



K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

WINTER-2024	
Exam Seat No.:	
Academic Year:2024-2025	Semester: I
Class: FY	Program: B. Tech
Branch Code: FYE	Pattern: 2023
Name of Course: Applied Physics-A	Course Code: 2300103A
Max. Marks:60	Duration:2.30 Hrs.

Instructions:

Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

- 1.This question paper contains 2 page(s).
- 2.Answer to each new question is to be started on a new page.
- 3.Assume suitable data wherever required, but justify it.
- 4.Draw the neat labelled diagrams, wherever necessary.
- 5.The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

6.Constants: - charge of electron and proton = 1.6×10^{-19} C

Velocity of light = 3×10^8 m/s

Permeability of air $\mu_0 = 4\pi \times 10^{-7}$ H/m

Mass of electron = 9.1×10^{-31} kg

Mass of proton = 1.67×10^{-27} kg

Mass of neutron = 1.67×10^{-27} kg

Marks CO

Question No. 1

- 1a) Explain how to use the Cross (\times) and Dot (\cdot) conventions in electromagnetism. (2) CO4
- 1b) A conductor 10 cm long lies perpendicular to a field strength of 1000 A/m. Calculate induced emf in the conductor if conductor is moving with a speed of 1 m/s. (4) CO4

Question No. 2

- 2a) Discuss the application of superconductors in magnetic levitation (MAGLEV) technology and its advantages. (2) CO5
- 2b) Calculate the conductivity of intrinsic silicon used in lab testing at 300 K. The intrinsic carrier concentration is $1.5 \times 10^{10} \text{ cm}^{-3}$, and the mobilities of electrons and holes are $\mu_e = 1350 \text{ cm}^2/\text{Vs}$ and $\mu_h = 480 \text{ cm}^2/\text{Vs}$, respectively. (4) CO5

Question No. 3

- 3a) What is diffraction grating? Explain how it can be prepared? describe the conditions of maxima and minima in diffraction grating? (6) CO1

OR

- 3b) Obtain conditions for maxima and minima due to interference of reflected light in thin transparent film of uniform thickness. (6) CO1
- 3c) With the help of a suitable diagram, explain the working of LCD? (6) CO5

OR

- 3d) What is anti-reflection coating? Explain its principle and application. (6) CO5
- 3e) A plane transmission grating has 5000 lines/cm. Find out the highest order spectrum observed if incident light has $\lambda=6000 \text{ \AA}$. (4) CO4

OR

- 3f) Parallel light (5000 \AA) is normally incident on a single slit. The central maximum fans out at 30° on both sides of the direction of the incident light. Calculate the slit width. (4) CO4

Question No. 4

- 4a) What is de-Broglie's hypothesis of matter waves? Explain the properties of matter waves. (6) CO3

OR

- 4b) What is the definition of a wave function in quantum mechanics, and what are the criteria that define a well-behaved wave function? (6) CO3
- 4c) Derive step-by-step time-dependent Schrödinger equation for a one-dimensional quantum system. (6) CO1

OR

- 4d) Show that the de Broglie wavelength for electron is found to be equal to $\frac{12.27}{\sqrt{V}} \text{ \AA}$. (6) CO1
- 4e) An electron is emitted from a particle accelerator with a speed of 0.5 times the speed of light. What is the de Broglie wavelength? ($m = 9.11 \times 10^{-31} \text{ kg}$). (4) CO5

OR

- 4f) For X-ray diffraction experiments, wavelengths of the order of 0.10 nm are often used. Find the energy in electron volts for a particle with this wavelength if the particle is an electron ($m = 9.1 \times 10^{-31} \text{ kg}$). (4) CO5

Question No. 5

- 5a) Discuss the concept of multi-junction solar cells, including their composition, structure, and working principle. How do multi-junction solar cells improve efficiency compared to single-junction cells? (6) CO2

OR

- 5b) What is a photovoltaic effect? Explain the construction and working of solar cell. (6) CO2
- 5c) How do wind turbines operate, and what are the various configurations of wind farms used to harness wind energy? (6) CO2

OR

- 5d) Explain the working principle of quantum dot solar cells and how the properties of quantum dots make them suitable for photovoltaic applications. How does the band gap of quantum dots vary with their size? (6) CO2
- 5e) Solar cell mounted on roof-top of the house, where insolation on solar cell rectangular module ($1.49 \text{ m} \times 1.98 \text{ m}$) is 551 W/m^2 . If the efficiency of the cells is 11.9%. What is the power output of the module? (4) CO5

OR

- 5f) At the Jaisalmer Wind Park in Rajasthan, the average wind speed is around 7 m/s. A turbine with a blade length of 50 m is installed here, and the local air density is around 1.18 kg/m^3 due to the dry desert climate. Calculate the power generated by the turbine. (4) CO5

..... End of question paper.....