課程大綱及進度表

開課系所　　　　　　數學系
開課學年　　　　　　99 學年度
開課學期2
課程名稱(中文)　　　偏微分方程（一）
課程名稱（英文）　　Partial Differential Equations (I)
課程碼　　　　　　　 L170310
分班碼
先修科目或先備能力　高等微積分和微分方程
學分數　　　　　　　 3
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課程概述　　We study the concepts and basic types of PDE, and their properties. Then we discuss boundary problems, Fourier Series, and Harmonic Funtions. Next we investigate the ideas of Green`s Identities and Green`s Functions.

教學目標　　We expect to grab the basic idea and concept of PDE. Then we learn various properties of important types of PDE from different aspects.

授課課程大綱明細
Ch01: Where PDEs Come From
Ch02: Waves and Diffusions
Ch03: Reflections and Sources
Ch04: Boundary Problems
Ch05: Fourier Series
Ch06: Harmonic Functions
Ch07: Green`s Identities and Green`s Functions
Ch09. Waves in Space
Ch10. Boundaries in the Plane and in Space
Ch11. General Eigenvalue Problems
Ch12. Distributions and Transforms
Ch13. PDE Problems from Physics
Ch14. Nonlinear PDEs

參考書目　　Partial Differential Equations, An Introduction (Chapter 1 - 7)　by　Walter Strauss
課程要求　　Advanced Calculus and Differential Equations

Homework, PDE , Spring 2011

Chapter 01:

1.1: 1, 3, 5, 7, 9　　　1.2: 2, 4, 5, 8, 9　　　1.3: 1, 3, 5, 7, 9　　　1.4: 2, 4, 6　　　1.5: 1, 3　　　1.6: 2, 4, 6

Chapter 02:　　　2.1: 1, 3, 5, 7　　2.2: 2, 4　　　2.3: 1, 3, 5　　　2.4: 2, 4, 6, 8, 10, 12　　　2.5: 1

Chapter 03:　　　3.1: 2, 4　　　3.2: 1, 3, 5, 7, 9　　　3.3: 2, 3　　　3.4: 3, 5, 7, 9, 13　　　3.5: 1

Chapter 04:　　　　4.1: 2, 4, 6　　　　4.2: 1　　　　4.3: 4, 6, 8, 10, 12, 14, 16

Chapter 05:

5.1: 3, 5, 7, 9　　　　5.2: 4, 6, 8, 10, 12　　　　5.3: 3, 5, 7, 9, 11　　　　5.4: 4, 6, 8, 10, 12, 16

5.5: 3, 6, 9, 12　　　　5.6: 2, 5, 8, 11

Chapter 06:　　　　6.1: 2, 5, 8, 11　　　　6.2: 1, 4　　　　6.3: 1, 2　　　　6.4: 2, 5, 8, 11

Chapter 07:　　　　7.1: 2, 5, 8, 11　　　　7.2: 1　　　　7.3: 2　　　　7.4: 3, 6, 9, 12, 15

Chapter 08:　　　　8.1: 1, 3　　　8.2: 2, 5, 8, 11, 14　　　8.3: 1, 4, 7　　　8.4: 2, 5, 8, 11　　　8.5: 1, 4

Chapter 09:　　　9.1: 1, 4, 7　　　　9.2: 2, 5, 8, 11, 14　　　　9.3: 3, 6, 9　　　　9.4: 1, 4

Chapter 10:

10.1: 1, 4　　　10.2: 2, 4, 6　　　10.3: 3, 6, 9, 12　　　10.4: 2　　　10.5: 3, 6, 9, 12, 15　　　10.6: 2, 5, 8

Chapter 11:　　　11.1: 1, 3　　　11.2: 1, 4, 7　　　11.3: 2　　　11.4: 1, 3, 5　　　11.5: 2　　　11.6: 1, 4, 7

Chapter 12:　　　12.1: 2, 5, 8　　　12.2: 1, 4, 7　　　12.3: 2, 5, 8　　　12.4: 1,4　　　12.5: 2, 5

Chapter 13:

Chapter 14:

Errata in "Partial Differential Equations, an Introduction", First Edition, by Walter A. Strauss
(John Wiley and Sons, New York, ISBN 0-471-54868-5)
The Second Edition is now available (ISBN-13 978-0470-05456-7), as well as the Solutions Manual, written
jointly with Julie and Steve Levandosky.

