

THE CHINESE UNIVERSITY OF HONG KONG
Department of Mathematics
MATH5022 Theory of Partial Differential Equations, 2nd Term 2016-17

Final Projects:

- Read Sections 6.1, 6.2, and 6.3 of the book
 - Evans, Lawrence C. Partial differential equations. Second edition. Graduate Studies in Mathematics, 19. American Mathematical Society, Providence, RI, 2010.

Write a report on the existence and regularity of weak solutions to second-order elliptic equations in L^2 framework.

- Read Chapter 4 and Chapter 6 of the book:
 - Gilbarg, David; Trudinger, Neil S. Elliptic partial differential equations of second order. Reprint of the 1998 edition. Classics in Mathematics. Springer-Verlag, Berlin, 2001.

There, the following result (Theorem 6.13) is stated:

- Let L be strictly elliptic in a bounded domain Ω , with $c \leq 0$, and let f and the coefficients of L be bounded and belong to $C^\alpha(\Omega)$. Suppose that Ω satisfies an exterior sphere condition on every boundary point. Then, if φ is continuous on $\partial\Omega$, the Dirichlet problem $Lu = f$ in ω , $u = \varphi$ on $\partial\Omega$, has a unique solution $u \in C(\bar{\Omega}) \cap C^{2,\alpha}(\Omega)$.

Write a report to sketch the complete proof of the above result.

- Read the book chapter:
 - Caffarelli, Luis A.; Vasseur, Alexis The De Giorgi method for nonlocal fluid dynamics. Nonlinear partial differential equations, 1–38, Adv. Courses Math. CRM Barcelona, Birkhuser/Springer Basel AG, Basel, 2012.

Write a report on the subject, particularly focusing on the application of the De Giorgi method.

- Read the paper
 - F Golse, Cyril Imbert, Clement Mouhot, A Vasseur, Harnack inequality for kinetic Fokker-Planck equations with rough coefficients and application to the Landau equation, arXiv:1607.08068v2.

This paper presents an application of the De Giorgi-Nash-Moser theory to a class of kinetic Fokker-Planck equations. Write a report on the paper, and also give remarks on an alternative approach of treating the regularity of degenerate parabolic equations in [60] and [61] in references of the paper.

- Choose one topic from below and write a report on the choosed subject.
 - DeGiorgi-Nash-Moser Theory for Parabolic Equations
 - Regularity Results for Monge-Ampere Equations
 - Weyl’s Law for Distribution of Eigenvalues of Elliptic Operators
 - Compensated Compactness Method and Applications
 - Regularity Results for Navier-Stokes Equations

Please send by email BOTH the tex and pdf files of your report on the project to me at rjduan@math.cuhk.edu.hk. Due is May 13, 2017.