1. **Course Number and Course Title:**

   COE 59410 Generative Deep Learning

2. **Credit Hours:**

   3-0-3

3. **Prerequisites and/or Co-Requisites:**

   Prerequisite: Approval of Department Head
   Concurrent: None
   Competencies: Programming skills and undergraduate courses in Probability and Statistics.

4. **Name and Contact Information of Instructor:**

   Dr. Imran Zualkernan

5. **Course Description (Catalog Description):**

   Presents the principles of generative deep learning. Covers foundational networks like multi-layer perceptron and convolutional neural network (CNN). Examines generative learning techniques like autoencoders/variational autoencoders (VAE), and various types of generative adversarial networks (GAN). Includes examples using state-of-the-art software.

6. **Textbook and other Supplemental Material:**

   Textbook:
   - Rowel Atienza, *Advanced Deep Learning with TensorFlow 2 and Keras: Apply DL, GANs, VAEs, deep RL, unsupervised learning, object detection and segmentation, and more,* 2nd edition, Packt Publishing, 2020, ISBN-13: 978-1838821654.

   Other recommended books:
   - Jakub Langr and Vladimir Bok*, GANs in Action: Deep learning with Generative Adversarial Networks*, Manning Publisher, 2019, ISBN-13: 9781617295560.
   - David Foster*, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play,* 1st edition, O'Reilly Media, 2019, ISBN-13: 978-1492041948.

   Supplemental material:
   - Deep learning software (free, open source).
   - Selected articles, journal papers, and data sets.

7. **Course Learning Outcomes:**

   Upon completion of the course, students will be able to:
   1. Analyze the back-propagation algorithm and its caveats.
   2. Implement convolutional neural networks.
   3. Design various types of autoencoders.
   4. Design various types of GANs.
   5. Assess the challenges in training and evaluating GANs.
   6. Discuss methods used to create adversarial examples.
   7. Communicate current research results in generative deep learning effectively.

8. Teaching and Learning Methodologies:

Methods include lectures, problem and project-based learning methods (assignments, exams, survey paper, research project, presentation), and class discussions.

9. Course Topics and Schedule:

Topic	Week #
Introduction and overview of Python	1
The back-propagation algorithm	2
Multi-layer perceptron, CNN and RNNs	3
Convolutional networks	4
Autoencoders	5
Variational autoencoders	6
Introduction to Generative adversarial networks (GAN)	7
Deep Convolutional GAN	8
Challenges in training and evaluation of GANs	9
The Semi-Supervised GAN (SGAN)	10
The Conditional GAN (CGAN)	11
The Progressive GAN	12
The Cycle GAN	13
Adversarial Examples	14
Class Presentations	15
Final Exam	16