The following errata are for the 6th (or later) printing of the First Edition. (To identify which printing your
copy is, look at the last number on the page before the preface.) If you have an earlier printing and you wish
a list of errata for it, please send me an e-mail message to that effect.

Page

P13, last line: ds should be dxdy.

P17-18: The second, third and fourth triple integrals should be over all of R^3.

P19, Ex. 8: Assume u and grad(u) tend to zero as |x| tends to infinity. (This exercise is difficult.)

P42: The bottom line of the page got dropped in the 6th printing! It should be:

u(x,0)=phi(x), u(0,t)=g(t), u(ell,t)=h(t).

P42: In some printings, near the bottom of the page, change L to ell.

P42: Four lines got dropped in the 9th printing!   Below equation (2) it should say: .....which is the "diffusion inequality". Now suppose that v(x,t) attains its maximum at an interior point (x_0,t_0). By ordinary calculus, we know that v_t=0 and v_{xx} <=0 at (x_0,t_0). This contradicts the diffusion inequality (2). So there can't be an interior maximum. Suppose now.....

P44, line 7: Change min to max.

P49, line 2: Omit the phrase "letting..."

P57, eqn. (8): Change the second >= to <= .

P58, Ex. 4: Let f(x)=x+1-exp(2x) for x<0 [instead of x+1].

P60, below eqn.(3): Change ct to c|t|.

P64, Ex. 10: Change ell to pi/2.

P66, midpage: "integral in (5)" should be "integral in (6)". Also, "to formula (3)" should be "to formula (5)".

P70, line -4,-3: 1+T+T^2 should be replaced by (1+T+T^2){-1} 77, Ex. 7: Change n to m in the exponent in the sum. The series converges uniformly for bounded t.   Also S"(t)+ A2S(t) = 0.

P79, line 13: The integrand should be |p| exp(-p^2/4) instead of p exp(-p^2/4).

P94, sentence below eqn. (15): Change "only if a_0 and a_ell have opposite signs" to "only if a_0 or a_ell is negative or else both vanish".

P98, Ex. 4, line 5: Reverse the sign of the curve.

P98, Ex. 7, line 3: replace \lambda by \beta and delete the square, where \beta^2=\lambda.

P100, line 7: Should be x>a.

P119, line 8: The sum should start at n=0.

P123, Example 2: Change ell to 1.

P126, eqn.(11): 4/pi, not pi/4.

P127, lines -7,-6: The integrals go from a to b.

P127-8: Change E_n to E_N.

P129, lines 3,5: Replace \ell by \pi. 133: In the proof of (5), change the sign of the second-to-last line.

P136, line -13: Place a factor 2 inside the second square root.

P140, Ex. 12: Assume it satisfies the periodic BC.

P141, end of second paragraph: See Example 3 in Section 5.4 for the dangers of differentiation.

P143, line -3: Switch omega and c.

P149, line 15: Replace "less than" by "less than or equal to".

P153, line 3: (r, theta, phi)

P153, eqn.(7): Delete u.

P158, Ex. 5: Take b=1 for simplicity.

P162, line -1: The last u(x) should be x.

P164, Ex. 3: sin3 theta and sin(3 theta) should be switched.

P165, two lines above (5): Replace n by n pi.

P168, Ex. 12: The domain should be assumed to be connected.

P176, below eqn.(G2): Change (G2) to (G1).

P178, eqn. (5): The left side should be $u(x\_0)$.

P180, line -9: (7.2.1)

P187, Ex. 7(d): Change $h(y)$ to $h(x)$.

P188, Ex. 18: octant

P188, Ex. 19: Change r-3/2 to r-2.

P188, Ex. 25: Delete this exercise.

P190, line -5: change the third + to -.

P194, line below (3): A factor of 4 is missing.

P199, Ex. 3: Change 0<x<1 to 0<x<5.

P207, Ex. 2(a): Replace 2 by 0.5.

P207, Ex. 8: Do it for the equation $u\_{tt} = u\_{xx} - u^3$.

P207, line -1: The - should be +.

P222, Ex. 6: Take the boundary conditions to be homogeneous.

P240, Ex. 1, Hint: Exercise 2.4.10 is an alternative hint.

