Dr. N.G.P. ARTS AND SCIENCE COLLEGE (Autonomous)

REGULATIONS 2024-25 for Post Graduate Programme
(Outcome Based Education model with Choice Based Credit System)
M.Sc. Degree

(For the students admitted during the academic year 2024-25 and onwards)

Programme:

M.Sc. Medical Physics – Two year (2 Years of academic + 1 Year Internship)

Eligibility

The candidates who have passed B.Sc. Physics with 60% and above aggregate marks with Mathematics as one of the ancillary subjects in regular mode from a recognized university.

Admission Criteria

The admission is based on the marks secured in the entrance examination conducted by Dr.N.G.P.ASC and the marks secured in UG degree by the candidate. The entrance examination will be conducted for 100 marks in the pattern of multiple choice questions from B. Sc. Physics. (Major Subjects - 75 marks and Ancillary Subjects – 25 marks).

Programme Educational Objectives

1. The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their post graduation.
2. The aim of this programme is designed to enable a student to optimize their learning and their knowledge by implementing in medicine and biology in order to improve health care.
3. To develop new methods & techniques for the radiology and imaging and radiotherapy related science.
4. To plan radiotherapy treatment methods, delivery, verification and execution.
5. To develop radiation dosimetry and ensure radiological safety of healthcare workers, patients and public.
6. At the end of the programme the student will have an in depth knowledge in the field of Medical Physics and related sciences.

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	To impart the quality of Medical Physics program focuses on the clinical application of radiation sciences in medicine. Students are trained to play a central role in developing, planning and implementing patient treatment programs.
PO2	To apply Medical Physics theories, methods and tools related to measurement of radiation dose (relative and absolute), verification of output from radiation producing machines, patient-specific treatment plans development, approval, and verification.
PO3	To provide hands-on clinical education and to prepare the graduate for the AERB board certification examination and a professional career in radiation therapy.
PO4	To develop treatment plans that provides adequate target coverage while sparing normal and critical tissues.
PO5	To demonstrate an awareness of the complexity of knowledge in medical physics as well as receptiveness to alternative interpretations, new knowledge, and alternative approaches to problem solving.

TOTAL CREDIT DISTRIBUTION

Courses	Credits	Total Marks		Credits	Cumulative Total
Core- Theory	4	10x100	1000	40	40
	5	2x100	200	10	10
	3	1x100	100	3	3
Core- Practical	3	3x 100	300	9	9
EDC	4	1x100	100	4	4
Elective	4	4x100	400	16	16
Medical Physics Summer Training	2	1x100	100	2	2
Project work	8	1x200	200	8	8
Total			**2400**	**92**	**92**

PG CURRICULUM

M.Sc. MEDICAL PHYSICS PROGRAMME – AY 24-25

Course Code	Course Category	Course Name	L	T	P	Instruction (h)		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
24MPP1CA	Core	Nuclear Physics	4	1	-	5	60	3	25	75	100	4
24MPP1CB	Core	Radiation Physics	4	1	-	5	60	3	25	75	100	4
24MPP1CC	Core	Biomedical Electronics and Instrumentation	4	1	-	5	60	3	25	75	100	4
24MPP1CD	Core	Radiological Anatomy, Physiology and Tumour Pathology	4	1	-	5	60	3	25	75	100	4
24MPP1CP	Core Practical-I	Biomedical Electronics and Instrumentation	-	-	6	6	72	3	40	60	100	3
24MPP1DA	DSE - I	Solid State Physics	4	-	-	4	48	3	25	75	100	4
24MPP1DB		Non-Ionizing Radiation in Medicine				4	48					
24MPP1DC		Programming in C++				4	48					
		Total	20	4	6	30	360				600	23

Course Code	Course Category	Course Name	L	T	P	Instruction (h)		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Second Semester												
24MPP2CA	Core	Radiation Detectors and Instrumentation	4	1	-	5	60	3	25	75	100	4
24MPP2CB	Core	Physics of Radiation Therapy	4	1	-	5	60	3	25	75	100	4
24MPP2CC	Core	Physics of Radiology Imaging	4	1	-	5	60	3	25	75	100	4
24MPP2CP	Core Practical-II	Radiation Measuring and Monitoring Instrumentation	-	-	6	6	72	6	40	60	100	3
24MTP2EB	EDC	Mathematical Physics	4	-	-	4	48	3	25	75	100	4
24MPP2DA	DSE – II	Advanced Materials in Medicine and Healthcare	4	1	-	5	60	3	25	75	100	4
24MPP2DB		Radiation Dosimetry and Standardization				5	60					
24MPP2DC		Information Technology and Software tools for Medical Physics				5	60					
		Total	20	4	6	30	360				600	23

Course Code	Course Category	Course Name	L	T	P	Instruction (h)		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Third Semester												
24MPP3CA	Core	Advanced Radiotherapy Physics	4	1	-	5	60	3	25	75	100	4
24MPP3CB	Core	Physics of Nuclear Medicine	4	1	-	5	60	3	25	75	100	4
24MPP3CC	Core	Radiation Biology	4	1	-	5	60	3	25	75	100	5
24MPP3CD	Core	Brachytherapy Physics	4	1	-	5	60	3	25	75	100	4
24MPP3CP	Core Practical -III	Treatment Planning, Radiation Dosimetry and Survey	-	-	6	6	72	6	40	60	100	3
24MPP3DA	DSE – III	Materials for Radiation Dosimeters	4	-	-	4	48	3	25	75	100	4
24MPP3DB		Biological Dosimetry				4	48					
24MPP3DC		Artificial Intelligence in Healthcare				4	48					
24MPP3CT	Summer Training	Medical Physics Summer Training						3	40	60	100	2
		Total	20	4	6	30	360				700	26

Course Code	Course Category	Course Name	L	T	P	Instruction (h)		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
Fourth Semester												
24MPP4CA	Core	Radiation Hazards, Evaluation and Control	5	1	-	6	72	3	25	75	100	5
24MPP4CB	Core	Professional Ethics and Legal Aspects	2	1	-	3	36	3	25	75	100	3
24MPP4DA	DSE – IV	Quality Control, Acceptance Testing and Calibration of Radiation Systems	4	1	-	5	60	3	25	75	100	4
24MPP4DB		Monte Carlo Techniques in Dosimetry				5	60					
24MPP4DC		Advances in Medical Physics				5	60					
24MPP4CV	Project	Project and Viva-Voce	-	-	16	16	192	-	80	120	200	8
Total			11	3	16	30	360				500	20
Grand Total												92

Note:

- As per the Atomic Energy Regulatory Board safety code: AERB/RF-SC/MED, the candidate should undergo minimum 12 Months of internship at AERB recognized well-equipped radiation therapy department after successful completion of M.Sc. Medical Physics Programme to work as a qualified Medical Physicist in a Radiotherapy facility in India.
- The Candidates are eligible for appearing RSO examination after completion of minimum 12 Months of internship at AERB recognized well-equipped radiationtherapy department.

03/04/24
BoS Chairman/HoD
Department of Medical Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS- 17th 03.04.24 | AC - 17th 17.04.24 | GB -

Academic Council
17.04.2024
CHAIRMAN
Dr.N.G.P. Arts and Science College

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed electivecourse during Semesters

Semester I (Elective I)

List of Elective Courses

S. No.	Course Code	Name of the Course
1	24MPP1DA	Solid State Physics
2	24MPP1DB	Non-Ionizing Radiation in Medicine
3	24MPP1DC	Programming in C++

Semester II (Elective II)

List of Elective Courses

S. No.	Course Code	Name of the Course
1	24MPP2DA	Advanced Materials in Medicine and Healthcare
2	24MPP2DB	Radiation Dosimetry and Standardization
3	24MPP2DC	Information Technology and Software tools for Medical Physics

Semester III (Elective III)

List of Elective Courses

S. No.	Course Code	Name of the Course
1	24MPP3DA	Materials for Radiation Dosimeters
2	24MPP3DB	Biological Dosimetry
3	24MPP3DC	Artificial Intelligence in Healthcare

Semester IV (Elective IV)

List of Elective Courses

S. No.	Course Code	Name of the Course
1	24MPP4DA	Quality Control, Acceptance Testing and Calibration of Radiation Systems
2	24MPP4DB	Monte Carlo Techniques in Dosimetry
3	24MPP4DC	Advances in Medical Physics

EXTRA CREDIT COURSES

The following are the courses offered under self-study to earn extra credits:

