Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): **MATH 3606 Partial Differential Equations (3,3,0)**

Course Aims: This course introduces the theory of multi-dimensional scalar and system of parabolic, elliptic and hyperbolic partial differential equations (PDEs) that model physical processes in areas such as physics, biology, chemistry and social science. Solution techniques such as the separation of variables, eigenfunction expansions, Green functions, Fourier and Laplace transforms for solving the equations in a bounded and unbounded domain, with homogeneous and inhomogeneous source term will be studied in detail. Some classical numerical methods such as finite difference schemes and finite elements schemes for solving partial differential equations will also be introduced.

Prerequisite: MATH2205 Multivariate Calculus and MATH3405 Ordinary Differential Equations

Recommended: Experience with high level programming languages (MATLAB, C/C++ or FORTRAN)

Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
1	Classify and derive (scalar, quasilinear and nonlinear) partial differential equations into parabolic (diffusion equation), elliptic (Laplace equation) and hyperbolic equations (wave equation).
2	Describe the properties of each class of PDEs and to apply classical solution techniques in solving the PDEs.
3	Solve problems that are formulated in partial differential equations.
4	Analyze and solve PDEs analytically and numerically with confidence.

Teaching & Learning Activities (TLAs)

CILO	TLAs will include the following:
1,2,3,4	**Lecture and in-class activity** Instructor will use lectures to introduce the topics of the course's materials and ample of examples will be given in order to aid the learning of the topics. Students will consolidate the knowledge through discussion within lectures/tutorials.
1,2,3,4	**Assignments** Instructor will assign programming assignments, when and where applicable, to allow students to apply the numerical techniques learnt in the lecture and to solidify their understanding of the numerical methods and their limitations.
1,2,3,4	**Assessment** Instructor will use weekly homework, quizzes, midterm and final examination to allow students to measure their progress in learning the topics of the course.

Assessment:

No.	Assessment Methods	Weighting	CILO Address	Remarks

1	Continuous assessment	30%	1,2,3,4	Continuous assessment from homework and midterm is designed to measure how well the students have learned the basic concepts and fundamental theory of partial differential equations and their applications. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions.
2	Final Examination	70%	1,2,3,4	Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills based to assess the student's versatility in understanding of classical PDEs and their solution techniques.

Course Intended Learning Outcomes and Weighting:

Content	**CILO No.**
I. Introduction	1
II. Parabolic Equations	1,2,3,4
III. Elliptic Equations	1,2,3,4
IV. Hyperbolic Equations	1,2,3,4
V. Quasilinear Equations	1,2,3,4

Textbook

1. R. Haberman, Applied Partial Differential Equations, 4th Edition, Prentice-Hall, 2004.

References

1. W.A. Strauss, Partial differential equations: an introduction, John Wiley & sons, 1992.
2. G.R. Carrier and Carle E. Pearson, Partial Differential Equations, Theory and Technique, 2nd edition, Academic Press, Inc., 1988.
3. E. Zauderer, Partial Differential Equations of Applied Mathematics, 2nd Ed., John Wiley & Sons, Inc., 1989.
4. J. Kevorkian, Partial Differential Equations, Analytical Solution Techniques, Brooks/Cole Publishing Company, 1990.
5. Fritz John, Partial Differential Equations, 4th Ed., Springer-Verlag, 1982.

Course Contents in Outline:

Topics

I Introduction

A Definitions and examples

Topics

B Classification of second-order equations with constant coefficients

II Parabolic Equations

A Heat conduction, initial and boundary conditions

B Separation of variables

C Eigenvalue problems, eigenfunctions

D Applications of Fourier series

E Inhomogeneous problems

F Integral transforms methods

G Fundamental solution

III Elliptic Equations

A Steady-State problem, equilibrium problem

B Energy integral, uniqueness

C Maximum-minimum principles

D Separation of variables

E Dirichlet problem, Green's function

IV Hyperbolic Equations

A Wave propagation, uniqueness

B d'Alembert solution

C Cauchy problem, characteristics

V Quasilinear Equations

A Quasilinear first order equations

B Characteristic curves

C Weak solutions

D Burgers' equation and shocks wave

Updated on: 2016-01-19 10:30:19