P240, Ex. 5: up to a constant factor.

P248, line -5: In the last term move the bar to the other v.

P251, Ex. 4: Change Robin BC to dv/dy=-v. In (b) change - to +.

P251, Ex. 5(b): Put a minus in front of the operator.

P254, (18): The coefficients are not correct: see the second edition.

P251, Ex. 5(d): Change Dirichlet to Neumann.

P252, line below (9): Change n to lambda.

P258, line below (4): Change (1) to (2).

P262, table: In the third line, the last -1 should be -r2.

In the fifth line, cos(2 theta) should be cos (2 phi).

P267, Ex. 2, Hint: The last two factors should be replaced by 3-2sin2x-2sin2y.

P270, eqn. (10): Change the second + to -.

P271, eqn. (12): Take the square root of 2/pi.

P272, eqn. (18): Change 1/pi to 2/pi.

P280, two lines above (11): Cahnge 1/r to -1/r.

P290, line 14: Change 27.3 to 30.5.

P290, formulas for A and B: factors of 2 pi are missing.

P290, above eqn. (6): Assume the trial functions are linearly independent.

P292, Ex. 4: a=1.

P295, eqn. (4): Change j to n.

P295, eqn. (6) and above: The subscripts should be N+1.

P297, Ex. 3: Delete the boundary integral. Replace the constraint /int w2 dx=1 by w=g on bdy(D).

P308, Theorem 4: each Dirichlet eigenvalue.

P309: Delete the second paragraph.

P312, Ex. 2 and 3: These exercises are difficult.

P312, Ex. 5: ellipse

P312, Ex. 9(b): On the third line replace D by D+ in two places.

P322, line -10: Change (1/2)c to 1/(2c).

P322-3, eqns. (9),(10): We have permitted any t, positive or negative, in these formulas.?

P327, table: In the last entry, a is positive.

P342, line 1: Change the signs in the equation. ...the inhomogeneous Maxwell equations.

P348, line below (11): The function R is related to Bessel's equation by R(kr) = H-(kr)/sqrt(kr).

P348-350: Replace H+ by H- throughout.

P348-9, eqn. (12) and eqn. below (17): Divide H-(kr) by sqrt(kR).

P350: Replace the first R by r.

P353, Ex. 2: The second term is q psi, not psi. Assume Q>0.

P364, eqn. (12) and line -1: Several terms are missing their integral signs {line integrals over the curve x=xi(t))}.

P372, line -1: Change 3 to 1.

P373, Ex. 2: Change + to -.

P374, Ex. 12: There is a missing factor of kt^{-1/3}.

P378, Ex. 10: Change - to +.

P391, line -1: Change the last cos\phi to cos\theta.

P394, lines 7 and 19: Change (1) to (2).

In the following pages, there are a few additional errors in the answers and hints. See the second edition for all the corrections.

P401, Ex. 1.4.4: Reverse the sign.

P401, Ex. 1.6.5: beta = -4 and gamma = 1/sqrt{3}.

P402, Ex. 2.2.5: Put rho in the integrand.

P403, Ex. 3.2.9(a): Change 11/81 to 4/27.

P404, Ex. 4.3.12, line 3: Delete the 2 in the argument of the cosine.

P404, Ex. 4.3.18(e): Delete the last sentence.

P406, Ex. 5.6.9: Change the last + to -.

P406, Ex. 7.1.10: Change 2 to 1/2.

P407, Ex. 7.4.1: Divide the given answer by ell.

P410, Ex. 10.1.2: Change 16 to 64.

P410, Ex. 10.2.5: In the exponent, betan should be squared.

P410, Ex. 10.3.6: 193.9 seconds

P410, Ex. 10.3.7: 3a2/10 instead of 3/10.

P410, Ex. 10.5.15: superscripts + on H.

P411, Ex. 10.6.7: Replace A-B by (A-B)/2. Also replace !! by (ell-2)!! in the numerator.

P412, Ex. 11.4.4: Replace -sech by 2 sech .

P412, Ex. 12.4.1: Replace k by kappa.

(Errata updated as of January 2008)

I take this opportunity to thank all the people who have notified me of errors in the text since its publication. See the Second Edition for specific acknowledgements. (Hopefully I have not forgotten to mention anyone.)