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Dr. Vishwanath Karad
MIT WORLD PEACE UNIVERSITY | PUNE
TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

Engineering Physics (FYBTech)

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About Me?

Indian Institute of Technology Kharagpur

Master in Science
Physics, India

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

PhD
Material Science and Engineering, Singapore

DALIAN UNIVERSITY OF TECHNOLOGY

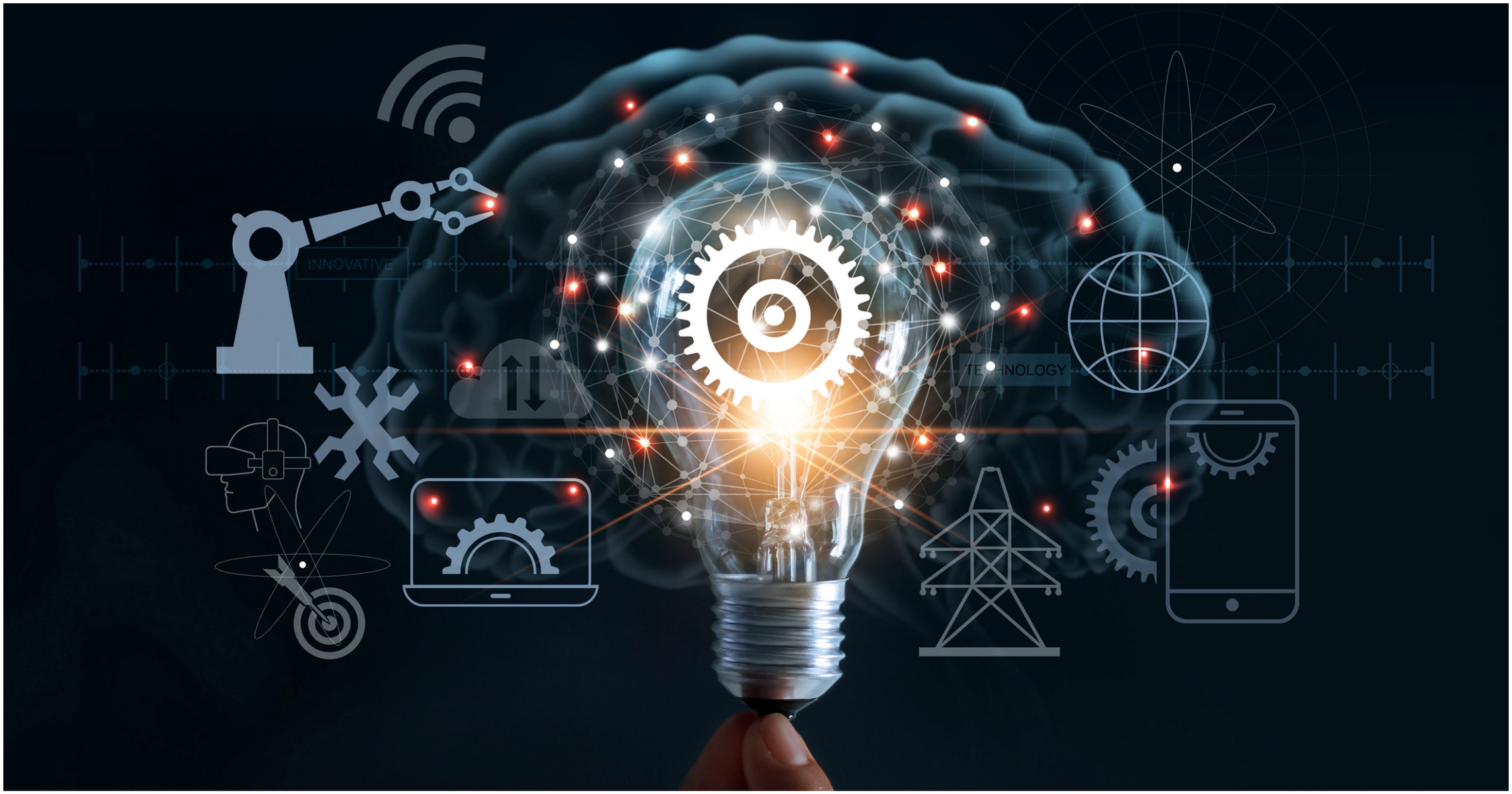
Post-Doctorate
Optoelectronics Engineering, China

UNIVERSITY OF BATH

RWTH AACHEN UNIVERSITY

Visiting Scholar, UK & Germany

What is Engineering?



