Exam *23 May 2019*

OPEN BOOK, no other material — (but calculator allowed)

1. For the dyadic $\overline{\overline{B}} = \overline{\overline{I}} + \mathbf{ab}$ where **a** and **b** are arbitrary complex vectors, compute

   (a) $\mathrm{tr}\overline{\overline{B}}$

   (b) $\mathrm{spm}\overline{\overline{B}}$

   (c) $\det\overline{\overline{B}}$

   (d) $\overline{\overline{B}}^{-1}$

   (e) Check and show that $\overline{\overline{B}} \cdot \overline{\overline{B}}^{-1} = \overline{\overline{I}}$ and $\overline{\overline{B}}^{-1} \cdot \overline{\overline{B}} = \overline{\overline{I}}$.

2. Derive Equation (4.16) in our textbook, using the duality transformations of the fields in (4.11) and (4.12).

3. The electric field of a plane wave obeys the following description

$$\mathbf{E}(\mathbf{r}) = \left[(1+\mathrm{j})\mathbf{u}_x + (3-2\mathrm{j})\mathbf{u}_y\right] \mathrm{e}^{-\mathrm{j}k_0 z}$$

   where $k_0 = \omega\sqrt{\mu_0\varepsilon_0}$ is the free-space wave number.

   (a) Compute the polarization vector **p** of this wave.

   (b) Determine the polarization of this wave (ellipticity, handedness).