Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): **MATH 2220 PARTIAL DIFFERENTIAL EQUATIONS** (3,3,0)

Course Aims: This course treats the theory and solution techniques for partial differential equations appearing in physics, biology, chemistry and social science.

Prerequisite: MATH 1111 Mathematical Analysis I and MATH 2110 Differential Equations

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Learning Outcomes (LOs):

Upon successful completion of this course, students should be:

No.	Learning Outcomes (LOs)
	Knowledge
1	Able to classify partial differential equations
2	Able to understand the basic techniques in solving parabolic equations
3	Able to understand the basic techniques in solving elliptic equations
4	Able to understand the basic techniques in solving hyperbolic equations
5	Able to understand the basic techniques in solving quasilinear equations
6	Able to recognize some second-order partial differentical equations of mathematical physics, such as diffusion equation, Laplace equation and wave equation
	Skills
7	Able to formulate real life problems by partial differential equations
8	Able to apply the method of separation of variables to solve partial differential equations

Assessment:

No.	Assessment Methods	Weighting	Remarks
1	Continuous assessment	30%	Continuous assessment is designed to measure how well the students have learned the basic concepts and fundamental theory of partial differential equations and their applications.
2	Final Examination	70%	Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be understanding and skills based to assess the student's versatility in partial differential equations.

Learning Outcomes and Weighting:

Contents		LO No.	Teaching (in hours)
I	Introduction	1	2
II	Parabolic Equations	2, 6 - 8	12
III	Elliptic Equations	3, 6 - 8	11
IV	Hyperbolic Equations	4, 6 - 7	9
V	Quasilinear Equations	5, 7	6

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

References: W.A. Strauss, Partial differential equations: an introduction, John Wiley & sons, 1992

George R. Carrier and Carle E. Pearson, Partial Differential Equations, Theory and Technique, 2nd edition, Academic Press, Inc., 1988.

E. Zauderer, Partial Differential Equations of Applied Mathematics, 2nd Ed., John Wiley & Sons, Inc., 1989.

J. Kevorkian, Partial Differential Equations, Analytical Solution Techniques, Brooks/Cole Publishing Company, 1990.

Fritz John, Partial Differential Equations, 4th Ed., Springer-Verlag, 1982.

Course Content in Outline:

	Topics	**Hours**
I.	Introduction	2
	A. Definitions and examples	
	B. Classification of second-order equations with constant coefficients	
II.	Parabolic Equations	12
	A. Heat conduction, initial and boundary conditions	
	B. Separation of variables	
	C. Eigenvalue problems, eigenfunctions	
	D. Applications of Fourier series	
	E. Nonhomogeneous problems	
	F. Integral transform methods	
	G. Fundamental solution	
III.	Elliptic Equations	11
	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	9
	A. Wave propagation, uniqueness	
	B. d'Alembert solution	
	C. Cauchy problem, characteristics	
V.	Quasilinear Equations	6
	A. Quasilinear 1st-order equations	
	B. Characteristic curves	
	C. Weak solution	
	D. Burgers' equation, shock wave	