lawrence E. Murr. ***Electron and Ion microscopy and Microanalysis principles and Applications***. Marcel Dekker Inc., New York, 1991	
4.	D. Kealey and P. J. Haines. ***Analytical Chemistry***. Viva Books Private Limited, New Delhi, 2002.	
5.	Li, Lin, Ashok Kumar ***Materials Characterization Techniques*** Sam Zhang; CRC Press,(2008).	
Reference Books		
1.	Cullity, B.D., and Stock, R.S., ***"Elements of X-Ray Diffraction",*** Prentice-Hall, (2001).	
2.	Murphy, Douglas B, ***Fundamentals of Light Microscopy and Electronic Imaging***, Wiley-Liss, Inc. USA, (2001).	
3.	Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., ***Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series),*** Volumes 49 – 51, (2009).Volumes 49 – 51, (2009).	
4.	Wendlandt, W.W., ***Thermal Analysis***, John Wiley & Sons, (1986).	

5.	Wachtman, J.B., Kalman, Z.H., ***Characterization of Materials***, ButterworthHeinemann, (1993).
Web Resources	
1.	https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci(AC).pdf
2.	http://www.digimat.in/nptel/courses/video/113106034/L11.html
3.	https://nptel.ac.in/courses/104106122
4.	https://nptel.ac.in/courses/118104008
5.	https://www.sciencedirect.com/journal/materials-characterization

Mapping with Programme Outcomes:

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	3	3	2	2	2	2	2	2	3
CO 2	3	3	3	2	2	2	2	2	2	2
CO 3	3	3	2	2	2	3	2	2	2	2
CO 4	2	2	2	3	2	3	2	2	2	2
CO 5	2	2	2	2	2	2	3	2	2	2

Strong-3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	3	3	2	2	2	2	2	2	3
CO 2	3	3	3	2	2	2	2	2	2	2
CO 3	3	3	2	2	2	3	2	2	2	2
CO 4	2	2	2	3	2	3	2	2	2	2
CO 5	2	2	2	2	2	2	3	2	2	2

Strong-3 Medium-2 Low-1