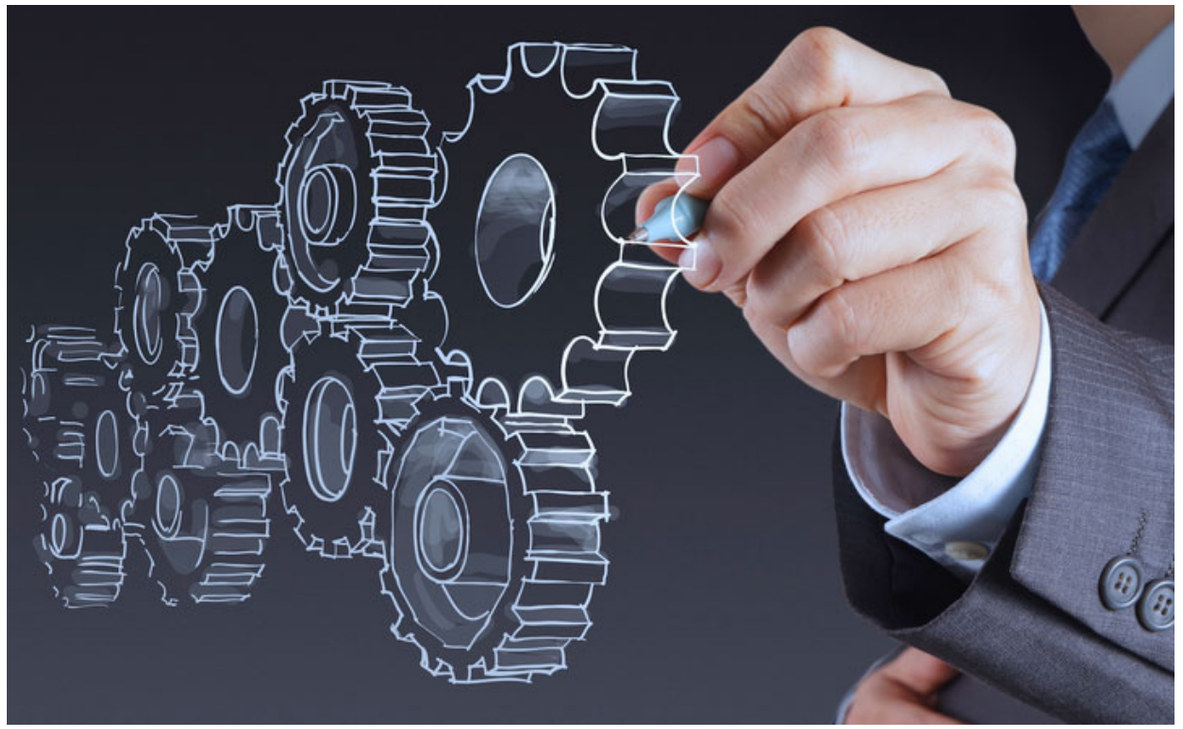
Engineering is the mindset to think over the use of scientific principles, to design and build machines, structures, and other items. Engineering enables us to think out of the box

What is Physics ?

- Physics is one of the most fundamental scientific disciplines, and its main goal is to understand how the universe behaves.
- Physics generates fundamental knowledge needed for the future technological advances.
- Physics, science that deals with the structure of matter and the interactions between the fundamental constituents of the observable universe.
- In the broadest sense, physics (from the Greek physikos) is concerned with all aspects of nature on both the macroscopic and submicroscopic levels.

