PG CURRICULUM

M.Sc. MEDICAL PHYSICS PROGRAMME – AY 26-27

Course Code	Course Category	Course Name	L	T	P	Instruction (h)		Exam (h)	Max Marks			Credits
						Week	Total		CIA	ESE	Total	
First Semester												
26MPP1CA	Core -I	Nuclear and Radiation Physics	3	1	-	4	60	3	25	75	100	4
26MPP1CB	Core -II	Non-Ionizing Radiation Physics in Medicine	3	0	-	3	45	3	25	75	100	3
26MPP1CC	Core -III	Medical Electronics and Instrumentation	3	1	-	4	60	3	25	75	100	4
26MPP1CD	Core -IV	Anatomy, Physiology, Tumour Pathology and Genetics	4	0	-	4	60	3	25	75	100	4
26MPP1CE	Core -V	Solid State Physics and Radiation Detectors	3	1	-	4	60	3	25	75	100	4
26MPP1CP	Core Practical-I	Electronics and Radiation Instrumentation	-	-	6	6	90	6	25	75	100	3
26MPP1DA	DSE - I	Programming, Data Science and Computational Methods for Medical Physics	3	1	-	4	60	3	25	75	100	3
26MPP1DB		Health Technology Assessment				4	60					
Total			19	4	6	29	435				700	25

Semester – I CORE I: NUCLEAR AND RADIATION PHYSICS							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1CA	NUCLEAR AND RADIATION PHYSICS	CORE	45	15	-	4

Preamble	This course has been designed for students to learn and understand • The fundamental concepts of Nuclear Physics and the interaction of various types of radiation with matter • Radiation quantities, dosimetric parameters and radiation protection units. • Medical radiation sources and develop analytical skills in nuclear physics.
Prerequisite	Classical mechanics, Atomic physics and basic mathematical methods

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Understand nuclear structure, decay mechanisms, and radioactivity principles relevant to radiological sciences.	K2
CO2	Analyze photon, charged particle, and neutron interactions with matter quantitatively.	K4
CO3	Compute radiation quantities, dosimetric parameters, and apply appropriate units and relationships.	K3
CO4	Identify and evaluate suitable radiation sources used in medical diagnosis and therapy.	K5
CO5	Develop analytical and computational proficiency in radiological physics problem-solving.	K6

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

26MPP1CA	NUCLEAR AND RADIATION PHYSICS

Syllabus

Unit	Content	Hrs	Resources
I	**Nuclear Physics** Nucleus- Scattering experiment, properties, Discovery of neutrons, Experimental determination of size of the nucleus etc. Nuclear forces- properties, spin dependence, charge independence etc. Liquid drop model-Binding energy, semi-empirical mass formula, mass parabola, application in stability of neutron star- Radioactivity – α decay - general properties of α particles, spectrum, Gamow's theory, Geiger-Nuttal law- Beta decay- general properties, Fermi theory, spectrum, fall of parity, neutrinos – Positron emission-Electron capture-gamma emission-Internal conversion- Laws of radioactivity- Laws of successive transformations and application in dating- Natural radioactive series- Radioactive equilibrium- Nuclear isomerism– Nuclear reactions- Artificial radioactivity- Elementary ideas of fission and its application in nuclear reactors and nuclear weapons– Fusion-energy production in the sun, production of elements in the universe-big bang and stellar nucleo synthesis- Particle Physics. **Tutorial:** Students solve numerical problems on binding energy and Q-value determination and analyze isotopic stability using real nuclear data.	12	Text Book
II	**Interaction of Electromagnetic Radiations and Neutrons with Matter** Interaction of electromagnetic radiation with matter – Exponential attenuation –Thomson scattering – Photoelectric and Compton process and energy absorption –Pair production – Attenuation and mass energy absorption coefficients – Relative importance of various processes. Interaction of neutrons with matter – Classification of neutrons, slow and fast neutron interactions – Microscopic and macroscopic interaction cross section – Charged particle emission, radiative capture and its significance in radiation dose to humans – Elastic and inelastic scattering – Neutron induced nuclear reactions – Neutron activation – Fission – Neutron attenuation. **Tutorial:** Students derive and plot attenuation curves for various materials and energies, and calculate photon attenuation coefficients using real experimental data.	12	Text Book
III	**Interaction of Charged Particles with Matter** Interaction of charged particles with matter – Classical theory of inelastic collisions with atomic electrons – Energy loss per	12	Text Book

	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: Scattering, Excitation and Ionization - Radiative collision (Bremsstrahlung) - Range energy relation - Continuous slowing down approximation (CSDA) - Transmission and depth dependence methods for determination of particle penetration - Empirical relations between range and energy - Backscattering. Interaction of heavy charged particles with matter - Energy loss by collision - Range energy relation - Bragg curve - Spread Out Bragg Peak (SOBP) - Specific ionization - Stopping Power - Bethe–Bloch Formula. **Tutorial:** Students calculate attenuation coefficients, HVL, and analyze energy dependence of interaction processes. Comparisons are made between photon and charged particle interactions through plotted graphs.		
IV	**Radiation Quantities and Units** Radiometric quantities: Activity, exposure, particle flux, fluence, fluence rate, energy flux and energy fluence. Interaction quantities: Linear and mass attenuation coefficients, mass energy transfer and mass energy absorption coefficients, stopping power, mass stopping power, LET. Dosimetric quantities: Exposure, absorbed dose, kerma, terma, charged particle equilibrium (CPE), relationship between kerma, absorbed dose and exposure under CPE, radiation chemical yield, W-value. Radiation protection quantities: Equivalent dose, effective dose, committed equivalent dose, committed effective dose, radiation weighting factor, tissue weighting factor, Annual Limit on Intake (ALI), Derived Air Concentration (DAC). Operational quantities: Dose equivalent, ambient and directional dose equivalents [H*(d), H′(d)], personnel dose equivalents for strongly and weakly penetrating radiation, Hp(10), Hp(0.07) and Hp(3). Radiation units: Becquerel & Curie, exposure units (C/kg & roentgen), gray & rad, sievert & rem. **Tutorial:** Students perform numerical calculations on dose–kerma relationships, unit conversions, and effective dose estimation from radiation protection data.	12	Text Book
V	**Radiation Sources and their Medical Applications** Radiation sources - Natural and artificial radioactive sources - Large scale production of isotopes - Reactor produced isotopes (^{60}Co, ^{192}Ir, ^{99}Mo etc.) - Cyclotron produced isotopes (^{18}F, ^{13}N, ^{15}O, ^{11}C) - Fission products (^{137}Cs, ^{99}Mo, ^{131}I, ^{90}Sr), Ga-68 - Teletherapy and brachytherapy sources - Sources for permanent implants (^{198}Au, ^{125}I, ^{103}Pd) - Beta ray applicators - Ophthalmic applicators (^{90}Sr, ^{125}I, ^{106}Ru)- Thermal and fast	12	Text Book

	neutron sources (^{241}Am–Be, ^{252}Cf. **Tutorial:** Students identify suitable isotopes for specific medical applications and calculate activity required for therapeutic and diagnostic uses.		
	Total	**60**	

