SEMESTER 1/2

ENGINEERING PHYSICS - B

Course Code	Teaching hours per week				Credits	Exam hours	Course type	CIE Marks	ESE Marks
	L	T	P	R					
26NBNBS102	2	0	2	0	3	2 Hrs. 30 Min.	Theory +Lab	40	60

1. Preamble: Physics forms the foundation of all branches of engineering and provides the basic principles that govern electrical and electronic systems. This course aims to strengthen the understanding of fundamental concepts of physics and relate them to applications in Electrical Sciences. It promotes scientific thinking and analytical skills among students while linking theoretical knowledge with practical aspects. The course also provides experimental exposure to develop the ability to apply physics-based concepts to solve engineering problems.

2. Prerequisites: Fundamental understanding of core concepts in Physics and Electronics.

Module Number	Syllabus Description	Contact Hours
1	**Introduction to Semiconductors** Classification of materials into conductor, semiconductor and insulator. Types of semiconductors - intrinsic and extrinsic. Intrinsic semiconductor- derivation of density of electrons in conduction band and density of holes in valence band, intrinsic carrier concentration, its variation with temperature. Fermi energy, Fermi level in intrinsic semiconductors. Extrinsic semiconductor(qualitative), formation of p-n junction, V-I Characteristics in the forward and reverse biasing.	7
2	**Semiconductor Devices and Photonic Devices** Zener diode - V-I characteristics and applications, Zener breakdown and Avalanche breakdown, Tunnel diode-V-I characteristics and applications, Photonic devices (qualitative): junction photodiode, PIN Photodiode - construction and applications, Solar cells - V-I characteristics, efficiency, Stringing of Solar cells into solar panels, Light Emitting Diode- V-I Characteristics, Applications.	7

3	**Superconductivity and Dielectric Materials** **Superconductivity**: transition temperature, critical field, Meissner effect, Type I and II superconductors, applications (qualitative study only). **Dielectrics**: Dielectric constant, polarization, permittivity, relative permittivity, relation between polarization and dielectric constant. Types of polarization - electronic, ionic, orientation, and space charge polarization (no derivation). Clausius-Mossotti relation – derivation.	7
4	**LASER and Fibre Optics** **LASER -** Characteristics, Optical processes – absorption, spontaneous and stimulated emission, Principle of Laser, conditions for sustained lasing (population inversion, pumping, metastable states). Components- active medium, optical resonant cavity, Ruby laser and CO_2 Laser– construction and working. Applications of Lasers (Qualitative Overview) **Fibre Optics**: Principle of light propagation, types (step index and graded index), numerical aperture – derivation, Fibre optic communication system (Block diagram), Applications	7
	Total hours (Theory)	**28**
	Total hours (Practical)	**10**
	Total hours	**38**

3. Course Assessment Method (CIE: 40 Marks, ESE: 60 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination -1 (Written)	Internal Examination -2 (Written)	Internal Examination -3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module • Total of 8 Questions, each carrying 3 marks. **(8 x 3 = 24 marks)**	• Each question carries 9 marks • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4 x9 =36 marks)**	**60**

4. Course Outcomes

At the end of the course students should be able to:

Course Outcomes	Description	Blooms Taxonomy Level
CO1	Apply the fundamental concepts and principles of Semiconductor physics in engineering.	K3
CO2	Apply the principles of semiconductor materials in semiconductor devices.	K3
CO3	Apply the fundamental theories of superconductivity and dielectrics to study the practical applications.	K3
CO4	Apply the principles of lasers and optical fibres in various engineering systems.	K3
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

5. Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	2	2	-	-	-	3
CO2	3	3	3	-	-	2	2	-	-	-	3
CO3	3	3	-	-	-	2	2	-	-	-	3
CO4	3	3	-	-	-	2	2	-	-	-	3
CO5	3	3	3	2	3	3	2	3	2	-	3

