CSM : 18

PHYSICS

PAPER - I

Time Allowed : 3 hours | Full Marks : 100

Marks for each question is indicated against it.

Attempt any 5 (five) questions taking not more than 3 (three) questions from each Part.

PART - A

1. (a) A reference frame 'a' rotates with respect to another reference frame 'b' with an angular velocity w. If the position, velocity and acceleration of a particle in reference frame 'a' are represented by $\vec{r}$, $\vec{v}_a$, $\vec{a}_a$ then show that acceleration in frame 'b' is given $\vec{a}_b = \vec{a}_a + 2\omega\vec{v}_a + \vec{\omega}(\vec{\omega}.\vec{r}) + \frac{d\vec{\omega}}{dt}.\vec{\omega}$. Explain the physical significance of various terms in the above expression and show that Coriolis force and centrifugal forces are consequence of rotation of the frame of reference. **(8+6=14)**

(b) Prove that a central force is a conservative force and a conservative force can be expressed as a negative gradient of potential. **(3+3=6)**

2. (a) What is rotational invariance of space? Show that the property of rotational invariance of space leads to the law of conservation of angular momentum. **(10)**

(b) Calculate the moment of inertia of a solid cone of mass *M*, height *h*, vertical half angle a and the radius of the base *r*, about an axis through its vertex and parallel to its base. What changes happen to the moment of inertia if the axis is shifted from the vertex to the diameter of the base, keeping all other parameters unchanged. **(10)**

3. (a) Describe Michelson-Morley experiment with the help of a neat diagram and explain the significance of negative results. **(10+2=12)**

(b) What are the basic postulates of Einstein's special theory of relativity. **(2+6=8)**

4. (a) Write down the various microstate sand the macrostates for a system of three particles in two compartments when the particles are distinguishable. **(8)**

(b) What is phase space? What is the minimum size of a phase space cell in classical and quantum mechanics? **(8)**

(c) Justify the application of Maxwell - Boltzmann statistics to an ideal gas. **(4)**

PART - B

5. (a) Explain the meaning of forced oscillations? Find an expression for the amplitude at resonance in the case of a damped vibration. **(1+6=7)**

(b) State Fermat's principle. Show how reflection and refraction can be established using Format's Principle. **(1+3+3=7)**

(c) Explain the terms spherical and chromatic aberrations. Give the methods to reduce spherical aberration. **(2+2+2=6)**

6. (a) What is meant by interference of light? State the conditions for producing sustained interference fringes. Derive an expression for the fringe width in an interference pattern and show that it is directly preportional to the wavelenght of the light used. **(2+2+5+1=10)**

(b) What is Fraunhofer diffraction? Discuss with necessary theory the intensity distribution in a single slit diffraction pattern, and hence show that the width of the central and the secondary maxima are in the ratio of 2:1. **(1+4+3+2=10)**

7. (a) An alternating e.m.f. $E_o \sin wt$ is applied to ends of circuit containing L, C and R connected is series. Calculate the impedance of the circuit, phase angle and the current at any instant. Find the condition for resonance in this circuit. Why a series resonant circuit is called a acceptor circuit. **(2+2+3+2+2=11)**

(b) State Biot-Savart's law. Using this law find the force between two parallel straight curent carrying conductors. Use the result thus obtained to define "an ampere". **(2+5+2=9)**

8. (a) Establish Planck's radiation law and obtain Wien's displacement law and Raleight -Jeans law as its limiting case. **(2+2+2=6)**

(b) What are normal and anomalous dispersion? Discuss briefly the theory of normal dispersion. **(2+2+2=6)**

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