Course Description Form

1. Course Name:
Deep Learning
2. Course Code:
Ph.D.
3. Semester / Year:
First / PhD
4. Description Preparation Date:
20/12/2025
5. Available Attendance Forms:
In the class
6. Number of Credit Hours (Total) / Number of Units (Total)
45 hours / 3 units
7. Course administrator's name (mention all, if more than one name)
Name: Prof. Dr. Ban N. Dhannoon Email: ban.n.dhannoon@nahrainuniv.edu.iq
8. Course Objectives

Course Objectives	• **This course discusses the latest deep learning models that researchers are currently using. Different deep architectures and their components are discussed in detail.** • **It also discusses algorithms used to train deep architectures to improve deep models. These deep architectures are not only capable of learning complex tasks but can even outperform humans in some custom applications.**

9. Teaching and Learning Strategies

Strategy	**Provide lectures in PowerPoint slide show** **Execute selected methods for more understanding**

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	3	• Shallow Learning • Why to Use Deep Learning • AI categories • According to its capabilities (ANI vs. AGI vs. ASI)		Powerpoint	

		• According to its functions (Reactive, limited memory, theory of mind, and self-awareness) • vs. AGI vs. ASI) • Limitations of AI • Advantages and disadvantages of AI • Key characteristics of machine learning • Types of ML (supervised, unsupervised, semi-supervised, and reinforcement) • Limitations of ML • Key differences between ML and DL • Testing and Validating (types of cross-validation) • Bias and Variance in ML • Overfitting vs underfitting (reasons, techniques to reduce over- and under-fitting) • Regularization Techniques: Dropout, L1, and L2 Regularization • NN Example			
2	3	• Convolutional Neural Network (ConvNet/CNN) • Evolution of CNN Models • AlexNet: (2012) • ZFNet: (2013) • VGGNet: (2014) • GoogLeNet: (2015) • ResNet: (2015) • Inception-ResNet: (2017) • Xception (Extreme Inception) • SqueezeNet • ShuffleNet (2017)			
3	3	• Architecture of CNN. • A typical CNN layers			

		• Example of a convolution operation • Hyperparameters • Activation Function • Pooling Layer • Dropout			
4	3	• Training Convolution Neural Networks • Gradient descent • Forward and backward pass • Loss Functions and Softmax Classifier			
5	3	• Gradient Descent-Based Optimization Techniques • Improving Gradient Descent (AdaGrad, AdaDelta, RMSProp, and Adam)			
6	3	Mid 1			
7	3	• Challenges in Training Deep Networks (problems and solutions) • Weight Initialization Techniques • Transfer learning • Fine-Tuning vs. Transfer Learning			
8	3	• LeNet-5 architecture • AlexNet architecture • ZFNet architecture • VGGNet architecture • GoogleNet architecture • ResNet (residual blocks)			
9	3	• (DenseNet) • Capsule Network • RNN • LSTM • GRU			
10	3	• Restricted Boltzmann Machine (RBM)			
11	3	• Deep Belief Network • Autoencoders • Deep Autoencoders • Generative Adversarial Networks			
12		• Supervised Deep Learning in Face Recognition • VGG vs Modified VGG-Face Architecture			
13		Mid 2			

14	3	• Supervised Deep Learning in Fingerprint Recognition. • Automatic Fingerprint Identification System (AFIS) • Deep Learning Architectures segmentation and classification for Fingerprint Recognition			
15	3	• Unsupervised Deep Learning in Character Recognition • Unsupervised Pretraining • Supervised Fine Tuning			

11. Course Evaluation

Final Exam 70
Mid1 Exam 10
Mid2 Exam 10
Two monthly projects 10

12. Learning and Teaching Resources

Required textbooks (curricular books, if any	• Advances in Deep Learning, 2020
Main references (sources)	• Dive in Deep Learning 2019
Recommended books and references (scientific journals, reports…)	• The Little Book of Deep Learning, François Fleuret, 2023
Electronic References, Websites	• Youtube