1. Course Number and Course Title COE 476 – Neural Networks and Deep Learning

- 2. Credit Hours 3-0-3
- **3. Prerequisites and/or Co-Requisites:** <u>Prerequisites:</u> CMP 220 (Programming II) and MTH 221 (Linear Algebra)
- 4. Name and Contact Information of Instructor: Dr. Imran Zualkernan

5. Course Description (Catalog Description):

Covers tensors, neural network modelling, gradient descent optimization and loss functions, feature engineering, and evaluation of neural networks. Focusses on various types of neural networks including feedforward networks, auto-encoders, convolutional neural networks, recurrent neural networks. Discusses topics in generative deep learning.

6. Textbook and other Supplemental Material:

Textbook:

□ François Chollet, Deep Learning with Python, November 2017, Manning Press.

Other supplemental material:

- □ Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, 2016, The MIT Press.
- □ Aurélien Géron, Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems, 2017, O'Reilly Media.

The supplemental material is available on reserve in the AUS library.

7. Learning Outcomes:

Upon completion of the course, students will be able to:

- 1. Build feedforward neural networks
- 2. Demonstrate an understanding of issues in feature modelling and overfitting
- 3. Apply neural network evaluation techniques
- 4. Design auto-encoders
- 5. Design convolution neural networks
- 6. Design recurrent neural networks
- 7. Apply generative deep learning techniques to create synthetic data

8. Teaching and Learning Methodologies:

Methods include lectures; problem and project-based learning methods (homework, simulationbased projects) and class discussions.

9. Course Topics and Schedule:

| Topic Week | Topic Week |
|---|------------|
| Introduction and history of Neural Networks | Week #1 |
| Bootcamp in Python | Week #2 |
| Review of Linear Algebra for Neural Networks | Week #3 |
| Feedforward Neural Networks | Week #4 |
| The Backpropagation Algorithm and Implementation | Week #5 |
| Feature Modelling | Week #6 |
| Evaluation of Neural Network Models | Week #7 |
| Introduction to Keras | Week #8 |
| 1D Convolutional Neural Networks and Applications | Week #9 |
| 2D Convolutional Neural Networks - Image Processing | Week #10 |
| 2D Convolutional Neural Networks – Audio Processing | Week #11 |
| Hyperparameter optimization and transfer learning | Week #12 |
| Recurrent Neural Networks and Applications | Week #13 |
| Autoencoders and Applications | Week #14 |
| Generative Adversarial Networks (GANS) and Applications | Week #15 |
| Final Exam | Week #16 |
| Total: | 16 |