S. No.	Course Code	Course Name
1	24MPPSSA	Research Methodology
2	24MPPSSB	Cancer Biology

Semester - I
Core 1: Nuclear Physics

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1CA	NUCLEAR PHYSICS	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The basic principles, theory and concepts of nuclear physics • The concepts of particle accelerators • The various types of natural/particles induced nuclear reactions
Prerequisite	Quantum Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Describe nucleus, its energy states and radioactivity principles	K2
CO2	Classify the decay types and nuclear reactions	K2
CO3	Illustrate the concepts of accelerators and their medical applications	K3
CO4	Interpret various nuclear models and nuclear reactions	K3
CO5	Apply the concept of different types of spectroscopies with varied detectors	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1CA - NUCLEAR PHYSICS
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Nucleus** General Properties of Nuclei – Constituents of Nuclei, Nuclear Size, Nuclear Radii, Nuclear Mass – Nuclear Units - Atomic Mass Unit, Electron Volt- Binding Energy - Systematic of Binding Energy - Mass Defect, Mass Excess, Packing and Binding Fraction - Discovery of Radioactivity – Radioactive Decay- Activity, Half Life, Mean Life - Decay Constant - Radioactive Series – Radioactive Equilibrium - Secular, Transient, Non-Equilibrium.	8	Text Book
II	**Radioactive Decay Types** Alpha Decay - Geiger-Nuttal law – Energetics and Spectrum- Beta Decay and its Energies – Origin of Continuous Beta Spectrum - Neutrino Hypothesis – Properties of Neutrino - Nuclear Isomerism- Gamma Decay – Nature of Gamma Rays- Internal Conversion – Positron Emission - Electron Capture- Nuclear Fission and it's Discovery - Energy Release in Fission - Nature of the Fission Fragments - Energy Distribution Between the Fission Fragments - Fissile and Fertile Materials - Spontaneous Fission - Source of Energy in Stars - Nuclear Reactions and its Types - Conservation Laws - Q Values - Cross Section.	10	Text Book
III	**Particle Accelerators** Introduction - Classification and Performance Characteristics of Accelerators - Industrial, Medical and Research Applications – Resonant Transformer – Cascade Generator - Van De Graff Generator - Cyclotron - Betatron - Synchro Cyclotron- Linear Accelerator - Microtron– Electron Synchrotron – Proton Synchrotron.	12	Reference Book
IV	**Nuclear Models, Fission and Fusion Reactors** Shell Model, Liquid Drop Model - Fission - Energetics of Fission Process, Controlled Fission Reactions - Chain Reaction – Basics of Reactor - Gas Cooled Reactors - Advanced Gas Cooled Reactors- Pressurized Water Reactor - Boiling Water Reactor - Heavy Water Reactor - Breeder Reactor - Fusion Process - Characteristics of Fusion - Solar Fusion - Controlled Fusion Reactors - Critical Conditions - Four Factor Formula - Nuclear energy and social development.	15	E-Resource
V	**Nuclear Electronics and Techniques** Preamplifiers – Amplifiers - Single Channel Analyzers - Counting Statistics - Energy Measurements - Spectrometer - Introduction to Spectroscopy - Definition of Energy Spectra - Measurement of an Integral Spectrum and Differential Spectrum - Energy Resolution of a Detection System - Multichannel Analyzer - Calibration of MCA - Charged Particle Spectroscopy - Energy Straggling- Time of Flight Spectrometer – Detector Telescopes - Position - Sensitive Detectors (PSD), Categories - Photonic devices, Light detection and Characterization, Optoelectronics, Vision, Displays and Imaging, Optical metrology topics.	15	Reference Book
	Total	60	

Text book	1.	Enge. H. 1983. Introduction to Nuclear Physics, 1st Edition, Addison Wesley publisher.
	2.	Ghoshal. S. N. 1997. Nuclear Physics, 4th Edition, S. Chand Ltd publisher.
Reference Books	1.	Kenneth Krane. S, 1987, "Introductory Nuclear Physics", 3rd Edition, John Wiley and Springer publisher.
	2.	MuraleedharaVarier. M, 2009, "Nuclear Radiation Detection, Measurements and Analysis", 2nd edition, Narosa publisher.
	3.	Stefaan Tavernier, 2010, "Experimental Techniques in Nuclear and Particle Physics", 4th Edition, Springer publisher.
	4.	Tayal D.C, 2009,"Nuclear Physics", 2nd edition, Himalaya Publishing House.

Journal and Magazines	https://www.resurchify.com/impact/details/14621
E-Resources and Website	https://www.youtube.com/playlist?\list=PLRN3HroZGu2n_j3Snd_fSYNLvCkao8Hix

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - I
Core 2: Radiation Physics

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1CB	RADIATION PHYSICS	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The production and its properties of electromagnetic radiations and particulate radiations. • The broad knowledge on the Ionizing Radiation, X-ray production, and properties of X-rays • The Interaction of Directly and indirectly ionizing radiation with matter and its effects
Prerequisite	Atomic and Nuclear Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Discuss about electromagnetic spectrum and particulate radiation and it's properties	K2
CO2	Outline the X-ray tube construction and safe operation of the X-ray tube and its function	K2
CO3	Illustrate the theories of atomic physics nuclear reactions uncertainty and exclusion principles to radiation physics	K3
CO4	Interpret the Physics aspects of interaction of indirectly ionizing radiation with matter	K3
CO5	Summarize the interaction of directly ionizing radiation with matter and its effects inside a living object	K2

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1CB - RADIATION PHYSICS
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Electromagnetic Spectrum** Electromagnetic Radiation and its Properties – Electromagnetic Spectrum - Radio waves, Microwaves, Infrared, Visible light, UV, X-rays and Gamma rays – Particulate Radiation – Properties of alpha, beta, neutrons and positrons – Classification of Radiation – Directly Ionizing Radiation – Electrons, Positrons, Heavy charged particles and Pions - Indirectly Ionizing Radiation – X-rays, Gamma rays and Neutrons.	10	Text Book
II	**X-Ray Generators** Discovery - Production - Properties of X-Rays - Characteristics and Bremsstrahlung - Design of Hot Cathode X-Ray Tube - Basic Requirements of Medical Diagnostic, Therapeutic and Industrial Radiographic Tubes - Rotating Anode Tubes - Hooded Anode Tubes - Rating of Tubes - Safety Devices in X-Ray Tubes : Ray Proof and Shockproof Tubes - Insulation and Cooling of X- Ray Tubes - Fixed X-ray machines, Portable X-ray machines and Mobile X-ray machines - C-Arm , Mammography and Dental Unit – Maintenance of X-Ray Tube Unit. Filament and High Voltage Transformers – High Voltage Circuits - Half-Wave and Full Wave Rectifiers - Condenser Discharge Apparatus - High Frequency Generators - Voltage Doubling Circuits - Current and Voltage Stabilizers - Control Panels - Automatic Exposure Control-Automatic Brightness Control-Measurement of kV and mA-Timers- X-Ray Circuits - Image Intensifiers and Closed-Circuit TV Systems – Flat Panel Technology.	12	Reference Book
III	**Interaction of Photons with Matter** Ionization and Excitation - Attenuation - Linear Attenuation Coefficient - Mass Attenuation Coefficient - Energy Transfer and Mass Energy Absorption Coefficients - HVL – Rayleigh Scattering – Thomson Scattering - Photoelectric Effect - Compton Effect – Pair Production – Positron Annihilation - Photo disintegration - Relative Importance of Various Types of Interactions - Importance of Interaction in Tissue.	12	Text Book
IV	**Interaction of Charged Particles with Matter** Classical Theory of Inelastic Collisions with Atomic Electrons – Energy Loss Per Ion Pair by Primary and Secondary Ionization – Dependence of Collision Energy Losses on the Physical and Chemical State of the Absorber – Cerenkov Radiation – Electron Absorption Process – Radiative Collision – Range Energy Relation –Continuous Slowing Down Approximation (CSDA) – Straight ahead Approximation and Detour Factors – Transmission and Depth Dependence Methods for Determination of Particle	14	Reference Book

	Penetration - Empirical Relations Between Range and Energy – Back Scattering. Interaction of Heavy Charged Particles - Energy Loss by Collision – Range Energy Relation – Alpha Bragg curve and Proton Bragg curve – Specific Ionization – Stopping Power – Bethe Bloch Formula.		
V	**Interaction of Neutrons with Matter** Neutron Sources – Properties – Energy Classifications - Fast neutron, Slow neutron and Thermal Neutron and its interactions with matter, Neutron capture – Elastic and Inelastic Scattering Coefficients and Cross Sections – Energy Transfer and Logarithmic Energy Decrement - Nuclear Reactions –Dependence on E and Z – (n,p), (n,2n), (n,γ) and other Reactions – Neutron Activation - Radio Isotope Production.	12	E-Resource
	Total	60	

Text book	1.	Johns. H. E and Cunningham, 1984, "The Physics of radiology", 4th Edition, Charles C Thomas Publishers.
	2.	E.B. Podgarsak, 1996, "Radiation Physics for Medical Physicists", 2nd Edition, Springer Verlag Publishers.
Reference Books	1.	Todd Pawlicki, Daniel J Scanderbeg, George Starkschall, 2016, "Hendee's Radiation Therapy Physics", 4th Edition, Wiley-Blackwell Publisher.
	2.	Curry, T.S. Dowdey and J.E. Murry R.C, 1984, "Christensen's introduction to the Physics of diagnostic radiology", 3rd Edition, Philadelphia, Lea & Febiger. publisher.
	3.	Podgarsak. E.B, 2005, "Radiation Oncology Physics: Handbook for Teachers and Students", IAEA, Vienna publisher.
	4.	Attix. F. H, 2004, "Introduction to Radiological Physics and Radiation Dosimetry", 4th Edition, Viley VCH, Verlog publisher.

Journal and Magazines	https://www.aerb.gov.in/english/publications
E-Resources and Website	https://www.nrc.gov/docs/ML1122/ML11229A705.pdf