Text book	1.	Johns. H. E and Cunningham, 1983, "The Physics of radiology", 4th Edition, Charles C Thomas Publishers..
	2.	Knoll. G. F, 2010, "Radiation detection and measurement", 4th Edition, John Wiley Publisher.
Reference Books	1.	Attix. F. H, 2004, "Introduction to Radiological Physics and Radiation Dosimetry", 4th Edition, Viley VCH, Verlog publisher..
	2.	Podgarsak E B, 2016, "Radiation Physics for Medical Physicists", 3rd Edition, Springer Verlag Publishers
	3.	Dowsett D J, Kenny P A, Johnston C R E., 2006, "The Physics of Diagnostic Imaging", 2nd Edition, CRC Press.
	4.	Faiz Khan. M, 2014,"The Physics of Radiation Therapy", 5th Edition, Wolterskluwer.
	5.	Podgarsak. E B. 2005, "Radiation Oncology Physics: Handbook for Teachers and Students", IAEA, Vienna publisher.
	6.	Cember H. C, Johnson, T E, 2009, "Introduction to Health Physics", McGraw-Hill.
	7.	Evans R.D, 1995, "Atomic Nucleus", 1st edition, McGraw-Hill Book Company.
	8.	Preston M. A., 1962, "Physics of the Nucleus", 1st edition Addison-Wesley Publishing Company.
	9.	Lapp R. E, 1972, "Nuclear Radiation Physics", 4th edition, Prentice-Hall.
	10.	Segre E, 1953," Experimental Nuclear Physics", 1st edition, John Wiley & Sons.
	11.	Slack L., 1957," Radiations from Radioactive Atoms", 1st edition, McGraw-Hill Book Company.
	12.	Oliver R, 1968, "Radiation Physics in Radiology", 1st edition, Blackwell Scientific Publications.
	13.	Crouthamel C E., 1970, "Applied Gamma-Ray Spectrometry", 2nd edition, Pergamon Press.

Journal and Magazines	https://www.aerb.gov.in/english/publications)
E-Resources and Website	https://www.youtube.com/playlist?\list=PLRN3HroZGu2n_j3Snd_fSYNLvCkao8Hix

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

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

Semester – I CORE II: NON-IONIZING RADIATION PHYSICS IN MEDICINE							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1CB	NON-IONIZING RADIATION PHYSICS IN MEDICINE	CORE	45	-	-	3

Preamble	This course has been designed for students to learn and understand • The Non-Ionizing Radiation properties and its interaction with tissue. • Applications of laser, radio waves and microwaves in Medicine. • Applications of theranostics and biosensor technologies.
Prerequisite	Classical mechanics, Electromagnetism and wave optics

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Discuss Various sources of Non-Ionizing Radiations and their interaction mechanism.	K2
CO2	Identify lasers for medical applications and basics of optical and electron microscopy.	K3
CO3	Analyse tissue optical properties for disease diagnosis and therapy, including current optical imaging technologies in research.	K4
CO4	Analyse the integration of diagnostic and therapeutic strategies in oncology, and evaluate biosensors for clinical use and their safety.	K5
CO5	Evaluate the use of thermography in medicine, and assess the principles and applications of radio frequency and microwaves in medical practices.	K6

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

26MPP1CB	NON-IONIZING RADIATION PHYSICS IN MEDICINE

Syllabus

Unit	Content	Hrs	Resources
I	**Lasers and Tissue Optics** Optical Radiations Overview and types- UV, Visible, IR-FTIR, Raman spectroscopy: Principles and applications in medical diagnostics and therapy. First law of photochemistry - Law of reciprocity -Lasers: Theory and mechanism. Surgical lasers: CO2, Nd-YAG, ArF lasers. Measurement of fluence from optical sources. Tissue Optics: Absorption and scattering in turbid media – Theory and experimental techniques. Interaction of laser radiation with tissues – Photo thermal – photo chemical – photo ablation – electromechanical effect – Bio simulation – Integrating Sphere, Monte Carlo Simulation.	9	Text Book
II	**Mediphotonics and Optical Imaging Techniques** Lasers in ophthalmology, dentistry, dermatology, oncology. Photo Dynamic Therapy (PDT) and laser thermo therapy and cell biology. Application of ultrafast pulsed lasers in medicine and biology. Fiber optics in medicine. Optical Imaging Techniques: Principles of optical microscopy. Fluorescence microscope - Confocal microscope - Two-photon microscopy - Optical coherence tomography - Super-resolution imaging. Imaging Techniques: Imaging Techniques based on light transport through tissue, Polarization, phase contrast, and differential interference contrast microscopy (DIC) microscopy	9	Text Book
III	**IR, RW and Microwave in Medical Applications** Overview of NIRP-Study of non-ionising electromagnetic radiation (UV, Visible, IR, Microwave, RF, ELF, Laser, Ultrasound) and its significance in medical science. Understanding mechanisms of interaction and biological effects on tissues- Infrared Radiation and Applications-IR sources and sensors for medical use (thermal imaging, non-contact temperature measurement) -Principles of thermography and clinical applications. non-thermal effects FTIR, RAMAN– Applications –Label free disease diagnosis-Treatment of cancer cells. Volatile Organic Compound (VOC) Sensors for Surgical Guidance – electronic nose. Radiofrequency (RF) and Microwave Radiation -Introduction, frequency and wavelength ranges, and generation methods. RF/Microwave delivery systems for therapeutic applications.	9	Text Book
IV	**Theranostics and Biosensors** Theranostics: Integration of diagnostics and therapy in oncology using Nuclear Medicine – Personalized treatment	9	Text Book

