Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Condensed Matter Physics II **Semester: III**

Program: MSc (Physics) **Time: 03 hours**

Course Code: PHYS 8018 **Max. Marks: 100**

Instructions:

- All questions are compulsory (**Q9** and **Q11** have an internal choice).
- Scientific calculators can be used for calculations.

SECTION A
(5Q x 4M = 20 Marks)

S. No.		Marks	CO
Q1	What do you understand by annihilation and creation operator?	**4**	**CO1**
Q2	Write down essential features of electron-phonon coupling constant.	**4**	**CO1**
Q3	What is crystal field effect?	**4**	**CO2**
Q4	How is time reversal symmetry different in quantum mechanics than that in classical mechanics?	**4**	**CO3**
Q5	Explain Quantum Hall effect with the help of mathematical expression.	**4**	**CO5**

SECTION B
(4Qx10M= 40 Marks)

Q6	What are the advantages of occupation number representation with examples?	**10**	**CO1**
Q7	Discuss the effect of octahedral and tetrahedral environments on the orbital interaction.	**10**	**CO2**
Q8	Explain fractional quantum Hall effect with relevant examples.	**10**	**CO5**

Q9	Write down the Hamiltonian for Heisenberg exchange interaction and discuss the long-range magnetic ordering. **OR** Describe metamagnetic transition. What do you understand by spin-flip and spin-flop transitions for an antiferromagnetic material?	**10** **10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q10	a) Discuss the important properties of a topological semiconductor. b) Elaborate the salient features of Dirac semi-metals.	**10** **10**	**CO4**
Q11	a) What is quantum criticality and non-Fermi liquid behavior? b) What do you understand by time reversal symmetry in condensed matter? **OR** a) Explain parity transformation and its applicability on different operators. b) Describe Kondo effect and heavy fermion behaviors.	**10** **10** **10** **10**	**CO3**