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - I

Core 3: Biomedical Electronics and Instrumentation

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1CC	BIOMEDICAL ELECTRONICS AND INSTRUMENTATION	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The knowledge in digital principles and its applications • The application of op-amps for various mathematical applications • The bio electric signal recording, physiological assist devices, operation theater equipment
Prerequisite	Basic Electronics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Manipulate the component types and connections used to build functioning electronic circuits	K3
CO2	Explain about solving problems related to number systems and Boolean algebra	K4
CO3	Construct the basic architecture of different Microprocessors	K3
CO4	Illustrate the concept of various bioelectric potentials generated in human body and related equipment	K3
CO5	Interpret the human physiology and anatomy with signal processing paradigms	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1CC - BIOMEDICAL ELECTRONICS AND INSTRUMENTATION
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Basic Electronics** Unijunction Transistor (UJT) - Semi Conductor Diode - Characteristics - Voltage Regulator Circuits - LED - Bipolar Junction Transistors - CB and CE Configuration - FET - MOSFET-JFET Amplifier - Characteristics - Principle of Operation. Op-Amp - Circuit Symbol-Ideal Op-Amp Characteristics - CMRR-Applications: Adder, Subtractor, Analog Integrator, Analog Differentiator, Voltage-to-Current Converter, Current-to-Voltage Converter and Logarithmic Amplifier	8	Text Book
II	**Digital Electronics** Logic Gates - Boolean Algebra - Boolean Laws – De-Morgan's Theorem - Implementation of Logic Circuits from Truth Table – Sum – of - Products Method – Products – of - Sum Method Combinational Circuits: Multiplexer and De-Multiplexer Circuits - BCD to Decimal Decoders - Seven Segment Decoders - Decimal to BCD Encoder. Arithmetic Building Blocks: Half-Adder and Full-Adder - Digital Comparator - Flip Flops: RS, Clocked RS, D-Flip Flop, Edge-Triggered D Flip Flop – J K Flip Flop - Sequential Logic Circuits: Registers - Shift Registers – Applications - Counters: Ripple Counters Up, Down and Up-Down Ripple Counters - Asynchronous and Synchronous Counters - ADC and DCA.	10	Text Book
III	**Microprocessor** Architecture of 8-Bit Microprocessor: Intel 8085A Microprocessor, Pin Description and Internal Architecture - Operation and Control of Microprocessor: Timing and Control Unit, Op-Code Fetch Machine Cycle, Memory Read/Write Machine Cycles, I/O Read/Write Machine Cycles, Interrupt Acknowledge Machine Cycle, State Transition Diagram - Instruction Set - Assembly Language Programming - Interfacing - Interrupts - Programmable Peripheral Interface - Programmable Interval Timer- Sample 8085 Assembly Language Programmes	12	Reference Book
IV	**Physiological Assist Devices** Cardiac Output Measuring Techniques – Dye Dilution Method, Thermodilution Method, BP Method - Blood Flow Measuring Techniques: Electromagnetic Type - Ultrasound Blood Flow Meter, Automatic Counting Of RBC, WBC and Platelets. Measurement of Blood Pressure – Direct Methods and Indirect Methods - Temperature - Respiration Rate - Heart Rate Measurement - O2, CO2 Measurements, Respiratory Volume Measurement, BMR Measurement, Plethysmography Technique, Detection of Various Physiological Parameters Using Impedance Technique - Kidney Machine – Haemodialysis Units – Peritoneal Dialysis- Lithotripsy - Various Types of Endoscopy- Ventricular Assist Devices (VADs)	15	E-Resource

V	**Bioelectric Signal Recording and Clinical Equipment** Bio-Electrodes: Surface - Micro - Needle Electrodes - Equivalent Circuits of Electrodes – Biochemical and Transcutaneous - Electrodes: PH, PO2, PCO2 Bio amplifiers – Bio potential Signals and their Recording: Bio amplifiers- Carrier Amplifier, - Isolation Amplifier - Differential Amplifier - Chopper Amplifier - Instrumentation Amplifier - Bioelectric Signals (ECG, EMG, EEG, EOG & ERG) and their Characteristics - Different Types of Bio Electric Signal and Recording Electrodes - Surface Electrodes and the Deep - Seated Electrodes - Electrodes for ECG, EEG And EMG - ECG Machine - EMG Machine – 10-20 Electrodes Placement System for EEG - EEG Machine - Heart Sound and Characteristics, PCG - Biochemical Measurement Techniques: Chemical Fibro Sensors, Fluorescence Sensors - Glucose Sensor - Colorimeter, Spectro Photometer, Flame Photometer – Chromatography - Mass Spectrometer, Auto Analyzer.	15	Text Book
	Total	60	

Text book	1.	Malvino. A. P and Leach. D. P. 1994, "Digital Principles and Applications", 5th Edition, Tata McGraw-Hill Publishing Co publisher, New Delhi.
	2.	Arumugam. M, 2014," Biomedical Instrumentation", Anuradha Publications, Chennai.
Reference Books	1.	Bhattacharya. A. B. 2007, "Electronic Principles and Applications", 2nd Edition, New Central Book Agency, Kolkata
	2.	Geddes LA and Baker L.E. 1989, "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley and sons, New York.
	3.	Mathur. A. P. 2005, "Introduction to Microprocessors", 3rd Edition, Tata McGraw-Hill Publishing Co, New Delhi.
	4.	R. S. Khandpur 1990, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi.

Journal and Magazines	https://www.longdom.org/biomedical-engineering-medical-devices.html
E-Resources and Website	https://www.youtube.com/playlist?list=PLL_6qtCTrqLmRjr9GP3d_mn6Zu5iMgfV_

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Innovations, Intellectual Property Rights, Entrepreneurial development Social Awareness/ Environment.

Semester - I

Core 4: Radiological Anatomy, Physiology and Tumour Pathology

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1CD	RADIOLOGICAL ANATOMY, PHYSIOLOGY AND TUMOUR PATHOLOGY	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The structure and function of the organs and systems. • The cancer screening, detection and treatments. • Cancer prevention and public education.
Prerequisite	Basic Biology

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Demonstrate the cross anatomy of the organs and its functions.	K3
CO2	Identify the different organ/structures on radiological images.	K2
CO3	Analyze the tumour grade and cancer staging.	K4
CO4	Distinguish the site-specific signs, symptoms, diagnosis and management for all types of cancer.	K2
CO5	Discuss the various treatment modalities and cancer prevention.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓		✓	✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1CD - RADIOLOGICAL ANATOMY, PHYSIOLOGY AND TUMOUR PATHOLOGY
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Human Anatomy and Physiology** Introduction to Human Body - The Cells, Tissues and Organization of Body - Blood Skin - Lymphatic System - Skeletal System - Nervous System - Endocrine System - Cardiovascular - Respiratory System - Digestive System - Gastro-Intestinal - Excretory System - Reproductive System - Special Senses.	12	Text Book
II	**Radiographic Anatomy** Anatomy of Human Body Nomenclature - Surface Anatomy - Radiographic Anatomy - Cross Sectional Anatomy – Identify the Different Organs/Structures on Plain X-rays, Computed Tomography (CT) scans, Magnetic Resonance Imaging (MRI), Single Photon Emission Computed Tomography (SPECT), and Positron Emission Tomography (PET) Scans - Normal Anatomy and Deviation for Abnormalities.	12	E-Resource
III	**Tumour Pathology and Cancer Screening** Tumour Pathology and Carcinogenesis - Basic Pathological Features of Cancers and Interpretation of Clinico-Pathological Data - Benign and Malignant Disease - Methods of Spread of Malignant Disease - Staging and Grading Systems - Screening - Definition, Principles, Evaluating Screening Tests, Developing and Evaluating a Cancer Screening Programme - Different Kinds of Screening Tests - Screening for Specific Types of Cancer	12	Text Book
IV	**Site Specific Signs, Symptoms, Diagnosis and management** Head and Neck, Breast, Gynaecological, Gastro-Intestinal Tract, Genito - Urinary, Lung and Thorax, Lymphomas, Leukaemia & other Cancers including AIDS Related Cancers.	12	Reference Book
V	**Cancer Treatment Modalities** Treatment Intent – Curative & Palliative -Types of Treatment - Surgery, Radiation Therapy, Chemotherapy, Biological Therapy, Hormone Therapy, Transplantation, Targeted Therapy, Radiolabelled Immunotherapy, Gene Therapy , Cryosurgery, Laser Therapy, Photodynamic Therapy and Hyperthermia - Cancer Clinical Trials - Patient Management on Treatment – Monitoring and Common Management of Side Effects – Information and Communication - Cancer Prevention and Public Education.	12	Reference Book
	Total	60	

Text book	1.	Ross and Wilson, 2014, "Anatomy and Physiology in Health and Illness" by Anne Waugh, Allison Grant, 12th Edition, Churchill Livingstone.
	2.	Henry Gray, 2009, "Anatomy and physiology", 30th Edition, Philadelphia: Lea & Febiger.
Reference Books	1.	Perez & Bradys, 2008, "Principles and practice of radiation oncology", 30th Edition, Lippincott Williams and Willins.

	2.	Meschan, 1969, "Normal Radiation Anatomy", 8th edition, WB Sunders Company.
	3.	C. K. Warrick, 2001, "Anatomy and Physiology for Radiographers", Oxford University Press.
	4.	C. H. Best and N. B. Taylor, 1999, "A Test in Applied Physiology", Williams and Wilkins Company, Baltimore.

Journal and Magazines	https://link.springer.com/journal/432
E-Resources and Website	https://www.kenhub.com/en/library/anatomy/medical-imaging-and-radiological-anatomy

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - I

Core Practical I: Biomedical Electronics and Instrumentation

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1CP	BIOMEDICAL ELECTRONICS AND INSTRUMENTATION	CORE PRACTICAL	-	-	72	3

Syllabus

S. No.	Experiments
1	Zener regulated power supply and percentage of regulation.
2	Transistor characteristics- CB and CE configuration.
3	Single stage R-C coupled transistor amplifier.
4	Single stage FET amplifier- CS configuration.
5	FET characteristics.
6	OP-Amp parameters – Adder, Subtractor, Differentiator and Integrator.
7	OP-Amp applications - Inverting and Non- Inverting
8	Logic gates OR, AND, NOT, NOR and NAND Gates.
9	Half adder and Full adder.
10	NAND gate as a universal gate.
11	A/D and D/A converters.
12	MOSFET characteristics.
13	Photosensitive diodes.
14	Verification of De-morgan's theorem.
15	Microprocessor - LED interfacing
16	Microprocessor – Timing and Control Unit

Reference Books	1.	Hughes J, 2015. "Practical Electronics: Components and Techniques", 1st edition, O'Reilly Media Publisher.
	2.	Ian Sinclair, 1980. "Practical Electronics Handbook", 6th Edition, Elsevier Publisher.
	3.	Bhatt N.D, 1990, "Elementary Engineering Drawing", Charater Publishing Co.
	4.	Hajra Choudry S.K, 1992, "Elements of Workshop Teaching", Vol.I and II. Tata McGraw Hill Publishing Co., New Delhi.

