



**Student ID:**

**Name:**

**Instructions:** Please write your answer on a file or piece of paper and return it to me by uploading it in the Assignment Moodle section. I will look at all homework but will consider for evaluation only those returned **not later than Friday June 7<sup>th</sup>**.

**IMPORTANT:** This homework is not mandatory so you will still be able to get your full score at the final test even if you can't do it or can't return it on time!

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**Questions:**

1. Design a 1D photonic crystal whose normal-incidence photonic bandgap is maximized. Assuming the materials composing the multilayer are PMMA ( $n_1=1.5$ ) and  $\text{Ta}_2\text{O}_5$  ( $n_2=2$ ), calculate the thickness of the layers to obtain a central wavelength  $\lambda_{\text{Bragg}} = 1200\text{nm}$ .
2. Calculate the penetration depth (i.e. the length at which the field amplitude reduces by a factor  $1/e$ ) of a gold-air surface plasmon polariton at  $\lambda=1064\text{nm}$  in the direction perpendicular to the propagation direction. Assume the dielectric constant of gold at  $\lambda=1064\text{nm}$  is  $\epsilon_g=-43.8-j4.2$  whereas the permittivity of air is  $\epsilon_a=1$ . If the interface is patterned with shallow perturbation, what is the periodicity required to excite the gold-air surface plasmon at normal incidence with the first diffraction order of the grating?
3. Describe the Maxwell-Garnett and Bruggeman effective medium theories. What are the main differences between the two methods?