

Tribhuvan University

2077

Bachelor Level 4 Yrs. Prog./1st Year/Science & Tech.

Physics (Phy.101)

Full Marks: 100

(Mechanics, Thermodynamics and Statistical Physics, Electricity & Magnetism)

Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

New Course

Attempt ALL the questions.

1. Describe the motion of a particle under central force. Give two examples of conservation of angular momentum under central force.

OR

[10]

Discuss kinematics of moving fluid by giving equation of continuity and hence explain streamline and turbulent flow. Find the expression for critical velocity.

2. Explain quasi-static, isothermal, adiabatic, isobaric and isochoric processes in the thermodynamical system. Explain the importance of internal energy in these processes.

OR

[10]

3. Discuss spectral energy density for black body radiation. Define emissive and absorptive power and hence discuss Kirchhoff's law.

4. Give reciprocity theorem of mutual inductances. Find the expressions for self inductance of a solenoid and two long parallel wires.

OR

[10]

5. Explain polar and non-polar molecules. Find expression for electric field due to a polarized dielectric (three electric vectors) and hence discuss dielectric polarization effect.

6. Find the expression for gravitational potential and gravitational field due to (a) a thin spherical shell and (b) due to a solid sphere.

7. Describe first and second latent heat equations. What do you mean by triple point? Discuss triple point of water.

2
6. Describe four Maxwell equations and derive and explain plane wave solution of it. [8]

7. Solve any TWO questions [2×3=6]

1. 5. (a) What is Cantilever?

(b) Explain the process of liquefaction of Helium.

(c) Discuss Maxwell's distribution law of velocities.

(d) Explain power factor in AC circuits.

8. Solve all the questions [4×2.5=10]

(a) Explain the concept of division of phase space into cells.

(b) What do you mean by diffusive radiation?

(c) Explain Helmholtz resonator.

(d) Explain energy loss due to hysteresis.

2 9. A gas bubble of diameter 2 cm rises steadily through a solution of density 1.75g/cc at the rate of 0.75 cm/s. Calculate the coefficient of viscosity of the solution (assume that the density of gas is negligible) [5]

H 10. The speed of a particle moving along the x axis of the (x, y) plane is $v = (14 - 8t + t^2)$ m/s where t is in seconds. Calculate the average acceleration from $t = 1$ s to $t = 4$ s. [5]

11. Calculate the total change in entropy if 4000 J of heat transfer occurs from a hot reservoir at 327°C to a cold reservoir at -23°C , assuming there is no temperature change in either reservoir. [5]

12. Four particles are to be distributed in two cells. Find the number of microstate. [5]

2 13. Find the image charge of a real charge q when placed at distance y from the center of a conducting sphere of radius 'a'. [5]

H 14. A coil of 100 turns and area 5 square cm is placed in a magnetic field $B = 0.2$ T. The normal to the plane of the coil makes an angle of 60° with the direction of the magnetic field. Calculate the magnetic flux linked with the coil. [5]

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P.T.O.

Old Course

Attempt ALL the questions.

1. What do you mean by central force? Describe the motion of a particle under central force. Give an example of conservation of angular momentum under central force.

OR

[10]

What do you mean by the damped oscillator and N-coupled oscillator? Describe the oscillation of two particles connected by a spring.

2. How entropy changes in reversible and irreversible process? give principle of increase of entropy as described by second law of thermodynamics. How third law of thermodynamics describe the entropy? Discuss.

OR

[10]

What do you mean by regenerative cooling and cascade cooling? Describe cooling in Joule-Thomson expansion.

3. State reciprocity theorem of mutual inductances and discuss it. Find the expressions for self inductance of a solenoid and two long parallel wires.

[10]

OR

Describe four Maxwell equations and derive and explain plane wave solution of it.

4. Distinguish between streamline and turbulent flow of fluid. Find the expression for critical velocity. [8]
5. Describe Helmholtz's and Gibb's function. Describe the conditions for constants of enthalpy. [8]
6. Discuss Biot-Savart's law and its applications. [8]

7. Solve any TWO questions

[2×3=6]

- (a) Discuss non-conservative forces with examples.
- (b) Explain isochoric and isobaric processes in a thermodynamical system.
- (c) What do you mean by canonical ensemble?
- (d) Explain Stocke's theorem.

8. Solve All the questions [4×2.5=10]
(a) Explain the concept of division of phase space into cells.
(b) What do you mean by diffusive radiation?
(c) Describe Bernoulli's theorem.
(d) Explain the terms magnetic susceptibility and permeability.
9. Find the ratio of magnitudes of the maximum particle velocity of a progressive wave $y = a \sin (kx - \omega t)$ to its phase velocity. [5]
10. A rope of breaking strength 43 N is used to lower a 5 kg object from a roof. What will be the maximum acceleration of the object without breaking the rope? [5]
11. The filament of a light bulb is cylindrical with length $l = 30$ mm and radius $r = 0.05$ mm. The filament is maintained at a temperature $T = 6000$ K by an electric current. The filament behaves as a black body, emitting radiation isotropically. At night, you observe the light bulb from a distance $D = 5$ Km with the pupil of your eye fully dilated to a radius $p = 5$ mm. (a) What is the total power radiated by the filament? (b) How much radiation power enters your eye? [5]
12. Spherical waves are emitted from a 1.0 W source in an isotropic non absorbing medium. What will be the wave intensity at 1 m from the source? [5]
13. A metal ball of radius = 1.5 cm has a charge $q = 10 \mu\text{C}$. Find the modulus of the vector of the resultant force acting on a charge located on one half of the ball. [5]
14. Use Maxwell equation to find the impedance (value of Z in ohm) of electromagnetic wave in the free space. [5]

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