Semester - I
DSE I: Solid State Physics

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1DA	SOLID STATE PHYSICS	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The basic principles, theory and concepts of rigid solid matter • The Crystalline state and structure • The Magnetic, Superconductivity and Semiconducting properties of solids
Prerequisite	Properties of matter and quantum mechanics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Illustrate the various crystal structures and forces associated with it	K3
CO2	Interpret the application of lattice structures heat processes associated with it	K3
CO3	Explain the theories of various metals and semiconductors and their mobility phenomena	K4
CO4	Classify different types of magnetic materials	K2
CO5	Discuss different types of superconductors and their applications	K2

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓		✓	✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1DA - SOLID STATE PHYSICS
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Crystal Physics** Lattice, Points and Space Lattice, Basis and Crystal Structure – Unit Cells and Lattice Parameters, Primitive Cells –Crystal Systems, Bravais Lattice –Metallic Crystal Structure–Directions, Planes and Miller Indices –Reciprocal Lattice- Crystal Diffraction, Bragg's Law, Powder Crystal Method .	8	Text Book
II	**Bonding in Solids** Ionic Bonding; Bond Energy of NaCl molecule-Calculation of Lattice Energy of Ionic Crystals and Madelung Constant – Properties of Ionic Solids – Covalent Bond; Saturation, Directional Nature, Hybridization, Properties: Metallic Bond, Intermolecular Bonds, Dispersion Bonds, Dipole Bonds, and Hydrogen Bonds	10	Text Book
III	**Band Theory of solids** Bloch Theorem- Kronig -Penney Model-Effective Mass of an Electron- Nearby force Electron Model- Conductor-Semiconductor-Insulator- Intrinsic Semiconductor - Extrinsic Semiconductor-Free Carrier Concentration in Semiconductor - Hall Effect and its Applications.	10	Text Book
IV	**Thermal and Magnetic properties of solids** Specific Heat – Dulong and Petit Law- Einstein's Theory – Debye's Theory – Magnetism in Solids – Origin of Magnetic Properties of Materials - Bohr Magneton- Electron Spin and Magnetic moment - Nuclear Spin–Types of magnetism; Diamagnetism-Langevin's Theory- Paramagnetism -WeissTheory, Susceptibility of Solids – Ferromagnetism, Hysteresis-Applications of Magnets in Medicine.	10	Reference Book
V	**Super Conductivity** Mechanism of Super Conductors – Effect of Magnetic Field – AC Resistivity – Critical Currents – Meissner Effect – Thermal Properties – Penetration Depth – Type I and Type II Superconductors–London's Equations –BCS Theory– Single Particle Tunneling - Josephson Tunneling - DC And AC Josephson Effects–Applications; Superconducting Magnets, High Temperature Superconductor- SQUIDS	10	E-Resource
	Total	48	

Text book	1.	Kittel. C, 2005, "Introduction to Solid State Physics", 7th Edition, Wiley, New York.
	2.	Pillai. S. O, 2002, "Solid State Physics", 6th Edition, New Age International, New Delhi.

Reference Books	1.	Blakemore. J. S, 1985, "Solid State Physics", 2nd Edition, Publisher Cambridge University.
	2.	Dekker. A. J, 1986, "Solid State Physics", 2nd Edition, Macmillan India, New Delhi.
	3.	Pillai. S. O, 2007, "Problems and Solutions in Solid State Physics", 4th Edition, New Age International, New Delhi.
	4.	Wahab A M, 2007, "Structure and Properties of Materials", 2nd Edition, Narosa Publishing house, New Delhi, India.

Journal and Magazines	https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
E-Resources and Website	https://nptel.ac.in/courses/115101012

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Innovations, Intellectual Property Rights, Entrepreneurial development.

Semester - I
DSE I: Non-Ionizing Radiation in Medicine

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1DB	NON-IONIZING RADIATION IN MEDICINE	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The non-ionizing radiations and its properties. • The interaction of non-ionizing radiations with tissues. • The applications of lasers, ultrasound, radio frequency and microwaves in medicine.
Prerequisite	Atomic Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Illustrate the various sources of non-ionizing radiations and its properties	K3
CO2	Discuss the interaction of optical radiations with tissues	K2
CO3	Summarize the applications of Lasers in dermatology, oncology and cell biology	K2
CO4	Describe the ultrasound production, properties and its application in medicine	K2
CO5	Interpret the interaction of radiofrequency waves and microwaves with biological system	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1DB - NON-IONIZING RADIATION IN MEDICINE
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Fundamentals of Non-Ionizing Radiation Physics** Electromagnetic spectrum - Different sources of non-ionizing radiation and its physical properties - Laws of photochemistry – Grothus -Draper Law and Stark-Einstein Law - Law of reciprocity - Electrical impedance and Biological impedance - Principle and theory of thermography – Applications.	10	Text Book
II	**Interaction of Optical Radiation** Introduction to optical radiations – UV, Visible and IR sources - Lasers: Theory and mechanism - Lasers in surgery - Fluence measurement from optical sources - Optical properties of tissues – Interaction of laser radiation with tissues – Photothermal - Photochemical – Photoablation – Electromechanical effect.	10	Text Book
III	**Lasers in Medicine** Lasers in medicine - Applications of ultrafast pulsed lasers - Lasers in dermatology, oncology and cell biology - Lasers in blood flow measurement - Fiber optics in medicine - Hazards of lasers and their safety measures.	8	Text Book
IV	**Ultrasound in Medicine** Production, Properties and Propagation of ultrasonic waves – Bioacoustics - Acoustical characteristics of human body - Ultrasound in obstetrics and gynaecology -Vascular System - Early pregnancy and foetal activity - Ultrasound in ophthalmology and echocardiography - Ultrasonic dosimetry - High power ultrasound in therapy	10	E-Resource
V	**Radio Frequency and Microwave in Medicine** Production and Properties - Interaction mechanism of RF and microwaves with biological systems: Thermal and non-thermal effects on whole body, lens and cardiovascular systems - Tissue characterization - Hyperthermia and other applications.	10	Reference Book
	Total	48	

Text book	1.	Martellucci S. S and Chester A. N, 1985,"Laser Photobiology and Photo medicine", Plenum Press, New York.
	2.	Markolf H. Neimz, 1996, "Laser-Tissue Interactions", Springer Verlag, Germany.

Reference Books	1.	Greening J. R, 1999, "Medical Physics", North Holland Publishing Co., New York.
	2.	Pratesi R and Sacchi C. A, 1980, "Lasers in Photomedicine and Photobiology", Springer Verlag, West Germany.
	3.	Harry Moseley Hospital Physicists' Association, 1999, "Non-ionising radiation: microwaves, ultraviolet, and laser radiation", A. Hilger, in collaboration with the Hospital Physicists' Association.
	4.	Malvino A.P, 2007, "Electronic principles", 7th edition, Tata McGraw Hill Publication Co. Ltd., New Delhi.

Journal and Magazines	https://onlinelibrary.wiley.com/loi/20513909
E-Resources and Website	https://www.youtube.com/watch?v=e65sEYi3t8k

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Social Awareness/ Environment.

Semester - I
DSE I: Programming in C++

Semester	Course Code	Course Name	Category	L	T	P	Credits
I	24MPP1DC	PROGRAMMING IN C++	DSE	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The fundamental programming concepts and methodologies which are essential to build good C++ programs • The fundamental programming methodologies in C++ language through laboratory experiences • The fundamental Microsoft Visual Studio programming
Prerequisite	Basic Functionality of Computer Programs.

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Demonstrate the basic concepts of C++ programs	K2
CO2	Discuss the methods of classes and objects	K2
CO3	Interpret the binary operators and types of inheritance	K3
CO4	Discuss about pointers and arrays	K2
CO5	Describe about file stream classes	K2

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP1DC - PROGRAMMING IN C++
Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Introduction to C++** Key concepts of Object-Oriented Programming – Advantages – Object-Oriented Languages – Usages of C++ - I/O in C++ - C++ Declarations - Control structures - Decision making and statements: If, Else, jump, goto, break, continue, Switch case statements - Loops in C++: For, While, Do - Functions in C++ - Inline functions – Function overloading.	10	Text Book
II	**Classes and Objects** Declaring objects – Defining member functions – Static member variables and functions – Array of objects –Friend functions – Overloading member functions – Bit fields and classes – Constructor and destructor with static members.	10	Text Book
III	**Operator Overloading** Overloading unary, binary operators – Overloading friend functions – Type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base Classes – Abstract classes - Sample programs to implement inheritance.	10	Reference Book
IV	**Pointers** Pointers – Declaration – Pointer to Class, Object – this pointer – Pointers to derived classes and Base classes – Arrays – Characteristics – Array of classes – Memory models – New and delete operators – Dynamic object – Binding, Polymorphism and Virtual functions - Sample programs to implement polymorphism	10	E-Resource
V	**Files** Operations – Binary and ASCII Files – Random access operation – Templates – Exception handling - String – Declaring and Initializing string objects – String attributes – Miscellaneous functions	8	E-Resource
	Total	48	

Text book	1.	Ashok N Kamthane, 2006, "Object-Oriented Programming with ANSI and Turbo C++", 1st Edition, Pearson Education.
	2.	Balagurusamy E, 2013, "Object-Oriented Programming with C++", 6th Edition, Tata Mc-Grawhill.
Reference Books	1.	Maria Litvin & Gray Litvin, 1997, "C++ for you", 1st Edition, Skylight.

	2.	Brian W. Kernighan and Dennis M. Ritchie, 2006, "The C programming Language" Prentice-Hall.
	3.	Bjarne Stroustrup, "The C++ Programming language", 3rd Edition, Pearson Education.
	4.	HM Deitel and PJ Deitel "C++ How to Program", 7th Edition, 2010, Prentice Hall.

Journal and Magazines	https://www.sciencedirect.com/journal/science-of-computer-programming
E-Resources and Website	https://archive.nptel.ac.in/courses/106/105/106105151/

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability.