Role of Physics in Engineering

Engineering is a profession in which scientific knowledge and mathematics is used for innovations, to develop new things that benefit mankind, which is important to society and nature, making everything around us easier.



Engineering is basically an application of physics and mathematics to solve everyday problems.

- ➡ Physics is a science that tries to figure out the fundamental laws of the universe in a way that will allow you to make predictions. It tries to boil the universe down into some basic, mathematical laws.
- ➡ Engineering, on the other hand, is concerned with figuring out how to design, build, and use structures and machines. So how are those two things related?

Role of Physics in Engineering

Civil engineering

Civil engineering involves designing and building bridges, dams, skyscrapers, roads, and railways using our physics knowledge of forces, fluid pressure, and gravity.

- Consider building a complex suspension bridge. It has to be strong enough that it can take the weight of dozens of cars, and handle wind, ice, rain, and whatever else nature might throw at it. If you get it wrong, the whole thing could collapse.

- Hence, it is important to analyze it using the laws of physics. The laws of physics can tell you about forces, tension, harmonic vibrations and oscillations, tensile strength, elasticity, and other things which can help in making calculations for the stability of the bridge.

Role of Physics in Engineering

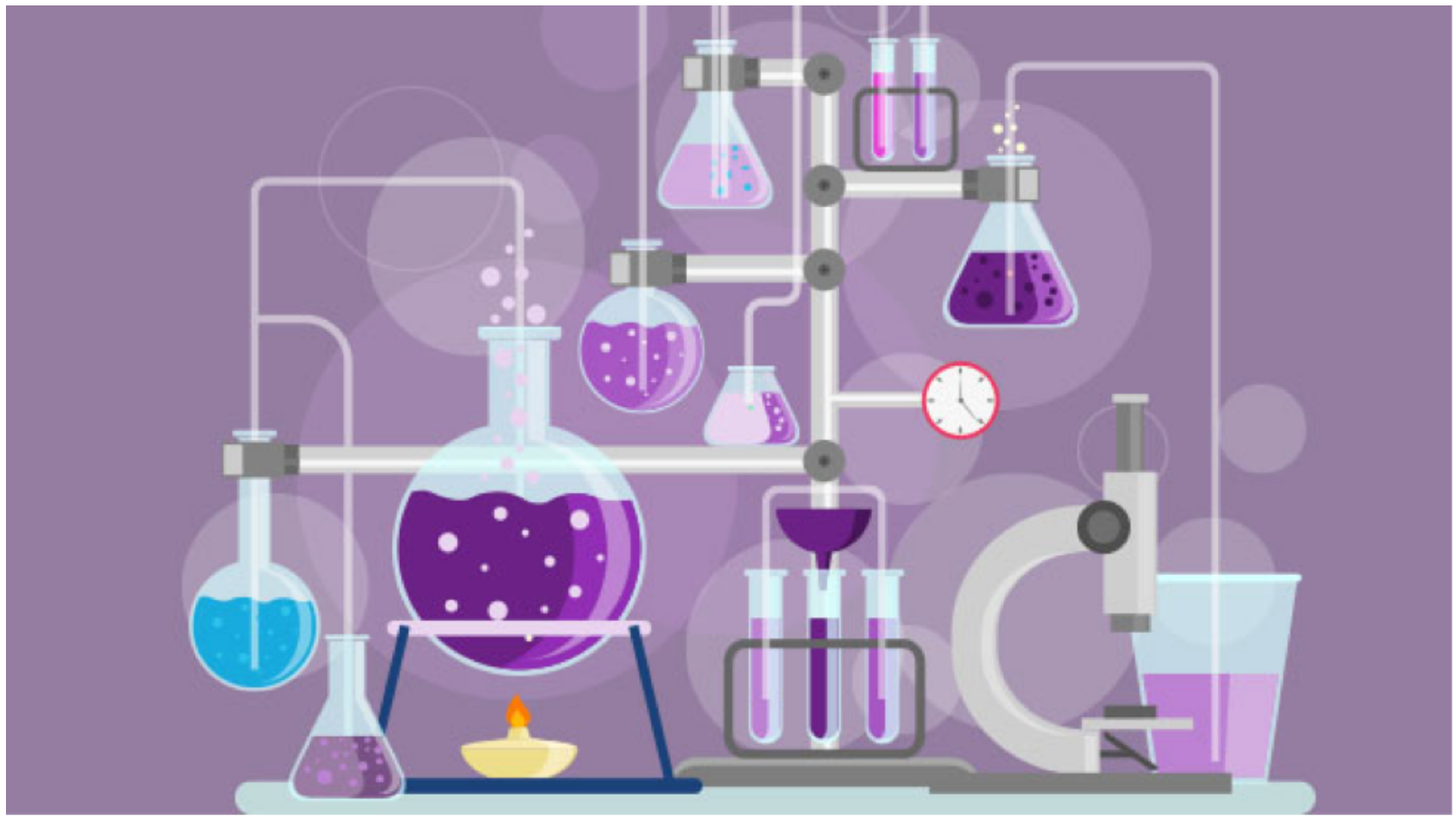
Electrical and electronics engineering

Electrical and electronics engineering involves designing electrical circuits, including motors, electronic appliances, optical fiber networks, computers, and communication links. Circuits use physics principles like voltage, current, and resistance.

Role of Physics in Engineering

Chemical engineering

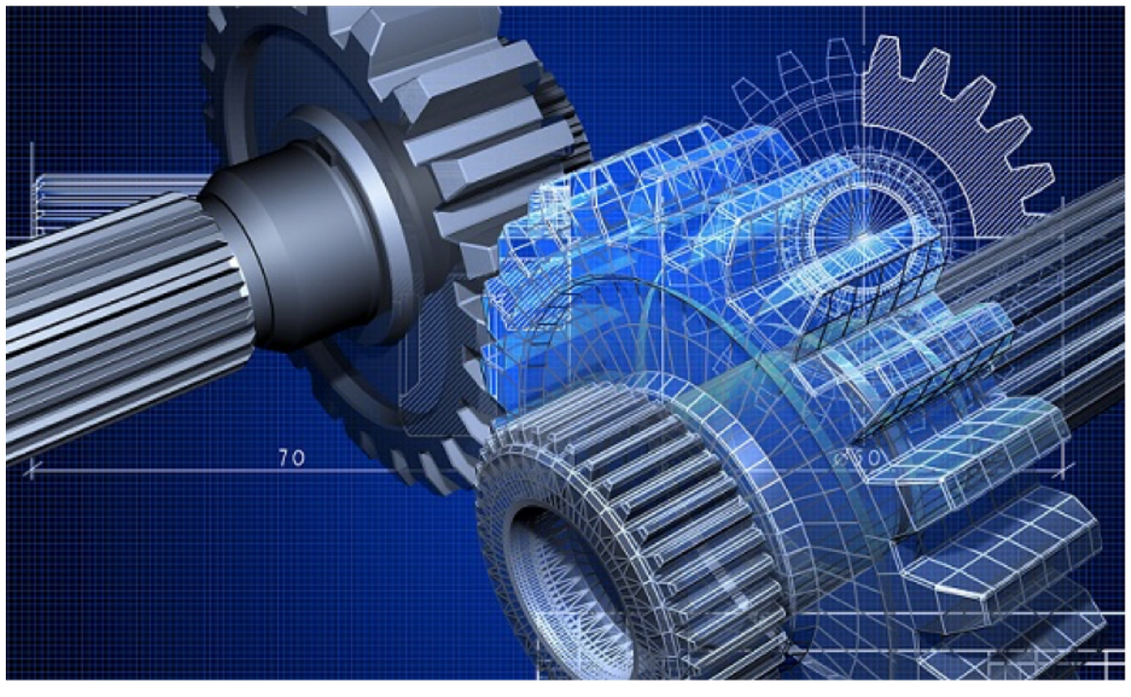
Chemical engineering involves designing systems for oil refining, the creation of industrial chemicals, and man-made fibers and products, which requires an understanding of molecular forces

