Semester I/II
Engineering Physics - A

Course Code	Teaching hours per week				Credits	Exam Hours	Course Type	CIE Marks	ESE Marks
	L	T	P	R					
26ANNBS102	2	0	2	0	3	2Hr. 30 Mins.	Theory+ Lab	40	60

1. **Preamble:** This course introduces the fundamental physical principles that form the backbone of modern computing and communication technologies. It helps students to understand how electronic materials, semiconductor devices, optical systems and emerging quantum technologies operate at a physical level. By linking core physics concepts with real-world information systems, the course equips engineering students with the scientific foundation needed to design, analyse and optimize modern hardware and information-processing solutions.

2. **Prerequisites:** Fundamental understanding of core concepts in Physics.

Syllabus

Module Number	Syllabus Description	Contact Hours
1	**Conduction in Materials** **Electrical conductivity :** Classification of materials into conductor, semiconductor and insulator, Energy bands, Classical free electron theory, Electrical conductivity in metals, Fermi-Dirac distribution, Variation of Fermi function with temperature, Fermi Energy. **Superconductivity :** Transition temperature, Critical field, Meissner effect, Type I and Type II Superconductors. Applications of superconductors.	**7**
2	**Quantum Mechanics** Introduction, de-Broglie wavelength, matter waves, concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Wave function – properties - physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one- dimensional box - Derivation of energy eigen values and normalized wave function, Quantum Mechanical Tunnelling (Qualitative)	**7**
3	**Semiconductor Physics** Intrinsic semiconductor, Derivation of density of electrons in conduction band and density of holes in valence band, Intrinsic carrier	**7**

Module Number	Syllabus Description	Contact Hours
	concentration, Variation of Intrinsic carrier concentration with temperature, Extrinsic semiconductor (qualitative), V-I Characteristics of p-n junction.	
4	**Semiconductor devices** Zener diode - V-I characteristics, Zener breakdown and Avalanche breakdown, Tunnel diode - V-I characteristics, Photonic devices (qualitative) - Photo detectors -Junction and PIN photodiodes, Solar cells - V-I Characteristics, Efficiency, Stringing of solar cells to solar panel, Light Emitting Diode - V-I Characteristics, Applications (qualitative).	**7**
	Total hours (Theory) Total hours (Practical) **Total hours (Theory + Practical)**	28 10 **38**

Practical Sessions:

(Minimum 10 Experiments)

Experiment Number	Syllabus Description: List of Experiments
1	Diode characteristics
2	Zener diode - V-I characteristics
3	Tunnel diode – V-I characteristics
4	Half wave rectifier
5	Full wave rectifier
6	Hall effect in semiconductors
7	Determination of band gap energy of a semiconductor
8	Characteristics of LED
9	Solar Cell- V-I and Intensity Characteristics
10	Laser – Determination of wavelength using diffraction grating
11	Laser- To measure the wavelength using a millimeter scale as a grating
12	Compare the variation of current with potential difference, for a metal, filament bulb and semiconductor diode.
13	Determination of dielectric constant
14	CRO -Measurement of frequency and amplitude of wave forms
15	Photo diode - V-I Characteristics
16	Numerical aperture of optical fibre.

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 x 9 =36 marks)**	**60**

4. Course Outcomes
At the end of the course students should be able to:

Course Outcomes		Blooms Taxonomy Level
CO1	Apply the principles of electrical conductivity and superconductivity in practical applications.	K3
CO2	Apply the principles of quantum mechanics to study the behaviour of matter at the atomic and sub-atomic level.	K3
CO3	Apply the fundamentals of Semiconductor Physics in engineering.	K3
CO4	Apply the principles of semiconductor materials in semiconductor devices.	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	-	-	-	2	2	-	-	-	3
CO3	3	3	-	-	-	2	2	-	-	-	3
CO4	3	3	3	-	-	2	2	-	-	-	3
CO5	3	3	3	2	3	3	2	3	2	-	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), - : No Correlation

6. Text Books

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

7. Reference Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Semiconductor Devices	Robert F. Pierret	Pearson Education	1/e, 1995
2	Advanced Semiconductor Fundamentals	Robert F. Pierret	Pearson Education	2/e, 2002
3	Solid State Electronic Devices	Ben G. Streetman and Sanjay K. Banerjee	Pearson Education	6/e, 2010
4	Solid State Physics	S. O. Pillai	New Age International Publishers	10/e, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	8/e, 2019
6	Advanced Engineering Physics	Premlet B	Phasor Books	10/e, 2017
7	A Textbook of Engineering Physics	I. Dominic and A. Nahari	Owl Books Publishers	2/e, 2016
8	Engineering Physics Practicals.	Rao, B. S., Kesava Vamsi Krishna V, and K. S. Rudramamba.	Laxmi Publications,	2/e, 2013.