03/04/24
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CHAIRMAN
Dr.N.G.P. Arts and Science College

Semester - II
Core : Radiation Detectors and Instrumentation

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2CA	RADIATION DETECTORS AND INSTRUMENTATION	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The principle of radiation detection and types of detector • The Function of electronic equipments used to measure and count ionizing radiation • The characteristics of radiation detection systems
Prerequisite	Electronics and Radiation Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Explain the principle of radiation detector in the measurement of high energy radiation.	K3
CO2	Apply the concept of scintillation and other detectors.	K3
CO3	Illustrate the theory behind dosimetric instruments and their applications.	K3
CO4	Demonstrate the various radiation protection instruments and their uses	K3
CO5	Interpret the nuclear medicine instruments	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP2CA	CORE: RADIATION DETECTORS AND INSTRUMENTATION

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Introduction to Radiation Measurements and Gas Filled Detectors** Radiation - Statistical nature of radiation emission - Accuracy and Precision of measurements - Error -Types of errors- Random error and Systematic error. Basic principle of radiation detection and detector properties - Detector types - Principle of gas filled detectors- Voltage and current characteristic of gas filled detectors -Ionization chamber, Thimble chamber, Condenser type chamber and its construction and working - Gas multiplication - Proportional counters, Geiger-Muller counters - Dead time and recovery time – Quenching -Characteristics of organic and inorganic counters – Calorimetry –Principle and application for absolute dosimetry.	12	Text Book
II	**Principles of Radiation Detection Using Scintillation and Other Detectors** Principle of scintillation- Scintillator and its properties - Organic and Inorganic scintillator - Relationship between pulse height and energy and type of incident particle - Photomultiplier tube - Assembly of a scintillation counter and role of light pipes - Dead time of scintillation counters – Sources of background in a scintillation counter - Resolving time–Resolving power- -Liquid scintillator. Semiconductor detectors: Diode, Metal oxide semiconductor field effect transistor (MOSFET) - Voltage current characterization - Thermoluminescence dosimeters (TLD) – Detection process - Glow curve and dose response - Common TLD materials and their characteristics – Fading-Residual TL - Annealing Process –Reuse - Optically stimulated luminescence dosimeters(OSLD). Radiographic and Radiochromic films - Film characteristic and calibration –Radiophoto luminescent dosimeters - Neutron detectors – Nuclear track emulsions for fast neutrons – Solid state nuclear track detectors (SSNTD)..	14	Text Book
III	**Dosimetry Instruments** Secondary standard therapy level dosimeters: Farmer type, Parallel Plate and Well type chambers (Re-entrant, Sealed chamber) – BF_3 Proportional Counter - Pocket dosimeters – Multipurpose dosimeters – Different types of electrometers – String electrometer - MOSFET, Vibrating condenser and Varactor bridge types – Phantom – Classifications (Water, Solid, Anthropomorphic phantom) - Characteristics– Radiation field analyzer (RFA) – Thermoluminescent dosimeter reader for medical applications - Calibration and maintenance of dosimeters.	12	Reference Book
IV	**Radiation Safety and Monitoring Instruments** Film Badge –Film densitometers - TLD badge and reader – Glass dosimeter readers – Digital pocket dosimeters using solid state	12	E-Resource

	devices and GM counters –Teletector-Survey meter - GM type and Ion chamber type – Industrial gamma radiography survey meter– Gamma area (Zone) alarm monitors. Contamination monitors for alpha, beta and gamma radiation – Hand and foot monitors - Laundry and portal monitors - Scintillation monitors for X and gamma radiations – Neutron monitors, Tissue equivalent survey meters – Flux meter and Fluence - Dose equivalent monitors – Pocket neutron monitors - Teledose systems.		
V	**Nuclear Medicine Instruments** Radioisotope calibrator– Thyroid uptake probe -Instruments for counting and spectrometry– Portable counting systems for alpha and beta radiation – Gamma ray spectrometers – Multichannel analyzer– Liquid scintillation counting system – RIA counters – Whole body counters – Air monitors for radioactive particulates and gases - Details of commercially available instruments and systems.	10	Reference Book
	Total	60	

Text Book	1.	Knoll. G. F, 2000, "Radiation detection and measurement", 3rd Edition, John Wiley Publisher.
	2.	Nicholas Tsoulfanidis, 1995. "Measurement and Detection of Radiation", 2nd Edition, Taylor & Francis.
Reference Books	1.	Podgarsak. E.B. 2005.,"Radiation Oncology Physics: Handbook for Teachers and Students", IAEA, Vienna publisher.
	2.	Meredith.W.J and Massey.J.B, 1972.,"Fundamental Physics of Radiology", 2nd Edition, John Wright and sons, UK.
	3.	Price W.J, 1964. "Nucleus Radiation detection", 2nd Edition, McGraw-Hill, New York.
	4.	Kapoor. S.S. and. Ramamurthy.V, 1986," Nuclear Radiation Detectors", 1st Edition, New Age International (P)Ltd.

Journal and Magazines	https://www.scimagojr.com/journalsearch.php?q=21100921312&tip=sid&clean=0
E-Resources and Website	https://humanhealth.iaea.org/HHW/MedicalPhysics/elearning/Nuclear_Medicine_Handbook_slides/Chapter_06._Basic_Radiation_Detectors.pdf. https://www.youtube.com/watch?v=NoumT_8YWQw

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - II

Core: Physics of Radiation Therapy

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2CB	PHYSICS OF RADIATION THERAPY	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The Physics of radiation beam generators used in radiation therapy • The dose distribution of therapeutic beams and its dosimetric parameters • The various treatment techniques, the concept of treatment planning and dose calculation for external beam therapy
Prerequisite	Nuclear Physics & Radiation Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Illustrate the construction and working of various therapy beam generators	K3
CO2	Interpret the various central axis dosimetric parameters	K3
CO3	Classify the beam modifying devices and its uses	K4
CO4	Analyze the concept of treatment planning process in teletherapy	K4
CO5	Demonstrate the characteristics of electron beam, treatment techniques and dose calculation	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓		✓	✓	
CO4	✓		✓	✓	
CO5	✓	✓	✓	✓	✓

24MPP2CB	CORE: PHYSICS OF RADIATION THERAPY

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Therapy Beam Generators** Kilovoltage therapy X-ray units – Grenz ray therapy, Contact therapy, Superficial therapy, Deep therapy and Supervoltage therapy – Spectral distribution of kV X-rays and effect of filtration - Thoraeus filter - Telecobalt units: Construction and working, Source design, Beam shutter mechanisms – Radiation field - Beam collimation, Penumbra and its types, Trimmers and Breast cones - Beam directing devices - Front and Back Pointers, Pin & arc ODI, Laser - Isocentric gantry. Linear accelerator - Design - Principle and function of klystron and magnetron, traveling and standing waveguide, pulse modulators and auxiliary systems, Bending magnet systems, Treatment head - Electron beam, X-rays, Beam collimation, Asymmetric collimator, Multileaf collimator, Dose monitoring systems - Interlocks – Output calibration procedure - Relative merits and demerits of kV X-rays, gamma rays, MV X-rays and electron beams	12	Text Book
II	**Dosimetry Parameters** Collimator scatter factor, Phantom scatter factor and Total scatter factor - Percentage depth dose (PDD) - Factors affecting PDD - Maynord factor-Tissue air ratio(TAR), Backscatter factor / Peak scatter factor (BSF/PSF) - Tissue phantom ratio (TPR) - Tissue maximum ratio(TMR) - Relationship between TAR and PDD and its applications – Relationship between TMR and PDD and its applications – Scatter air ratio (SAR)–Scatter maximum ratio (SMR) - Off axis ratio and field factor - Surface dose and buildup region - Isodose chart - Measurements of Isodose curves – Characteristic of isodose curves – Dosimetric data resources for treatment calculation – Concept of dose calculation for equivalent square field.	13	Text Book
III	**Beam Modification and Shaping Devices** Bolus and its types – Beam spoilers -Wedge filters – Individual, Universal, motorized and dynamic wedges – Shielding blocks - Field shaping, Custom blocking -Styrofoam cutting machine -Tissue compensators – Design of compensators, 2D compensators, 3D compensators – Multileaf collimator (MLC).	10	Reference Book
IV	**Treatment Planning in Teletherapy** Electron contamination, Dmax, Buildup Dose, Entrance dose, Exit dose, Target volume definition and Dose prescription criteria – ICRU 29, ICRU 50, ICRU 62 and ICRU 83 -Treatment planning in teletherapy-Positioning/Immobilization- 2D and 3D localization techniques - Conventional simulator and CT simulator – Contrasts - Markers - Patient data acquisition – DICOM- Relative electron density - Image registration and segmentation using CT, MRI, US and PET.	13	E-Resource

	SSD and SAD set ups – Extended SSD - Field arrangements – Single, Parallel opposed and Multiple fields – Corrections for tissue inhomogeneity, Contour shapes and beam obliquity– Integral dose- Arc/Rotation therapy and Clarkson technique for irregular fields – Mantle and inverted Y Fields. Conventional and Conformal radiotherapy-Gradient Index, Treatment time and Monitor unit calculations for Co-60 and Linear accelerator – SSD and SAD/Isocentric techniques - Dose prescription and normalization - Virtual simulation – Digitally reconstructed radiographs (DRR)- Beam's Eye view - Plan evaluation - DVHs – Differential and Cumulative		
V	**Electron Beam Therapy** Energy specification - Depth dose characteristics of electron beam (Dmax, Ds, Dx, dmax, R90, R50, Rp and Bremsstrahlung Tail) - Characteristic of clinical electron beams - Collimation - Electron cutouts, Electron applicator - Determination of absorbed dose - Applicator factor - Cut out factor- Monitor unit calculations – Output factor formalisms - Planning and dose calculation effects of patient and beam geometry - Internal heterogeneities - Treatment planning techniques – Field abutment techniques – Photon and electron mixed beams – Electron arc therapy - ICRU71.	12	Reference Book
	Total	60	

Text book	1.	Faiz Khan. M, 2014," The Physics of Radiation Therapy", 5th Edition, Wolterskluwer.
	2.	Podgarsak. E.B. 2005, "Radiation Oncology Physics: Handbook for Teachers and Students", IAEA, Vienna publisher.
Reference Books	1.	G. C. Bentel, 1992," Radiation Therapy Planning", 1st Edition, Macmillan Publishing Co., New York.
	2.	Faiz M. Khan, Roger A. Potish, 1998," Treatment Planning in Radiation Oncology", Williams & Wilkins, Baltimore.
	3.	Hendee. W. R, 2004," Medical Radiation Physics", preface of 3rd Edition, Medical Publishers Inc London.
	4.	Bomford. C. K, kunkler. I. H, "Walter and Miller's, 2002.," Textbook of Radiotherapy", 6th edition, Churchill Livingstone.

