

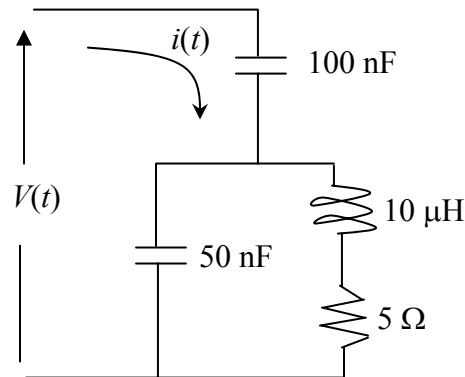
ME413/513 Exam I
Lumped Parameter Systems, Steady State Analysis, and Fundamentals of Acoustics
in Fluids.

Instructions: 55 minutes to complete the exam. Complete the first page of the exam without reference materials (closed book, closed notes). After completing the first page, turn in to instructor and work the problems on the second page. Reference materials, including notes and the text, may be used for the second page of the exam.

1. The speed of sound in air is _____.
2. The speed of sound in water is _____.
3. The formula for wavelength is _____.
4. $\text{Re}\left[\hat{X}e^{j\omega t}\right] =$ _____.
5. The wavelength λ in air at 1000 Hz is approximately _____.

Open-book, open-notes portion of the exam.

1. For the following circuit, compute the current flow $i(t)$ and impedance \hat{Z}_e when $V(t)=125\cos(2\pi ft)$ mV, and $f=110$ kHz.



2. A leftward traveling plane wave propagates in air at 5 kHz and is specified by $\hat{p}(x,t) = (3 + 2j)e^{j(\omega t + kx)}$. Compute the acoustic pressure $p(x,t)$, the SPL in dB re 20 μPa , the particle velocity $u(t)$, the wave propagation speed, and the peak-to-peak particle displacement amplitude.
3. A sphere of diameter 40 cm pulsates radially at a frequency of 2 kHz in water with an amplitude of 100 nm. Determine the SPL in dB re 20 μPa and time-averaged intensity in W/m^2 at a distance of 5m from the center of the sphere.
4. A device is being designed to measure distance by measuring the time-of-flight for a transient pulse of sound propagating in air. The device is being nominally designed to measure the distance to an object at a temperature of 70°F. What “percent error” will be encountered in a distance measurement when the temperature is 90°F for this device?