UNIVERSITY OF BARI “ALDO MORO”
FACULTY OF MEDICINE
Bari English Medical Curriculum

COURSE: MEDICAL PHYSICS AND INFORMATICS
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Syllabus of the Medical Physics Course (CFU 6)
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INTRODUCTION

1. Mathematics review
   - Trigonometry
   - Powers and scientific notation
   - Exponent, Logarithm
   - Derivatives
   - Integrals
2. Introduction to physics, and to measure

MECHANICS

3. Kinematics
   - Linear kinematics
     - Displacement, velocity, acceleration
     - Motion with constant acceleration
     - Free falling objects
   - 2D-3D kinematics
     - Vectors, vector components, vector derivatives
     - Projectile motion
     - Uniform circular motion
4. Dynamic
   - Newton's laws
   - Inertial and Gravitational mass
   - Static and Kinetic Friction
   - Inclines and Tension
5. Work and Energy
   - Kinetic energy
   - Work definition
   - Work-Energy principle
   - Conservative forces and Potential energy
   - Mechanical energy conservation
   - Potential energy of Gravitational, Elastic and central forces
   - Power

6. Linear momentum
    - Momentum conservation
    - Collisions and impulse
    - Elastic and Inelastic collisions
    - Completely inelastic collisions
    - Center of mass
    - Linear momentum of an extended system
7. Rotation and angular momentum
    - Angular velocity
    - Angular acceleration, and centripetal acceleration
    - Motion with constant angular acceleration
    - Torque or Moment of a force
    - Moment of Inertia
    - Rotational kinetic energy
    - Work done by a torque
    - Angular momentum and its conservation
8. Gravitation
    - Kepler's laws
9. Static equilibrium and stability
10. Levers

FLUIDS

11. Phases of matter
12. Fluids at rest
    - Pressure in fluids
    - Pascal's Principle
    - Buoyancy and Archimedes' Principle
13. Hydrodinamics
    - Equation of continuity
    - Bernoulli's equation
    - Viscosity
    - Poiseuille's equation
    - Surface tension and capillarity
    - Pumps

WAVES AND OPTICS

14. Harmonic Oscillator
    - Spring oscillation
    - Simple pendulum
    - Damped oscillations
    - Forced vibrations and Resonance
15. Waves
    - Equation and characteristics of sinusoidal waves
    - Transverse and Longitudinal waves

- Energy transported by waves
- Interference and Principle of superposition
- Standing waves
- Reflection and Refraction
- Diffraction

16. Sound waves
    - Speed of sound
    - Human ear response to sound
    - Beats
    - Doppler effect
    - Ultrasound and Medical imaging
17. Light and Optics
    - The Ray Model of Light
    - Reflection and Image formation by Mirrors
    - Refraction: Snell's Law
    - Total internal reflection: Fiber optics
    - Thin lenses
    - Combinations of Lenses
    - Wave nature of light
    - Huygens' Principle and Diffraction
    - Huygens' Principle and the Law of Refraction
    - Interference and the Young's Double-Slit Experiment
    - The Visible Spectrum and Dispersion
    - Diffraction by a Single Slit or Disk
18. Optical Instruments
    - Cameras, Film and Digital
    - The Human Eye
    - Corrective Lenses and Magnifying Glass
    - Telescopes
    - Compound Microscope
    - Aberrations of Lenses and Mirrors
    - Resolution of Telescopes and Microscopes
    - Resolution of the Human Eye and Useful Magnification
    - X-Rays and X-Ray Diffraction
    - X-Ray Imaging and Computed Tomography (CT Scan)

THERMODYNAMICS

19. Temperature and kinetic theory
    - Atomic theory of Matter
    - Temperature and thermometers
    - Thermal equilibrium and the zeroth law of thermodynamics
    - Thermal expansion
    - The Ideal Gas Law
    - Kinetic theory and the molecular interpretation of temperature

- Real Gases and Changes of Phase
- Vapor pressure and Humidity
- Diffusion

20. Heat
    - Heat as Energy Transfer
    - Internal energy
    - Specific heat
    - Calorimetry
    - Latent heat
    - Heat transfer: Conduction, Convection, and Radiation
21. Laws of thermodynamic
    - The first law of thermodynamics
    - Human metabolism and the first law
    - The second law of thermodynamics
    - Heat engines: Refrigerators, Air Conditioners and Heat Pumps
    - Entropy and the second law of thermodynamics

ELECTROMAGNETISM

22. Electromagnetism
    - Charge and electric field
    - Potential
    - Currents
    - Magnetic field
    - Induction and Faraday's Laws
    - Electromagnetic waves
23. Electric charge and electric field
    - Static electricity
    - Electric charge and its conservation
    - Insulators and Conductors
    - Induced Charge
    - Coulomb’s law
    - The Electric Field
    - Gauss’s Law
    - Electric forces in Molecular Biology
24. Electric potential
    - Electric potential energy and Potential Difference
    - Equipotential Lines
    - Electric Potential Due to Point Charges
    - Capacitance, Dielectrics, and storage of Electric Energy
    - Cathode Ray Tube: TV and Computer Monitors, Oscilloscope
    - The Electrocardiogram (ECG or EKG)
25. Electric currents
    - The electric battery
    - Ohm’s law: Resistance and Resistors

- Resistivity
- Electric power
- Alternating current
- Electrical conduction in the Human Nervous System

26. DC circuits
    - Resistors in series and in parallel
    - Kirchhoff’s Rules
    - Capacitors in Series and in Parallel
    - RC Circuits and their medical application
27. Magnetism
    - Magnets and Magnetic Fields
    - Magnetic Fields produced by currents
    - Force on an Electric Current in a Magnetic Field
    - Force on Electric Charge Moving in a Magnetic Field
    - Force between two parallel wires
    - Solenoids and Electromagnets
    - Ampère’s Law
    - Mass spectrometer
    - Ferromagnetism: Domains and Hysteresis
28. Electromagnetic induction
    - Faraday’s Law of Induction
    - Lenz’s Law
    - EMF Induced in a Moving Conductor
    - EMF induced by varying the Magnetic Flux
    - Electric generators
29. Electromagnetic waves
    - Maxwell’s Equations
    - Light as an Electromagnetic Wave
    - The Electromagnetic Spectrum
    - Speed of Light

NUCLEAR PHYSICS

30. Nuclear physics
    - Particles
    - Passage of particles through the matter
    - Radioactivity
    - Dosimetry
    - Medical imaging devices and Hadron-therapy
