COURSE TITLE	**ENGINEERING PHYSICS**
COURSE CODE	**01EC1111**
COURSE CREDITS	**3**

Objective:

1. The course aims to develop a deep and integrated understanding of the fundamental and advanced physical principles that govern modern electronics and communication systems. The course is designed to equip students with the ability to analyse, model, and innovate across multiple scales—from quantum-level phenomena to system-level performance analysis

Course Outcomes: After completion of this course, student will be able to:

1. Correlate the fundamental physical principles that governs the modern electronic devices and communication system.
2. Identify the key parameters and measurement metrics governing semiconductor device behaviour and efficiency.
3. Insight into the parameter-dependent quantum effects influencing the performance and behavior of electronic and communication systems.
4. Familiarize with advanced materials and their properties suitable for application in electronic and communication engineering systems.

Pre-requisite of course: Understanding of the basic knowledge of physics covered in higher secondary level.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	0	2	0	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Physics in Modern Electronics and Communication systems** Physics in Everyday Engineering Systems, Fundamental Laws Governing Electronic and Communication Systems, Interconnection of Physical Domains and Energy Perspective Across Systems, Metrology and Analytical Modelling of Physical Quantities	4

DR. RAJENDRAKUMAR DAHYALAL PATEL
Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA
Digitally signed by (Name of Dean/ Principal)

Contents : Unit	Topics	Contact Hours
2	**Engineering Metrics for Semiconductor Devices** Identification of Semiconductor Components and Their Functional Roles, Key Datasheet Parameters of Semiconductor Devices, Functional Significance of I–V Characteristics, Temperature, and Doping, Temperature Effects on Voltage, Current, and Leakage, Electric Field and Bias Dependence (Breakdown and Conduction Regions), Frequency and Switching Effects on Device Performance, Optical and Injection-Level Effects in Optoelectronic Devices, Control of Doping Concentration and Junction Properties, Structural and Geometrical Design Considerations, Material Selection and Device-Specific Parameter Tuning	10
3	**Quantum Phenomena in Electronic and Communication Systems** Quantum Effects in Modern Engineering Systems, Nanoscale Behavior of Semiconductor Devices, Laser Diodes and Optical Communication, Photodetectors and Imaging Systems, High-Speed and Low-Power Electronics, Device Parameters Influenced by Quantum Effects, Introduction to Quantum Computing and Integrated Device-to-Quantum Perspective	7
4	**Advanced Materials for Electronics and Communication Systems** Materials for Integrated Circuits and Processors, Materials for Communication Devices (RF Systems, Antennas), Materials for Power Electronics (EVs, Converters), Materials for Sensors and Optoelectronic Systems, Key Decision Parameters for Electronic Material Selection, Interpretation of Material Parameters in Device Performance, External Factors and Material Engineering for Specific Applications	7
Total Hours		**28**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment No. 1** Analyze the variation of forward current with temperature in a P–N diode and thereby obtain the forward current derating curve by interpreting the relationship between thermal effects and safe operating limits.	2
2	**Experiment No. 2** Apply experimental methods to obtain and plot the B–H curve of a magnetic material and determine its magnetic parameters such as permeability, retentivity, and coercivity.	2
3	**Experiment No. 3** Evaluate the dielectric constant of a material and assess its variation with frequency.	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
4	**Experiment No. 4** Evaluate the charge carrier concentration of the given semiconductor.	2
5	**Experiment No. 5** To apply the principles of quantum mechanics to experimentally estimate Planck's constant.	2
6	**Experiment No. 6** Analyze the Leakage Current in Semiconductor Devices.	2
7	**Experiment No. 7** Analyze the tunnelling and avalanche breakdown regimes of Zener diode.	2
8	**Experiment No. 8** Evaluate the bandgap of the given semiconductor using four probe method.	2
9	**Experiment No. 9** Evaluate the bandgap of the given LED.	2
10	**Experiment No. 10** Analyze the effect of doping on the properties of p-n diode.	2
11	**Experiment No. 11** Analyze the effect of temperature on intensity of LED	2
12	**Experiment No. 12** Analysis of bandgap engineering and emission Control in LEDs through Material Composition and Doping Effects.	2
13	**Experiment No. 13** Analyze the variation of depletion region width with applied bias and doping asymmetry.	2
14	**Experiment No. 14** Evaluate the breakdown voltage of diode and its variation with temperature.	2
15	**Experiment No. 15** Analyze reduction in efficiency at high injection levels.	2
16	**Experiment No. 16** Apply the concept of total internal reflection and hence estimate the numerical aperture and acceptance angle of the given optical fibre.	2
17	**Experiment No. 17** Examine the variation of magnetic field with current in a coil and interpret its relationship with electromagnetic behaviour.	2
18	**Experiment No. 18** Apply the principle of diffraction of light and hence estimate the wavelength of the given laser.	2
Total Hours		**36**

Textbook :

1 Principles of Physics, David Halliday, Robert Resnick, Jearl Walker, Wiley, 2023

Textbook :

2 University Physics with Modern Physics, Young Hugh & Freedman Roger, Pearson Education, 2017

3 Principles of Electronic Materials and Devices, Safa Kasap, McGraw Hill Education, 2017

4 Engineering Physics, M.N. Avadhanulu and P.G. Kshirsagar, S. Chand Publishing, 2019

References:

1 Solid State Electronic Devices, Solid State Electronic Devices, Ben G. Streetman and Sanjay Banerjee, Pearson Education, 2016

2 Concepts of Modern Physics, Concepts of Modern Physics, Arthur Beiser, McGraw Hill, 2017

3 Introduction to Nanoscience and Nanotechnology, Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay and A.N. Banerjee, PHI Learning, 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	15.00	35.00	20.00	20.00	5.00

Instructional Method:

1 The internal evaluation will be done based on the continuous evaluation of students in the laboratory and class-room.

2 A practical examination will be conducted at the end of the semester for evaluation of practical performance.

3 Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.

4 The course delivery method will depend upon the requirements of content and need of the students. The teacher in addition to conventional teaching methods (Chalk and Talk) may use any of the tools/techniques such as demonstration, role play, Quiz, brainstorming, flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

Supplementary Resources:

1 https://nptel.ac.in/courses/113106065

2 https://www.youtube.com/playlist?list=PLyqSpQzTE6M9yUzTnI4oxqgaKLsFxRvGA

3 https://www.youtube.com/watch?v=LIj26m36qrk&list=PLLy_2iUCG87A0iDXvW7FBaL1HPwA_88Te

4 https://nptel.ac.in/courses/115103129

5 https://devsim.org/introduction.html

Supplementary Resources:

6 https://tcadcentral.com/Software.html

7 https://ngspice.sourceforge.io/download.html

DR. RAJENDRAKUMAR DAHYALAL PATEL

Digitally signed by (Name of HOD)

DR. RAJENDRASINH BAHADURSINH JADEJA

Digitally signed by (Name of Dean/ Principal)