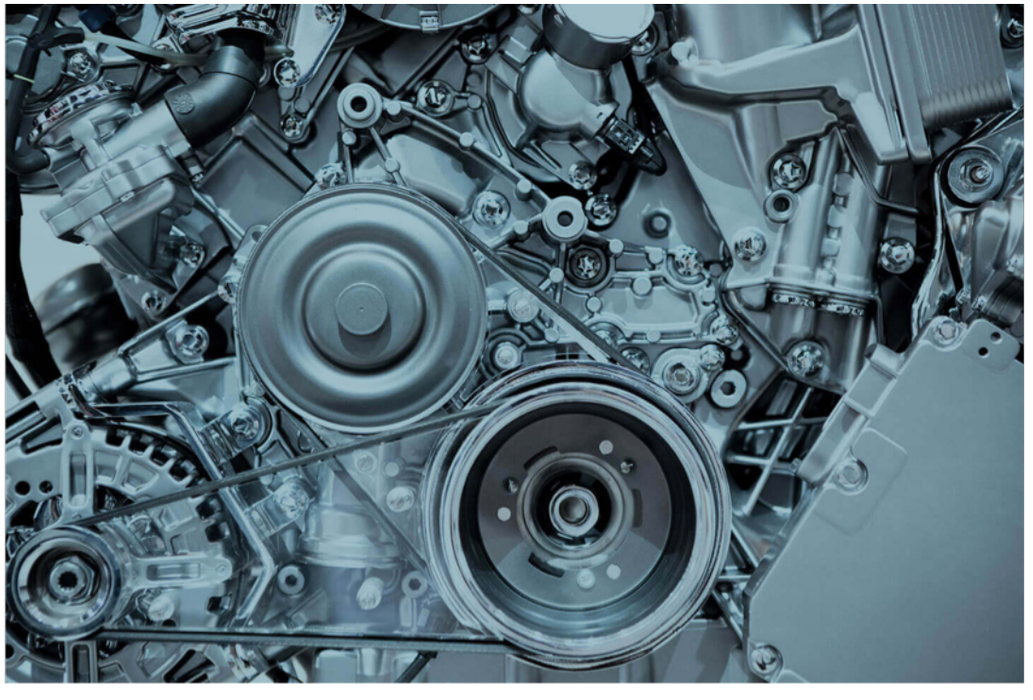


Role of Physics in Engineering

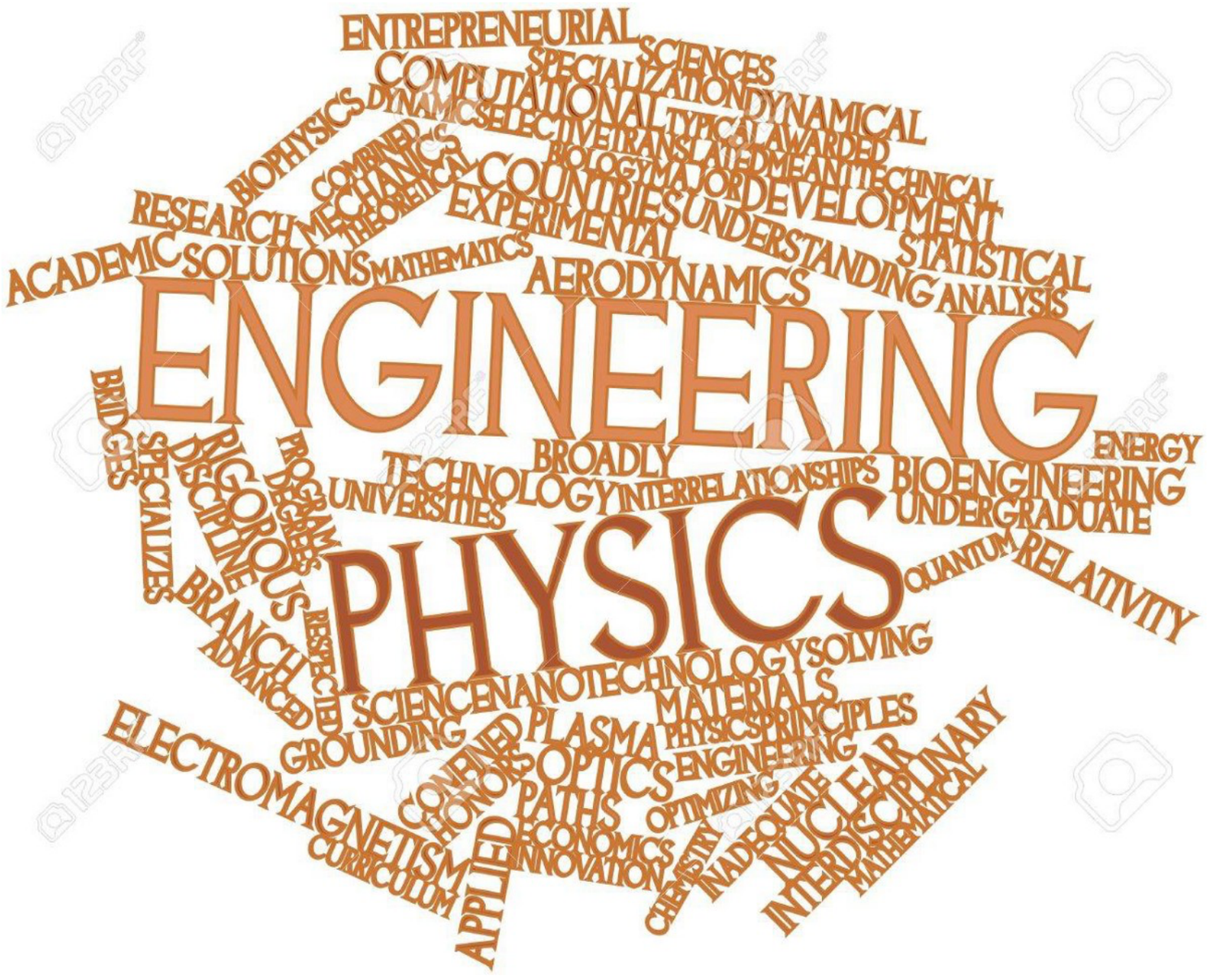
Mechanical engineering

Mechanical engineering deals with aircraft, engines, weapons, cars, pneumatics, and hydraulics. For these, we have to understand forces and complex fluid motions, like air flow across an aircraft or water flow through tubes





Role of Physics in Engineering



An engineer might design the product itself, or just figure out a way to build it. But either way, success is impossible without an understanding of the physics behind each of them.

Course Structure

	Introduction	Introduction of the Physics course, its importance for engineers, review of the syllabus, instructions, teaching scheme, exam scheme, CCA LCA etc.	1
	Interference	Introduction to optics and its importance in engineering and technology, Introduction to interference, importance of interference in engineering and technology,	1
		A brief review of thin film interference Thin Parallel film (P D ,conditions maxima, minima,, wedge shaped film, and fringe width (without derivations), Numerical	1
		Newton's rings Formation,, Applications of Newton's rings(only formulae, without derivation) for the determination of (i) wavelength of incident light (ii) radius of curvature of Planoconvex lens, (iii) for the determination of refractive index of a given liquid Other applications of interference: testing flatness and irregularity of surfaces Antireflection (high transmission) coating, anti-transmission (high reflection coatings), Numerical	1

Course Structure

	Diffraction	Diffraction of waves, importance of diffraction in engineering and technology, , Fraunhofer diffraction at single slit (without derivation, all formulae just to be stated) conditions for maxima and minima, diffraction grating, its properties and uses (all without derivations, formulae just to be stated)	1
	Polarization	Introduction, importance of polarization in engineering and technology, Polarization of light, Representation of UPL, PPL, CPL, EPL, PRPL(brief), Law of Malus (to be taught in the lab), double refraction, Method of producing PPL. Huygens theory of double refraction,	1
		Double refraction of calcite crystal with optic axis perpendicular to direction of propagation, QWP,, List of applications of polarization (Polarizing sunglasses, optical activity LCD, 3D movies, photoelasticity (only a rapid review)	1

