

Bachelor of Technology (B. Tech.)

B. Tech. Semester I/II

Subject Name: Engineering Physics

Subject Code: BTAS11105

Type of course: Basic Science

Prerequisite: Basic understanding of Maths, Physics and Chemistry

Rationale: The basic science physics course is to prepare students for careers in engineering program where physics principles can be applied to the advancement of technology. This education at the intersection of engineering and physics will enable students to seek employment in engineering upon graduation while, at the same time, provide a firm foundation for the pursuit of graduate studies in engineering.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
2	0	2	3	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Module-1: Material Science	6	17%
	<ul style="list-style-type: none"> Atomic structure and bonding in materials. Bonding in solids: covalent and metallic bonding Crystal structure of materials and crystal systems Determination of structures of simple crystals by x-ray diffraction, miller indices of planes and directions Concept of amorphous, single and polycrystalline structures and their effect on properties of materials. 		
2.	Module -2: Semiconductor Physics	7	22 %
	<ul style="list-style-type: none"> Free electron theory of metals, Density of states and energy band diagrams 		

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Sr. No.	Topics	Teaching Hrs.	Module Weightage
	<ul style="list-style-type: none"> 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) 		
3.	<p>Module-3: Light-Semiconductor Interaction and LASERS</p> <ul style="list-style-type: none"> Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Optical loss and gain; Photovoltaic effect, Exciton Properties of Laser: mono-chromaticity, coherence, directionality and brightness, laser speckles Amplification of light by population inversion Different types of lasers • gas lasers (He-Ne) solid-state lasers(ruby) Applications of lasers in science, engineering and medicine. 	6	22%
4.	<p>Module-4: Superconductivity</p> <ul style="list-style-type: none"> Introduction of Superconductivity Properties of superconductor: Effect of magnetic field, Meissner effect, Pressure effect, Impurity effect, Isotopic mass effect etc. Mechanism of Superconductivity: BCS Theory Josephson's junction and its application Application of superconductors 	5	17%
5.	<p>Module-5: Measurement Techniques:</p> <ul style="list-style-type: none"> Resistivity, conductivity and carrier concentrations in metals and semiconductors: Hall effect, Four-point probe and Van Der Pauw measurements Parameter extraction from diode I-V characteristics Wavelength, frequency, refractive index (optical and acoustical methods) Pressure, flow and viscosity measurements Sensors: Resistive, capacitive, inductive, electromagnetic, thermoelectric, piezoelectric, photo sensitive and 	6	22%

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	electromechanical		

Suggested Specification Table of Marks as per Bloom's Taxonomy (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	40	30	0	0	0

Legends: R: Remembrance, U: Understanding; A: Application, N: Analyze, E: Evaluate C: Create and above Levels.

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Materials science and engineering : a first course	Raghavan, v.	PHI Learning 9788120350922	2020	6 th Edition
2.	Crystals and Crystal Structures, 2nd Edition	Richard J. D. Tilley	Wiley 978-1-119-54859-1	May 2020	2 nd Edition
3.	Introduction to Solid State Physics for Materials Engineers	Emil zolotoyabko	Wiley 978-3-527-34884-8	April 2021	1 st Edition
4.	Superconductivity: an introduction,	Reinhold kleiner, wernerbuckel, rudolfhuebener	Wiley 978-3-527-68654-4	Sept 2015	3rd Edition
5.	Applied Superconductivity: Handbook on Devices and	Paul seidel (editor)	Wiley 978-3-527-67065-9	July 2015	1 st Edition

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Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
	Applications				
6.	Semiconductor optoelectronics: physics & technology	Jaspritsingh	McGrew Hill 9353165873 · 9789353165871	2019	1 st edition
7.	Instrumentation Measurement & Analysis	B.C. Nakra, K.K. Chaudhry	McGrew Hill 9385880624 · 9789385880629	2016	4 th Edition
8.	Fundamentals of Temperature, Pressure, and Flow Measurements, 3rd Edition	Robert P. Benedict	Wiley 978-0-471-89383-7	1984	4 th Edition
9.	Electronic Instrumentation And Measurements	H S. Kalsi	McGrew Hill 9353162513 9789353162511		

