

Semester 1st

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH104-18	Semiconductor Physics	L-3, T-1, P-0	4 Credits
Prerequisite (if any): Introduction to Quantum Mechanics desirable			
Course Objectives: The aim and objective of the course on Semiconductor Physics is to introduce the students of B. Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.			
Course Outcomes: At the end of the course, the student will be able to			
CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors		
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.		
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.		
CO4	Understand the design, fabrication, and characterization techniques of Engineered semiconductor materials.		
CO5	Develop the basic tools with which they can study and test the newly developed devices and other semiconductor applications.		
Detailed Syllabus:			
PART-A			
UNIT 1: Electronic materials (10 lectures)			
Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch’s theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.			
UNIT II: Semiconductors (10 lectures)			
Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.			
PART-B			
UNIT III: Light-semiconductor interaction (10 lectures)			
Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Joint density of states, Density of states for phonons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.			

UNIT IV: Measurement Techniques (10 lectures)

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, hall mobility using Four-point probe and van der Pauw method, Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics.

Reference books and suggested reading:

1. J. Singh: Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich: Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze: Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Ben G. Streetman: Solid State Electronics Devices, Pearson Prentice Hall.
7. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
8. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore, 1988.
9. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

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BTPH114-18	Semiconductor Physics Lab	L-0, T-0, P-3	1.5 Credits
Pre-requisite (if any): (i) High-school education			
Course Objectives: The aim and objective of the Lab course on Semiconductor Physics is to introduce the students of B.Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.			
Course Outcomes: At the end of the course, the student will be able to			
CO1	Able to verify some of the theoretical concepts learnt in the theory courses.		
CO2	Trained in carrying out precise measurements and handling sensitive equipment.		
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."		
CO4	Learn to draw conclusions from data and develop skills in experimental design.		
CO5	Write a technical report which communicates scientific information in a clear and concise manner.		
Detailed Syllabus:			
Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.			
Section-A			
<div>1. To study the characteristic of different PN junction diode-Ge and Si.</div> <div>2. To analyze the suitability of a given Zener diode as a power regulator.</div> <div>3. To find out the intensity response of a solar cell/Photo diode.</div> <div>4. To find out the intensity response of a LED.</div> <div>5. To determine the band gap of a semiconductor.</div> <div>6. To determine the resistivity of a semiconductor by four probe method.</div> <div>7. To confirm the de Broglie equation for electrons.</div> <div>8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.</div> <div>9. To study the magnetic field of a circular coil carrying current.</div> <div>10. To find out polarizability of a dielectric substance.</div> <div>11. To study B-H curve of a ferro-magnetic material using CRO.</div> <div>12. To find out the frequency of AC mains using electric-vibrator.</div> <div>13. To find the velocity of ultrasound in liquid.</div> <div>14. To study the Hall effect for the determination of charge current densities.</div> <div>15. Distinguish between Diamagnetic material, Paramagnetic and ferromagnetic material.</div> <div>16. Measurement of susceptibility of a liquid or a solution by Quincke's method.</div> <div>17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.</div> <div>18. To study the temperature coefficient of Resistance of copper.</div> <div>19. To determine the ratio k/e Using a transistor.</div> <div>20. To compare various capacitance and verify the law of addition of capacitance.</div> <div>21. To determine dipole moment of an organic molecule acetone.</div> <div>22. To measure the temperature dependence of a ceramic capacitor.</div> <div>23. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.</div> <div>24. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.</div>			

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25. To study laser interference using Michelson's Interferometer.
26. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtual lab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. <http://www.vlab.co.in>
11. <http://vlab.amrita.edu/index.php?sub=1>

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Branch/Course: COMPUTER SCIENCE AND ENGINEERING

BTAM104-18	Mathematics Paper-I (Calculus & Linear Algebra)	4L:1T:0P	4 credits
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Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (13 hours)

Rolle's theorem, Mean value theorems, Statements of Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L' Hôpital's rule; Maxima and minima.

Evaluation of definite and improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions; Beta and Gamma functions and their properties.

Unit-II: Matrix Algebra (12 hours)

Matrices, vectors addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

Section-B

Unit-III: Linear Algebra (13 hours)

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, statement of rank-nullity theorem, Matrix associated with a linear map.

Unit-IV: Linear Algebra (Contd.) (12 hours)

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases; Similar matrices, diagonalization.

