

I M.Sc. (PH)	MEDICAL PHYSICS	18EPPH25
SEMESTER – II		HRS/WK-5
ELECTIVE – IIB		CREDIT- 3

OBJECTIVES:

To know about the principle and usage of various physical instrumentation in Medical field.

COURSE OUTCOMES (CO):

CO1: Get the knowledge of production of X-ray images and applications

CO2: Acquire knowledge about vitro and in vivo testing

CO3: Aware of knowledge of ultrasound in medicine

CO4: Get the knowledge about the radiotherapy

CO5: Get the basic ideas of neuroelectrics and neuromagnetics

Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes

SEMESTER -II	COURSE CODE: 18EPPH25					COURSE TITLE: MEDICAL PHYSICS						Hours: 5	Credit: 3
Course Outcomes COs	Programme Outcomes POs					Programme Specific Outcomes PSOs						Mean Score of CO's	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	2.1	3.8	2.0	3.5	2.2	4.6	3.2	3.4	4.3	3.4	2.1	3.14	
CO2	2.2	3.6	2.2	3.4	2.1	4.1	3.4	3.8	4.4	3.2	2.1	3.13	
CO3	2.3	2.2	2.4	3.3	2.2	4.4	3.4	3.7	4.6	3.3	2.1	3.08	
CO4	2.4	2.4	2.0	3.1	2.1	4.3	3.2	3.6	4.4	3.5	2.3	3.02	
CO5	2.6	2.4	2.4	2.8	2.4	4.7	3.3	3.8	3.1	3.8	2.1	3.18	
Mean Overall Score											3.11		

Result: The Score for this course is 3.11 (High)

Association	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Interval	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Rating	Very Poor	Poor	Moderate	High	Very High

This course is having **High** association with Programme Outcome and Programme Specific Outcome.

UNIT - I

(15 Hours)

X-Ray Imaging: Production of X-ray images, attenuation coefficients, choice of suitable energy, contrast, hardware; digital imaging X-ray computed tomography, five generations of scanners, reconstruction methods, CT number, contrast Stretching-Optical Chromatography.

UNIT - II (15 Hours)

Nuclear Medicine: In vitro and in vivo testing, gamma rays for imaging, radiopharmaceuticals, the gamma camera, SPECT, PET, examples of clinical use.

UNIT - III (15 Hours)

Ultrasound in Medicine: Ultrasound imaging, generation and detection of ultrasound, ultrasound propagation, choice of frequency, A-scan, B-scan, M-mode imaging and echo cardiography. Use of Doppler techniques for blood flow etc. Use of ultrasound in therapy

UNIT - IV (15 Hours)

Radiotherapy: Effect of radiation on normal and malignant tissue, cell survival Types of radiotherapy unit: low voltage, orthovoltage, megavoltage, electron beam, brachytherapy Dosimetry: calculation and measurement of dose, % depth dose, isodose lines, scattering effects Treatment planning, fractionation, conformal radiotherapy- Photodynamic Therapy.

UNIT - V (15 Hours)

Neuroelectrics and Neuromagnetics: Basic electrophysiology, genesis of electric and magnetic signals Techniques for measurement and imaging of EEG, ECG, MEG and MCG.

TEXT BOOKS:

1. Webb. S (Ed), The Physics of Medical Imaging, Hilger 1988
2. Dendy. P.P and B Heaton, Physics of Diagnostic Radiology, IOPP 2012
3. Brown. B.H et. al., Medical Physics and Biomedical Engineering IOPP 1999

REFERENCE BOOKS:

1. Hedrick W.R, DL Hykes, and DE Starchmann, Ultrasound Physics and Instrumentation, Mosby 1995
2. Steele. G, Basic Clinical Radiobiology, Arnold 2002
3. Carlton. R and A. Adler, Principles of Radiographic Imaging, Delmar 2005

I M.Sc. (PH)	PHYSICS OF NANOMATERIALS	EPPH24A
SEMESTER - II		HRS/WK-5
ELECTIVE – IIA		CREDIT- 3

OBJECTIVES:

To understand the principle, synthesis and applications of nanomaterials and gain knowledge over various characterization methods.

COURSE OUTCOMES (CO):

CO1:Classify nanoparticles based on various factors.

CO2: Use the different methodologies for synthesis and characterization of nanomaterials

CO3: Differentiate between pure and composite nanoparticles and their uses

CO4: Select a particular methodology and material for synthesis, characterization and analysis.

CO5: Design or develop sensors for different applications. Catering to the needs of the recent developments.

Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes

SEMESTER-II	COURSE CODE: EPPH24A					COURSE TITLE: PHYSICS OF NANOMATERIALS						Hours: 5	Credit: 3
	Programme Outcomes POs					Programme Specific Outcomes PSOs						Mean Score of CO's	
Course Outcomes COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	1.4	3.3	1.1	3.1	2.3	4.2	4.2	4.1	3.8	4.7	2.3	3.13	
CO2	1.2	3.5	1.3	3.2	2.6	4.4	4.3	4.1	3.9	4.2	2.1	3.16	
CO3	1.6	3.8	1.4	3.2	2.6	4.8	4.6	3.9	3.8	4.0	2.4	3.28	
CO4	1.8	3.8	1.4	3.2	2.4	4.5	4.1	3.9	4.2	3.5	2.1	3.17	
CO5	1.2	3.6	1.1	3.3	2.9	4.1	4.4	4.0	4.1	4.3	2.1	3.19	
Mean Overall Score												3.186	

Result: The Score for this course is 3.18(High)

Association	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Interval	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Rating	Very Poor	Poor	Moderate	High	Very High

This course is having **High** association with Programme Outcome and Programme Specific Outcome.

UNIT – I

(15 Hours)

Introduction to Nanoparticles: Introduction – Historical perspective of nanoparticles Zero Dimension, 1D, 2D & 3D nanostructured materials - time and length scale in structures-

Influence of nano over micro /macro, size effects, and crystals- mechanical -physical and chemical properties- Energy landscapes basic intermolecular forces – inter dynamic aspects of intermolecular forces.

UNIT – II

(15 Hours)

Classification of Nanomaterials:

Metal Nanoparticles: Definition of a Nanosystem- classification of nanocrystals; quantum dots, nanowires, and nanotubes, 2D films; Nano mesopores.

Magnetic nanomaterials: Fundamentals of magnetic materials, Dia, Para, Ferro, Ferric, and Super para magnetic materials, Nanostructured Magnetism.

Semiconductor Nanocomposites: Types of Nanocomposites (Metal oxides, ceramic, and Glass), Core-Shell nanoparticles - Types of systems - properties of nanocomposites.

Carbon Nanostructures:Introduction, Fullerenes, C60, CNT, mechanical, optical properties.

UNIT - III

Synthesis of Nanomaterials

(15 Hours)

Physical methods:Thermal evaporation, Spray pyrolysis, Molecular beam epitaxy (MBE), Physical vapour deposition (PVD), Microwave heating.

Chemical methods: Chemical and co-precipitation, Sol fundamentals - sol - gel synthesis of metal oxides, Microemulsions or reverse micelles, Solvothermal, Sonochemical synthesis, Electrochemical synthesis, Photochemical synthesis, Langmuir - Blodgett (LB) technique, Chemical vapor deposition (CVD).

UNIT-IV

(15 Hours)

Characterization Techniques

Powder X-Ray Diffraction, Field emission scanning electron microscopy (FE-SEM) High Resolution Transmission Electron Microscope (HR-TEM), Scanning Tunnelling Microscope (STM), Atomic Force Microscope (AFM), Scanning Probe Microscopy (SPM), UV - Visible absorption, Impedance measurement. Brunauer - Emmett - Teller (BET) Surface Area Analysis, Energy Dispersive X - ray (EDX), X - ray Photoelectron Spectroscopy (XPS) and Photoluminescence.

UNIT – V

Applications of Nanoscience

(15 Hours)

Nanophotonics and Devices: Imaging of cancer cells, Biological tags and Targeted nano-drug delivery system. Issues and Challenges of functional Nanostructured Materials for electrochemical Energy Storage Systems.

Nano sensors: Sensors based on physical properties - Electrochemical sensors, Sensors for aerospace, defense and Biosensors. Energy: Solar cells, LEDs and photovoltaic device applications. Photocatalytic applications: Environmental Applications: Air purification, Water purifications and Volatile organic pollution degradation. Carbon nanotubes: Field emission, Fuel cells and Display devices.

TEXTBOOKS:

1. Viswanathan, B. (2006). *Structure and Properties of Solid-state materials* (2nd ed.). Alpha Science International.
2. Pradeep, T. (2017). *Nano:The Essentials: Understanding Nanoscience and Nanotechnology*. McGraw Hill Education.
3. David.B. Williams and C. Barry Carter (2016) *Transmission Electron microscopy : A Textbook for Materials Science*, Springer International Publishing Switzerland
4. Hellborg, D. Brunt, R. Hellborg H. J. Whitlow O. Hunderi (1992) *SEM Surface characterization A users sourcebook*.
5. David Brandon & Wayne D. Kaplan (2003) *Microstructural characterization of materials*, John Wiley & sons, 2nd edition.

