RAN-2103000206021001

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B.Sc. (Sem. VI) Examination September - 2023

Physics : PH-606

Classical Mechanics and Solid State Physics

[Total Marks: 50

સૂચના : / Instructions

(૧) **નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.**
Fill up strictly the details of ☛ signs on your answer book

Name of the Examination:

☛ **B.Sc. (Sem. VI)**

Name of the Subject :

☛ **Physics : PH-606 : Classical Mechanics and Solid State Physics**

Subject Code No.: **2103000206021001**

Seat No.:

Student's Signature

(2) Draw neat diagrams wherever necessary.
(3) Symbols used in the paper have their usual meaning.
(4) Figures to the right indicate full marks of the question.
(5) Scientific calculator may be used.

Q. 1 Answer briefly: (10)

1) On which factor shape of the Fermi surface depends? Is it exact circle?
2) Distinguish electron like and hole like orbit in reciprocal space with reference to brillouin zones.
3) What are the Euler angle?
4) Is moment of inertia a scalar quantity?
5) Define cooper pairs?
6) Classify type I and type II semi conductors from the following
Hg, Zn, NbTi, $pbMo_6S_8$
7) What is an inertial frame of reference?
8) Give some phenomenon arising due to coriolis force.
9) Distinguish between a symmetric top, spherical top & asymmetric top.
10) Write down the equation of constrain for rigid body?

Q. 2 Attempt any one of the following in details: (7)

(a) A frame of reference is fixed with the surface of earth. Is it inertial or non inertial ? Derive the equation of Galilean transformation equations for space time coordinates. Show that acceleration remain invariant under Galelian transformation.

(b) Discuss rotating co-ordinate systems and obtain expression for effective force acting on a body accelerating in a uniformly rotating frame.

Q. 2 Attempt any one of the following: (3)

(a) A river is flowing northward with a horizontal velocity of 3 km/hour in the northern hemisphere .what is the effect of corilis force on every 1000 kg water flowing, which arises due to rotation of earth at latitude 45°.

(b) How does the coriolis force affect the flow of the wind ?

Q. 3 Attempt any one of the following in details: (7)

(a) Find the moment of inertia of a thin uniform rectangular plate of mass m, side 'a' and 'b', relative to the axis which is parallel to the side 'a' and passes through one of its end.

(b) Obtain Euler's equation of motion for rigid body.

Q. 3 Attempt any one of the following: (3)

(a) Show that the moment of inertia of spherical shell having a mass M and internal and external radii r_1 and r_2 is $\frac{2M}{5}\left[\frac{r_2^5 - r_1^5}{r_2^3 - r_1^3}\right]$

(b) A merry-go-round at a play ground is rotating at 2 rev/min. Three children jump on and increase the moment of inertia of the merry-go-round by 10%. Find the new angular velocity of the merry-go-round.

Q. 4 Attempt any one of the following in details: (7)

(a) Explain construction of Fermi surface. Draw in k-space first three brillouin zone of a square lattice. Mapping the first three brillouin zone in the reduce zone scheme.

(b) Describe Harrison's construction of free electron Fermi surface in two dimension.

Q. 4 Attempt any one of the following: **(3)**

(a) Draw the three types of orbits diagram in a magnetic field of the wave vector of an electron on the Fermi surface. Define hole orbits.

(b) Explain reduced zone scheme.

Q. 5 Attempt any one of the following in details: **(7)**

(a) Explain the thermodynamics of the super conducting transition and obtain the expression for stabilization energy density of the super conducting state at absolute zero.

(b) Derive London equation and give their significance.

Q. 5 Attempt any one of the following: **(3)**

(a) Distinguish between type I and type II superconductors.

(b) The number density of free electrons in aluminum is 1.6×10^{29} m^{-3}. Calculate the penetration depth predicted by the London model, assuming that all of the free electrons are superconducting.
$m_e = 9.1 \times 10^{-31}$ kg, $\mu_0 = 4\pi \times 10^{-7}$ SI, $e = 1.6 \times 10^{-19}$ C.

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