

E&M 2025 HW10

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Technion

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1 Question 1

1.1 Part 1

Show that

$$\left| \int_0^t dt' e^{i\omega t'} \right|^2 = \frac{\sin(\frac{\omega t}{2})}{\left(\frac{\omega}{2}\right)^2} \quad (1)$$

$$\int_0^t dt' e^{i\omega t'} = \left(\frac{1}{i\omega} e^{i\omega t'} \right) \Big|_{t'=0}^{t'=t} \quad (2)$$

$$= \frac{1}{i\omega} (e^{i\omega t} - 1) \quad (3)$$

$$\therefore \quad (4)$$

$$\left| \int_0^t dt' e^{i\omega t'} \right|^2 = \left| \frac{1}{i\omega} (e^{i\omega t} - 1) \right|^2 \quad (5)$$

$$= \frac{1}{i\omega} (e^{i\omega t} - 1) \cdot \overline{\frac{1}{i\omega} (e^{i\omega t} - 1)} \quad (6)$$

$$= \frac{1}{i\omega} (e^{i\omega t} - 1) \cdot \frac{-1}{i\omega} (e^{-i\omega t} - 1) \quad (7)$$

$$= \frac{1}{\omega^2} (2 - e^{i\omega t} - e^{-i\omega t}) \quad (8)$$