	strategies. Cancer Pathways & Nanotechnology: Deregulated signalling in cancer. Theranostic nanomedicine – Smart and multifunctional nanopreparations – Controlled release via biomacromolecule-gated mesoporous silica systems. Magnetic nanoparticles – Detection via microscopy and assays – Toxicity and biodistribution evaluation – Magnetic targeting strategies. Biosensors: Definition, classification, and components (receptor, transducer) – Types: electrochemical, optical, and mass-based biosensors – Principles of surface plasmon resonance (SPR) – Application in point-of-care diagnostics and biomarker detection – Integration of microfluidics with biosensors		
V	**Safety standards of Non-Ionizing Radiation in Physics** Hazards of lasers and their safety measures. - Mechanisms of interaction RF, MW with tissues- biological effects on tissues- SAR – Safety standards- International exposure limits and safety standards (ICNIRP, WHO, IEEE). Measurement, monitoring, and shielding techniques for NIR sources-Safety protocols, risk assessment, and regulatory aspects in medical and research settings.	9	Text Book
	Total	**45**	

Text book	1.	Lihong V Wang and Hsin-I Wu,2007, "Biomedical Optics: Principles and Imaging", 1st Edition, Wiley-Interscience.
	2.	Douglas B. Murphy, 2012, "Fundamentals of Light Microscopy and Electronic Imaging", 2nd Edition, Wiley-Liss.
Reference Books	1.	Valery Tuchin, 2014, "Tissue Optics". 3rd Edition, SPIE Press..
	2.	William T Silfvast, 2004," Laser Fundamentals". 1st Edition, Cambridge University Press.
	3.	Xie J, Lee S, & Chen X, 2010, "Nanoparticle-Based Theranostic Agents" Elsevier.
	4.	Turner A P F, 1987, "Biosensors: Fundamentals and Applications", 1st Edition, Oxford University Press.
	5.	Bernhardt J H, 2020, "Non-Ionizing Radiation: Protection and Standards", CRC Press.
	6.	Andre Vander Vorst, Arye Rosen, Youji Kotsuka, 2006," RF/Microwave Interaction with Biological Tissues", Wiley Publications.
	7.	Tuan Vo-Dinh, 2014, "Biomedical Optics: Introduction", 2nd Edition, CRC Press.
	8.	Markolf H Niemz, 2007, " Laser Tissue Interactions: Fundamentals and Applications", Springer Publications.

	9.	Paras N Prasad, 2003, "Introduction to Biophotonics",Wiley Interscience publications.
	10.	Pawley J B, 2016, "Handbook of Biological Confocal Microscopy", 3rd Edition, Springer.
	11.	Henderson J, Chatten A J , 2018, "Non-Ionizing Radiation: Physical and Biological Basis of Radiation Protection", Oxford University Press.

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/Assignment/Seminar/ Group Discussion.

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

Semester – I CORE III: MEDICAL ELECTRONICS AND INSTRUMENTATION							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1CC	MEDICAL ELECTRONICS AND INSTRUMENTATION	CORE	45	15	-	4

Preamble	This course has been designed for students to learn and understand • Analog, digital, and embedded systems used in medical and nuclear instrumentation • Microprocessors, biomedical sensors and interfacing techniques for healthcare devices. • Modern healthcare technologies like IoT, robotics AI-assisted systems.
Prerequisite	Basic knowledge of physics and electronics.

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Explain the principles of analog, digital, and embedded electronics used in medical and nuclear systems.	K4
CO2	Design and analyze basic microprocessor and microcontroller-based circuits for healthcare applications.	K6
CO3	Evaluate and implement regulated and noise-free power supply systems for medical and nuclear instrumentation.	K6
CO4	Analyze the operation and interfacing of radiation detectors and biomedical sensors with electronic circuits.	K4
CO5	Apply knowledge of modern biomedical technologies such as IoT, robotics, and AI in medical instrumentation and patient monitoring systems. Electronics and Biomedical Instrumentation.	K3

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

26MPP1CC	MEDICAL ELECTRONICS AND INSTRUMENTATION

Syllabus

Unit	Content	Hrs	Resources
I	**Fundamentals of Analog and Digital Electronics** Semiconductor diodes, BJT, FET, MOSFET – characteristics and applications. Operational amplifiers – inverting/non-inverting, summing amplifier, integration, differentiation, active filters, and oscillators. ADCs and DACs – types and performance parameters. Digital fundamentals – logic gates, Boolean algebra, combinational and sequential circuits, multiplexers, counters, flip-flops. Introduction to programmable logic devices (PLD, FPGA) and their applications in medical electronics.	12	Text Book
II	**Microprocessors, Microcontrollers and Embedded Systems** Review of 8085 and 8086 architectures and instruction sets. Introduction to 8051 and ARM-based microcontrollers. Memory organization, I/O interfacing, and serial communication. Embedded system design for medical instruments – data acquisition, control, and display modules. Introduction to IoT in healthcare – wearable sensors, telemetry, and data transmission.	12	Text Book
III	**Power Supplies and Signal Conditioning in Nuclear Instrumentation** Rectifiers – half-wave, full-wave, bridge; filters and voltage regulators. SMPS, DC-DC converters, RF power supplies, and isolation techniques. Grounding, shielding, and noise reduction methods in nuclear systems. High-voltage and low-noise power supplies for radiation detectors. Recent developments: micro-power supplies, battery management in portable devices, and smart energy-efficient designs.	12	Text Book
IV	**Electronics for Radiation Detection and Signal Processing** Detector-preamplifier interface – charge-sensitive and voltage-sensitive preamplifiers. Pulse shaping, discrimination, and amplification. Analog and digital pulse processing – baseline restoration, linear gating, and time-to amplitude conversion. Data acquisition systems, multi-channel analyzers (MCA), and digital signal processors (DSP). Introduction to FPGA-based nuclear instrumentation and AI-assisted signal interpretation.	12	Text Book
V	**Biomedical Instrumentation and Emerging Technologies** Bioelectric potentials – origin, measurement, and recording (ECG, EEG, EMG). Biomedical sensors and transducers – optical, piezoelectric, and MEMS-based devices. Diagnostic and therapeutic instruments – pacemaker, defibrillator, dialysis unit, ventilator, diathermy. Robotics and automation	12	Text Book

	in surgery, rehabilitation, and prosthetics. Modern trends – wearable health monitoring, wireless telemetry, IoT-based patient monitoring, and medical AI systems.		
	Total	**60**	

