**University of Management and Technology**

**Course Outline**

Course code: MTH 638 Course title: Astrophysics and Cosmology

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| Program | MS |
| Credit Hours | 3 credit  |
| Duration | 1 Semester |

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

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

**Course Descriptions:**

Revision of tensor calculus, Einstein Equations, Application of Einstein Equations, Stellar Structure, Gravitational Collapse, Compact Stars, Galaxies, Superclusters and Filaments, Dark Matter, Cosmological Principles, Dark Energy, The Cosmological Constant, Universe Model.

**Learning Objective:**

To introduce students to the field of astrophysics and cosmology. To provide conceptual skills and analytical tools necessary for astrophysical and cosmological applications. On successful completion of this course, students should be able to:

1. apply the mathematical and physical ideas of the theory of gravity for the study of various systems in astrophysics and cosmology.
2. demonstrate knowledge and discuss the dynamic interactive physical processes in astrophysics and cosmology by using a relativistic gravitational approach

**Learning Methodology:**

 The course is based upon the concept of Riemannian geometry, most often expressed in the language of tensor calculus. It thus involves mathematics along with physics of astronomy and cosmology. So the learning methodology of the course depends upon three approaches:

1. Mathematical approach that defines the framework of gravitational theories to demonstrates phenomena.
2. Physics approach that discuss applications of gravitational theories to Physical phenomena of the universe.
3. The intertwined + active-learning approach. This approach intertwined mathematical approach with Physics approach to demonstrate the phenomena of astrophysics and cosmology.

 **Recommended Text Books:**

Rennan Barkana: The Encyclopedia of Cosmology (World Scientific, 2018).

Bradley W. Carrol and Dale A. Osttile: An Introduction to Modern Astrophysics (Cambridge University Press, 2017) .

Oliver Piattella: Lecture Notes on Cosmology (Springer, 2018).

Pankaj Jain: An Introduction to Astronomy and Astrophysics (CRC Press, 2016).

**Reference Books:**

Peter Hoyng: Relativistic Astrophysics and Cosmology (Springer, 2007).

Plebanski, J. and Kransinski, A.: An Introduction to General Relativity and Cosmology (Cambridge University Press, 2006).

A.K. Raychaudhuri et al.: General Relativity, Astrophysics and cosmology (Springer, 2003).

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

**Course code: 638 Course title:** Astrophysics and Cosmology

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| **Week** |  **Course Contents**  |
| **1** |  Revision of Tensor Calculus  |
| **2** |  Einstein Equations |
| **3** |  Application of Einstein Equations  |
| **4** |  Stellar Structure |
| **5** |  Gravitational Collapse |
| **6** |  Compact Stars  |
| **7** |  Galaxies, Super clusters and Filaments |
| **8** |  Dark Matter |
| **9** |  Cosmological Principles  |
| **10** |  Dark Energy |
| **11** |  The Cosmological Constant  |
| **12** |  Universe Model  |
| **13** |  Presentations and discussion on latest research papers  |
| **14** |  Presentations and discussion on latest research papers |
| **15** |  Presentations and discussion on latest research papers |