Instructor: Prof. Boaz Ilan  
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Lecture time & location: M W, 12:30 pm – 1:45 pm, COB 272

Office hours: by appointment.

Course goal: My goal is that by the end of this course you will have learned:

- What are the universal linear and nonlinear dispersive equations and their salient features.
- Analytical and computational techniques for deriving and solving these equations.
- Related research topics.

Graduates of MATH 292 should be able to fulfill the following learning objectives:

1. Apply asymptotic and perturbation methods to derive reduced equations.
2. Find analytically and computationally solitary wave solutions.

Prerequisites: Instructor’s consent. An advanced course in partial differential equations (such as Math 221) and/or in asymptotic methods (such as Math 223) would help.

Tentative outline:

- Dispersive waves: equations and key physical phenomena; derivations using the methods of stationary phase and steepest decent.
- KdV and NLS equations: application to water waves and nonlinear optics; derivations – the failure of regular perturbation methods and success of matched asymptotic expansion and multiple scales.
- Solitary waves and solitons: analytical and computational techniques; examples from optics and condensed matter physics.
- Research topics: collapse, dispersive shock waves, stability of solitary waves.

Recommended reading:

1. Asymptotics and perturbation methods:  
   A. Erdélyi, *Asymptotic Expansions*, Dover, 1956;  

2. Linear and nonlinear dispersive waves:  
Grade determination: Your final grade in the course will be based on the following approximate scheme: 90% homework problems and 10% active participation in class.

Homework will be given and collected approximately every other week. You are encouraged to work in groups, but all work turned in must be your own.