**Progress updates**

===== 5/24: week 2

1. Review Gibbs Phenomenon:
2. Plan for Project2: Chapter 2 (week 2)

TODO: Done 5/27

- to make slight changes to PPT; to do video recording; Hojun will try the Panapto first;

- Laplace equation on rectangle

>> Use the analytical solution:   
 1) compute the coefficients for each of the 4 equations;   
 2) add them together.   
- Laplace equation on circle

>> the same as the rectangle case; use polarplot;

== 5/31: week 3

* Explore wave equation: standing/traveling wave; >>> DONE in week 4

===== 6/7 week 4

* String with a fixed end and a forced end

===== 6/14 week 5

* String with a fixed end and a forced end. >>>> code done by FL; Hojun added black background; slides not yet.

===== 6/21 week 6:

* Hojun updated Gibbs Phenomenon recording (FL+Casey’s comments)

=== 6/28 week 7

* Hojun wrote note about SLEP numerical approximation by Finite Difference.
* Qingci An join the project to help (7/2)

Todo:

* code (use eig(A,R)); with p, p’, q, r as input
* Test what happens when N goes large (change p,q,r) and see if Gibbs phenomenon happens
* >> heat flow on a non-uniform rod; (week 6>>7)

>> vibrations of a non-uniform string; (week 7)

=== 7/5 week 8

**Project plan for PDE Technology Fellow**

**Phase 1: projects development; May 17--- July 31, 2021.**

* 10 weeks; 6 projects in Week1-9; Review in Wk10.
* 2 meetings(30-45min)/week: Monday 10am(11EST); Thursday 10am(11EST)

+ Monday meeting: set details of project and tasks of the week.   
+ Thursday meeting: report and conclude.

* Document sharing by GitHub.

**Phase 2: teaching implementation. Spring 2022.**

==== TO pay attention to:

- keep it well-documented;

- follow the book: our goal is to help teaching;

- lead to potential projects for the class;

- make function routines, which can be called by PDEs

- make example demonstrations;

=== Output/product:

>> easy to use code/software;

>> graphics/animations: figures and animations, possible GUI’s

>> 5-15 minute videos: explaining concepts; --- pre-class videos, then discussions/projects/problem-solving in class. Record via Zoom/Panopto/;

>> possible projects for class;

Principle: they aim to assist but not replace the lectures

— math requires deductive thinking, which is best inspired by writing-based lectures;

— the slides/video are good for demonstration and inspiration;

From Reid:

* **Focus group:** Opportunity to share with colleagues, students, after week2, so as to **get feedback early on**.
* Video with Panopto: edit, slides (We use mainly slides in video, because this is a theory oriented course, so we focus on concepts, not programming.)
* About GUI: it may take more time, so it is better to do it after video, which determines if GUI will significantly help / or if the students would be interested.
* About payment: 15$/hrs\*300hrs. We may bring other hand for help if needed.
* Next meeting: June 8th.

**Project List**

1. Chapter 3: Fourier Series (week1: 5/17-5/23) % DONE 5/27

- show the convergence of FS, and demonstrate Gibbs phenomenon;

- divergence of TBTD;

- complex FS (optional)

~ connection with FFT (Fourier transform)

~ connection with image processing;

1. Chapter 2 (week 2: 5/24-5/30) DONE 6/3  
   - Laplace equation on rectangle   
   - Laplace equation on circle
2. Chapter 4 Wave Equation: (homogeneous) (week 3-4: 5/31-6/13)

* standing wave and traveling wave
* Vibrating strings: Visualize the movement of the spring-mass system with different BC and with different body forces.

- vibrating membrane: (link to Laplace in 2D, also future in 7.7) --- option

1. Chapter 5 Sturm-Liouville (week 5-7)

* self-adjoint operator by matrix: DE to linear algebra; (week 5)

- numerical solution to the eigenvalue problem: illustrate the SL theorem:

~ eigenvalue increasing;

~ eigenfunctions: orthogonality, zeros (connection with Bessel functions)

~ Rayleigh quotient: (optional): Demonstrate large eigenvalue problem

- approximation properties (5.10 – Mean Square)

- minimax principle (5.6, TBD)

>> heat flow on a non-uniform rod; (week 6)

>> vibrations of a non-uniform string; (week 7)

Visualize heat flow in non-uniform rod (how it changes as the *p* and *q* terms changes).

1. Chapter 7 High Dimensional PDEs (week 8)

- Visualize 2D Heat/Wave equations.

- Vibrating Circular Membrane – demonstrate physical motion

- Bessel functions (TBD)

1. Chapter 8: nonhomogeneous equation (week 9)

- heat flow with source (8.2)

- Forced vibrating membranes and resonance (8.5)

====== optional / future projects ====

1. Chapter 9: Green’s function (potential)

* Green’s function for HE with and without source term

1. Chapter 12: method of characteristics (future)