



$$KE = \frac{1}{2}mv^2$$



PLANCK'S PARADOX



STUDY GUIDE



Electromagnetism

Electromagnetism explores how electric charges and currents interact with magnetic fields. It explains phenomena such as current-induced magnetism, electromagnetic induction, and wave propagation. These principles form the backbone of technologies like motors, generators, sensors, and wireless communication. A strong grasp of electromagnetism enables precise energy transfer, signal detection, and force control with minimal losses.

Rotational Dynamics

Rotational dynamics focuses on the motion of rotating bodies and the forces affecting them. It involves concepts such as torque, angular momentum, moment of inertia, and rotational energy. These ideas govern systems ranging from gears and turbines to satellites and drones. Mastery of rotational dynamics enables smooth, stable, and efficient rotational motion.

Thermo-Fluid Interactions

Thermo-fluid interactions examine the relationship between heat transfer and fluid motion. This field combines thermodynamics and fluid mechanics to study convection, phase change, and thermal gradients. Its applications include cooling systems, turbines, and environmental control technologies. Understanding these interactions allows for efficient thermal management in dynamic systems.

Dynamics

Dynamics studies how forces influence the motion of objects over time. It is based on principles such as Newton's laws, momentum, energy transfer, and damping. Dynamics helps predict motion, stability, and system response under varying forces. This understanding is essential for designing efficient and controlled mechanical systems.

Waves and Optics

Waves and optics explore how mechanical and electromagnetic waves propagate and interact with matter. Key topics include interference, diffraction, reflection, refraction, and polarization. These principles are fundamental to imaging, sensing, and communication technologies. It is important to understand the behaviour of light on a quantum level as well, which includes the narrow slit experiments and polarization. Polarization is important as it can illustrate quantum phenomena in various experiments.

Optoelectronics

Optoelectronics studies devices that convert electrical signals into light and vice versa. It includes technologies such as LEDs, lasers, photodiodes, and optical sensors. These systems combine semiconductor physics with electromagnetic and quantum principles. Understanding optoelectronics enables efficient light-based communication and sensing solutions.



Quantum Mechanics

Quantum physics studies the behavior of matter and energy at atomic and subatomic scales. The conceptual part of quantum mechanics is its continuous and deterministic output rather than a digital 1 or a 0. It is also key to understand the “state” of a particle when it is not measured; measurement in itself is a concept that is treated differently in quantum mechanics, hence the careful usage of the word is implied.

Condensed Matter Physics

Condensed matter physics investigates the properties of solids and liquids arising from atomic and electronic interactions. It examines conductivity, magnetism, crystal structures, and phase transitions. This field underpins the development of advanced materials and electronic devices. Mastery of condensed matter physics enables the design of materials with tailored electrical and mechanical properties.