Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Course: Electromagnetic theory **Semester : VI**
Program: B. Sc (Hon) Physics **Time : 03 hrs.**
Course Code: PHYS 3003 **Max. Marks: 100**

Instructions:

1. All questions are compulsory (Q.No. 9 and Q.No. 11 have internal choices).
2. Scientific calculators can be used for calculations.
3. All bold representations are vectors.
4. Plot all graphs on graph sheet only.

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain the significance of gauge transformations.	**4**	**CO1**
Q 2	Explain what evanescent waves are in 100 words.	**4**	**CO2**
Q 3	Write the expression for momentum density and angular momentum density and explain its application.	**4**	**CO1**
Q 4	Explain the role of plasma in wave propagation with suitable examples.	**4**	**CO2**
Q 5	Define numerical aperture and acceptance angle.	**4**	**CO3**

SECTION B

(4Qx10M= 40 Marks)

Q 6	Given that $\boldsymbol{H_1} = -2\boldsymbol{a_x} + 6\boldsymbol{a_y} + 4\boldsymbol{a_z}$ **A/m** in region $y - x - 2 \leq 0$ where $\mu_1 = 5\mu_0$. Calculate $\boldsymbol{H_2}$ and $\boldsymbol{B_2}$ in region $y - x - 2 \geq 0$ where $\mu_2 = 2\mu_0$.	**10**	**CO4**
Q 7	Explain the wave reflection through metallic surface, obtain the solution for Helmholtz equation for normal incidence.	**10**	**CO3**

Q 8	Plot and explain the reflection coefficient (TE and TM modes) vs angle of incidence (0 to 90° in a step of 10°) for the following cases: *a)* $n_1 > n_2$ *b)* $n_1 < n_2$ Derive the expression for Brewster's angle.	**10**	**CO2**
Q 9	Distinguish the various types of optical fibers based on structure parameters and performance characteristics. Or Explain the production and detection of elliptically polarized light with neat diagram. Give applications of circularly polarized light.	**10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	Derive the Fresnel's formulae for parallel polarization case with neat diagram (explain the propagation vector, ***E*** and ***H*** directions).	**20**	**CO3**
Q 11	a) A uniform plane wave propagating in a medium has $\boldsymbol{E} = 2e^{-\alpha z}\sin(10^8 t - \beta z)\,\boldsymbol{a_y}\ \boldsymbol{V/m}.$ If the medium is characterised by $\varepsilon_r = 1,\ \mu_r = 20\ and\ \sigma = 3\frac{mhos}{m},\ find\ \ \alpha, \beta, and\ \boldsymbol{H}.$ b) Explain the construction and working of Babinet Compensator and its uses. Or a) Derive a pair of time-harmonic transmission-line (generalized) equations for phasors $\boldsymbol{V}(z)\ and\ \boldsymbol{I}(z)$. b) Two of Nicol's prism have parallel polarizing directions so that the intensity of the transmitted light is maximum. Through what angle must either Nicol prism be turned if the intensity is to drop by one fourth of its maximum.	**20**	**CO4**