Phys210: Mathematical Methods in Physics II

Homework 7

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Policies

- Please adhere to the *academic integrity* rules: see my explanations here for further details!
- For the overall grading scheme or any other course-related details, see the syllabus.
- Non-graded question(s) (if any) are for your own practice!
- Unless stated otherwise, you are expected to show your derivation of the results.
- The homework is due May 31st 2024, 23:59 TSI.

(1) Problem One *(8 points)*

Let us define the higher order function $\mathcal{I}$ as

$$\mathcal{I} :: (\mathbb{R} \to \mathbb{R}) \to (\mathbb{Z}^+ \to \mathbb{R}) \tag{1.1a}$$

$$\mathcal{I} = \Big(x \to f(x)\Big) \to \left(n \to f\left(\int_{-\infty}^{\infty} \frac{dx}{\prod_{i=1}^{n}(x^{2i}+1)}\right)\right) \tag{1.1b}$$

Compute $\mathcal{I}(\cos)(1)$ and $\mathcal{I}(\text{ceiling})(10)$ where

$$\text{ceiling} :: \mathbb{R} \to \mathbb{Z} \tag{1.2a}$$

$$\text{ceiling} = x \to \min\{m \in \mathbb{Z} \mid m \geq x\} \tag{1.2b}$$

Hint: Use residue theorem.

(2) Problem Two *(not graded)*

The question above can be solved rather efficiently using Mathematica; for instance:

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Integrate[1/Product[x^(2 n) + 1, {n, 1, 6}],
   {x, -\[Infinity], \[Infinity]}, Assumptions -> Element[x, Reals]]
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