Engineering Physics: Course Brief

Engineering Physics-Theory

Anurag Srivastava

Professor

Department of Engineering Science and Dean AER

Web address: https://profanurag.in

Email: profanurag@gmail.com

Visit me: Room-110, Block-E, IIITM Campus

Syllabus

- **Physics of Materials**: Crystal structure, crystal systems, bonding in solids, P.E curve and Properties of materials, miller indices, Brillouin zones, symmetry, Atomic Packing fraction, imperfections, energy bands in solids,, classification of solids, conductivity in metals and concepts of Fermi level, effective mass and holes, concept of phonons, electron distribution function, Fermi-Dirac distribution function, properties of bulk materials and nanomaterials. Carbon materials.

- **Laser and Fiber Optics**: Principles of lasers, Einstein Coefficients and their relations, Types of Lasers and their applications. Concept of optical fibers and types of optical fibers, modes of propagation, fiber optic communication, optical fiber sensors, connector and couplers.

Syllabus

- **Electrodynamics**: Maxwell's equations: differential and integral forms, significance of Maxwell's equations, displacement current and correction in Ampere's law, electromagnetic wave propagation, transverse nature of EM waves, wave propagation in bounded system, applications.

- **Quantum Physics**: Dual nature of matter, de-Broglie Hypothesis, Heisenberg uncertainty principle and its applications, postulates of quantum mechanics, wave function & its physical significance, probability density, Schrodinger's wave equation, Eigen values & eigen functions, Applications of Schrödinger equation.

Reference Books:

- Panofsky & Phillips, *Classical Electricity & Magnetism*, 2nd ed., Dover Publications, 2005. (Text Book).
- David J Griffith, *Introduction to Quantum Mechanics*,2nd ed. , PHI, 2013. (Text Book).
- Avadhanulu, M. N, & Kshirsagar, S. G., *A Textbook of Engineering Physics*, S. Chand, 2014. (Text Book)
- Neeraj Mehta, *Applied Physics for Engineers*, PHI Learning Pvt. Ltd., 2011. (Text Book)
- Fiber optic communication- J Keiser (McGraw Hill) (Text Book)
- David J Griffith, *Introduction to Electrodynamics*, 4th ed. , PHI, 2014. (Ref.).
- Paul Dirac, *Principles of Quantum Mechanics*, 4th ed., Oxford Uni. Press, 2004. (Ref.)
- Kittel, C., *Introduction to Solid State Physics*, 8th ed., Wiley, 2014. (Ref.)
- Ohring, M., *Engineering Material Science*, Academic Press, 1995. (Ref.)

Evaluation

Component	Duration	Marks
Mid Semester Exam	Two Hour	20
Quiz/Surprise Test	One Hour	10
Assignment + Class Performance (attendance, interaction and presentation)		10
Major Test	Two Hour	40
Lab		20
Total Marks		**100**

Engineering Physics: Brief

Engineering Physics-Lab

OBJECTIVE:

The objective of the course is that the student will have exposure to various experimental and computational skills which is very essential for an Engineering student. This lab helps to have knowledge of the world due to the constant interplay between observations and hypotheses, experiments and theory in physics. The experiments are selected from various areas of Physics like Physical Optics, Lasers, Fiber Optics, Mechanics, Electricity & Magnetism, and Basic Electronics. Students will gain knowledge in various areas of physics so as to have real-time applications in all engineering streams.

OUTCOMES:

After completing this course, the student must demonstrate the knowledge and ability to:

1. Understand the concept of error and its analysis.
2. Develop experimental skills
3. Design new experiments in Engineering.
4. Compare the theory and correlate it with the experiment.
5. Identify the appropriate application of a particular experiment.
6. Understand and apply fundamental electronic circuits.
7. Analyze the experimental result.
8. Understand the applications of physics experiments in day-to-day life.

Tentative List of Experiments

S.No.	Aim/Title of the Experiment
01	Study of Hall Effect
02	Resistivity and band gap of semiconductor Ge by four Probe Setup
03	Verification of Frank Hertz Experiment
04	e/m with the help of a magnetron valve
05	Bending losses of a given Optical Fiber
06	Fibre Optic Trainee Kit
07	Characteristics of Solar Cell
08	Universal B-H Curve
09	Variation of Magnetic Field
10	Charging & Discharging
11	Dielectric constant
12	Lattice Dynamic Kit
13	Curie Temperature

NOTE: Students are advised to maintain the chronology as per the allotted experiments.

Tentative List of Experiments

S.No.	Aim/Title of the Experiment
14	Plank's Constant using LED (Dark Room)
15	Laser Trainer Kit (Dark Room)
16	Study Laser Beam parameter (Dark Room)
17	Dispersive power of prism/ Diffraction of Grating (Dark Room)
Computational Experiments list	
18	Material Stability Analysis: Plot total energy vs lattice constant or volume of the supercell of Si/GaAs or any other material, to determine the most stable or optimized configuration.
19	Electronic properties analysis of Metal (eg. Au/Ag/Cu), Semiconductor (eg. Si/GaAS), and Insulator (eg. SiO_2/HfO_2): Compute the following by considering an example from metal, semiconductor, and insulator: ▪ Band structure plot ▪ Density of States (DOS) profile

Format of Lab Report Submission

S.No.	Content
01	**Front Page:** Student Name & Roll No, Batch
02	Index of experiment's with page number(s)
03	Aim of the experiment
04	Apparatus used
05	Theory (*in brief*)
06	Results/Observation table (*including suitable graph and plots*)
07	Conclusion

Tentative Evaluation Pattern

S.NO.	COMPONENT	DURATION	Weightage (%)
01	Mid-Semester Examination (Laboratory)	2 Hr	20
02	End-Semester Examination (Laboratory)	2 Hr	30
03	Lab Record File + Viva	-	30
04	Lab performance + Attendance, etc.	-	20
	TOTAL		=20 Marks

Reference Books: Lab

- Practical Physics- G L Squires
- A text book of practical physics-William Watson
- Practical Physics- C L Arora
- Text Book of practical Physics- M N Srinivasan
- Engg. Physics Practical- Rao, Krishna, Rudramamba

Learning Objectives: Theory

1. The course has been designed in such a way so that a ICT graduate can understand the fundamental concepts of physics and chemistry of materials, Electrodynamics and Quantum Physics.

2. Besides the basic concepts, how it is useful in variety of possible applications.

3. There are few topics of future interest too, like lasers, fiber optics and 1D/2D materials, especially the wonder material graphene.

4. Lot many opportunity for those who are interested in making their career as researcher in the area of scientific computing, communication, Quantum Computing, Energy and Environment related projects.

Learning Objectives: Lab

1. The experiments have been introduced to visualize the fundamental concepts of Physics.

2. Most of the experiments are based on the concepts, which have been taught during 12^{th} at a very basic level but by doing experiment they can be visualized better.

3. Few experiments are being introduced to make the students aware about new concepts and tools of modern physics and very useful for the understanding the other subjects like in Materials science, Optics, Semiconductor physics, Magnetism and Communication electronics.