REFERENCE BOOKS:

1. Ajayan, P. M., Schadler, L. S., & Braun, P. V. (2006). *Nanocomposite Science and Technology*. Wiley-VCH.
2. Schmid, G. (2011). *Nanoparticles: From theory to application* (2nd ed.). Wiley.
3. Kulkarni, S. K. (2014). *Nanotechnology: Principles and practices* (3rd ed.). Springer.
4. Viswanathan, B. (2009). *Nanomaterials*. Narosa.
5. Bandyopadhyay, A. K. (2009). *Nanomaterials* (2nd ed.). New Age International.
6. Brundle, C. R., Evans, C. A., & Wilson, S. (1992). *Encyclopedia of materials characterization: Surfaces, interfaces, thin films*. Butterworth Heinemann.
7. Charles P. Poole, J., & Owens, F. J. (2007). *Introduction to Nanotechnology*. Wiley.
8. Schubert, U. S., &Husing, N. (2019). *Synthesis of inorganic materials* (4th ed.). Wiley.
9. Milani, P., &Iannotta, S. (2012). *Cluster beam synthesis of Nanostructured materials*. Springer
10. Hari Singh Nalwa (2001), *Nanostructured Materials and Nanotechnology*, Academic Press Inc;

II – M.Sc. (PH)	MATERIALS SCIENCE	18EPPH43
SEMESTER - IV		HRS/WK –5
ELECTIVE – IV B		CREDIT – 3

OBJECTIVES:

To understand the classification of materials and learn about the principle, theory and properties of its types.

COURSE OUTCOMES:

CO1: To understand the classification of materials.

CO2: To study various phase diagrams.

CO3: To know the phase transformation and nucleation.

CO4: To learn the electron theory of metals

CO5: To study the electric and magnetic properties of materials.

Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes

SEMESTER – IV	COURSE CODE: 18EPPH43					COURSE TITLE: MATERIALS SCIENCE						Hours :5	Credit :3
Course Outcomes COs	Programme Outcomes POs					Programme Specific Outcomes PSOs						Mean Score of CO's	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	1.1	4.1	1.2	3.3	1.0	4.2	4.2	4.1	4.3	4.3	1.0	2.98	
CO2	1.0	3.3	1.0	3.2	1.0	4.2	4.1	4.2	4.3	4.3	1.0	2.87	
CO3	1.0	3.4	1.0	3.6	1.1	4.4	4.4	4.6	4.4	4.5	1.1	2.65	
CO4	1.1	3.3	1.0	3.5	1.0	4.4	4.8	4.1	4.2	4.2	1.0	2.87	
CO5	1.0	4.0	1.1	3.2	1.0	4.3	4.3	4.1	1.0	4.4	1.1	2.68	
Mean Overall Score												2.81	

Result: The Score for this course is 2.68 (Moderate)

Association	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Interval	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Rating	Very Poor	Poor	Moderate	High	Very High

This course is having **Moderate** association with Programme Outcome and Programme Specific Outcome.

UNIT - I

(15 Hours)

Classification of Materials: Engineering materials- Material structure- Types of Bonds and their energies – Bond formation mechanism- Ionic bond-covalent bond examples-ceramics-thermal and electrical properties – Uses-Metallic bond- comparison of bond (dispersion bonds,

dipole bonds and hydrogen bonds)-Crystal imperfection –Types of imperfections- Thermal vibrations – point, line and surface imperfections- Frank –Read source.

UNIT - II (15 Hours)

Phase Diagrams: Basic terms- solid solutions- Hume – Rothery’s rules- intermediate phase- Gibb’s Phase rules- Time – temperatures cooling curves- construction of phase diagrams- the Lever rule- eutectic systems- eutectoid - Systems- peritectic and peritectoid System-Ternary equilibrium diagrams.

UNIT - III (15 Hours)

Phase Transformation: Rate of transformation- nucleation (homogeneous and heterogeneous)-nucleation and growth –applications of phase transformations – micro constituent of iron – carbon system –the allotropy of iron – Iron-Carbon equilibrium diagram- formation of Austenite- TTT diagram- transformation Austenite upon continuous cooling.

