

COURSE	FACULTY OF PHYSIOTHERAPY
PROGRAM	BACHELOR OF PHYSIOTHERAPY
SEMESTER	1
COURSE TITLE	BIOMEDICAL PHYSICS
COURSE CODE	17PT1107
COURSE CREDITS	5

Course Outcomes:

In the end of course, the candidate will be able to...

1. Understand the physics principles & Laws of Electricity, Electromagnetic Spectrum & ultrasound.
2. Describe effects of environmental & man-made electromagnetic fields at the cellular level & risk factors on prolonged exposure.
3. Describe the main electrical supply, electric shock –precautions.
4. Enumerate types & production of various therapeutic electrical currents. Describe the panel diagrams of the machines.
5. Describe in brief, certain common electrical components such as transistors, valves, capacitors, transformers, etc. & the simple instruments used to test/calibrate these components (such as a potentiometer, oscilloscope, etc.) of the circuitry & will be able to identify such components.
6. Describe & identify various types of electrodes used in therapeutics, describe electrical skin resistance & the significance of various media used to reduce skin resistance.
7. Understand the fundamentals of physics, its relation in Physiotherapy sciences, and basic physical principles of sound, light, and heat and their application in the physiotherapy field.

Pre-requisite of course: To understand the concept of physics and its application in Physiotherapy.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
80	0	40	25	15	10	0	0

Contents : Unit	Topics	Contact Hours

1	General Mechanics & Properties of Matter Force – Definition, unit, resolution of forces, Newton’s laws of motion. Types of motion, direction and quantity of motion, Speed, Velocity, Work, Energy and Power., Reaction forces, ground reaction force, Equilibrium, determination of equilibrium of a body, Inertia, Acceleration, Momentum and Torque., Friction – the force of friction, static and dynamic friction, the limit of friction, friction a necessity, and evil., Fluid mechanics: Viscosity, definition, coefficient of viscosity, streamline and turbulent flow, the effect of temperature and pressure on viscosity. Principle of Archimedes, laws of floatation, hydrostatic pressure, buoyancy, surface tension, Physical property of water.	15
2	Heat & Temperature Heat transfer, properties of thermal radiation, Specific heat, thermal capacity, Energy conversion, I and II law of thermodynamics, physical effects of heat: expansion, evaporation, thermionic emission, etc., Concept of heat and temperature, measurement of heat thermometry, thermometer. Method of measuring body temperature. Human body temperature, Biophysics of superficial heat and cold.	10
3	Waves & Sound Sound: Origin of sound, Characteristics of sound waves (Intensity of Sound, loudness, pitch and frequency, noise, echo, Factors affecting sound propagation, Simple Harmonic Motion Revisited: Damping and Resonance, Wave Concepts, Traveling Waves, Waves at a Boundary: Interference, Standing Waves and Resonance, The Human Ear: Physiology and Function, The Doppler Effect in Sound, Ultrasound, Ultrasonic – production and its application, Piezoelectricity., Frequencies of sound waves, Infrasonic, Normal hearing band and Ultrasonics, Reflection, Refraction, and Attenuation of Sound waves, Acoustic Impedance, Interference of sound waves, Resonance, Echo, Doppler effect and Fresnel and Fraunhofer zones in Ultrasonics.	15
4	Modern Optics Electromagnetic Spectrum: Electromagnetic Radiation (EMR): Laws Governing EMR, Laws of Reflection, Refraction, Absorption, Cosine law, Attenuation, Inverse-square law. Grotthuss law etc., Light: Emission and absorption spectra. Electromagnetic spectrum. Laws of transmission, reflection, refraction, absorption. Internal reflection and fiberoptics, Interference of light. LASER and its application.	15
5	Electricity & Magnetism Structure of atom, Isotopes, States of matter; Compound formation (covalent formation)., Static Electricity: Theories of Electricity, Production of Electric Charge, Characteristic of a Charged body, Potential and Capacity, Potential Difference., Current Electricity: Energy sources for electricity, Electromotive Force (EMF), Resistance, Intensity, Ohm’s Law, resistance in Series / Parallel, Devices for regulating Intensity (Types, Construction, and working of Rheostat), Electric energy and power, Thermal Effects of Electric (Joule’s Law)., Magnetism: Nature, Type, Molecular Theory of Magnetism, Property of Magnet, Magnetic Effect of Electric Current, Electromagnets, Milliamperemeter & Voltmeter (Construction and working), Meters for measuring AC., Capacitor / Condenser: Principles, Capacity (Measurement and factors	25

	<p>determining), Types and Construction, Electric field, lines of force and characteristics of lines of force, Charging and discharging of the condenser, Duration of discharge, discharge through inductance, capacitive reactance, and uses of a condenser., Electromagnetic Induction: Principles (Faraday's/Lenz's law), Production, Direction of Induced EMF, Strength of induced EMF, Types (Self and Mutual) and inductive reactance. Eddy Currents, Dynamo, Transformers (Functions, Types, Constrictions), Choke coil., Thermionic Valves (Diode and Triodes), Types of rectification (Half and full-wave– Voltage halving and Westinghouse Bridge), Semi-Conductors: Types, semiconductor diodes, Metal rectifier & Transistors, Integrated circuits (IC), Main Supply: Production of Electricity, Types, Distribution, Earthing, Types of Plugs & Switches. Fuse., Electric and electronic circuits: Oscillating circuit, Smoothing Circuit, surging circuit, CR circuit, multivibrator circuit, faradic coils (Lewis jones and smart Bristow), panel diagram of an electrical stimulator, Production of high-frequency current by a klystron, magnetron., Frequencies of Current – Low, Medium and High-frequency currents and their characteristics, Biological Cell as a capacitor and resistor, frequency of current and its relation to capacitive reactance (resistance), Types of current – Direct Current (DC) and Alternating Current (AC), Sources of DC, Necessity for rectification of AC, Use of DC as a therapeutic current and its dangers, Electrical Skin Resistance, Electrolysis, acidic and alkaline reactions under anode and cathode, Electrolytic burns and its prevention, Shock: Types (Electric Shock, Earth Shock), Definition, Severity, Effects, Causes, and Precautions.</p>	
Total Hours		80