6. Text Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6th Edition, 2003
2	Engineering Physics	H. K. Malik and A. K. Singh	McGraw Hill	2nd Edition, 2017
3	A Textbook of Engineering Physics	M. N. Avadhanulu, P. G. Kshirsagar, and T. V. S. Arun Murthy	S. Chand & Company Ltd.	11th Edition, 2018
4	Advanced Engineering Physics	Premlet B.	Phasor Books	10th Edition, 2017

7. Reference Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Semiconductor Devices	Robert F. Pierret	Pearson Education	1995
2	Advanced Semiconductor Fundamentals	Robert F. Pierret	Pearson Education	2002
3	Solid State Electronic Devices	Ben G. Streetman and Sanjay K. Banerjee	Pearson Education	6th Edition, 2010
4	Solid State Physics	S. O. Pillai	New Age International Publishers	10th Edition, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	2019
6	A Textbook of Engineering Physics	I. Dominic and A. Nahari	Owl Books Publishers	Revised Edition, 2016
7	A Textbook of Engineering Physics	M. N. Avadhanulu and P. G. Kshirsagar	Owl Publishers (India)	Latest Edition, 2020
8	Laser Fundamentals and Applications	K. Thyagarajan and A. K. Ghatak	Macmillan Publishers India	2nd Edition, 2010
9	Electronics Laboratory Manual (Vol. 1)	K. A. Navas	PHI Learning Pvt. Ltd.	2nd Edition, 2015

10	Engineering Physics Practical Manual	S. L. Gupta and Sanjeev Gupta	Dhanpat Rai Publications	Revised Edition, 2019
11	Engineering Physics Practicals	B. S. Rao, Kesava Vamsi Krishna V, and K. S. Rudramamba	Laxmi Publications	2nd Edition, 2013
12	A Textbook of Engineering Physics	M. N. Avadhanulu and P. G. Kshirsagar	S. Chand & Company Pvt. Ltd.	2010
13	B.Sc. Practical Physics	C. L. Arora	S. Chand & Company Ltd.	2001

8. **Video Links or any other Reference Materials**

Sl No	Details Like Web link, Publication Details	Module
1	https://nptel.ac.in/courses/108106181	1
2	https://nptel.ac.in/courses/108108112	2
3	https://nptel.ac.in/courses/115103108	3
4	https://nptel.ac.in/courses/115102124	4

9. Practical Sessions

Experiments List
(Minimum 10 Experiments Mandatory)

Experiment Number	Syllabus Description: List of Experiments
1	Diode characteristics
2	Zener diode - V-I characteristics
3	Tunnel diode – V-I characteristics
4	Hall effect in semiconductors
5	Determination of band gap energy of a semiconductor
6	Characteristics of LED
7	Solar Cell - V-I and Intensity Characteristics
8	Laser – Determination of wavelength using diffraction grating

9	Laser – To measure the wavelength using a millimetre scale as a grating
10	Compare the variation of current with potential difference for a metal, filament bulb and semiconductor diode
11	Determination of dielectric constant
12	CRO - Measurement of frequency and amplitude of waveforms
13	Photo diode - V-I Characteristics
14	Numerical aperture of optical fibre
15	Half Wave Rectifier
16	Full Wave Rectifier
17	Spectrometer I – Determination of Wavelength of Hg spectral lines
18	Spectrometer II - Resolving power of grating and dispersive power
19	Determination of particle size of lycopodium powder using diffraction phenomena

10. Laboratory Evaluation

I. Continuous Assessment – (Total: 10 Marks)

The continuous assessment for laboratory sessions will be based on the following four components, with marks awarded for each experiment. Final marks will be the average of all experiments conducted as per the syllabus.

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Students will be evaluated based on pre-lab assignments or quizzes that assess their understanding of the upcoming experiment.
- Understanding of Theory: Marks will reflect the student's preparedness and conceptual clarity related to the theory behind the experiment.

ii. Execution of Experiments (2 Marks)

- Procedure and Implementation: Assessment of how accurately and safely the experiment is performed, with adherence to standard procedures.
- Skill Proficiency: Evaluation of the student's efficiency in handling apparatus, precision in observations, and ability to address any issues during the experiment.