UNIT - IV (15 Hours)

Electron Theory of Metals: Fundamental theories of electrons (Drude and Lorentz theory and Sommerfeld free electron theory) –electron energies in a metal- Zone theory of solids- energy gaps – density of states – Zones in conductors, insulators and semiconductors - factors affecting electrical resistance of materials.

UNIT - V (15 Hours)

Electrical and Magnetic Properties of Materials: Resistivity- conductivity- semiconductors –classification of semiconductors on the basis of Fermi energy and Fermi levels- insulators – dielectrics –Ferro electricity –electrostrict ion- Piezo electricity –uses of dielectrics –capacitors dielectric strength- magnetic properties of materials –magnetostrict ion-magnetic domain – soft and hard magnetic materials.

TEXT BOOKS:

1. Saxena B.S, Gupta. R.C and Saxena. P.N, Fundamentals of Solid State Physics
2. Singhal.R.L, 2000-2001, Solid State Physics, KedarNath Ram Nath& Co, Meerut.
3. Kittel C,1992, Introduction to Solid State Physics, New India Publishing House.

REFERENCE BOOKS:

1. Raghavan.V, 1990, Materials Science and Engineering a first course, III Ed, PrenticeHall of India.
2. Structural M, 1990, Materials Science, Anuradha Agencies & Publishers
3. Manchandra. V.K, 1992, a Text Book of Materials Science, New India Publishing House.
4. William D. Calister, Fundamentals of Material Science & Engineering, Jr. John William & sons Inc, 2001.

II – M. Sc. (PH)	ELECTRONIC INSTRUMENTATION	18EPPH44
SEMESTER - IV		HRS/WK - 5
ELECTIVE – V A		CREDIT - 3

OBJECTIVES:

To understand the principle, construction and working of various analytical, digital and electronic instrumentations.

COURSE OUTCOMES:

- CO1: Understand the various transducers
- CO2: Study digital instrumentation methods
- CO3: Know the analytical instrumentation techniques
- CO4: Study the bio medical instrumentation
- CO5: Apply the knowledge of computer peripherals

Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes

SEMESTER – IV	COURSE CODE: 18EPPH44					COURSE TITLE: ELECTRONIC INSTRUMENTATION						Hours :5	Credit :3
Course Outcomes COs	Programme Outcomes POs					Programme Specific Outcomes PSOs						Mean Score of CO's	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	3.2	2.6	4	3.5	3	2.8	3.5	3	4	3.1	3.2	3.26	
CO2	3.4	3.2	3	3.1	3.5	3.6	4.1	3	3	2.6	3.5	3.27	
CO3	3.5	4	3.2	2.8	3	3.2	3.1	3.5	3.4	3.5	3	3.29	
CO4	3.2	3.4	3	4	3.1	3.5	3.3	2.8	3.5	3.5	3.6	3.35	
CO5	4.2	3.5	3.5	3.2	3.5	2.5	3.6	3	4.1	3.4	3.5	3.45	
Mean Overall Score											3.32		

Result: The Score for this course is 3.32 (High)

Association	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Interval	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Rating	Very Poor	Poor	Moderate	High	Very High

This course is having **High** association with Programme Outcome and Programme Specific Outcome.

UNIT - I

(15 Hours)

Transducers: Classification of transducers –Principle, construction and working of Thermistor, LVDT, Electrical strain gauges and capacitive transducers - Measurement of non –electrical quantities –strain, Displacement, temperature, pressure and force.

UNIT - II (15 Hours)

Digital Instrumentation: Principle, block diagram and working of Digital frequency counter. Digital multimeter, digital pH meter, digital conductivity meter and digital storage oscilloscope

UNIT - III (15 Hours)

Analytical Instrumentation: Principle,block diagram, description,working and application of UV-VIS Spectrometer, IR spectrometer, Flame emission spectrometer and ICP-AES Spectrometer – Basic concept of gas and liquid chromatography.

UNIT - IV (15 Hours)

Bio –Medical Instrumentation: Physiological transducers to measure blood pressure, body temperature. Source of Bio- electric potentials – resting potential action potential, bio-potential, block diagram and operation of ECG an EEG –Records.

UNIT - V (15 Hours)

Computer Peripherals: Printers – Printer mechanism – Classification - Dot matrix, Ink jet and Laser printer.Basic concept of key board and mouse - Mass data storage - floppy disk – Hard Disk -Operation Dick(CD) - Pen drive (thumb drive).

