KATHMANDU UNIVERSITY
End Semester Examination
March/April, 2025

Level : B.E.
Year : I
Time : 2 hrs. 30 mins.

07 APR 2025

Course : PHYS 101
Semester : I
F. M. : 40

SECTION "B"
[5Q ×3= 15 marks]

Attempt *ALL* questions.

1. What is ballistic pendulum? Explain, how it can be used to find the muzzle velocity of a bullet.

OR

What is ideal fluid? Establish the Bernoulli's equation of an ideal fluid flowing across a pipe of non-uniform cross-section.

2. State and prove work-kinetic energy theorem for a variable force in one dimensional motion.

3. What do you mean by polarization of light? State Brewster's law for polarized light by reflection. Also show that reflected and refracted are perpendicular to each other when reflected light is completely plane polarized.

OR

What is laser? How can it be produced? Write two applications of laser.

4. Starting from the Planck's formula for black body radiation, obtain the Wein's displacement law.

5. Unpolarized light travelling in a liquid with refractive index μ is incident on the surface of the liquid, above which there is air. If the light incident on the surface at an angle of 31.2° with respect to the normal, the light reflected back into the liquid is completely polarized.
   a. What is the refractive index of the liquid?
   b. What angle does the refracted light travelling in air make with the normal to the surface?

OR

Assume that limits of the visible spectrum are arbitrarily chosen as 430 nm and 680 nm. Design a grating that will spread the first order spectrum through an angular range of 20°.

P.T.O.

SECTION "C"

[5Q ×5= 25 marks]

6. Obtain the Newton's second law of motion for the system of variable mass and hence derive the equation of rocket.

OR

Establish the equation of motion for a forced oscillation and solve it. Obtain the condition for resonance and derive the amplitude at the resonance.

7. State parallel axes theorem of moment of inertia. Find the moment of inertia of a solid sphere of radius R and uniformly distributed total mass M about (i) diameter and (ii) about a tangent.

8. A projectile is fired from a gun at an angle of 45° with the horizontal and with a muzzle speed of 457.2 m/s. At the highest point in its flight the projectile explodes into two fragments of equal masses. One fragment, whose initial speed is zero, falls vertically. How far from the gun does the other fragment land, assuming a level terrain?

OR

A hypodermic syringe contains a medicine having density of water. The barrel of the syringe has a cross-sectional area $"A = 2.50 \times 10^{-5} m^2$, and the needle has cross-sectional area $a = 1.00 \times 10^{-8} m^2$. In the absence of a force on the plunger, the pressure everywhere is 1 atm. A force F of magnitude 2.00 N acts on the plunger, making medicine squirt horizontally from the needle. Determine the speed of the medicine as it leaves the needle's tip.

9. Define center of mass. Locate the center of mass of homogeneous semi-circular disc of radius R.

10. Explain the phenomenon of Fraunhoffer's diffraction through N-slits. Plot an intensity distribution graph for 6-slits system.

OR

Consider two waves each of angular frequencies ω and amplitudes $a_1 \, and \, a_2$ are superposed to each other. Both the waves have constant phase difference of δ. Find the amplitude of resultant wave after superposition. Explain the condition for maximum and minimum intensities. What would happen when both the wave has same amplitudes each of a_0? Give