جامعة آل البيت
دائرة ضمان الجودة والتخطيط

**Al al-Bayt University**

**College of Sciences**

**Department of Mathematics**

**Course Syllabus: Partial Differential Equations(1)**

**First semester 2019**

## 1. Instructor Information

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| **Instructor Name** | Husein Mahmoud Jaradat |
| **Office Hours** | [Sunday, Tuesday and Thursday: 9:30-10:00,<br>12:00-13:00,<br>14:00-14:30 ] |
| **Office Number and Telephone Extension** | 2199 |
| **Email:** | husseinjaradat@yahoo.com |

## 2. Course Description

Introduction to Partial Differential Equations(PDEs), second order equations and classification into canonical forms (parabolic, elliptic, and hyperbolic), Sturm-Liouville boundary-value problems, Fourier series: a basic Fourier series, Fourier sine and cosine series, separation of variables for linear homogeneous PDEs, the heat equations, wave equations, Laplace's equation and potential equation in a disk, Fourier transforms for finding solution of PDEs, Fourier sine and cosine transforms for finding solution of PDEs, finite Fourier transforms for finding solution of PDEs.

## 3. Course Information

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| **Course Number:** 401304 | **Course Title:** Partial Differential Equations (1) | **Level:** Third year |
| **Delivery Mode:** Lecture | **Pre-requisite:** 401272 | **Day(s) and Time:** Sunday, Monday, Tuesday and Wednesday: 11:45-13:00 |
| **Academic year:** 2019-2020 | **Semester:** First semester | **Credit Hours:** 3 |

## 4. Course Objectives

The main purpose of this course is to introduce fundamental concepts of the theory of partial differential equations (PDEs). By the end of the semester the students should be able to
1. provide examples of real-world problems modeled with Partial Differential Equations (PDEs) and classify PDEs with respect to dimension, linearity, order, and canonical forms.
2. apply some methods of solving ordinary differential equations to solve PDEs.
3. understand basic properties of eigenvalue problems.
4. determine different types of Fourier series for periodic functions.
5. use separation of variables method for solving BVPs (Heat equation, the wave equation, Laplace's equation and potential equation in a disk).
6. use different types of Fourier transforms for finding solution of PDEs.
7. use different types of finite Fourier transforms for finding solution of PDEs.

## 5. Intended Student Learning Outcomes

Successful completion of the course should lead to the following outcomes:
**1) Knowledge and Understanding Skills:** Student is expected to

* be able to classify PDEs with respect to dimension, linearity and the order.
* be able to find canonical forms
* be able to recognize situations that partial differential equations can be used and formulate problems with such a tool.
* be able to solve Sturm-Liouville problems.
* be able to use the method of separation of variables.
* be able to understand of trigonometric Fourier series and other orthogonal expansions.
* be able to apply integral transforms to solve problems on unbounded domains.
* be able to solve PDEs problems in coordinate systems other than rectangular.

**2) Professional Skills**
Use mathematical methods (method of finite Fourier transforms, the Fourier integral transforms, method of separation of variables) to describe, solve and interpret real- world problems.

**3) General Competences (Transferable skill and attributes)**
- Study main properties of the classical equations of Mathematical Physics.
- Develop and practice disciplined habits of successful learning such as
  * Attending class regularly making sure to arrive on time ready to focus and staying to the end of each class.
  * Preparing for each class by prior textbook reading, making a list of questions.
  * practicing with problems, etc.
  * Taking responsibility for one's own learning—staying up to date in everything that concerns the course.
- Encourage the development of
  * Critical thinking
  * Estimation skills
  * Elementary problem solving

## 6. Course Content

| Teaching Week | Topics/Activities to be Covered |
|---|---|
| **1** | Introduction to partial differential equations(PDE). |
| **2** | Classification of PDE. |
| **3** | The Cononical form of 2nd order PDE. |
| **4** | The Cononical form of 2nd order PDE. |
| **5** | The Sturm-Liouville Eigenvalue Problems. |
| **6** | Fourier Series, Fourier Cosine and Sine series. |
| **7** | First Exam |
| **8** | Heat equation: Derivation and boundary conditions, Steady-state temperatures, fixed ends temperatures, Different boundary condition |
| **9** | The wave equation: The vibrating string, solution of the vibration string problem. |
| **10** | Laplace's equation: Solutions and qualitative properties |
| **11** | Laplace Equation for a Circle, Circular Annulus. |
| **12** | Second Exam. |
| **13** | Fourier Transforms and its Applications to PDEs Integral Transforms Methods: The Fourier Transform, The Finite Fourier Transforms (Sine and Cosine Transforms) |
| **14** | Fourier sine and cosine Transforms and its Applications to PDEs |
| **15** | The Finite Fourier Transforms (Sine and Cosine Transforms) and its Applications to PDEs. |
| **16** | Final Exam |

## 7. Teaching and learning Strategies and Evaluation Methods

| Learning Outcomes | Teaching Strategies | learning Strategies | Evaluation Methods |
|---|---|---|---|
| - be able to classify PDEs with respect to dimension, linearity and the order<br>- be able to find canonical forms<br>- be able to solve Sturm-Liouville problems. | - Writing on the blackboard<br>- Ask students questions and discuss them<br>- Solve various issues | Give homework assignments | - Classroom presentations<br>- Discussion<br>- First exam |
| - be able to find the solution for PDEs (Heat equation, the wave equation, Laplace's equation and potential equation in a disk) by using the method of separation of variables | - Writing on the blackboard<br>- Ask students questions and discuss them<br>- Solve various issues | Give homework assignments | - Classroom presentations<br>- Discussion<br>- Second exam |
| - be able to apply Foureir transforms to solve problems on unbounded domains.<br>- be able to apply different types of finite Fourier transforms for finding solution of PDEs. | - Writing on the blackboard<br>- Ask students questions and discuss them<br>- Solve various issues | Give homework assignments | - Classroom presentations<br>- Discussion<br>- Final exam |

## 8. Assessment

| Assessment | Grade Proportion | Week/Dates |
|---|---|---|
| **Class Work (Quizzes, Homework and Attendance of the lecture)** | | |
| **First exam** | 25% | 7th Week |
| **Second midterm exam** | 25% | 12th Week |
| **Final exam** | 50% | End of Semester |
| **Total** | **100%** | |

## 9. Text Book

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| **The main reference** | Partial Differential Equations for Scientists and Engineers |
| **Authors** | Tyn Myint-U and Lokenath Debnath |
| **Publisher** | Appleton & Lange |
| **Year** | 1987 |
| **The edition** | 3rd. edition |
| **The reference website** | /www.abebooks.com/book-search/author/tyn-myint-u-lokenath-debnath |

## 10. References and additional resources


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| 1- | Elementary Applied Partial Differential Equations, Richard Haberman |
| 2- | Partial Differential Equations for Scientists and Engineers, Stanley J. Farlow, Willy & Sons, 1982. |
| 3- | An Introduction to Partial Differential Equations , Y. Pinchover, J. Rubenstein , Cambridge, 2005. |