- Teamwork: Consideration of the student's cooperation, communication, and participation in collaborative lab work.

iii. Laboratory Records and Reports (3 Marks)

- Quality of Report: Lab reports will be assessed for clarity, completeness, correctness, and appropriate interpretation of experimental data and conclusions.
- Timely Submission: Importance will be given to punctual submission of neatly maintained rough record for Laboratory works.

iv. Viva Voce (3 Marks)

- Oral Examination: Students will be examined on their ability to explain the experimental setup, procedures, results, and relevant theoretical background during viva sessions.

(Marks obtained under each of the above components will be recorded for every experiment and averaged to calculate the final internal mark for the laboratory course.)

II. Laboratory Examination Evaluation Pattern (5 Marks)

1. Procedure / Preliminary Work / Conduct of Experiments (2 Marks)

- Understanding and Explanation of Procedure: Clarity in describing the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

2. Result (2 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (1 Mark)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

11. Model Question Paper

MODEL QUESTION PAPER				
FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY(FISAT)(Autonomous) FIRST/SECOND SEMESTER B. TECH DEGREE EXAMINATION (2026 Scheme)				
Course Code: 26NBNBS102				
Course Name: ENGINEERING PHYSICS - B				
Max. Marks: 60				**Duration: 2 Hours 30 Minutes**
PART A				
Q. No.		***Answer all questions. Each question carries 3 marks***	**CO**	**Marks**
		Distinguish between intrinsic and extrinsic semiconductors	CO1	3
2		Draw the V-I characteristics of the pn junction diode and mark the breakdown voltage and Knee voltage in that.	CO1	3
3		Explain the principle of LED and write any two applications of LED.	CO2	3
4		Explain the V -I Characteristics of Tunnel diode	CO2	3
5		Define Meissner effect and prove that diamagnetism is an essential property of superconductors	CO 3	3
6		Define ionic and orientation polarization in dielectrics	CO 3	3
7		Distinguish between spontaneous emission and stimulated emission	CO 4	3
8		Explain the principle of propagation of light through an optical fibre.	CO 4	3
PART B				
Answer any one full question from each module. Each full question carries 9 marks				
Module 1				
9	a	Derive the expression for the density of electrons in the conduction band of an intrinsic semiconductor.	CO1	6
	b	Explain the variation of intrinsic carrier concentration with temperature in a semiconductor.	CO1	3
10	a	Derive the expression for Fermi Energy in an intrinsic semiconductor at 0K.	CO1	6
	b	Explain how Fermi energy varies with temperature in an n-type semiconductor	CO1	3
Module 2				

11	a	Explain with a neat diagram the construction, working and V- I characteristics of Solar Cell.	CO2	6
	b	Explain stringing of solar cells into solar panels	CO2	3
12	a	Explain the construction and working of PIN photodiode and explain the advantage of PIN photodiode over junction photodiode	CO2	6
	b	Write any 3 applications of Photodiode	CO2	3
Module 3				
13	a	Define superconductivity and explain how critical field varies with temperature along with proper equations and diagram and also define Hc and Tc.	CO3	7
	b	Outline any four applications of superconductors	CO3	2
14	a	Derive Clausius- Mossotti Relation	CO3	6
	b	A thick polythene sheet of thickness 0.8 mm having a dielectric constant of 2 is subjected to a potential of 100 V. Calculate the polarization	CO3	3
Module 4				
15	a	Explain the construction and working of Ruby Laser	CO4	7
	b	Write any four applications of LASERs briefly.	CO4	2
16	a	Explain Fibre optic communication system with block diagram	CO4	5
	b	Calculate the maximum value of angle of incidence that a ray can make with the axis of a step index fibre, so that it gets guided through the fibre with n_1 =1.61 and n_2 =1.5	CO4	4

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