**University of Management and Technology**

**Course Outline**

Course code: MTH733 Course title: Asymmetric Distance Spaces with Applications

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| --- | --- |
| Program | MS/PhD |
| Credit Hours | 3 |
| Duration | One Semester |
| Prerequisites | Functional Analysis |
| Resource Person | Dr Basit Ali |
| Counseling Timing  (Room# ) |  |
| Contact | [basit.ali@umt.edu.pk](mailto:basit.ali@umt.edu.pk)  03334710429 |

**Chairman/Director signature………………………………….**

**Dean’s signature…………………………… Date………………………………………….**

**Course Description:**

This applied analysis course has been designed for graduate students of computer sciences, economics, mathematics and applied mathematics.

The first part of the course deals with the basics of various distance spaces, and notions like convergence and continuity in these spaces. We will discuss fixed point theory and variational principles in these spaces. Second part of this course is about the asymmetric distance spaces, fixed point theorems, variational principles in these spaces. Moreover, some applications in computer sciences, game theory, economics, behavioral sciences and biology will be covered as well.

**Learning Objective:**

After successfully completing the course, students should be

1. comfortable with several concepts involving distance spaces,
2. able to understand several tools related to variational principles and fixed point theorems
3. able to apply the concepts in problems related to computer sciences, economics, and behavioral sciences.

**Learning Methodology**

**Grade Evaluation Criteria**

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

**Marks Evaluation Marks in percentage**

Quizzes (3-4): 10

Assignments (3-4) 10

Mid Term (1) 25

Attendance & Class Participation 00

Term Project (1) 10

Presentations (1) 05

Final exam (1) 40

Total 100

**Recommended Text Books:**

S. Cobzaş, Functional analysis in asymmetric normed spaces, arXiv preprint arXiv:1006.1175 (2010).

**Reference Books:**

1. H.-P.A. K¨unzi, An introduction to quasi-uniform spaces, Beyond topology, 239–304, Contemp. Math., 486, Amer. Math. Soc., Providence, RI, 2009
2. R.E. Megginson, An introduction to Banach space theory, Springer, BerlinHeidelberg-New York, 1998.
3. E. Kreyszig, Introductory functional analysis with applications (1) (1978) New York: wiley.

**Calendar of Course contents to be covered during semester**

**Course code……………………………...... Course title………………………………………**

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| --- | --- | --- |
| **Week** | **Course Contents** | **Reference Chapter(s)** |
| 1 | Basics of metric spaces, examples, topology of metric spaces, convergence and continuity |  |
| 2 | Fixed point theory of metric spaces |  |
| 3 | Variational principles in metric spaces |  |
| 4 | Some applications of fixed point theorems and variational principles |  |
| 5 | Quasi-metric spaces and asymmetric normed spaces |  |
| 6 | The topology of a quasi-semimetric space,  Bitopological spaces, |  |
| 7 | Compactness in bitopological spaces,  Topological properties of asymmetric seminormed spaces, |  |
| 8 | Quasi-uniform spaces,  Asymmetric locally convex spaces |  |
| 9 | Various notions of completeness for quasi-metric spaces  Compactness, total boundedness and precompactness |  |

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| 10 | Baire category in bitopological spaces  Completeness and compactness in quasi-uniform spaces  Completions of quasi-metric and quasi-uniform spaces |  |
| 11 | Banach contraction principle and generalizations in asymmetric distance spaces |  |
| 12 | Ekeland variational Principle in asymmetric distance spaces |  |
| 13 | Applications in computer sciences, and economics, and game theory |  |
| 14 | Applications in behavioral sciences |  |
| 15 | Project presentations |  |