



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: 25/09/2026	SESSION: March Intake
DURATION: 3h	TOTAL MARKS: 40
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 Gauss law for Electric Field (First Maxwell Equation which states that $\nabla \times \vec{E} = \frac{\delta}{\epsilon_0}$, where E is the Electric field and δ is the charge density, ϵ_0 is the permeability in the vacuum means? Give example of this case in power transmission.
2. Define the current density and the charges density. From the definition deduce their relation and unity.
3. Plot to find the image of a concave mirror for the case the object is placed between the center of the curvature (C) and the focus (F), interpret characteristics of the image.

SECTION B/ 20 marks

1. If $y_1 = a \sin(\omega t - \theta)$ and $y_2 = a \sin(\omega t + \theta)$ show that when these two waves are suspended, $y_1 + y_2 = 2a \cos \theta \sin \omega t$. What is the amplitude of this resulting wave? At what angle is the amplitude zero? Indicate the application of such suspension of waves in electrical power generation.
2. A convex mirror used for rear-view on an automobile has a radius of curvature of 3.00 m. If a bus is located at 5.00 m from this mirror, find the position, nature and size of the image. The focus is at 2m from the center and the length of the object is 6m.
3. If $i = \frac{dQ}{dt}$, and $Q = \epsilon_0 \phi_E$, ϕ_E is the charge flus i is the current, Q is the charge, t is the time ϵ_0 is the permittivity in the vacuum and A is the area. Show that $\mu_0 i = \mu_0 \epsilon_0 d \frac{\phi_E}{dt}$. μ_0 is the permeability in the vaccum. What this expression mean in energy storage or charging, give an example?

SECTION C/ 10 marks

1. Write four Maxwell equations in différentiation form, indicating the meaning of all letter of those equation.
2. A) State the difference between the concave and convex mirror.

B) An object, 4.0 cm in size, is placed at 25.0 cm in front of a concave mirror of focal length 15.0 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image? Find the nature and the size of the image.