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
9	Electronics Lab Manual:Volume I.	Navas, K. A	PHI Learning Pvt. Ltd.,	5/e, 2015.
10	A Textbook of Engineering Physics	Avadhanulu, M. N., and P. G. Kshirsagar.	Chand & Company Pvt. Ltd.,	7/e, 2010.

8. Video Links or any other Reference Materials

Sl No	Details Like Weblink, 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. Continuous Assessment – Laboratory Evaluation (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.)

10. Evaluation Pattern for Lab Examination (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: 26ANNBS102 Course Name: Engineering Physics -A			
Programme : CSE/CSD			
Max. Marks: 60		Duration: 2 Hours 30 Minutes	
PART A			
Q. No	***Answer all questions. Each question carries 3 marks***	**CO**	**Marks**
1	Define Fermi level? Show the graphical representation of Fermi energy with fermi function at T=0 and T>0.	CO1	(3)
2	Define critical temperature and critical magnetic field? Give	CO1	(3)

		their relation.		
3		An electron has a speed of **1.05×10^4m/s** with an accuracy of **0.02%**. Calculate the uncertainty in the position of electron?	CO2	(3)
4		Describe the phenomena of Quantum mechanical tunnelling.	CO2	(3)
5		Differentiate intrinsic and extrinsic semiconductors.	CO3	(3)
6		Explain the current flow across a p-n junction when it is forward biased.	CO3	(3)
7		Distinguish between p-n junction diode and Zener diode.	CO4	(3)
8		What are photodiodes? Draw the symbol and explain how they work.	CO4	(3)
PART B				
Answer any one full question from each module. Each full question carries 9 marks				
Module 1				
9	a)	What is Fermi-Dirac distribution function? Obtain its value at 0K for energy levels i) greater than Fermi energy and ii) less than Fermi energy.	CO1	(6)
	b)	Explain the classification of materials based on band theory.	CO1	(3)
10	a)	Compare Type I and Type II superconductors with proper figures. Write two examples for both.	CO1	(6)
	b)	Find the critical field of a super conducting material at 0K if the critical field at 7K is 3×10^4A/m. The critical temperature for the material is 12K.	CO1	(3)
Module 2				
11	a)	Write the Schrodinger equation, state the boundary conditions of its solution and show that the energy levels are quantized for a quantum particle confined to an infinite deep potential well having finite width.	CO2	(6)
	b)	Find the de Broglie wavelength of a bullet of mass 4g moving with speed 150 m/s.	CO2	(3)
12	a)	Derive time independent Schrodinger's wave equation starting from the time dependent Schrodinger wave equation.	CO2	(7)
	b)	What voltage should be applied to an electron microscope to produce electrons of wavelength 0.50Å?	CO2	(2)
Module 3				
13	a)	What are intrinsic semiconductors? Derive expression for the intrinsic carrier concentration by using the equations of density of free electrons and holes. What are the main points that can be inferred from the above equation about the variation of intrinsic carrier concentration with temperature.	CO3	(6)

	b)	Derive the expression for Fermi Energy in an intrinsic semiconductor at 0K.	CO3	(3)
14	a)	A silicon sample is doped with donor concentration 5×10^{15} cm^{-3} at 25^0C. Assume intrinsic carrier concentration is 1.5×10^{10} cm^{-3}. Calculate the equilibrium hole concentration in the silicon sample at 25^0C. Assume complete ionization of donors.	CO3	(3)
	b)	What are intrinsic semiconductors? Derive expression for the intrinsic carrier concentration by using the equations of density of free electrons and holes. What are the main points that can be inferred from the above equation about the variation of intrinsic carrier concentration with temperature	CO3	(6)
Module 4				
15	a)	What is a tunnel diode? Write any four applications of a tunnel diode.	CO4	(7)
	b)	What is a photo diode? Explain the construction and working of a PIN photodiode.	CO4	(2)
16	a)	Draw the I-V characteristics of a solar cell and explain the terms efficiency and fill factor	CO4	(5)
	b)	How does the stringing of solar cells (series and parallel) affect the output of a solar panel?	CO4	(4)

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