Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

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

Program: Int. BSc-MSc (Physics) **Time: 03 hours**

Course Code: PHYS 3036 **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 is Fermi liquid behavior? Give example.	**4**	**CO1**
Q2	Describe electron-phonon interaction by illustrating the emission and absorption of phonons.	**4**	**CO1**
Q3	What do you understand by molecular field theory in case of magnetism?	**4**	**CO2**
Q4	Illustrate Doniach phase diagram with schematics.	**4**	**CO3**
Q5	How will you differentiate between classical and quantum Hall effect?	**4**	**CO5**

SECTION B

(4Qx10M= 40 Marks)

Q6	What is occupation number? Explain benefit of occupation number representation over a Slater determinant? Write Slater determinant for a system of two particle systems.	**10**	**CO1**
Q7	What is field-induced metamagnetic transition? What is the origin on nuclear spins and discuss its contribution to the magnetization.	**10**	**CO2**

Q8	Elaborate integral quantum Hall effect with the help of a diagram. Make a comparison with the fractional Quantum Hall effect.	**10**	**CO5**
Q9	Elaborate crystal electric field splitting of free *d*-ions in octahedral and tetrahedral environments. **OR** Discuss magnetic susceptibility of a single crystal with the help of a diagram for antiferromagnetic materials. Why is the susceptibility along the easy axis different from that along the hard axis?	**10** **10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q10	a) Describe the salient features of a topological insulator. b) Discuss Weyl semi-metal behavior on the basis of experimental observation.	**10** **10**	**CO4**
Q11	a) What do you understand by a quantum phase transition? Discuss the scaling behavior near a quantum critical point. b) What is time reversal symmetry? How can it be applied to condensed matter physics? **OR** a) What do you understand by parity transformation in condensed matter physics? What are pseudo-vectors and pseudo-scalars? Give examples. b) Elaborate different aspects of heavy fermion and non-Fermi liquid systems.	**10** **10** **10** **10**	**CO3**