

First course handout for PHY-422/663

In this course we will mainly focus on group theory and the theory of partial differential equations. The course will be mainly based on solving various problems and trying to understand the nature of the underlying theory from the problems. This course will be focussed more on the mathematical nature of the theories which are relevant for various physical problems.

A general understanding of group theory will be initially presented. The motivations for studying group theory will be presented. Then we will focus on finite groups. The character table and other rules for representation of the groups will be taken up. Then we will move to the topic of continuous groups. We will focus on Lie groups as three dimensional rotation group, $SU(2)$ and Lorentz group.

The next half of the course will focus on the study of first order and second order partial differential equations. The initial value and boundary value problems will be discussed thoroughly. Then we will focus on some specific partial differential equations which naturally occur in physics, as the diffusion equation, the wave equation, the Schroedinger equation. Various methods to solve these equations will be discussed in the classes.

Primarily there will be two examinations and one or two quizzes for this course. The quiz dates will be determined once the course starts.

Prerequisites: One must have some understanding of theory of linear vector spaces, both finite dimensional and infinite dimensional cases. The theory of linear vector spaces will be used while discussing group theory problems or the theory of partial differential equations.

Reference:

1. A Physicist's Introduction to Algebraic Structures by Palash B. Pal.
2. Group Theory in a Nutshell by A. Zee.
3. Mathematical Methods of Physics by J. Mathews and R. J. Walker.
4. Mathematical methods by Arfken and Weber.

One may consult any of the above books. In general the student may read any material which he/she finds suitable to follow the class material.