



INSTITUT D'ENSEIGNEMENT SUPÉRIEUR DE RUHENGRI

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CAT FOR WAVES AND OPTICS

FACULTY: FET	
PROGRAMME/DEPARTMENT: REE&EPE	
OPTION: REE&EPE	Year: 2026
MODULE CODE: PHY8123	MODULE TITLE: Waves and Optics
DATE: 21/09/2026	SESSION: March Intake
DURATION: 3h	TOTAL MARKS: 50
EXAMINER/LECTURER: Dr NDIZIHIWE Prosper	MODERATOR(S): Dr. NDIZIHIWE Prosper

INSTRUCTIONS TO THE CANDIDATE/STUDENT

This Exam has THREE Sections:

SECTION A is compulsory 25%

SECTION B: Choose two questions (give minimum three questions) 50%

SECTION C: Choose one question (give minimum 2 questions to choose from). 25%



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SECTION A / 10 marks

1. What is the meaning of the meaning of Faraday's law (Maxwell Equation of induction which states that $\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$, where B is the Magnetic field and E is electric field and t is time? Give example of its application in Electrical Power Generation.
2. What are symbols and unities of the capacitance and the inductance? Plot a closed LC circuit.

SECTION B/ 20 marks

1. Using the fact that the restoring force in a string is $F = -kx$, where k is a positive constant and x is the distance; and the Newton's force $F = ma$, prove that the differential equation of simple harmonic motion (SHM) is

$$\frac{d^2x}{dt^2} + \omega^2 x = 0 \quad \text{where} \quad \frac{k}{m} = \omega^2$$

2. What are main equivalences to shift from the mechanical situation (mass, length, and velocity) of the string to electromagnetics (capacitor, inductor and charges)?
3. The solution of SHM is above is $x = A \cos(\omega t + \theta)$, Apply the derivative to find the velocity (v). Use equivalence in B.2. to transform SHM to the velocity (v(t) to the current

(i(t)). Hint: $i(t) = \frac{dq(t)}{dt}$

SECTION C/ 10 marks

In an LC circuit, the self-inductance is $2 \times 10^{-2} H$ and the capacitance is $8 \times 10^{-6} F$. At all of the energy is stored in the capacitor, which has charge $1.2 \times 10^{-5} C$. (a) What is the angular frequency of the oscillations in the circuit? (b) What is the maximum current flowing through circuit? (c) How long does it take the capacitor to become completely discharged? (d)

1. Find an equation that represents $q(t)$.
2. Write four Maxwell Equations in integral, indicating the meaning of all letter of those equation. What the Gauss Equation of magnetism, which states that the divergence of magnetic field means is equal to zero means?