Course handout

PHYSICS FOR ENGINEERS

(Common to branches CSE/AI&ML/DS**)**

SEMESTER: I **YEAR:** B. Tech I Year

Course Code	23PHY101	**L**	**T**	**P**	**S/O**	**C**
Course Title	APPLIED PHYSICS	**3**	**0**	**2**	**0**	**4**
Pre-requisites	12^{th} standard Physics					
Co-requisites	Basic mathematics course with vector calculus					

Course Instructors: **Dr Shaik Ahmed and Dr Ram Soorat**

Course overview:

The basic structure of the course deals with the learning of theoretical concepts of physics along with their practical applications. Our aim is to bridge the gap between school and university physics by providing a more complete and logical framework in key areas of electromagnetism, wave optics, semiconductors and new areas such as quantum physics and quantum computing. This program emphasizes problem solving skills and an understanding of engineering design to address the needs and challenges of the technology age and allow students to take a broad range of engineering careers.

Course Learning Objectives:

- It aims at reviewing the concepts of vectors and getting the students exposed to the phenomena of electromagnetism.
- Familiarize the prospective engineers with semiconductor devices and wave optics
- Equip the students with the standard concepts of fundamental physics in broader way with an aim to solve engineering problems and obtain understanding of Quantum Physics and its applications in Quantum Computing.

Course Outcome:

On completion of this course, the students will be able to:

CLO1: Acquire the conceptual knowledge of vectors and electromagnetism and will be able to apply them in different analytical capacities.

CLO2: Explain the basic concepts of quantum physics, and will be able to apply them in quantum circuits essential for quantum computing.

CLO3: Summarize wave properties of light, apply the theory of semiconductors and lasers to explore a few of their technological applications.

Lecture Plan:

UNIT I: **8 lecture hours**

Vector Analysis: Gradient of a scalar field, Divergence and Curl of a vector field, Vector integration: Line, Surface and volume integrals (Qualitative), Statement of Gauss' and Stoke's theorems.

Electromagnetic Theory: Ampere's law and displacement current, Maxwell's equations in integral and differential forms, electromagnetic wave propagation in free space and conducting media, Poynting theorem.

UNIT II: **10 lecture hours**

Wave Optics: Introduction, Interference, Young's double slit experiment, Newton's rings, Michelson interferometer, Diffraction of light, Rayleigh's resolution criteria, Angular Dispersion, Dispersive power, and resolving power.

Lasers and Fiber Optics: Introduction to Lasers, Induced absorption, Spontaneous emission and Stimulated emission, Einstein's A and B coefficients; Population Inversion, Ruby Laser, He-Ne laser, semiconductor laser and their applications, Principle of Optical Fiber and its usage in communication.

UNIT III: **10 lecture hours**

Quantum Physics: Black Body radiation, Stefan's Law and Planck's Radiation Law (Statements), de-Broglie hypothesis, Heisenberg uncertainty principle, Schr*ö*dinger time-dependent and independent wave equations, Physical significance of a wave function, Particle in a one-dimensional infinite potential box.

Quantum Computing: Introduction to Quantum Computing, Superposition, Entanglement, Interference and Coherence/de-coherence, Representation of a qubit-Bloch sphere (Qualitative), Pure and mixed states, Polarization, von Neumann Entropy, Quantum logic gates: Hadamard Gate, Pauli Gates, C - NOT Gate and Toffoli gates, The Stern–Gerlach experiment.

UNIT IV: **8 lecture hours**

Semiconductors and Devices: Intrinsic and extrinsic semiconductors, Direct and indirect bandgap semiconductors, carrier concentration and conductivity in intrinsic semiconductors, Hall Effect and its applications, V-I characteristics of P-N junction diode. Semiconductor materials of interest for optoelectronic devices (LED, Photo diode, Solar cell).

Text Books:

1. Malik H.K, Singh A.K. (2011), "Engineering Physics", TMH, New Delhi. ISBN: 9780070671539

2. Nielson and Chuang, "Quantum Computation and Quantum Information", Cambridge University Press (2013).

Reference Book (s):

1. Laser Fundamentals, William T. Silfvast, 2nd edn, Cambridge University press, New York (2004).
2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand Publications.
3. David J Griffith, "Introduction to electrodynamics", 4th Edition (2020), Cambridge University Press.
4. Concepts of Modern Physics, Arthur Beiser, Tata McGraw-Hill, New Delhi (2010).
5. Semiconductor Devices, Physics and Technology, S. Sze , M. Kwei Lee, 3 edn, Wiley (2015).
6. A. K. Ghatak, Optics, Tata McGraw Hill, 2007.