Text book	1.	Floyd T L, 2017, "Electronic Devices", 10th Edition, Pearson Education Inc.
	2.	Coughlin R F, Driscoll F F, 2001, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, Pearson Education Inc.
Reference Books	1.	Floyd T L2015, "Digital Fundamentals", 11th Edition, Pearson Education Inc.
	2.	Khandpur R S, 2014," Handbook of Biomedical Instrumentation", 3rd Edition, McGraw Hill Education.
	3.	Brown S, Vranesic Z, 2013, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, Tata McGraw-Hill
	4.	Skalski H, 2012, "Electronic Instrumentation", 3rd Edition, Tata McGraw-Hill.
	5.	Cromwell L, Weibell F J, Pfeiffer E, 1990, "Biomedical Instrumentation and Measurements", 2nd Edition, Prentice Hall.
	6.	Arumugam M, 2004, "Biomedical Instrumentation", 2nd Edition, Anuradha Publishing Co.

Journal and Magazines	https://www.embs.org/tbme/
E-Resources and Website	https://www.youtube.com/playlist?list=PLL_6qtCTrqLmRjr9GP3d_mn6Zu5iMgfV_

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

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

Semester – I CORE IV:ANATOMY, PHYSIOLOGY, TUMOUR PATHOLOGY AND GENETICS							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1CD	ANATOMY, PHYSIOLOGY, TUMOUR PATHOLOGY AND GENETICS	CORE	60	-	-	4

Preamble	This course has been designed for students to learn and understand • The structure and function of the organs and systems. • The normal and pathological anatomy, biological basis of cancer, classification and progression. • Cancer staging, grading and cancer management modalities.
Prerequisite	Basic Biology

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Demonstrate human anatomical structures and physiological mechanisms relevant to medical physics	K3
CO2	Identify normal and pathological anatomy using radiological images and sectional anatomy	K4
CO3	Explain the principles of genetics and their role in tumour initiation and progression.	K5
CO4	Correlate clinical oncology principles with imaging and therapeutic applications	K5
CO5	Evaluate organ-specific cancers, staging, and treatment modalities.	K6

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

26MPP1CD	ANATOMY, PHYSIOLOGY, TUMOUR PATHOLOGY AND GENETICS

Syllabus

Unit	Content	Hrs	Resources
I	**Introduction to Human Anatomy and Physiology** General anatomical terminology –Levels of structural organization – Cells, tissues, organs, and systems – Overview of organ systems – Anatomical planes and positions – Skeletal system: bones and joints, classification and functions – Muscular system: types of muscles, mechanism of contraction – Cardiovascular system: structure and function of heart, major vessels, and blood circulation – Lymphatic system: lymph nodes, lymph circulation, and clinical significance.	12	Text Book
II	**Major Organ Systems and Their Physiology** Respiratory system – anatomy of lungs, mechanism of respiration, regulation of breathing – Digestive system – structure and function of alimentary canal, liver, pancreas – Urinary system – structure of nephron, urine formation and regulation – Endocrine system – pituitary, thyroid, adrenal, and pancreas – Nervous system – brain, spinal cord, peripheral nerves, synaptic transmission, reflex arc – Reproductive system (male and female): structure, function, and hormones – Sensory organs: anatomy and physiology of eye and ear.	12	Text Book
III	**Radiographic Anatomy and Cross-sectional Imaging** Radiographic anatomy of head, thorax, abdomen, pelvis, and extremities – Identification of anatomical landmarks on plain X-rays, CT, MRI, and PET/CT images – Surface and sectional anatomy of organs and structures –Radiological interpretation of normal variations – Identification of major vessels, muscles, and bones in imaging modalities – Correlation between imaging anatomy and radiation treatment planning – Radiographic anatomy of CNS, skeletal, and visceral systems.	12	Text Book
IV	**Genetics and Tumour Pathology** Basics of human genetics – structure and function of DNA and RNA – gene expression, mutations, chromosomal aberrations, and genetic disorders – Oncogenes, tumour suppressor genes, and molecular basis of cancer – Cell cycle and mechanisms of carcinogenesis – Tumour pathology: types, classification, grading, and staging – Differences between benign and malignant tumours – Mechanisms of tumour spread: local invasion, lymphatic and hematogenous metastasis – Tumour markers and biopsy interpretation – Genetic predisposition and familial cancers.	12	Text Book
V	**Basics of Radiation Oncology and Cancer Management** Site-specific cancers: Head and neck, breast, gynaecological,	12	Text Book

	gastrointestinal, genitourinary, lung, lymphomas, and leukemias – AIDS-related cancers – Staging and grading systems (TNM, Ann Arbor, FIGO, etc.) – Curative and palliative approaches – Modalities of cancer treatment: surgery, chemotherapy, radiotherapy, hormone therapy, immunotherapy, radionuclide therapy – Acute and late radiation effects – Radiation tolerance of organs – Side-effect management during treatment – Multidisciplinary cancer care and patient follow-up protocols.		
	Total	60	

Text book	1.	Waugh A., & Grant A., Ross, Wilson, 2022, "Anatomy and Physiology in Health and Illness", 14th Edition, Elsevier.
	2.	Chaurasia B D, 2019, "Human Anatomy (Volumes I–III)", 9th Edition, CBS Publishers.
Reference Books	1.	Snell R S, 2018, "Clinical Anatomy by Regions", 10th Edition, Lippincott Williams & Wilkins.
	2.	Kumar V, Abbas A K, Aster J C, Robbins and Cotran, 2020, "Pathologic Basis of Disease", 10th Edition, Elsevier.
	3.	Hall J E, Guyton and Hall, 2020, "Textbook of Medical Physiology", 14th Edition, Elsevier.
	4.	Moore K L, Dalley A F, Agur A M R, 2018, "Clinically Oriented Anatomy", 8th Edition, Lippincott Williams & Wilkins.
	5.	Junqueira L C, Carneiro J, 2018, "Basic Histology: Text and Atlas", 15th Edition, McGraw Hill.
	6.	Alberts B, 2014, "Molecular Biology of the Cell", 6th Edition, Garland Science.
	7.	Hendee W R, Ritenour E R, 2002, "Medical Imaging Physics", 4th Edition, Wiley-Liss.
	8.	Kumar V et al., 2017, "Robbins Basic Pathology", 10th Edition, Elsevier.