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	The student will gain knowledge of basic theoretical concept of atomic structure of a materials and their effect on properties of materials. (<i>R, U – cognitive level</i>)	17
CO-2	The student will demonstrate the understanding of basic principles properties and its applications associated with semiconducting materials. (<i>U, A – cognitive level</i>)	22
CO-3	The student will demonstrate understanding of basic theory and properties associated with optoelectronic materials and understanding of basic principles, properties, type and application of Lasers. (<i>U, A – cognitive level</i>)	22
CO-4	The student will demonstrate understanding of basic theory, properties and applications of Superconductivity (<i>U, A – cognitive level</i>)	17
CO-5	The student will gain knowledge of the different measurement techniques to characterize various semiconducting, electrical and optoelectronics materials and devices with electronic, optical, acoustical methods (<i>U, A – cognitive level</i>)	22

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	2	1	-	-	-	-	-	-	-	-	1			
CO-2	3	2	1	-	-	-	-	-	-	-	-	1			
CO-3	3	2	1	-	-	-	-	-	-	-	-	1			
CO-4	3	2	1	-	-	-	-	-	-	-	-	1			
CO-5	3	2	1	-	-	-	-	-	-	-	-	1			
Rationale*	15	10	5	-	-	-	-	-	-	-	-	5			

***Rationale:** It is matching with the PO -1-3 and PO - 12 maximum which helps to explain the application of fundamental physics in every day to day life and in advanced engineering.

LIST OF PRACTICALS: (Minimum 08 performed.)

- To measure the dielectric constant of a material
- To study the Hall-Effect.
- To study the I-Characteristic of Silicon diode.
- To study the I-Characteristic of Zener diode.
- To study the I-Characteristic of LED.
- To determine the efficiency of given solar cell.
- To measure the Resistivity & Band gap of Germanium Crystal (N-type) by Four Probe Method.
- To measure the numerical aperture of optical fiber.
- To Study of propagation & bending loss in optical fiber.
- P-N Junction diode as Bridge Rectifier.
- Energy gap of Semiconductor
- Study of cathode ray oscilloscope
- Time constant of an R-C circuit.
- L-C-R Circuit.
- Logic Gates
- Diffraction and interference experiments (from ordinary light or laser pointers); measurement of speed of light on a table top modulation; minimum deviation from a prism.
- Measurement of the Distance using Ultrasonic Sensors.
- Study of Object Detection using Ultrasonic Sensors.

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19. To determine the frequency of given laser source.
20. Wavelength of Light -Diffraction Grating Using LASER
21. Acoustic grating method set up for measurement of velocity of ultrasonic waves in liquid
22. Newton's rings, Determination of using sodium light.
23. Calibration of Spectrometer & determination of unknown wavelength
24. Virtual Physical Sciences Lab Experiments:

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Engineering Physics Practicals	G Vijyakumari	81-259-2157-5	2007	
2.	Physics Practicals	P R Sasikumar	978-81-203-4434-1	2011	

Major Equipment:

1. He- Ne Laser source
2. Newton's rings experiment setup
3. Hall Effect experiment setup
4. Spectrometers
5. Traveling microscopes
6. Characteristic study kit of Diode / Zener diode / LED
7. Four probe method setup
8. LCR / RC Circuit training kit
9. Ultrasonic interferometer
10. Logic gates training kit

List of Open Source/learning website:

1. <https://nptel.ac.in/courses/115/103/115103108/>
 - o Superconductivity)
2. <https://nptel.ac.in/courses/108/108/108108122/>
 - o Introduction to semiconductor)
3. <https://nptel.ac.in/courses/115/102/115102124/>
 - o Laser Physics

List of Open Source Software:

- 1 <https://vlab.amrita.edu/?sub=1&brch=189>
 - a. For LASER & Optical Experiments.



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- 2 <https://vlab.amrita.edu/?sub=1&brch=282>
 - a. For Solid state devices Experiments.
- 3 <https://vlab.amrita.edu/?sub=1&brch=195>
 - a. For Planck's constant, Photoelectric effect.