Course Structure

	Quantum Mechanics	Introduction, importance of quantum mechanics in engineering and technology, duality of radiation, failure of classical physics, De Broglie's hypothesis, Characteristics of De Broglie waves, De Broglie wavelength, applications of De Broglie's hypothesis (why electron microscope is better than optical microscope),	1
		Concept of phase velocity and group velocity in brief , introduction to Heisenberg's uncertainty principle and its explanation using concept of wavegroups	1
		Proving Heisenberg's uncertainty principle using electron diffraction experiment, Wave function & its physical interpretation	1
		Schrodinger's time independent equation	1
		Particle in a rigid box (energy quantization and eigen functions) , particle in 3D box just to be mentioned	1
		Particle in a non-rigid box (qualitative, without derivation), tunnel effect and list of it's applications	1
		A brief introduction to quantum superposition, Quantum entanglement	1

Course Structure

	Semiconductor Physics	Introduction, importance of semiconductor physics in engineering and technology, band theory of solids, energy bands in metals, insulators and semiconductors, How energy bands are formed? (with examples of Li, Be),	1
		Semiconductors and their useful properties, Fermi Dirac statistics, Fermi Dirac formula, concept of Fermi level and its physical significance	1
		Discussion of intrinsic and extrinsic semiconductors on the basis of Fermi level, Fermi level in intrinsic semiconductors at T = 0 K and T > 0 K (mathematical and graphical description)	1
		Fermi level and energy band diagram in P and N type of semiconductors at T = 0 K and T > 0 K, effect of impurity concentration (doping level)	1
		Quantitative description of semiconductors (I, J, V, E, R, , , , etc). without derivation	1
		Hall effect and its applications	1
		PN junction diode on the basis of energy band diagram	1
		NPN Transistor (basics and energy band diagram)	1
		Solar cell (diagram and working principle), Applications	1

Course Structure

	Physics of Nanoparticles	Introduction, importance of nanotechnology in engineering and technology, what is nanotechnology and what are nanoparticles, properties of nanoparticles (optical, electrical, mechanical, magnetic and structural), Synthesis of nanoparticles: physical methods (planetary ball milling, chemical vapor deposition (CVD), laser pyrolysis	1
		A rapid review of applications of nanotechnology: automobiles, energy, electronics, medical, space and defense, cosmetics, textile, sports and toys, environment	1
		A brief review of carbon based nanostructures (Graphene, Carbon nanotubes, Fullerene and Quantum dots)	1

Course Objectives

Course Objectives:

To equip engineering students with the fundamentals of and latest trends in Physics required for Engineering and to inculcate a scientific and analytical aptitude in them

1.Knowledge (i) To understand the properties and applications of light and matter
(ii) To understand the working of some notable Physics based instruments

2.Skills (i) To acquire skills of using light and laser in various applications
(ii) To acquire experimental and analytical skills required for engineering

3.Attitude A positive attitude towards Physics and it's connection with engineering

Course Assessment

Class Continuous Assessment (CCA): 50 marks

Assignments	Test	Presentations (Group activity)	Case study	MCQ	Oral	Any other (Attendance and initiative)
15/50 marks (30%)	15/50 marks (30%)	15/50 marks (30%)	--	--	--	5/50 marks (10%)

Tutorial Continuous Assessment (TCA): 50 marks

Extensive problem solving in tutorial sessions

Tutorial Exam I	Tutorial Exam II
25 marks (50%)	25 marks (50%)

Laboratory Continuous Assessment (LCA): 50 marks

Regularity and punctuality	Understanding of objective	Understanding of procedure	Experimental skills	Ethics
10/50 marks (20%)	10/50 marks (20%)	10/50 marks (20%)	10/50 marks (20%)	10/50 marks (20%)

Term End Examination : 50 marks

Thank You