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 https://healthsciences.missouri.edu/radiography/sectional-anatomy-tool/

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

Focus of the Course	Skill Development/ Employability/ Entrepreneurial Development/ Innovations

Semester – I CORE V: SOLID STATE PHYSICS AND RADIATION DETECTORS							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1CE	SOLID STATE PHYSICS AND RADIATION DETECTORS	CORE	45	15	-	4

Preamble	This course has been designed for students to learn and understand • The solid-state physics fundamentals and radiation detector materials. • Radiation detectors, monitoring instruments, spectrometry systems, and calibration methods used in radiation measurement • The application of material response, signal processing, and calibration concepts in medical physics instrumentation.
Prerequisite	Properties of matter, Basic electronics and Radiation Physics.

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Demonstrate solid-state physics principles governing the operation of detector materials.	K3
CO2	Explain the physical principles, modes, and characteristics of various radiation detectors.	K4
CO3	Apply radiation detection techniques in measurement, monitoring, and clinical instrumentation.	K3
CO4	Experiment calibration and quality assurance procedures for dosimetry and monitoring systems.	K4
CO5	Discuss material properties and defects with detector response and dosimetric performance.	K6

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

26MPP1CE	SOLID STATE PHYSICS AND RADIATION DETECTORS

Syllabus

Unit	Content	Hrs	Resources
I	**Solid State Physics Fundamentals for Detector Materials** Energy Bands in Solids: Electrons in periodic potentials; origin of energy bands; classification of materials as metals, semiconductors, and insulators; Bloch's theorem (1-D case); nearly free electron approximation; formation of bands and band gaps; Brillouin zones and their physical significance. Charge Carriers and Transport: Electrons and holes in semiconductors; effective mass concept and density of states; mobility and conductivity; influence of temperature, doping, and scattering mechanisms; Hall-effect measurements for carrier and defect characterization. Defects and Doping in Solids: Types of defects – point (vacancies, interstitials, antisites), line (dislocations), and planar (stacking faults); methods of observation and characterization; doping mechanisms – substitutional donors/acceptors, isoelectronic impurities, and defect complexes. Material Response: Colour centres and F-centres in luminescent materials; trap states in TL/OSL phosphors; link between defect/dopant chemistry and dosimetric response; semiconductor detectors – charge generation, transport, and collection. **Tutorial:** Draw band diagrams for metals, semiconductors, and insulators; calculate effective mass and mobility; analyze Hall data and relate trap states to luminescence behaviour.	12	Text Book
II	**Principles of Radiation Detection and Detector Characteristics** Principles of radiation detection and interaction of radiation with matter relevant to detection- Modes of detector operation – current, pulse, and mean-level modes; pulse height spectra; counting curves and plateaus- Detector performance parameters – energy resolution, sensitivity, efficiency, detector window, dead time, and recovery time Electronic components of detection systems – detector, preamplifier, amplifier, pulse processing electronics, and display- Noise sources and signal-to-noise ratio improvement; counting statistics and uncertainty analysis; Poisson statistics and propagation of errors. **Tutorial:** Exercises on pulse height spectrum analysis, energy resolution and efficiency calculations, dead-time correction, and counting error estimation.	12	Text Book

III	**Gas-Filled, Scintillation, and Semiconductor Detectors** Gas-Filled Detectors: Regions of operation – ionization, proportional, and Geiger-Müller; principles and construction of ionization chambers (cylindrical, plane-parallel, spherical, well-type, and extrapolation chambers); gas multiplication; proportional and GM counter mechanisms; sealed, flow, high-pressure, multi-wire, and position-sensitive variants- Applications: Radiation dosimeters, survey meters, and contamination monitors used in medical and protection measurements. Scintillation Detectors: Advantages and properties of ideal scintillators; radiation detection mechanism in organic and inorganic scintillators; photon detection devices – PMT, photodiodes; light collection systems; types of scintillators used in diagnostic, nuclear medicine, and therapy dosimetry. Semiconductor Detectors: Principles of operation – p-n junction, depletion region, charge collection; materials (Si, Ge, CdTe, CZT); diode and MOSFET dosimeters – calibration, temperature and energy dependence, and clinical applications. **Tutorial:** Determine GM counter plateau and operating voltage; compare NaI(Tl) and HPGe detector spectra; perform calibration exercises for ionization chambers and MOSFET dosimeters.	12	Text Book
IV	**Neutron, Chemical, and Emerging Detectors** Neutron detection mechanisms – nuclear activation, track detection, and proportional counter methods- Self-Powered Neutron Detectors (SPND); BF_3 and ^3He proportional counters; bubble detectors and solid-state nuclear track detectors (SSNTD)- Gel dosimeters – chemical basis, optical readout, and 3-D dose verification- Luminescent dosimeters – thermoluminescent (TLD), optically stimulated (OSLD), and radiophotoluminescent (RPL) dosimeters; radiographic and radiochromic films (Gafchromic)- Emerging detectors – Direct Ion Storage (DIS), diamond detectors, Radiation litmus films: principle, composition, and mechanism of color change under ionizing radiation exposure – applications in rapid dose visualization and qualitative radiation field mapping- advanced OSLD systems- Calorimeters for high-dose measurements and standards. **Tutorial:** Comparative study of neutron detection systems; design of moderator for neutron counters; evaluation of TL glow curves and OSL dose-response characteristics.	12	Text Book

V	**Radiation Measurement, Monitoring, and Calibration Systems** Measurement Instruments: Condenser and pocket chambers, quartz fibre electrometers, current-based dosimeters, Farmer chamber, secondary standard therapy-level dosimeters, water phantom systems, radiation field analyzer (RFA), isotope calibrators, and beam therapy dosimeters- Personnel Monitoring Instruments: TLD and OSLD badge readers, glass dosimeter readers, electronic pocket dosimeters, image analyzers, and densitometers- Area and Contamination Monitors: Portable/fixed survey meters, beta–gamma zone monitors, hand–foot–clothing and portal monitors, laundry/floor monitors, neutron monitors, REM counters, and whole-body counters for internal activity assessment- Spectrometry and Counting Systems: Alpha–beta counters, gamma spectrometers (NaI(Tl), HPGe), liquid scintillation counters, air monitors, and multichannel analyzers. Calibration of Radiation Instruments: Concepts and requirements of calibration; parameters checked – energy response, linearity, constancy, angular dependence; selection of sources and source strength; traceability to standards; uncertainty estimation; maintenance and periodic QA as per AERB/IAEA/ISO guidelines. **Tutorial:** Calibration exercises for survey meters and TLD readers; performance checks of RFA and spectrometers; design of QA schedule for radiation instruments; computation of calibration coefficients.	12	Text Book
	Total	60	