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Category	Engineering Science Course				
Course title	Basic Electrical Engineering (Theory & Lab.)				
Scheme and Credits	L	T	P	Credits	Semester –I/II
	3	1	2	5	

Pre-requisites (if any): Nil

Course code: BTEE-101-18

Course Title: Basic Electrical Engineering

(4 credits)

[L: 3; T:1; P : 0]

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will:

CO 1	Have the knowledge of DC circuits, AC Circuits, basic magnetic circuits, working principles of electrical machines, and components of low voltage electrical installations
CO 2	Be able to analyze of DC circuits, AC Circuits
CO 3	Understand the basic magnetic circuits and apply it to the working of electrical machines
CO 4	Be introduced to types of wiring, batteries, and LT switchgear.

Detailed contents:

Module 1: DC Circuits (9 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin's and Norton's Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (9 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Electrical Machines (16 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor.

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Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 4: Electrical Installations (7 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), MCCB, Contactors, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books

- D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
T.K. Nagsarkar and M.S. Sukhija, "Basic Electrical Engineering", Oxford University Press
D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
B. L. Theraja, "Electrical Technology", S Chand Publishing
J. B. Gupta, "Basic Electrical Engineering", S.K. Kataria & Sons

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NOTE:

1. The Question paper shall have following structure/weightage:
Section A – Short answer type Questions based upon whole syllabus – 10 questions of 02 marks each. (All questions are compulsory; 10 x 2 =20).
Section B – Questions from unit – I & II.; – 04 questions of 08 marks each
Section C – Questions from unit – III & IV.; – 04 questions of 08 marks each
(02 Question are to be attempted from Section B & C each; 01 question from Section B or C; 5 x 08=40 marks).

DETAILED CONTENTS

UNIT – I (18 Hrs.)

INTRODUCTION TO ENGINEERING DRAWING: Principles of engineering drawing / engineering graphics / technical drawing and their significance –Drawing Instruments: their Standard and uses – symbols and conventions in drawing practice – lettering & numbering – BIS conventions. Types of lines and their uses, Drawing Sheets: sizes and layout, methods of folding drawing sheet, Grades of pencils used, Dimensioning: definition, types and methods of dimensioning, geometrical construction, concept of scales in drawing, types of scales, construction of plane and diagonal scales.

UNIT – II (12 Hrs.)

ORTHOGRAPHIC PROJECTIONS: Relevance of projection, Types of projections, Principles of orthographic projections in reference to quadrants – conventions – first and third angle projections, illustration through simple problems of projection; Projections of points in quadrants. Projections and trace of a line with different possible orientations in a quadrant. Methods to find true length and inclination of a line with principal planes.

UNIT – III (18 Hrs.)

PROJECTIONS OF PLANES AND SOLIDS: Concept of plane and lamina, Projections of a lamina when; parallel to any reference plane, perpendicular to any reference plane, inclined to reference plane. Traces of planes. Definition of solid, types of solids – conventions-different possible orientations of solid in a quadrant. Projections of solid when; axis parallel to reference plane,

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perpendicular to reference plane, inclined to one and parallel to other reference plane, parallel to both horizontal and vertical planes.

UNIT – IV (12 Hrs.)

ISOMETRIC PROJECTIONS: Principles of Isometric Projections-Isometric Scale- Isometric Views or drawing- Conventions. Isometric drawing / projections of solids such as cube, prisms, pyramids, cylinder, and cone.

UNIT – V (12 Hrs.)

Practice using Computer Aided Drafting (CAD) tools:

Hands on training on any CAD software to strengthen the understanding of the engineering drawing wherein the students will be introduced to a number of assignments as mentioned in the syllabus.

Suggested Reading/Books:

TEXT BOOKS:

1. Engineering Drawing- Basant Agarwal, TMH
2. D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi.
3. P.S Gill, "*Engineering Drawing*", S K Kataria and sons, 18th edition, 2017 reprint
4. Jolhe, Dhananjay (2006), Engineering Drawing: With an Introduction to CAD, Tata Mc Graw Hill, India.

REFERENCE BOOKS:

1. N. D. Bhat (2006), *Engineering Drawing*, Charotar Publications, New Delhi.
2. Venugopal (2010), *Engineering Drawing and Graphics*, 2nd edition, New Age Publications, New Delhi.
3. Johle (2009), *Engineering Drawing*, Tata Mc Graw Hill, New Delhi, India.
4. Trymbaka Murthy (2007), *Computer Aided Engineering Drawing*, I.K. International Publishers, New Delhi.
5. R.B. Choudary (2005), *Engineering graphics with Auto CAD*, Anuradha Publishers, New Delhi