Course Syllabus
Mathematics 4FT
2017 – 2018, Semester 2

Instructor: Walter Craig
Classroom: Hamilton Hall 312
Course meeting times:
Monday and Thursday 13:30 - 15:00

Lectures:

(1) Introduction

(2) Wave equations

(i) transport equations
- solution by Fourier transform

(ii) Fourier transform on Hilbert space
- Fourier inversion on L^2
- Sobolev embedding theorem

(iii) derivation of the wave equation
(iv) energy and uniqueness
(v) initial value problem on $\mathbb{R}^n$
- standard form of initial data
- solution by Fourier synthesis

(vi) Duhamel's principle
(vii) Paley – Weiner theory
(viii) Huygens' principles

(3) First order equations

(i) first order linear equations
(ii) first order quasilinear equations
(iii) hyperbolic conservation laws
(iv) first order nonlinear equations

(4) Cauchy – Kowalevsky theorems

(i) noncharacteristic manifolds
(ii) Cauchy – Kowalevsky theorem - method of majorants
(iii) Holmgren – John uniqueness theorem
(iv) Nirenberg – Nishida abstract version of Cauchy – Kowalevsky

(5) Distributions

(i) Schwartz class
(ii) Malgrange – Ehrenpreis existence theorem
(iii) Gårding's condition of hyperbolicity

(6) Symmetric hyperbolic systems

(i) energy estimates

(ii) finite propagation speed
(iii) linear equations - existence theory
(iv) Lagrangians and Hamiltonian PDEs - symmetrizable hyperbolic systems
(v) quasilinear symmetric hyperbolic systems

Optional material (if there is time in our schedule)

(7) Fourier integral operators

(i) pseudodifferential operators
(ii) local and pseudolocal properties
(iii) wave front set
(iv) ellipticity and microlocal ellipticity
(v) propagation of singularities