Text Books	1.	Kittel C, 2005, "Introduction to Solid State Physics", 8th Edition, Wiley.
	2.	Knoll G F, 2010, "Radiation Detection and Measurement", 4th Edition, Wiley.
Reference Books	1.	Attix F H, 2008, "Introduction to Radiological Physics and Radiation Dosimetry", Wiley-VCH.
	2.	Cherry S R, Sorenson J A, Phelps M E, 2012, "Physics in Nuclear Medicine", 4th Edition, Elsevier.
	3.	Knoll G F, 2008, "Practical Gamma-Ray Spectrometry", 2nd Edition, Wiley.
	4.	Price W J, 1964, "Nuclear Radiation Detection", 2nd Edition, McGraw-Hill.
	5.	Stepanov B I, 1968, "Theory of Luminescence", Iliffe Books Ltd.,London.

	6.	Malvino A P, 2007, "Electronic Principles", 7th Edition, McGraw-Hill.
	7.	Boylestad R L, Nashelsky L, 2013, "Electronic Devices and Circuit Theory", 11th Edition, Pearson.
	8.	Horowitz P, Hill W, 2015, "The Art of Electronics", 3rd Edition, Cambridge University Press.
	9.	Greiner R A, 1961, "Semiconductor Devices and Applications", McGraw-Hill.
	10.	Crawford R H, 1967, "MOSFET in Circuit Design", McGraw-Hill.
	11.	Podgarsak. E B. 2005, "Radiation Oncology Physics: Handbook for Teachers and Students", IAEA, Vienna publisher.
	12.	International Atomic Energy Agency, Safety Reports and TECDOCs on Calibration and Instrumentation, IAEA Publications.
	13.	International Organization for Standardization 4037, "X and Gamma Reference Radiation Calibration Standards", ISO Publications.
	14.	Atomic Energy Regulatory Board, "Codes and Safety Guides on Radiation Instrumentation and Monitoring", AERB Publications.
	15.	Recent publications on OSL, DIS, diamond, and radiochromic detectors in medical dosimetry.

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/Assignment/Seminar/ Group Discussion

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

Semester – I CORE PRACTICAL I: ELECTRONICS AND RADIATION INSTRUMENTATION							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1CP	ELECTRONICS AND RADIATION INSTRUMENTATION	CORE PRACTICAL		-	90	3

Preamble	This course has been designed for students to learn and understand • Electronic circuits, operational amplifiers, and radiation instrumentation, and to develop practical skills in their applications. • Radiation detection, measurement, calibration, and the safe handling of ionizing radiation sources. • Diagnostic measurements, experimental data analysis, uncertainty estimation, and laboratory report preparation.
Prerequisite	Electronics, radiation physics, radiation detectors, and laboratory safety procedures.

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Demonstrate proficiency in constructing, testing, and analyzing electronic circuits and Op-Amp applications.	K3
CO2	Operate and calibrate radiation detection and dosimetry instruments.	K3
CO3	Experiment radiation measurements and analyze detector performance parameters.	K4
CO4	Formulate scientific methods to analyze radiation measurement data and uncertainties.	K5
CO5	Design and implement radiation safety protocols using appropriate shielding and measurement techniques.	K6

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

26MPP1CP	ELECTRONICS AND RADIATION INSTRUMENTATION

S.No.	List of Experiments
1	Characteristics of Semiconductor Diode (PN Junction).
2	Input and Output Characteristics of Junction Field Effect Transistor (JFET).
3	Input and Output Characteristics of Metal Oxide Semiconductor FET (MOSFET).
4	Study of Operational Amplifier (Op-Amp) Characteristics.
5	Op-Amp Applications - Addition and Subtraction.
6	Op-Amp Applications - Integration and Differentiation.
7	Decoder and Encoder Circuits using ICs.
8	Regulated Power Supply using IC.
9	AC Voltage Regulator using IC
10	Op-Amp Comparator Circuit
11	Measure the energy resolution of the Gamma ray spectrometer
12	Identify unknown gamma source using the Gamma ray spectrometer (Mandatory 1)
13	Activity Estimation of a Gamma Source using SCA (Relative / Absolute).
14.	Peak-to-Total and Peak-to-Compton Ratio Measurement using SCA (Effect of Collimation s Windowing)
15.	Verification of inverse square law and finding a hidden source using survey meters
16.	Estimation of efficiency of the alpha counting system (Mandatory 2)
17.	Measure the background radiation level using the pressurized ion chamber-based survey meter (Mandatory 3)

18. Measure the range and energy of beta particles by feather analysis using the GM counter

19. Measure the attenuation coefficients of various materials using the GM counter (Mandatory 4)

20. Measure HVL of various materials using the GM counter.

21. Find the resolving time of a GM counter.

22. Study the characteristics of a GM tube.

23. Calibration of radiochromic film and finding the unknown dose.

24. Calibrate the TLD/OSLD and find the unknown dose (Mandatory 5).

25. Reproducibility and Linearity Test of TLD/OSLD Response.

26. Determination of Fading Characteristics of TLD/OSLD.

[Perform 15 Experiments out of 26, including mandatory]

Text Books	1.	Knoll G F, 2010, "Radiation Detection and Measurement", 4th Edition, Wiley.
	2.	Tsoulfanidis N, Landsberger S, 2015, "Measurement and Detection of Radiation", 4th Edition., CRC Press.
	3.	Boylestad R and Nashelsky L, 2012, "Electronic Devices and Circuit Theory", 11th Edition, Pearson.
	4.	Millman J and Grabel A, 1987, "Microelectronics", 2nd Edition, McGraw Hill.
	5.	Horowitz P and Hill W, 2015, "The Art of Electronics", 3rd Edition, Cambridge University Press.