Web References:https://www.edx.org/course/subject/physics

2. https://ocw.mit.edu/search/?q=physics&t=Physics

E-Text Books:

1. https://www.scribd.com/document/70908178/Semiconductor-Devices-Basic-Principles-Jasprit-Sing
2. https://www.pdfdrive.com/laser-fundamentals-e18754996.html
3. https://www.pdfdrive.com/an-introduction-to-fiber-optics-e176261072.html

MOOCs Course:

i. https://nptel.ac.in/courses/115/102/115102025/
(Fundamental concepts of semiconductors)

ii. https://nptel.ac.in/courses/104/104/104104085/
(LASER: Fundamentals and Applications)

iii. https://archive.nptel.ac.in/courses/115/101/115101107
(Introduction to Quantum Physics)

iv. https://nptel.ac.in/courses/115/101/115101092/
(Quantum Information and Computing)

Evaluation Scheme:

Component	Marks	Remarks
Internal I	30	Closed Book
i. Assignment-I	5	
ii. Quiz-I/Seminar-I	5	
iii. Test-I	20	
Internal II	30	

i. Assignment-II ii. Quiz-II/Seminar-II **iii.** Test II	5 5 20	Closed Book
Comprehensive	40	Closed Book

Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives (PSOs)

COURSE ARTICULATION MATRIX															
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-											
Average	3	1.7	1.7	-	-										

1 = weakly mapped 2 = moderately mapped 3 = strongly mapped

Course code	22PHY101P
Pre-requisites/Exposure	12th level Physics
Co-requisites	12th level Mathematics

Course Instructors: **Dr. Shaik Ahmed & Dr. Ram Soorat**

This is an introductory laboratory course for students of all disciplines of engineering to emphasize the empirical nature of physics with the following objectives:

Objectives:

- To have a hands-on training application of the basic laws of physics and also to establish their usage in engineering and technology.
- Learning to make optimum use of available instruments to design experiments, record and analyse data, carryout error analysis, and infer robust conclusions.
- Design and develop practical applications of engineering materials

Course Learning Outcomes:

On completion of course, the students will be able to:

CLO1: Apply and demonstrate the theoretical concepts of Physics that will enable them to develop scientific attitude and provide solutions to complex engineering problems.

COL2: Apply the analytical techniques and graphical analysis to the experimental data.

CLO3: Analyze various parameters of semiconductors, explain the basic concepts of mechanics & quantum mechanics and apply fundamental laws to solve thermodynamic problems.

Text Books

1. Practical Physics by C. L. Arora, S. Chand Publications, ISBN: 9788121909099
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal ISBN: 978-8122500844

Reference Books

1. Engineering Practical Physics B Mallick S Panigrahi, Publisher: Cengage Learning, ISBN: 9788131525203.
2. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House, ISBN: 978-0423738902
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Modes of Evaluation: Progressive and End Semester Practical tests/ Viva

Evaluation Scheme:

Assessment 1	Assessment 2	Assessment 3
Write up	Conduct of experiment	Viva-voce

Course Content:

Sl. No.	List of Experiments
1	Newton's Rings: Radius of Curvature of Plano - Convex Lens
2	Wavelength of laser Using Diffraction Grating
3	Lee's Method – Determination of coefficient of thermal conductivity of a bad conductor
4	To verify the relation between thermo-EMF of a thermocouple and temperature difference between two hot junctions using the Seebeck Effect.
5	Magnetic Field Experiment: - Stewart & Gees Apparatus
6	Measurement of e/m by Thomson's Bar Magnet
7	Energy Band Gap of a Semiconductor
8	Hall Effect Characteristics
9	Solar Cell Characteristics
10	Study the photoelectric effect and determine the stopping potential from the photocurrent versus the applied potential graph
11	Stefan`s law of radiation and to determine Stefan's constant using an electrical method
12	Determination of Moment of Inertia of a Flywheel

COURSE ATRICULATION MATRIX

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	-	-	-	-
Average	2.7	2.7	1.3	1.3	-	-	-	-	-	-	-	-	-	-	-

1 = weakly mapped 2 = moderately mapped 3 = strongly mapped

1. Attendance Policy: A Student must normally maintain a minimum of 75% attendance in the course without which he/she shall be disqualified from appearing in the respective examination.

2. Make-up Policy: A student, who misses any component of evaluation for genuine reasons, must immediately approach the instructor with a request for a make-up examination stating the reasons. The decision of the instructor in all matters of make-up shall be final.

3. Chamber Consultation Hours: During the Chamber Consultation Hours, the student can consult the respective faculty in his/her chamber without prior appointment.

For further information on Attendance, Examination, and Evaluation Policy please refer to the student's handbook.