Journal and Magazines	https://journals.lww.com/jomp/pages/default.aspx
E-Resources and Website	https://humanhealth.iaea.org/resources/files/medicalphysics/radiation-oncology-physics/Chapter_07_Treatment_planning.pdf https://humanhealth.iaea.org/resources/files/medical-physics/radiation-oncology-physics/Chapter_08_Electron_beams.pdf

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - II
Core: Physics of Radiology Imaging

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2CC	PHYSICS OF RADIOLOGY IMAGING	CORE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The fundamentals of medical imaging techniques such as, X-ray, Fluoroscopy, Mammogram, CT, MRI, and Ultra Sound • The methods for generating 2D and 3D images in diagnostic radiology • The factor influences the image quality and QA protocols for various imaging modalities
Prerequisite	Radiation Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Interpret the principle of X-ray imaging and the associated technical parameters	K3
CO2	Illustrate the concept of generating mammography and fluoroscopy images	K3
CO3	Infer the physical principle behind CT and image reconstruction algorithms	K3
CO4	Demonstrate the Physics principle of MRI and Quality assurance	K3
CO5	Explain the interaction of ultrasonic waves with tissues and various modes of image display for ultrasound.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP2CC	CORE: PHYSICS OF RADIOLOGY IMAGING

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Principles of X-Ray Diagnosis & Imaging** Principle - Interactions of X-rays with human body - Differential transmission of x -ray beam -Spatial image formation - Visualization of spatial image - Limitations of projection imaging technique viz. superimposition of overlying structures and scatter - Application of contrast media and projections at different angles to overcome superimposition of overlying structures Prime factors kVp, mAs and SID/SFD and its influence on Image quality - Filters and its types - Beam restrictors and its types – Scatter reduction - Grid and its types – Air gap technique - Cassettes - Intensifying screen - Absorption efficiency and conversion efficiency - Structure of x-ray film, Types of films, Characteristics of x-ray film, Film processing, Manual and Automatic film processing - Computerized radiography- Film handling and storage, influence of temperature and time, Replenisher, dark room - Safe light - Image quality, Spatial and contrast resolution, noise, geometric factors, optimal quality image, artifact - QA of diagnostic x-ray. Different Radiography Techniques: Xeroradiography, Intra and Extra oral radiography – Orthopantomography (OPG), Dental CBCT – Bone mineral densitometer (BMD) - Conventional radiography (CR) and Digital radiography(DR).	14	Text Book
II	**Mammography and Fluoroscopy** Mammography: Mammographic X-ray tube design, Filter, Spectra, Compression paddle, Grids and AEC. Collimation, Filtration and HVL - Magnification – Screen film mammography – Digital mammography – Tomosynthesis -Display of digital mammography- QA. Fluoroscopy: Conventional fluoroscopy, Cine and Fluoro mode - Dark room adaptation, Image intensifiers, Closed circuit TV systems, Flat panel detectors - Modern trends in interventional radiology – Single and Bi-plane imaging, Rotational angiography, Cardiac imaging, Real time imaging characteristics – Filtration, Continuous and pulsed fluoroscopy, High dose-rate fluoroscopy, Spot imaging, Digital Subtraction acquisition technique, Road mapping, Image magnification, Lastimage hold, Automatic exposure control, Automatic brightness control, Brightness gain - Image quality - Radiation dose management: Dose area product (DAP) meters, Peak skin dose, Cumulative dose and Dosimetric techniques in interventional radiology - Dose management for pediatric and pregnant patients in interventional imaging, Diagnostic reference levels and guidelines – QA and Radiation protection.	14	Text Book

III	**Computed Tomography** Principle of Computed tomography - CT Equipment, System design, Gantry and Couch, X-ray tubes, Filters and Collimation, Detector array, Generations of CT-Dual energy CT - Modes of CT acquisition: Axial acquisition, Helical acquisition, Cone beam acquisition, Cardiac CT, CT angiography, CT perfusion-CT number-Image display –CT image reconstruction: Back projection, Filtered back projection, Fourier reconstruction, Cone beam reconstruction, Iterative reconstruction, Post processing tools, Volume rendering, Multiplanar reconstruction (MPR), Maximum intensity projection (MIP) - Image quality - factors influence on image quality – Contrast, Spatial resolution, Noise, Unsharpness, Magnification, Distortion and Artifacts - Quality assurance - Image artifacts, Radiation dose management: factors affecting patient dose CTDI, CTDIvol, Dose length product(DLP),Multiple scan average dose(MSAD)-QA of CT.	12	Reference Book
IV	**Magnetic Resonance Imaging** Basics Physics of MRI, Magnetism, Nuclear characteristics, Hydrogen characteristics, Magnetization vector, Precession, Radiofrequency and Resonance, MRI signal, Flip angle - Relaxation time: T1 relaxation time, T2 relaxation time, Comparison of T1 and T2 - MR signal localization, Gradient field, Slice selection, Phase encoding gradient, Frequency encoding gradient, Composite signal, K-space - MR imaging sequences - Spin echo sequence, T1 weighted image, T2 weighted image, Spin density weighted image, Inversion recovery, Gradient recalled echo– Specialized MR sequences, MR angiography, Perfusion imaging, Diffusion imaging, Functional imaging, MR spectroscopic imaging – MR instrument and biosafety - Image quality and artifacts - QA of MRI.	10	E-Resource
V	**Ultrasound** Basics of Ultrasound, Propagation of sound, interaction of Ultrasound with matter -Ultrasound transducer, Piezoelectric material, Transducer design, Transducer array - Beam properties - Near field - Far field - Side lobes - Spatial resolution - 2D, 3D and 4D Ultrasound-Data acquisition systems –ADC - Receiver, Echo display modes, Scan converter - Image data acquisition, Pulse echo acquisition - Ultrasound image display: Amplitude mode, Motion mode, Brightness mode - Doppler ultrasound - Ultrasound image quality - Image artifacts -Bio-effects of ultrasound- QA of ultrasound.	10	Reference Book
	Total	60	

Text Book	1.	Curry, T.S. Dowdey and J.E. Murry, R.C, 1990, "Christensen's introduction to the Physics of diagnostic radiology", 4th Edition, Philadelphia, Lea & Febiger Publisher.
	2.	Bushberg,S.T; Seibert, J.A; Leidholt, E.M & Boone, J.M, 2011," The essential Physics of Medical imaging", 3rd Edition, Baltimore, Williams & Wilkins Publisher.

Reference Books	1.	Johns. H.E. & Cunningham. J.R, 1983, "The Physics of Radiology", 4th Edition, Spring field.
	2.	Thayalan. K, 2014, "The Physics of Radiology and Imaging", 1st Edition, Jaypee Brothers Medical Publishers Private Limited.
	3.	David J. Dowsett; Patrick A. Kenny; Eugene Johnston R, 2006, "The Physics of Diagnostic imaging, 2nd Edition, CRC Press.
	4.	Farr. R. F and PJ Allisy-Roberts, 2006," Physics for Medical Imaging", 2nd Edition Saunders.

Journal and Magazines	https://journals.lww.com/jomp/pages/default.aspx
E-Resources and Website	https://humanhealth.iaea.org/HHW/MedicalPhysics/TheMedicalPhysicist/Studentscorner/HandbookforTeachersandStudents/Chapter_11.pdf https://humanhealth.iaea.org/HHW/MedicalPhysics/TheMedicalPhysicist/Studentscorner/HandbookforTeachersandStudents/Chapter_14.pdf

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - II

Core Practical: Radiation Measuring and Monitoring Instrumentation

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2CP	RADIATION MEASURING AND MONITORING INSTRUMENTATION	CORE PRACTICAL	-	-	72	3

Preamble	This course has been designed for students to learn and understand • The basic principles of radiation detection and measurement. • The calibration and quality assurance tests for radiology and radiotherapy equipment's. • The international dosimetry protocols and radiation safety standards.
Prerequisite	Nuclear Physics and Radiation Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Understand the statistical and operational principles of radiation counters and detectors.	K2
CO2	Analyze the absorption and scattering properties of beta and gamma rays for various absorbers.	K4
CO3	Demonstrate the calibration techniques for Thermoluminescent (TL) dosimeter and reader.	K3
CO4	Perform quality assurance tests of diagnostic X-ray machine.	K3
CO5	Apply TRS 398 protocol for cross calibration of ion chambers and dose measurement of high energy Photon and electrons beams in radiotherapy.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP2CP	CORE PRACTICAL: RADIATION MEASURING AND MONITORING INSTRUMENTATION

Syllabus

S. No.	Experiments
1	Statistics of radioactive counting
2	Determination of plateau and resolving time of a Geiger-Muller counter and its application in estimating the shelf ratio and activity of a beta source
3	Production and attenuation of Bremsstrahlung
4	Determine the range of beta particles
5	Backscattering of beta particles
6	Absorption and backscattering of Gamma rays - Determination of HVT
7	Calibration of TL phosphor and TL reader & its use in Dose distribution response.
8	Quality assurance of a diagnostic X-ray machine
9	Leakage level measurement of a diagnostic X-ray machine
10	Radiation protection survey of diagnostic radiology installation
11	Study of Voltage-Current (V-I) characteristics of an Ion Chamber
12	Cross calibration of Ion chambers
13	Dose output measurement of high energy photon beams used in radiotherapy department using TRS-398 protocol
14	Dose output measurement of high energy electron beams used in radiotherapy department using TRS-398 protocol
15	Determination of wedge and tray factor for a standard field size of nominal energy
16	Head leakage and collimator leakage level measurement of linear accelerator machine (IEC)

Manuals	1.	Deokar M.R, 2007." Laboratory Manual", Radiological Physics and Advisory Division, Bhabha Atomic Research Centre, Mumbai.
	2.	Narender Reddy J, Dr.Murty M.S.R, "Experiments with GM Counter", Nucleonix Systems Private Limited, Hyderabad.
	3.	Dr. Sathiyan S, 2014, "Monograph on Radiation Physics Practical's for Medical Physics Students".
	4.	Indhumathi K, Sivakumar D, 2023," Radiation Measuring and Monitoring Instrumentation", Dr.N.G.P. Arts and Science College