Learning Method	Demonstration / Hands on Experiments

Focus of the Course	Skill Development / Employability

Semester – I DSE I: PROGRAMMING, DATA SCIENCE AND COMPUTATIONAL METHODS FOR MEDICAL PHYSICS							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1DA	PROGRAMMING, DATA SCIENCE AND COMPUTATIONAL METHODS FOR MEDICAL PHYSICS	DSE	45	15	-	3

Preamble	This course has been designed for students to learn and understand • The Python and MATLAB programming fundamentals in medical physics applications. • To Perform data analysis, visualization, and medical image processing techniques for medical imaging workflows. • To Develop user interfaces and apply computational and machine-learning methods to solve medical physics problems.
Prerequisite	Basic knowledge of mathematics and computer programming

Course Outcomes (Cos)		
CO Number	Course Outcomes (COs) Statement	Bloom's Taxonomy Knowledge Level
CO1	Write modular, documented Python code and MATLAB scripts for medical physics tasks.	K3
CO2	Function Load, clean and analyse complex datasets (time-series, QA logs, image metadata) and produce visualisations appropriate for medical physics research.	K4
CO3	Apply filtering and segmentation methods to medical image data (DICOM) and interpret the results in a medical-physics context.	K4
CO4	Design and build a simple GUI tool to support a medical-physics workflow, and apply a machine-learning pipeline to a relevant medical-physics dataset.	K6
CO5	Use MATLAB toolboxes effectively for medical image display, processing, analysis and basic machine-learning/fuzzy logic tasks; relate results to clinical/physics practice.	K3

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

26MPP1DA	PROGRAMMING, DATA SCIENCE AND COMPUTATIONAL METHODS FOR MEDICAL PHYSICS

Syllabus

Unit	Content	Hrs	Resources
I	**Programming Foundations in Python** Installation of Python and development environment -Basic syntax and data types (lists, tuples, dicts, sets) -Control-flow statements (if/else, loops) - Functions, modules, packages - Interactive mode, scripting, error-handling and debugging - Object-oriented programming in Python. **Tutorial:** Writing small Python scripts, simple classes, modular code	12	Text Book
II	**Data Analysis & Visualization in Python** Introduction to numerical computing: NumPy, SciPy -Data handling with Pandas: data frames, indexing, grouping - Data visualization with Matplotlib and Seaborn: plotting profiles, histograms, scatter, time-series-Basic statistics, hypothesis testing (e.g., t-test, chi-square), correlation analysis - Case studies: medical-physics relevant data sets (e.g., QA logs, time-series of detector outputs) **Tutorial:** Load/clean data, compute summary statistics, generate visualizations.	12	Text Book
III	**Image Processing & Medical Physics Applications in Python** Python libraries for medical physics: e.g., PyDICOM for DICOM, OpenCV for image processing, pymedphys for medical-physics specific tools. -Basic image operations: reading DICOM series, image arrays, metadata handling - Image filtering, segmentation, morphological operations - Digital image processing concepts (noise, resolution, histogram, transforms) - Handling DICOM RT datasets (RT-Structure, RT-Plan, RT-Dose) - Case studies: segmentation of CT/MR images, dose distribution visualization, QA images. **Tutorial:** Work with DICOM datasets, apply filters/segmentations, ript basic analyses	12	Text Book
IV	**GUI Development & Machine Learning in Medical Physics** GUI development in Python: e.g., Tkinter, PyQt; event-driven programming; user flows for tools - User-interface design principles: usability, workflow for a medical physicist - Introduction to machine learning: supervised vs unsupervised algorithms, overview (e.g., regression, classification, clustering)-Application of ML in medical physics: QA anomaly detection, image classification, outcome prediction.	12	Text Book

	Tutorial: Build a simple GUI tool (for e.g., image viewer + segmentation); implement a small ML workflow (train/test) on a medical physics dataset.		
V	**MATLAB for Medical Physics** Introduction to MATLAB: environment, data types, operators, flow control, functions, I/O, array manipulation - Executing MATLAB programs, scripts, functions - Data reading, manipulation, display & plotting in MATLAB - DICOM file functions in MATLAB: reading, displaying medical images, processing & analysis- Machine learning and fuzzy logic in MATLAB context (basic introduction) **Tutorial:** MATLAB lab sessions – read DICOM image, process and display, simple ML/fuzzy logic demo	12	Text Book
	Total	60	

Text book	1.	Moruzzi G, 2025, "Essential Python for the Physicist", Springer.
	2.	Sun J, 2023, "MATLAB for Medical Physics: Real-life Clinical Scenarios and Projects", Springer.
Reference Books	1.	Dutta Majumder D K, Ray D, 2022, "Fundamentals of Medical Image Processing Using MATLAB", PHI Learning.
	2.	Birkfellner W, 2024, "Applied Medical Image Processing: A Basic Course", 3rd Edition, CRC Press.
	3.	Gezerlis A, 2023, "Numerical Methods in Physics with Python", Cambridge University Press.
	4.	VanderPlas J, 2016, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly Media.
	5.	Matthes E, 2023, "Python Crash Course", No Starch Press.
	6.	Shaw Z A, 2017, "Learn More Python 3: The Hard Way", Addison-Wesley, 2017.
	7.	Theobald O, 2017, "Statistics for Absolute Beginners: A Plain English Introduction", Scatterplot Press.
	8.	Gopi E S, 2013, "Digital Signal Processing for Medical Imaging Using MATLAB", Springer.

Journal and Magazines	http://mpijournal.org/content_currentissue.aspx)

E-Resources and Website	https://swayam-plus.swayam2.ac.in/courses/coursedetails?id=P_SMARTBRIDGE_01

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

Focus of the Course	Skill Development/ Employability/Entrepreneurial Development/ Innovations.

Semester – I DSE I: HEALTH TECHNOLOGY ASSESSMENT							
Semester	Course Code	Course Name	Category	L	T	P	Credits
I	26MPP1DB	HEALTH TECHNOLOGY ASSESSMENT	DSE	45	15	-	3

Preamble	This course has been designed for students to learn and understand • The concepts, evolution, principles, and methodologies of Health Technology Assessment (HTA) in global and Indian healthcare systems. • To analyze clinical, economic, ethical, legal, and social aspects involved in healthcare technology assessment and decision-making. • To apply HTA methods to evaluate healthcare technologies, public health programs, and their role in health policy and Universal Health Coverage (UHC).
Prerequisite	Basic knowledge of Healthcare Systems, Public Health, Biostatistics, and Health Economics.

