

**MANGALORE UNIVERSITY  
MEDICAL PHYSICS DIVISION**

**Syllabus for M. Sc. in Medical Physics Programme**

**Semester – I**

**MPH 401: Fundamentals of Physics**

**Teaching hours: Each Unit – 12 h**

**Objective:**

To familiarise the students with the basics of fundamental physics required to understand the basic processes, interactions, and interconnectedness of nuclear radiations with both physical and life science disciplines.

**Outcomes:**

- Students will be familiar with the fundamental principles of physics required to understand the multidisciplinary nature of medical physics programme.
- They will learn basics of condensed matter physics, thermodynamic laws, basics of optical radiations and lasers useful to the programme.
- Students will learn basics of radio-frequency and microwave radiations and interaction with tissues.
- They will get familiar with basics of ultrasound radiations and their uses in medical applications.

**Unit I: Condensed Matter Physics**

Ionic Bonding; Bond Energy of NaCl, Lattice Energy of Ionic Crystals, Madelung Constant – Properties of Ionic Solids – Co-valent Bond; Saturation, Directional Nature, Hybridization, Properties – Metallic Bond; Properties – Intermolecular Bonds; Van der Waal's bonds, Dispersion Bonds, Dipole Bonds, Hydrogen Bonds.

States of matter - crystalline and amorphous materials; thin films and nano structures. Conductors, semiconductors and superconductors. Absorption processes - Photoconductivity – Photoelectric effect – Photovoltaic effect – Photoluminescence – Thermoluminescence – Fluorescence – Radioluminescence- Phosphorescence.

**Unit II: 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, Orbital, Electron Spin and Nuclear Spin – Types of magnetism; Diamagnetism-Langevin's Theory, Paramagnetism - Classical Theory (Langevin's Theory and Curie's Law), Weiss Theory, Paramagnetic Susceptibility – Ferromagnetism, Hysteresis.

### **Unit III: Thermodynamics, Optics and Lasers**

Thermodynamic system.- Laws of thermodynamics, Concept of entropy - principle of entropy increase - entropy and disorder.

Introduction to optical radiations: UV, visible and IR sources. Fiber optics in medicine. Microscopy in medicine – Birefringence, fluorescence microscope, confocal microscope.

Lasers: Theory and mechanism. Interaction of laser radiation with tissues – photothermal - photochemical – photoablation – electromechanical effect. Lasers in medicine – Laser surgery, applications of Ultrafast Pulsed Lasers -Lasers in dermatology, oncology and cell biology - Lasers in blood flow measurement - Hazards of lasers and their safety measures.

### **Unit IV: Radio Frequency and Microwave in Medicine**

Production, properties and classification of electromagnetic radiation- Different sources of radiation - radio waves, microwaves, infrared, visible, ultra violet radiation, X-rays and Gamma-rays- production, physical properties and their interaction with tissues.

Interaction mechanism of RF and microwaves with biological systems - Thermal and non-thermal effects on whole body, lens and cardiovascular systems - tissue characterization and Hyperthermia and other applications

### **Unit V: Ultrasound in Medicine**

Production, properties and propagation of ultrasonic waves - Bioacoustics – Acoustical characteristics of human body- Ultrasonic Dosimetry - High power ultrasound in therapy – Ultrasound cardiography (UCG) – Doppler effect -Double doppler shift – doppler systems - ultrasonic tomography -applications of ultrasound in medicine.

### **Reference Books:**

1. David J. Griffiths, *Introduction to Electrodynamics*, fourth edition [QC680.G74 2013]
2. Mark A. Heald and Jerry B. Marion, *Classical Electromagnetic Radiation* [QC661.H43 1995]
3. S.O. Pillai, *Solid State Physics*, New Age International Publishers, 6th Edition, 2015.
4. *Solid State Physics*, R.K. Puri, V.K. Babbar, S.Chand, 1st Edition, 1996.
5. *Elementary Solid State Physics: Principles and Applications*, M.A.Omar, Pearson Education Pvt. Ltd., Delhi, India, 4th Edition, 2004.
6. J. P. Woodcock, *Ultrasonic, Medical Physics Handbook series 1*, Adam Hilger, Bristol, 2002.
7. R. Pratesi and C. A. Sacchi, *Lasers in Photo medicine and Photobiology*, Springer Verlag, West Germany, 1980.
8. Harry Moseley, Hospital Physicists' Association, *Non-ionizing radiation: microwaves, ultraviolet, and laser radiation*, A. Hilger, in collaboration with the Hospital Physicists' Association, 1988.
9. Markolf H. Neimz, *Laser-Tissue Interactions*, Springer Verlag, Germany, 1996.