

Homework 1 [11 Points]

Due: 10/5/2023

Required homework [Graded on effort only]:

1) Problem 1.3 from textbook [1 Point]

Problem 1.3: A harmonic wave traveling along a string is generated by an oscillator that completes 180 vibrations per minute. If it is observed that a given crest, or maximum, travels 300 cm in 10 s, what is the wavelength?

2) Problem 1.9 from textbook . [3 Points]

Problem 1.9: Give expressions for $y(x, t)$ for a sinusoidal wave traveling along a string in the negative x -direction, given that $y_{\max} = 40$ cm, $\lambda = 30$ cm, $f = 10$ Hz, and

(a) $y(x, 0) = 0$ at $x = 0$,

(b) $y(x, 0) = 0$ at $x = 3.75$ cm.

Use the solution for part 2(a) and plot $y(x=0, t)$ (i.e. sweep t to generate to generate the plot).
Submit your handwritten solution, MATLAB code, and graph.

Hints:

- You need to plot the equation of a wave with t as the independent variable. Refer to the MATLAB tutorial on how to enter variables and plot a sine wave. For this problem, your equations are in terms of cos. Define t as varying from 0 to $2 \cdot T$ where T is the period of the cosine wave. Generate 200 data points for T .
- Don't forget to include the phase angle in your equation. In MATLAB, the terms inside the parenthesis for sin or cos should be in radians. If your handwritten answer is in degrees, you can convert from degrees to radians using the function `deg2rad` (refer tutorial section IV)
- If there are two solutions for the phase angle, you can plot for either of them and indicate which solution you have used.

3) Problem 1.12 from textbook.

Problem 1.12: Given two waves characterized by

$$y_1(t) = 3\cos(\omega t)$$

$$y_2(t) = 3\sin(\omega t + 60^\circ),$$

does $y_2(t)$ lead or lag $y_1(t)$ and by what phase angle?

Plot $y_1(t)$ and $y_2(t)$ in the same graph using MATLAB and verify your solution. Assume that frequency $f=1$ and plot for two time periods. Submit your handwritten solution, MATLAB code, and graph. [3 Points]

Hint: To plot on the same graph, use `plot(t,y1,t,y2)`

4) Problem 1.16 (a-b) from textbook [1 Point]

Problem 1.16: Evaluate each of the following complex numbers and express the result in rectangular form:

(a) $z_1 = 8e^{j\pi/3}$

(b) $z_2 = \sqrt{3} e^{j3\pi/4}$

5) Problem 1.21 (a-c) from textbook. [1 Point]

Problem 1.21: Complex numbers z_1 and z_2 are given by

$$z_1 = 5 \angle -60^\circ$$

$$z_2 = 4 \angle 45^\circ$$

(a) Determine the product $z_1 z_2$ in polar form.

(b) Determine the product $z_1 z_2^*$ in polar form.

(c) Determine the ratio z_1/z_2 in polar form.

6) What physical dimension does each of the following unit represent? Write these units in fundamental SI units. [1 Point]

W (watt), Ω (ohm), F (farad), H (henry), J (joule)

7) What are the units of (a) permittivity (b) permeability (c) electric field intensity (d) magnetic flux density (e) electric flux density (f) magnetic field intensity (g) conductivity (h) angular velocity (i) wave number [1 Point]

Suggested homework: 1.4, 1.5, 1.13, 1.17, 1.23. This does not get turned in