



Continuous Assessment Test (CAT) – II OCTOBER 2025

Programme	: B.Tech (BVD)	Semester	: Fall Semester 2025-26
Course Code & Course Title	: BEVD101L Electronic Materials	Class Number	: CH2025260100500
Faculty	: Dr. Anisha Natarajan	Slot	: C1+TC1
Duration	: 90 minutes	Max. Mark	: 50 marks

General Instructions: Write only your registration number on the question paper in the box provided and do not write other information

- Only non-programmable calculator without storage is permitted
- Useful constants:
 - Electronic charge: 1.602×10^{-19} C
 - Mass of the electron in free space: 9.10939×10^{-31} kg
 - Avogadro's number: 6.0221×10^{23} mol⁻¹
 - Boltzmann constant: 1.3807×10^{-23} J K⁻¹
 - Absolute permittivity: 8.8542×10^{-12} F/m
 - Planck's constant: 6.6261×10^{-34} J s

Answer all questions

Q. No	Sub Sec.	Description	Marks	CO	BT Level
1.		The nuclear potential that binds protons and neutrons of an atom is approximated by an infinite square well potential. A proton is confined in an infinite well of 10 femto meter. Calculate the energy and wavelength of the photon when the proton undergoes a transition from the first excited state to the ground state. Mass of the proton is 1.67×10^{-27} kg.	10	CO2	K4
2.		Consider a two-dimensional electron gas in which the electrons are restricted to move freely within a square area a^2 in the xy plane. Following the procedure for a three-dimensional scenario, estimate the electron density of state function $g(E)$ for the above-mentioned two-dimensional electron gas and show that it is independent of energy.	10	CO2	K4
3.		Gold has an atomic weight of 197 and density of 1.9×10^4 kg/m ³ . The velocity of sound in Gold is 2100 m/s. Using the concept of phonon density of states, estimate the following a) Debye frequency (3 marks) b) Debye temperature (3 marks) c) Plot the Debye constant-volume molar heat capacity curve. What is its significance in the low and high temperature regions? (4 marks)	10	CO3	K4
4.	a)	Spectroscopic ellipsometry measurements on a germanium crystal at a photon energy of 1.5 eV show that the real and imaginary parts of the complex relative permittivity are	10	CO3	K3

		21.56 and 2.772, respectively. Find the complex refractive index. What is the reflectance? (5 marks)			
	b)	Consider a Si photodiode that is designed for operation at 900 nm. Given a choice of two possible antireflection coatings, SiO ₂ with a refractive index of 1.5 and TiO ₂ with a refractive index of 2.3, which would you use? Justify your answer. The refractive index of Si is 3.5. (5 marks)			
5.	a)	A solid contains 5×10^{28} atoms/m ³ each with a polarizability of 2×10^{-40} F m ² . Assuming that the internal field is given by Lorentz formula, calculate the ratio of internal field to the external field. (5 marks)	10	CO4	K3
	b)	The atomic weight and density of sulphur are 32 units and 2.08 gm/cm ³ respectively. The electronic polarizability of the atom is 3.28×10^{-40} Fm ² . If sulphur solid has cubic symmetry, what will be its relative permittivity? (5 marks)			
*****All the best *****					