Jashore University of Science and Technology

Department of Physics

Bachelor of Science in Physics

4th Year 2nd Semester Examination 2019

Admission Session: 2015-2016 **Academic Session: 2018-2019**

Course Code : PHY 4209 **Course Title : Superconductivity**

Time: 3 hours **Full Marks: 72**

(Marks allotted are indicated in the right margin)

There are **8 (eight)** questions. Answer any **6 (six)**. Symbols have their usual meaning.

1.	a.	What is superconductivity? Explain the dependency of superconductivity of a material on temperature and applied magnetic field.	6
	b.	Type-I superconductors exhibit perfect diamagnetism. Discuss the origin of this property and show the magnetization behavior of the superconductor with an appropriate sketch.	6
2.	a.	Derive the expression of specific heat of superconductor from Gibbs free energy. Hence show that normal-superconductor phase transition is of second order.	7
	b.	Write a short note on two fluid model of superconductor. Explain the change in specific heat in normal-superconductor transition using two fluid model.	5
3.	a.	Give an account of London theory of superconductor.	5
	b.	Write a short note on Meissner effect. From London theory prove that superconductor exhibits Meissner effect.	5
	c.	Define London penetration depth λ_L. Show that λ_L has the dimension of length.	2
4.	a.	Write down the free energy expression of the Ginzburg-Landau theory. Explain the significance of different terms in the energy expression.	7
	b.	Derive the expression of order parameter involved in Ginzburg-Landau theory in one dimension in the absence of field.	5
5.	a.	From Ginzburg-Landau theory show that flux inside a superconducting ring is quantized. Hence find the value of flux quantum.	5
	b.	What is Josephson effect in superconductor? From Ginzburg-Landau theory show that the dc Josephson effect depends on the phase difference of the order parameter of the two superconductors.	7
6.	a.	Write short notes on (i) BCS theory of superconductor and (ii) Cooper pair.	5+3
	b.	Define type-II superconductor and mixed state.	4
7.	a.	What is Abrikosov lattice? Explain why in Abrikosov lattices the vortices do not move though they repel each other?	2+3
	b.	Draw the structure of a cuprate superconductor and discuss its properties.	7
8.	a.	Discuss the use of superconductor in (i) superconducting quantum interference device (SQUID), (ii) high energy accelerators and (iii) fusion reactors.	12