CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE,

NUVEM – GOA.

B.Sc. CBCS Semester V (Regular) Examination, January 2022

Sub. Code: PYC105 Sub. Name: Classical Mechanics & Thermal Physics

Total marks: 80 Duration: 2 hours Total no. of pages: 03

Instructions:

1) All questions are compulsory. Internal choices are available.
2) Figures to the right indicate full marks.
3) Symbols have their usual meaning, unless otherwise stated.

Q.1 Answer any four: **(4x4=16)**

1) In a central force field, eccentricity of the orbit of Mars is 0.093. Find the ratio of aphelion to perihelion. Give two features of a central force.

2)An α-particle with an initial velocity 10^6 m/s is scattered through an angle of 90° (almost) when incident normally on a thin gold foil of silver. Find the impact parameter. Given: e= 1.6×10^{-19} C, charge on α-particle is 2e, atomic number of silver = 47, mass of α-particle =6.68×10^{-27} kg.

3) Show that a point in phase space corresponds to a cell of volume $\hbar^3$.

4) Explain the terms: 1) a priori probability 2) thermodynamic probability

5) The forces acting on four particles of masses 0.5kgs,0.6kgs,0.8kgs and 0.4kgs are (3i+j), (4j),6i+3j) and (5i-2j) Newtons. Find the resultant force and acceleration of the centre of mass.

6) A single stage rocket has the ratio of initial and final mass as 10. The fuel gets exhausted in 20 seconds. If the exhaust velocity is 2.2×10^3 m/sec. Calculate the final velocity of the rocket (rocket starts from rest).

Q.2 Answer any four: **(4x4=16)**

1) Show that in an inertial frame of reference Newton's laws of motion are invariant.

2) Give 3 properties of Liquid He II. What is meant by lambda point?

3) Briefly explain the process of cooling by adiabatic demagnetisation with a neat diagram

4) Indian cricket captain went for a toss 6 times, in six different games and, every time he called for a head. What is the probability that he wins the toss three times?

5) If the probability of unfavourable reaction from a covid vaccine is 3 per 1,00,000 population. What is the probability that out of 200000 people chosen at random in a city more than two will react unfavourably.

6) Briefly describe the experiment performed by Zartman and Co for molecular distribution of velocities in gas molecules.

Q.3

A) For a particle acted upon by central force inversely proportional to radius square, obtain the equation of the orbit. **6**

OR

A) Derive the expression for effective potential energy of a particle in a central force field.

B) Show that a two body problem can be converted into a single body problem under certain conditions. **6**

Q.4

A) Derive the relationship between the velocities in the coordinate frame of reference S at rest and a frame S * rotating with respect to S frame, having a common origin O. **6**

OR

A) Arrive at the expression for Poisson distribution from the expression for Binomial distribution.

B) Obtain the expression for mean and standard deviation of a binomial distribution

6

Q.5

A) Obtain the expression for the efficiency of the Otto engine. 6

OR

A) Obtain the expression for Joule-Thomson coefficient of cooling (μ).

B) Explain the principle of working of the vapour compression engine. What is the role of the throttling valve in it? 6

Q.6

A) Obtain the expression for most probable distribution for N balls thrown at random in k cell. 6

OR

A) What is meant distinguishable and indistinguishable particles?

What is meant by bosons and fermions? Give 2 points of difference between them. Support this explanation with examples

6

B) Describe the process of regenerative cooling used for liquefaction of gases. 6

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