National University of Computer and Emerging Sciences
Islamabad Campus

Applied Physics (NS1001)

Final Exam

Course Instructor(s):
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Section(s): CS(A,B,C,D,E,F,G,H,J)& DS(A,B)

Total Time (Hrs): 3
Total Marks: 150
Total Questions: 5

Date: Dec 26, 2025

Roll No **Course Section** **Student Signature**

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Attempt all the questions.

[CLO 1: Use knowledge of scalars and vectors quantities along with operation of basic operators on it to help them in computer graphics.]

Question 1 [10+10]

(i) A radar station locates a sinking ship at range 17.3 km and bearing 136° clockwise from north. From the same station, a rescue plane is at horizontal range 19.6 km, 153° clockwise from north, with elevation 2.20 km.(a) Write the position vector for the ship relative to the plane, letting $\hat{\imath}$ represent east, $\hat{\jmath}$ north, and $\hat{k}$ up.(b) How far apart are the plane and ship?

(ii) Find the directional derivative of $\nabla.(\nabla f)$ at point (1, -2, 1), where $f = 2x^3y^2z^4$ is in the direction of vector A= [1, -4, 2]

[CLO 2: Use oscillations and analyze different types of waves graphically & mathematically.]

Question 2[5+10+10+10]

(i) A simple pendulum having a length 2.23m and a mass of 6.74 kg is given an initial speed of 2.06m/s at its equilibrium position. Assume it undergoes simple harmonic motion. Determine its period, total energy and maximum angular displacement?

(ii) For a damped oscillator system with mass m = 0.4 kg, spring constant k = 120 N/m, and damping constant b = (0.08 kg/s). What is the ratio of the oscillation amplitude at the end of 25 cycles to the initial oscillation amplitude?

(iii) For the given transverse wavefunction find the transverse speed and transverse acceleration of an element of a medium at (1,1).

$y(x, t) = (2.00\ \text{mm})[(20m^{-1})\,x - (4s^{-1})t]^{0.5}$

(iv) Two waves are described by

$$y_1 = 0.3\cos(5\pi x - 200\pi t)$$

$$y_2 = 0.3\cos(5\pi x + 200\pi t + \pi/3)$$

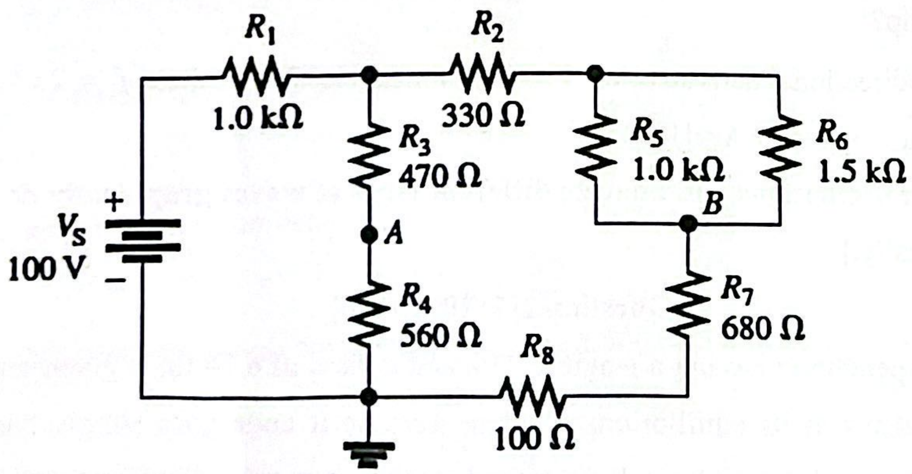
Where y_1, y_2, and x are in meters and t is in second. By using principle of superposition find (a) the resultant wave, (b) the position of first three nodes and three antinodes.

Use $\cos\alpha + \cos\beta = 2\cos\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$

[CLO:3 Define basic concepts of semiconductor physics to help them in advance course of digital logic design.]

