Course Title: Fractional Differential Equations

Course Description:
Special functions (Gamma, Mittag-Leffler, and wright), Riemann fractional integral, Riemann-Liouville and Caputo fractional derivatives, composition rules, embeddings, equivalence with integral equations, well posedness for Cauchy type problems, successive approximation method, Laplace and Mellin transform methods

Textbook:

Other references:

Learning Outcomes:
• Use the properties of the Gamma function and Mittag-Leffler functions
• Use the properties of fractional integrals and fractional derivatives
• State the well-posedness for some fractional differential problems
• Describe the appropriate underlying spaces
• Link FDE’s to their corresponding Volterra integral equations
• Use transforms to solve linear fractional differential equations

Grading:
Assessment 1: 15%
Midterm Exam: 15%
Assessment 3: 15%
Homework Assignments: 15%
Presentations: 15%
Final Exam: 25%
<table>
<thead>
<tr>
<th>Week</th>
<th>Sections</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Overview</td>
</tr>
<tr>
<td>2</td>
<td>1.1, 1.4, 1.5, 1.8, 1.10</td>
<td>Preliminaries: Spaces of continuous functions, special functions, transforms</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>The Abel integral equation (solvability in L1)</td>
</tr>
<tr>
<td>4-5</td>
<td>2.1</td>
<td>Riemann-Liouville fractional integral and fractional derivative</td>
</tr>
</tbody>
</table>
| 6-7  | 2.4      | Caputo fractional derivative  
Grunwald fractional derivative |
| 8-9  | 3.3.1, 3.3.2, 3.3.3, 3.3.5 | Fractional differential problems with RL derivative |
| 10-11| 3.5.1, 3.5.3 | Fractional differential problems with Caputo derivative |
| 12-13| 4.1.1, 4.1.2, 4.1.3 | Explicit solving of FDEs |
| 14-15| 5.3.1, 5.3.2 | Laplace transform |