Zewail City of Science and Technology

ZEWAIL CITY
ESTABLISHED 2000
INAUGURATED 2011

مدينة زويل للعلوم والتكنولوجيا

NANENG 430, Mid-term #1, Spring 2020

Student Name:

Student ID:

Time: 60 mins

Question no.	Grade	Student Grade
Q1	6	
Q2	4	
Q3	5	
Total	15	

- **ATTEMPT ALL QUESTIONS.**
- **SHOW ALL YOUR WORK.**
- **THE EXAM IS IN 11 PAGES.**
- **BEST WISHES**

Question 1 [6 Marks]

Explain briefly with equations and net sketches how the amplitude, phase, velocity of an electromagnetic (EM) plane wave are affected while propagating through the following media. Further, explain the relation between the electric and the magnetic fields (amplitude, phase and direction) of the EM plane wave inside each medium.

1. A perfect dielectric medium.

2. A lossy dielectric medium.

3. A good conductor medium.

4. A perfect conductor material.

Question 2 [4 Marks]

A uniform plane wave in air with

$$\mathbf{E} = 8\cos(\omega t - 4x - 3z)\,\mathbf{a}_y \ \text{V/m}$$

is incident on a dielectric slab $(z \geq 0)$ with $\mu_r = 1$, $\varepsilon_r = 2.5$, $\sigma = 0$.

Find

(a) The polarization of the wave

(b) The angle of incidence

(c) The reflected **E** field

(d) The transmitted **H** field

Question 3 [5 Marks]

An air-filled rectangular waveguide has a cut-off frequency of the TE_{10} mode equals 5 GHz, whereas that of TE_{01} mode is 2 GHz. Calculate:

(a) The dimensions of the waveguide.

(b) The cut-off frequencies of the next three higher TE modes.

(c) If the guide is filled with a lossless material having $\varepsilon_r=2.25$ and $\mu_r=1$, find the cut-off frequency and impedance of the fundamental TM mode.