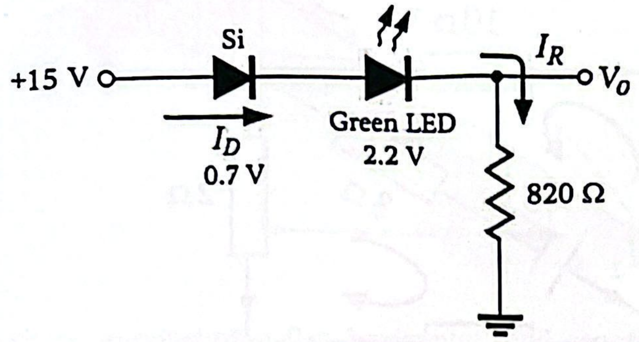
Question 3 [10+5+5+5+10]

(i) Determine the voltage, V_{AB}.

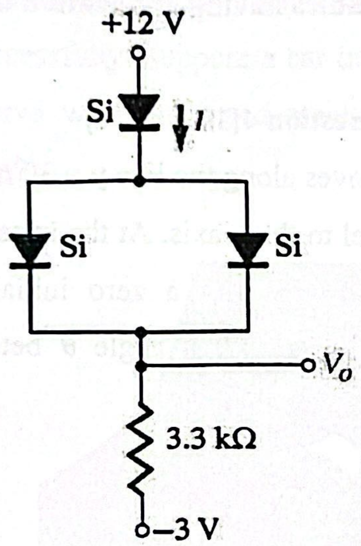


(ii) In the given figure below, silicon diode and a green LED are connected in series with a resistor across a 15 V DC supply. Forward voltage drop of the silicon diode = 0.7V, green LED = 2.2V and Resistance $R = 820\ \Omega$. Assume both diodes are forward biased and operate under the constant voltage drop model. Determine the diode current

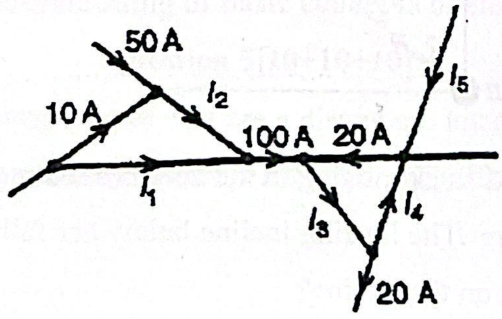
I_D flowing through the circuit and the output voltage V_o across the resistor.



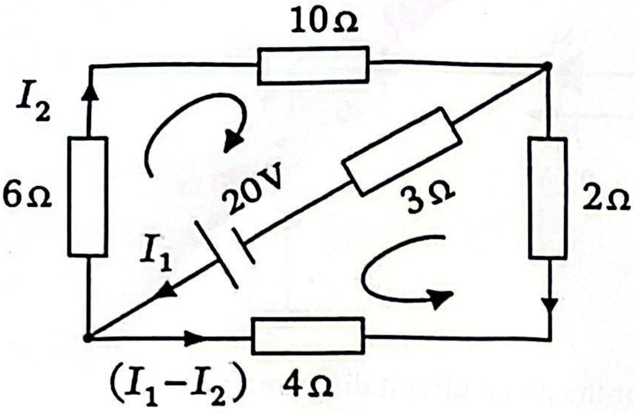
(iii) Determine V_O and I for the given circuit diagram.



(iv) Find the unknown currents in the given figure.



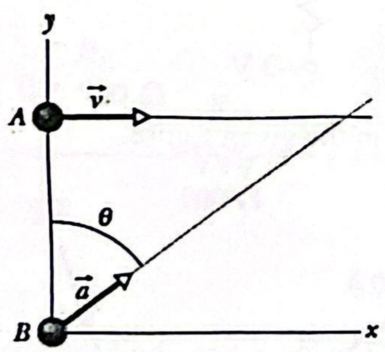
(v) Find the current flowing in the 3 Ω resistor for the network shown below. Find also the potential drop across the 10 Ω and 2 Ω resistors.



