International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B.Sc. Engineering in EEE

Midterm Examination, Spring 2024

Course Code: **EEE 3607** Course Title: **Solid State Devices**

Time: 1 hour 30 minutes Full Marks: 30

(i) Answer all the questions. The figures in the right-hand margin indicate full marks.

(ii) Course Outcomes (COs) and Bloom's Levels (BL) are mentioned in additional Columns.

CO	CO Statements	PO
CO1	Understand the physics of semiconductor devices regarding carriers, the energy band and their behaviour in solid.	POa
CO2	Develop the designing skill from the idea of carrier transportation in solid and their behaviour in various junctions.	POc
CO3	Understanding the working principle of different devices like FET, BJT, Solar Cell and gain necessary knowledge for device design, fabrication and characterization.	POd

Bloom's Levels (BL) of the Questions						
Letter Symbols	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

1)	a)	Classify solid in terms of their energy bands. How energy band is formed in a semiconductor.	CO1	C4	4
1)	b)	Calculate the concentrations of electrons in a semiconductor using Fermi–Dirac distribution function.	CO1	C5	4
		Show that, an energy state at the Fermi level has a probability of ½ of being occupied by an electron? Draw the *f(E)* vs *E* diagram of Fermi–Dirac distribution function.		C4	2
2)	a)	Derive the diffusion current in a semiconductor.	CO2	C5	4
2)	b)	Derive the relation between electron mobility and diffusion cofficient at equlibrium.	CO2	C4	6
		OR			
2)	a)	Show that, the current density, $J_x = \frac{nq^2t}{m_n^*}\,\varepsilon_x$; where all symbols have their usual meaning.	CO2	C5	4
2)	b)	Explain drift and diffusion of carrier in a solid.		C4	2
		"A measurement of the *Hall Voltage* for a known current and magnetic field yields a value for the hole concentration p_0."- analyse the statement with proper calculation.	CO2	C4	4
3)	a)	Derive the relation $n_n/n_p = e^{(qV_0/kT)}$ for equilibrium condition.	CO2	C5	4
3)	b)	Why contact potential cannot be measured by placing a voltmeter across the devices?	CO2	C4	2
		What is *depletion approximation*? Derive the relationship between the contact potential and width of the depletion region.		C4	4