Course Outcomes (Cos)		
CO Number	**Course Outcomes (COs) Statement**	**Bloom's Taxonomy Knowledge Level**
CO1	Explain the concept, scope, and evolution of HTA globally and in India	K2
CO2	Describe the institutional framework and role of HTAIn in India.	K6
CO3	Demonstrate knowledge of HTA frameworks, processes, and stakeholder engagement	K3
CO4	Apply economic and clinical methods to assess technology value and interpret outcome data	K3
CO5	Analyze ethical, legal, and political dimensions and integrate HTA into health policy.	K4

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

26MPP1DB	HEALTH TECHNOLOGY ASSESSMENT

Syllabus

Unit	Content	Hrs	Resources
I	**Introduction to Health Technology Assessment** Health Technology Assessment (HTA) – Scope of HTA in radiotherapy, nuclear medicine, diagnostics, and public health programs – Multidisciplinary nature of HTA: economics, epidemiology, ethics, policy – Historical evolution of HTA in USA, Canada, and Europe – Formation of INAHTA – Emergence of HTA in developing countries and Asia (HITAP, NICE International) – Importance and role of HTA in health systems – Evidence-based policy making – Priority setting and resource optimization – Role in Universal Health Coverage (UHC) – HTA in India: Institutional structure under DHR-ICMR – Role, objectives, and governance structure – HTAIn manual and its relevance – Conducive factors for HTA in Asia: Policy drivers, political commitment, capacity development **Tutorial:** Topic discussion on HTA evolution and evaluation in public health programs	12	Text Book
II	**Principles and Framework of HTA** Core principles of HTA – Transparency, accountability, scientific rigor, stakeholder involvement – Relevance, timeliness, ethical soundness – HTA triangle: Clinical, Economic, Social/Ethical dimensions – Relationship with Evidence-Based Medicine (EBM) and Comparative Effectiveness Research (CER) – HTA process steps: Topic nomination and prioritization – Scoping and protocol development – Evidence synthesis and appraisal – Formulating recommendations – Policy uptake and monitoring – Quality assurance and evaluation: Internal and external review – HTAIn quality check guidance (ICMR) – Reporting standards: HTAIn template, PRISMA, CHEERS checklist – Stakeholder engagement: Policymakers, clinicians, economists, patient groups **Tutorial:** Flowchart of HTA process– Evaluation of stakeholder roles in decision-making	12	Text Book
III	**Methodologies in Health Technology Assessment** Evidence synthesis – Systematic review – Meta-analysis – Critical appraisal – Databases: PubMed, Cochrane Library – Clinical effectiveness and safety evaluation: Clinical trial data – Observational studies – Surrogate and patient-relevant outcomes – Economic evaluation: Cost-Effectiveness Analysis (CEA) – ICER –Cost-Utility Analysis (CUA) – QALY, DALY –	12	Text Book

	Cost-Benefit Analysis (CBA) – WTP – Cost-Minimization and Budget Impact Analysis (BIA) – Modeling techniques: Decision tree – Markov models – Sensitivity analysis – Discounting – Uncertainty analysis – Reporting economic evidence – CHEERS checklist – Interpretation of incremental cost ratios **Tutorial:** Cost-effectiveness calculation – Critical appraisal of systematic review		
IV	**Ethical, Legal, and Political Dimensions of HTA** Ethical dimensions – Patient autonomy – Beneficence – Justice – Non-maleficence – Balancing cost and access – Public acceptability and transparency – Legal framework: Health technology regulations – Approval processes (CDSCO, FDA, CE) – Intellectual property and patent laws – Data privacy, consent, and confidentiality – Political and institutional factors: Power structures – Policy priorities – Role of advocacy, media, political economy – Case discussions: Pricing of cancer drugs – Medical device regulation – Framework for managing conflicts of interest – Transparency protocols – Governance **Tutorial:** Case study on ethical decision-making – Discussion on legal challenges in medical device approval	12	Text Book
V	**HTA in Practice - Global and Indian Perspectives** HTAIn – India's HTA system – Institutional framework under Department of Health Research – Process: Topic selection – Assessment – Appraisal – Decision – Examples: Cost-effectiveness of dialysis, knee implants, screening programs – International HTA models: NICE (UK), CADTH (Canada), PBAC (Australia), HITAP (Thailand) – HTA and reimbursement systems in developed and developing nations – Integration with health policy: HTA for Universal Health Coverage – National Health Policy linkages – Public health technology prioritization – Future of HTA: Digital health – AI – Genomics – Personalized medicine – Challenges: Capacity building – Sustainability **Tutorial:** Comparison of India vs UK HTA practices – Proposal of HTA plan for AI-based diagnostic tool	12	Text Book
	Total	60	

Text book	1.	Drummond M F, Sculpher M J, Claxton K, Stoddart G L., Torrance G W, 2015, "Methods for the Economic Evaluation of Health Care Programmes", 5th Edition, Oxford University Press.
	2.	Banta D, Jonsson E, 2009, "History of Health Technology Assessment", Academic Press.

Reference Books	1.	Oortwijn W, Jansen M, Baltussen R, 2020, "Health Technology Assessment: Methods and Applications", Springer.
	2.	Indian Council of Medical Research, 2018, "HTA In Manual", ICMR.
	3.	Drummond M F et al., 2008, "Key Principles for the Improved Conduct of Health Technology Assessment", International Journal of Technology Assessment in Health Care.
	4.	Chootipongchaivat S, 2016, "Conducive Factors to the Development of Health Technology Assessment in Asia", Amarin Printing and Publishing Public Co., Ltd, Thailand.
	5.	World Health Organization, 2015, "Health Technology Assessment: A Global Overview", WHO Publications.
	6.	Luce B R et al., 2010, "EBM, HTA, and CER: Clearing the Confusion", The Milbank Quarterly, Vol. 88(2), pp. 256–276.
	7.	Kieslich K et al., 2016, "Accounting for Technical, Ethical, and Political Factors in Priority Setting", Health Systems & Reform, Vol. 2, Issue 1, pp. 51–60.

Journal and Magazines	https://www.cambridge.org/core/journals/international-journal-of-technology-assessment-in-health-care)
E-Resources and Website	https://www.icm r.gov.in/

Learning Method	Chalk and Talk/Assignment/Seminar/ Group Discussion

Focus of the Course	Skill Development/Employability/Entrepreneurial Development/ Innovations

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- 21.ST 02.04.2026 | AC - | GB -