TEXT BOOKS:

1. Rajendra Prasad, Electronic Measurement and instrumentation, Khanna Publications.2001
2. Ramambhadran S, Electronic Measurements & Instrumentation, Khanna Publications.1986
3. Dhir S.M, Electronics and instrumentation, Khanna Publications.2009
4. Khandpur, Hand Book of Biomedical Instrumentation, TMH. Publications.

REFERENCE BOOKS:

1. Gromwell L, Bio medical instrumentation and measurement, Prentice Hall.2010
2. John R. Cameran and James G. Skofronick, 1978, Medical physics, John Wiley & Sons.
3. Aplen E.L, 1990, Radiation Physics, Prentice Hall.

II – M.Sc. (PH)	ASTRONOMY AND ASTROPHYSICS	18EPPH45
SEMESTER - IV		HRS/WK - 5
ELECTIVE – V B		CREDIT - 3

OBJECTIVES:

To understand the principle of relativity, Einstein's equations and know about the physical cosmology and early universe.

COURSE OUTCOMES:

- CO1: Understand the principles of relativity.
- CO2: Know the different frame works of relativity
- CO3: Study the Einstein's equation and its solutions
- CO4: Acquire the knowledge of cosmological models
- CO5: Explore the thermal history of the universe

Relationship Matrix Course Outcomes, Programme Outcomes and Programme Specific Outcomes

SEMESTER – IV	COURSE CODE: 18EPPH45					COURSE TITLE: ASTRONOMY AND ASTROPHYSICS						Hours :5	Credit :3
Course Outcomes COs	Programme Outcomes POs					Programme Specific Outcomes PSOs						Mean Score of CO's	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6		
CO1	4	4	3.5	4	3.5	4	4	3.5	3.5	4	3.5	3.77	
CO2	3.5	3.5	3.5	4	4	3.5	4	3.5	4	4	4	3.77	
CO3	4	4	4	3.5	4	3.5	3.5	3.5	3.5	4	4	3.77	
CO4	4	3.5	3.5	3.5	3.5	3	2.5	4	4	3.5	4	3.55	
CO5	3.5	4	3.5	4	3.5	3.5	4	4	3.5	3.5	3.5	3.68	
Mean Overall Score											3.71		

Result: The Score for this course is 3.71(High)

Association	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Interval	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Rating	Very Poor	Poor	Moderate	High	Very High

This course is having **High** association with Programme Outcome and Programme Specific Outcome.

UNIT - I

(15 Hours)

Principles of Relativity: Overview of Special Relativity, space time diagrams, Lorentz metric, light cones, electrodynamics in 4 dimensional languages. Introduction to general relativity (GR), equivalence principle, gravitation as a manifestation of the curvature of space time

UNIT - II (15 Hours)

Geometrical Framework of General Relativity: Curved spaces, tensor algebra, metric, affine connection, covariant derivatives, physics in curved space time, curvature - Riemann tensor, Bianchi identities, action principle, Einstein's field equations, energy momentum tensors, energy-momentum tensor for a perfect fluid, connection with Newton's theory.

UNIT - III (15 Hours)

Solutions to Einstein's Equations and Their Properties: Spherical symmetry, derivation of the Schwarzschild solution, test particle orbits for massive and massless particles. The three classical tests of GR, blackholes, event horizon - one way membranes, gravitational waves

UNIT - IV (15 Hours)

Cosmological Models: Cosmological principle, Robertson-Walker metric, cosmological red shift, Hubble's law, observable quantities - luminosity and angular diameter distances, dynamics of Friedmann-Robertson- Walker models: Solutions of Einstein's equations for closed, open and flat universes.

UNIT - V (15 Hours)

Physical Cosmology and The Early Universe: Thermal history of the universe: Temperature-redshift relation, distribution functions in the early universe - relativistic and non-relativistic limits. Decoupling of neutrinos and the relic neutrino background - nucleosynthesis - decoupling of matter and radiation; cosmic microwave background radiation - inflation - origin and growth of density perturbations

TEXT BOOKS:

1. General Relativity and Cosmology, J. V. Narlikar, Delhi: Macmillan Company of India Ltd. 1977
2. First Course in General Relativity, B. F. Schutz, Cambridge University Press. 2009
3. Introduction to Cosmology, J. V. Narlikar, Cambridge University Press. 2002

REFERENCE BOOKS:

1. Telescopes and Techniques, C.R.Kitchin, Springer. 2014
2. Observational Astrophysics, R.C. Smith, Cambridge University Press. 1995
3. Electronic Imaging in Astronomy, I.S. McLean, Wiley-Praxis. 1997