Learning Method	Demonstration/ Hands on Experiments/ Group Trials

Focus of the Course	Skill Development

Semester - II

EDC: Mathematical Physics

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MTP2EB	MATHEMATICAL PHYSICS	EDC	48	-	-	4

Preamble	This course has been designed for students to learn and understand • The basics of statistics and medical statistics • The different types of numerical methods and solving simultaneous linear equations • The Monte carlo method and the computational tools
Prerequisite	Basic Mathematics & Physics

Course Outcomes (COs)

CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Understand the basics of statistics and radiation detection	K2
CO2	Discuss the discrete and continuous distributions	K2
CO3	Explain clinical study designs and hypothesis testing	K2
CO4	Determine the interpolations and solve the system of equations	K3
CO5	Explain the advantages of computational tools like MATLAB & STATISTICA	K3

Mapping with Program Outcomes:

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MTP2EB	EDC: MATHEMATICAL PHYSICS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Statistics and Errors** Definition -collection, tabulation and graphical representation of data - Basic ideas of statistical distributions - frequency distributions - measures of central tendency - arithmetic mean - median - mode - geometric mean - harmonic mean - measures of dispersion - range - quartile deviation - standard deviation - root mean square deviation - standard error and variance. Application to radiation detection - Uncertainty calculations, error propagation, time distribution between background and sample, minimum detectable limit.	10	Textbook
II	**Probability and Distributions** Probability - addition and multiplication laws of probability - conditional probability - random variables - discrete random variables - continuous random variables -probability density function - discrete probability density function - continuous probability distributions - moments - skewness - kurtosis - Cumulative distribution function - accuracy and precision - law of large number - Central limit theorem - Binomial distribution - Poisson distribution - Gaussian distribution - exponential distribution - additive property of normal variates - confidence limits - Bivariate distribution - correlation and Regression - Chi-Square distribution -t-distribution-F distribution.	10	Textbook
III	**Counting and Medical Statistics** Statistics of nuclear counting - Application of Poisson's statistics - Goodness-of-fit tests - Lexie's divergence coefficients Pearson's chi-square test and its extension -Random fluctuations Evaluation of equipment performance - Signal-to-noise ratio -Selection of operating voltage - Preset of rate meters and recorders - Efficiency and sensitivity of radiation detectors - Statistical aspects of gamma ray and beta ray counting - Special considerations in gas counting and counting with proportional counters - Statistical accuracy in double isotope technique. Sampling and sampling distributions - Confidence intervals. Clinical study designs and clinical trials. Hypothesis testing and errors.	10	Reference book
IV	**Numerical Methods** Iteration for Solving x = g(x), Initial Approximation and Convergence Criteria. Interpolations: Finite differences - Forward –Backward- Central differences - Newton - Gregory forward, backward interpolation Formulae for equal intervals - Missing terms - Lagrange's interpolation formula for unequal intervals - Inverse interpolations - Curve fitting - Principle of least squares - Discrete Fourier Transform - Fast Fourier Transform - Applications – Random waveforms and noise. Simultaneous linear equations: Gauss elimination method - Jordan's modification. -Inverse of a matrix by Gauss - Jordan Method - Roots of nonlinear equations: Newton- Raphson method	10	Reference book

	- Iterative rule -Termination criteria -Taylor series -approximating the derivation - Numerical differentiation formulas - Introduction to numerical quadrature - Trapezoidal rule - Simpson's 2/3 rule - Simpson's Three- Eighth rule - Picard's method - Taylor's method -Euler's method - the modified Euler's method - Runge-Kutta method.		
V	**Monte Carlo method and Computational Tools** Monte Carlo Method: Random numbers and their generation - Tests for randomness - Inversion random sampling technique including worked examples - Integration of simple 1-D integrals including worked examples. Computational Tools: Overview of programming in C++, MATLAB/MATHEMATICA and STATISTICA in data analysis and graphics.	8	E-resources
	Total	**48**	

Text Book	**1.**	Croxton F.E., 1959, "Elementary statistics with applications in medicine and the biological sciences", Dover publications, New York.
	2.	Agarwal B.L., 2015, "Basic Statistics", New Age International publishers, New Delhi.
Reference Books	**1.**	Gupta S.P., 2014, "Statistical methods", Sultan Chand & Sons Educational publishers, New Delhi.
	2.	Dass H.K.,1988, "Advanced Engineering Mathematics", S.Chand & Company Pvt Ltd, New Delhi.
	3.	Syed Naeem Ahmed, 2007, "Physics and Engineering of Radiation detection", Academic press, New york.
	4.	Dahlberg G, 1948, "Statistical method of Medical and Biology students", G.Allen and Unwin Limited, London.

Journal and Magazines	https://pubs.aip.org/aip/jmp https://www.quantamagazine.org/tag/mathematical-physics/
E-Resources and Website	https://www.wolfram.com/mathematica/resources/ https://www.wolfram.com/mathematica/analysis/content/StatisticsPackages.html

Learning Method	Chalk and Talk

Focus of the Course	Skill development, Entrepreneurial development, Employability

Semester - II

DSE: Advanced Materials in Medicine and Healthcare

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2DA	ADVANCED MATERIALS IN MEDICINE AND HEALTHCARE	DSE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The classification of solids and its various structure • The material properties and their applications in medicine • The concept of Thermography and its applications
Prerequisite	Solid State Physics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Explain the different structure of crystals.	K3
CO2	Analyze the crystal structure and the properties of crystals	K4
CO3	Demonstrate the various method of Nanoparticles synthesis and its application	K3
CO4	Illustrate the types of biomaterials and its application in health care	K3
CO5	Interpret the concept of Thermography and its medical application	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP2DA	DSE: ADVANCED MATERIALS IN MEDICINE AND HEALTHCARE

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Material Structures** Classification of solid,-Types of solids- Space lattice-Crystal structure of materials- Unit cell-Symmetries in crystals-Bravais lattice- Miller and Miller - Bravais indices, Simple cubic structure (SC), Body centered cubic, (BCC), Face centered (FCC) structure, Hexa gonal closed Paced Structure (HCP), Special cubic crystal structure: Diamond, Zinc blende structure, NaCl structure.	14	Text Book
II	**Material Properties** Diffraction of X-rays, Bragg's law, Braggs's X-ray spectrometer, Determination of crystal structure: Laue's method, Powder crystal method & Rotating crystal method. Braggs's law & Crystal structures. Properties: Mechanical properties, Electric properties, Magnetic properties, Optical properties and Chemical properties. Optical properties and its applications: Introduction, Classification of optic materials, Absorption in metals, Insulators and Semiconductors, Traps, Excitons and Color centers.	14	Text Book
III	**Nanomaterials & Applications** Nanoscale, Nanotechnology, Production techniques, Sol-gel method, Co-precipitation method and Radiofrequency sputtering method - Characterization Techniques: X-ray diffraction, Spectroscopic techniques like UV-Visible, Infrared spectroscopy, Raman spectroscopy and Optical and Electron microscopy. Applications in Medicine: Targeted drug delivery, Hyperthermia, Bioimaging & Therapy biosensors, Photoablation Therapy, Carbon Nanotubes, Nanowires, Quantum dots and its properties and applications.	14	Reference Book
IV	**Biomaterial & Applications** Introduction- Biomechanism, Classifications of Biomaterials: Metals and Alloys, Glass and Glass Ceramics, Polymers and Composites-Applications: Uses of Biomaterial-Biomaterials in organ, Biomaterials in body system	10	E-Resource
V	**Thermography** Introduction - Thermal properties of solids - Specific heat - Basic principles, Detectors & Equipment, Medical Thermography, Thermographic camera, Advantages of Thermography. Applications In Medicine: Detection of tumors, Mapping of blood Vessels, Investigation of bone Fracture, Placental localization, Burns and Frostbite	8	Reference Book
	Total	60	

Text book	1.	Pillai S.O,2005, "Solid State Physics", 6th Edition, New Age International Pvt.Ltd.
	2.	Charles Kittel, 2013, "Introduction to Solid State Physics", 8th Edition, John Wiley.
Reference Books	1.	Srivastava C.M and Srivasan. C, 1997, "Science of engineering materials", 2nd Edition, New Age International Pvt. Ltd.
	2.	Raghavan .V , 2019, "Material Science and Engineering :A first course", 6th Edition, PHI Learning.
	3.	Rajendran.V, 2017, "Materials Science", McGraw Hill Education.
	4.	Hossein Hosseinkhani, 2019, "Nanomaterials in Advanced Medicine," 1st Edition, Wiley-VCH.

