**Problem 1** (10 Points) Prove that Dirac measure is a measure. Prove if it is finite or $\sigma$-finite measure. Prove if it is complete or not.

**Problem 2** (5 Points) Given a Hahn decomposition of a set $X$ for a signed measure $\nu$ show the Jordan decomposition for the signed measure.

**Problem 3** (10 Points) Prove that the union of a finite union of measurable sets is measurable.

**Problem 4** (10 Points) Show the steps for constructing a measure for a set $X$. State the condition for on a set function defined on a collection $S$ and the condition on $S$ such that the collection $S$ is measurable in the Caratheodory construction.