Suggested List of Experiments:

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1	<p>General Mechanics & Properties of Matter Force – Definition, unit, resolution of forces, Newton's laws of motion. Types of motion, direction and quantity of motion, Speed, Velocity, Work, Energy and Power., Reaction forces, ground reaction force, Equilibrium, determination of equilibrium of a body, Inertia, Acceleration, Momentum and Torque., Friction – the force of friction, static and dynamic friction, the limit of friction, friction a necessity, and evil., Fluid mechanics: Viscosity, definition, coefficient of viscosity, streamline and turbulent flow, the effect of temperature and pressure on viscosity. Principle of Archimedes, laws of floatation, hydrostatic pressure, buoyancy, surface tension, Physical property of water.</p>	8
2	<p>Heat & Temperature: Heat transfer, properties of thermal radiation, Specific heat, thermal capacity, Energy conversion, I and II law of thermodynamics, physical effects of heat: expansion, evaporation, thermionic emission, etc., Concept of heat and temperature, measurement of heat thermometry, thermometer. Method of measuring body temperature. Human body temperature, Biophysics of superficial heat and cold.</p>	4
3	<p>Waves & Sound Sound: Origin of sound, Characteristics of sound waves (Intensity</p>	8

	of Sound, loudness, pitch and frequency, noise, echo, Factors affecting sound propagation, Simple Harmonic Motion Revisited: Damping and Resonance, Wave Concepts, Traveling Waves, Waves at a Boundary: Interference, Standing Waves and Resonance, The Human Ear: Physiology and Function, The Doppler Effect in Sound, Ultrasound, Ultrasonic – production and its application, Piezoelectricity., Frequencies of sound waves, Infrasonic, Normal hearing band and Ultrasonics, Reflection, Refraction, and Attenuation of Sound waves, Acoustic Impedance, Interference of sound waves, Resonance, Echo, Doppler effect and Fresnel and Fraunhofer zones in Ultrasonics.	
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5	Electricity & Magnetism Structure of atom, Isotopes, States of matter; Compound formation (covalent formation)., Static Electricity: Theories of Electricity, Production of Electric Charge, Characteristic of a Charged body, Potential and Capacity, Potential Difference., Current Electricity: Energy sources for electricity, Electromotive Force (EMF), Resistance, Intensity, Ohm’s Law, resistance in Series / Parallel, Devices for regulating Intensity (Types, Construction, and working of Rheostat), Electric energy and power, Thermal Effects of Electric (Joule’s Law)., Magnetism: Nature, Type, Molecular Theory of Magnetism, Property of Magnet, Magnetic Effect of Electric Current, Electromagnets, Milliamperemeter & Voltmeter (Construction and working), Meters for measuring AC., Capacitor / Condenser: Principles, Capacity (Measurement and factors determining), Types and Construction, Electric field, lines of force and characteristics of lines of force, Charging and discharging of the condenser, Duration of discharge, discharge through inductance, capacitive reactance, and uses of a condenser., Electromagnetic Induction: Principles (Faraday’s/Lenz’s law), Production, Direction of Induced EMF, Strength of induced EMF, Types (Self and Mutual) and inductive reactance. Eddy Currents, Dynamo, Transformers (Functions, Types, Constrictions), Choke coil., Thermionic Valves (Diode and Triodes), Types of rectification (Half and full-wave– Voltage halving and Westinghouse Bridge), Semi-Conductors: Types, semiconductor diodes, Metal rectifier & Transistors, Integrated circuits (IC), Main Supply: Production of Electricity, Types, Distribution, Earthing, Types of Plugs & Switches. Fuse., Electric and electronic circuits: Oscillating circuit, Smoothing Circuit, surging circuit, CR circuit, multivibrator circuit, faradic coils (Lewis jones and smart Bristow), panel diagram of an electrical stimulator, Production of high-frequency current by a klystron, magnetron., Frequencies of Current – Low, Medium and High-frequency currents and their characteristics, Biological Cell as a capacitor and resistor, frequency of current and its relation to capacitive reactance (resistance), Types of current – Direct Current (DC) and Alternating Current (AC), Sources of DC, Necessity for rectification of AC, Use of DC as a	13

therapeutic current and its dangers, Electrical Skin Resistance, Electrolysis, acidic and alkaline reactions under anode and 34 cathode, Electrolytic burns and its prevention, Shock: Types (Electric Shock, Earth Shock), Definition, Severity, Effects, Causes, and Precautions.	
Total Hours	40

Textbooks:

1. Clayton's electrotherapy- Theory and Practice, Forster and Palastanga; 8th edition.
2. Fundamental of Electrotherapy and Biomedical Physics, Ashish Kakkad; Jaypee Brothers.
3. Biomedical Physics. Jignasha Patel; New Popular Publication

Reference books:

1. Physics-Foundation & frontiers by George Cramow & John M. Cleveland
2. Physics of the life sciences by Jay Newman. 2008.