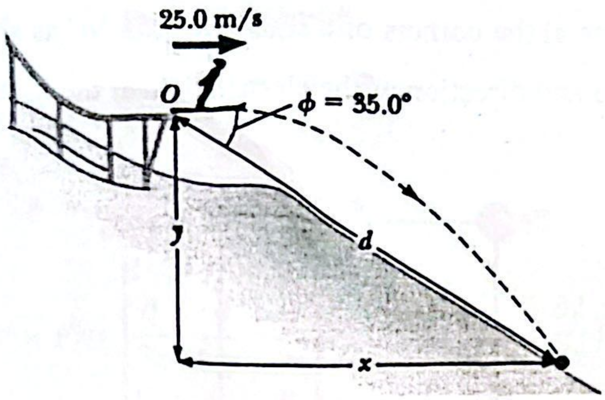
CLO:4 Use the Newtonian Mechanics having application in game programming along with simulations.]

Question 4[10+10+10]

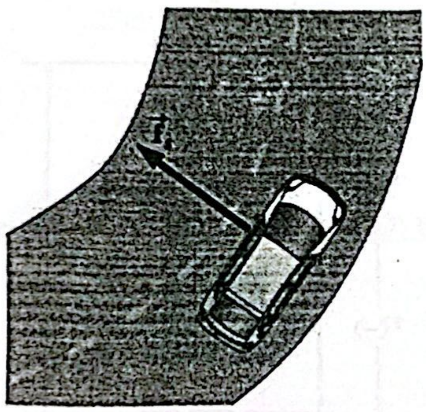
(i) In Figure below, particle 'A' moves along the line y = 30 m with a constant velocity $\vec{v}$ of magnitude 3.0 m/s and parallel to the x axis. At the instant particle 'A' passes the y axis, particle 'B' leaves the origin with a zero initial speed and a constant acceleration $\vec{a}$ of magnitude 0.40 m/s². What angle θ between $\vec{a}$ and the positive direction of the y axis would result in a collision?



(ii) A ski jumper leaves the ski track moving in the horizontal direction with a speed of 25.0 m/s as shown in Figure .The landing incline below her falls off with a slope of 35.0°. Where does she land on the incline?



(iii) A 1500-kg car moving on a flat, horizontal road negotiates a curve as shown in Figure. If the radius of the curve is 35.0 m and the coefficient of static friction between the tires and dry pavement is 0.523, find the maximum speed the car can have and still make the turn successfully. Suppose a car travels this curve on a wet day and begins to skid on the curve when its speed reaches only 8.00 m/s. Calculate the coefficient of static friction?



[CLO:5 Obtain understanding of basic concepts of electromagnetism.]

Question 5[10+10+10]

(i) Two free point charges +q & +4q are a distance L apart. A third charge is placed so that entire system is in equilibrium. Find sign, magnitude and location of the third charge.

5. Period:

   $T = 2\pi\sqrt{\frac{m}{k}}$ (period), $T=2\pi\sqrt{\frac{l}{g}}$

For Damped SHO

6. Position with damping:
   $x(t) = x_m e^{(-bt/2\,m)} \cos(\omega' t + \phi)$
7. Modified Angular Frequency:

   $$\omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$$

8. Energy over time:
   $E(t) \approx 1/2 k x_m{}^2 e^{(-bt/m)}$
   Or
   $E(t) = E_0 e(-t/\tau)$ where $\tau = m/b$

Waves and Interference

1. Sinusoidal Function.

   $$y(x,t) = y_m \sin(kx - \omega t)$$

2. Sinusoidal function with phase constant

   $$y(x,t) = y_m \sin(kx - \omega t + \Phi)$$

3. angular wave number

   $$k = \frac{2\pi}{\lambda}$$

4. Angular frequency, frequency and Time period relation

   $$\frac{\omega}{2\pi} = f = \frac{1}{T}$$

5. Wave speed

   $$v = \frac{\omega}{k} = \frac{\lambda}{T} = \lambda f$$