Journal and Magazines	https://www.rsc.org/journals-books-databases/about journals/biomaterials-science/
E-Resources and Website	https://sci-hub.se/downloads/2019-02-12/37/titus2019.pdf https://www.researchgate.net/publication/337341622_Biomaterials_and_Its_Medical_Applications

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - II
DSE: Radiation Dosimetry and Standardization

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2DB	RADIATION DOSIMETRY AND STANDARDIZATION	DSE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The fundamental concepts of radiation dosimetry • The dosimetric standardization of X ray, gamma ray, neutron and radionuclides • The basic principles of chemical dosimeters
Prerequisite	Nuclear Physics and Radiation Detectors

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Explain the radiation quantities and units.	K3
CO2	Demonstrate the cavity theories and measurement of D_w by using various dosimetric protocols	K3
CO3	Classify the neutrons and understand the concept of neutron standards and dosimetry	K4
CO4	Illustrate the principles of Geiger-Muller counter and scintillating counting methods for alpha, beta and gamma emitter	K3
CO5	Interpret the concept of chemical dosimetry and its applications	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓		✓	✓	
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP2DB	DSE: RADIATION DOSIMETRY AND STANDARDIZATION

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Radiation Quantities and Units** Radiation quantities and units - Radiometry - Particle flux and fluence – Energy flux and fluence - Cross section - Linear and mass attenuation coefficients – Mass energy transfer and mass energy absorption coefficients - Stopping power - LET- Radiation chemical yield – W-value - Dosimetry- KERMA- CEMA - Exposure - Air kerma rate constant - Energy imparted -Absorbed dose - Charged particle equilibrium (CPE) - Relationship between kerma, Absorbed dose and Exposure under CPE - Radiation and tissue weighting factors, Equivalent dose, Effective dose, Committed equivalent dose, Committed effective dose - Concepts of collective dose - Dose equivalent - Ambient and directional dose equivalents [(H*(d) and H'(d)] - Individual dose equivalent penetrating Hp(d) - Individual dose equivalent superficial Hs(d).	12	Text Book
II	**Dosimetry & Standardization of X and Gamma Rays Beams** Dosimetry Standards: Primary and Secondary standards, Traceability, Uncertainties in measurements. Two stage energy transfer process - Electronic equilibrium: Charged particle equilibrium (CPE), Transient charged particle equilibrium (TCPE). Cavity theories- Brag Gray, Burlin and Spencer Attix cavity theory. Free air Ionization chamber (FAIC) – Design, Measurement of exposure and limitations. Cavity ion chambers: Cylindrical, Parallel plate and spherical - Dose in free space (D_{gas}), Dose in medium (D_{med}), Expression for sensitivity, - General definition of calibration factors – N_x, N_k, ND_{air}, ND_w - IAEA TRS-398: D_w, ND_W, ND_{W_Q}, K_Q, $K_{Q\ Q_o}$ and $TPR_{20,10}$. Measurement of D_w for external beams from ^{60}Co teletherapy machines: Reference conditions for measurement, Type of ion chambers, Phantom, Waterproof sleeve, Derivation of an expression for machine Timing error, Procedure for evaluation of temperature and pressure correction. Measurement of D_w for high-energy photon and electron beams from linear accelerators: Beam quality, Beam quality index, Beam quality correction coefficient, Cross calibration of ion chamber. Reference conditions, Various correction factors and steps involved in absorbed dose to water (D_w) calculations for Telecobalt machines and Linear accelerators - Cross calibration of ion chamber. IAEA TRS-277, AAPM TG-51, TECDOC 1274, TRS 483 and other dosimetric protocols - Calorimetric standards – Inter comparison of standards	12	Text Book
III	**Neutron Standards & Dosimetry** Neutron classifications, Neutron sources, Neutron quality factor - Neutron standards – Primary standards, secondary standards - Neutron yield and Fluence rate measurements - Manganese	12	Reference Book

	sulphate bath system - Precision long counter - Activation method - Neutron spectrometry - Threshold detectors - Scintillation detectors - Multispheres - Neutron dosimetry - Neutron survey meters - Calibration - Neutron field around medical accelerators.		
IV	**Standardization of Radionuclide** Methods of measurement of radioactivity – Defined solid angle and 4JI counting – Beta gamma coincidence counting – Standardization of beta emitters and electron capture nuclides with proportional, GM and Scintillation counters – Standardization of gamma emitters with scintillation spectrometers – Ionization chamber methods – Extrapolation chamber – Routine sample measurements – Liquid counter – Windowless counting of liquid samples – Scintillation counting methods for alpha, beta and gamma emitter – Reentrant ionization chamber methods – Methods using (n, ŕ) and (n, p) reactions – Determination of yields of neutron sources – Space integration methods – Solids state detectors.	12	E-Resource
V	**Radiation Chemistry and Chemical Dosimetry** Definitions of free radicals and G-Values - Kinetics of radiation chemical transformations – LET and dose-rate effects – Radiation chemistry of water and aqueous solutions, Peroxy radicals, pH effects – Radiation chemistry of gases and reactions of dosimetry interest – Radiation polymerization - Effects of radiation on polymers and their applications in dosimetry – Description of irradiators from dosimetric view point – Dosimetry principles. Chemical dosimetry – Basic principle, Definitions of optical density - Molar absorption coefficient - Beer –Lamberts law-spectrophotometry – Dose calculations – Laboratory techniques – Reagents and procedures - Requirements for an ideal chemical dosimeter – Fricke dosimeter – FBX dosimeter – Free radical dosimeter – Ceric sulphate dosimeter – Other high and low level dosimeters – Applications of chemical dosimeters in radiotherapy and industrial irradiators. Biological Dosimetry - Chromosome aberration analysis.	12	Reference Book
	Total	60	

Text book	1.	Attix. F. M, 1991," Introduction to Radiological Physics and Radiation Dosimetry", 1st Edition, Viley– VCH, Verlog.
	2.	IAEA TRS 398, 2000,"Absorbed dose determination in External beam Radiotherapy", IAEA, Vienna.
Reference Books	1.	Govindarajan, 1992, "Advanced Medical Radiation Dosimetry",1st Edition, Prentice hall of India Pvt. Ltd., New Delhi.
	2.	AAPM TG 51, 2014, "Clinical reference dosimetry of high-energy photon and electron beams".
	3.	Greening J R, Green S, Charles M W, 2010," Fundamentals of Radiation Dosimetry",3rd Edition, London: Taylor & Francis.
	4.	Shaheen Dewji and Nolan E Hertel, 2019," Advanced Radiation Protection Dosimetry", 1st Edition, CRC Press.

Journal and Magazines	https://academic.oup.com/rpd
E-Resources and Website	https://www.radccore.org/files/documents/intro%20to%20radiation%20physics%20REIMAN.pdf. https://www.youtube.com/watch?v=WEQUy9apjNY&t=131s.

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights, Social Awareness/ Environment.

Semester - II

DSE: Information Technology and Software Tools for Medical Physics

Semester	Course Code	Course Name	Category	L	T	P	Credits
II	24MPP2DC	INFORMATION TECHNOLOGY AND SOFTWARE TOOLS FOR MEDICAL PHYSICS	DSE	48	12	-	4

Preamble	This course has been designed for students to learn and understand • The fundamentals of computer technology both hardware and software • The role of information technology in radiation oncology treatment planning and management systems • The software employed in simulation, treatment planning and quality assurance
Prerequisite	Electronics and Radiotherapy

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Tax anomy Knowledge Level**
CO1	Illustrate the principal hardware components, system software and calculation algorithms	K3
CO2	Analyze the International standards for medical information management and communication	K4
CO3	Explain the importance of information technology in various radiotherapy techniques	K3
CO4	Demonstrate the significance of software involved in radiotherapy process	K3
CO5	Infer the use of various software in radiation treatment planning and quality assurance.	K3

Mapping with Program Outcomes:					
Cos / POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	✓	✓	✓	✓	✓
CO2	✓		✓	✓	
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

24MPP2DC	DSE: INFORMATION TECHNOLOGY AND SOFTWARE TOOLS FOR MEDICAL PHYSICS

Syllabus

Unit	Content	Hours	E-Contents / Resources
I	**Fundamentals** Basic of computer networks - Local area network (LAN), Wide area Network (WAN) - Internet - Intranet - Operating system - System hardware - System software – Algorithms - Archive and Storage - Data transactions, Backup and Retrieval models - The role of algorithms in computing - Information technology (IT) - Oncology information and networking system.	14	Text Book
II	**International standards** IEC, DICOM, IHE, HIS/RIS/PACS, Vendor neutral archives (VNA) remote viewing Radiotherapy R&V systems, Navigation systems, Registration, segmentation, Imaging informatics, Programming with image, Quantitative image quality assessment	12	Text Book
III	**Overview of Information Technology in Radiation Oncology** IT needs in RO - RO IT related resources, RO IT resource management – IT demands in Treatment Planning Systems (TPS), Treatment management systems (TMS), Treatment delivery systems (TDS),RO specific EMR (RO EMR) and image viewing systems, Record and Verify (R&V) systems, – IT decisions in intensity modulated radiation therapy (IMRT), Image-guided radiation therapy (IGRT), Four-dimensional radiation therapy (4DRT), Electronic medical records (EMR)	14	Reference Book
IV	**Radiation Therapy Software** Imaging software - Simulation software - contouring software - Treatment Planning software - Dose calculation algorithm - Introduction to cloud computing in radiotherapy – Big data processing in Radiation Oncology - Machine learning in Radiation Therapy.	10	E-Resource
V	**Software in Radiation Treatment Planning and Quality Assurance** Brainlab-Radiosurgery software iPlan RT - Elekta XiO - Monaco – Pinnacle – Prowess panther – RayStation - Varian Eclipse - Oncentra - RADIANCE - PreciseART- ScandiDos - IBA myQA® Platform - Pinnacle - Leksell Gamma Plan - MapCHECK– NeuroBlate applications.	10	Reference Book
	Total	60	

Text book	1.	Issam El Naqa, Martin J. Murphy, 2022, "Machine and Deep Learning in Oncology, Medical Physics and Radiology", Springer Cham.
	2.	Patrick McDermott , Colin Orton ,2019, "The Physics & Technology of Radiation Therapy", 2nd edition, Medical Physics Publishing Corporation.
Reference Books	1.	Jacob Van Dyk ,1999, "The Modern Technology of Radiation Oncology A Compendium for Medical Physicists and Radiation Oncologists" Medical Physics Publishing.
	2.	John Christopher Draper , 2018, "A Text-Book of Medical Physics: For the Use of Students and Practitioners of Medicine", Forgotten Books.
	3.	Elizabeth Berry, 2007, "A Practical Approach to Medical Image Processing (Series in Medical Physics and Biomedical Engineering)" 1st edition, CRC Press.
	4.	Michael G.Herman, 1999, "Computer Networking and Information systems in Radiation Oncology" Radiation Oncology information systems.

Journal and Magazines	https://jmai.amegroups.org/
E-Resources and Website	https://www.aapm.org/meetings/99am/pdf/2755-16806.pdf. http://wwwnaweb.iaea.org/nahu/DMRP/documents/slides/Chapter_11_Computerized_treatment_planning_systems.pdf.

Learning Method	Chalk and Talk / ICT Tools /Assignment / Seminar

Focus of the Course	Skill Development, Employability, Entrepreneurial Development, Innovations, Intellectual Property Rights.

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APPROVED
BoS- 18th 04.11.24 | AC - 18th 26.11.24 | GB -