Course Title	**Deep Representation Learning**	Course Code	CS 6XXX			
Dept./ Specialization	Computer Science Engineering and Electronics Engineering	Structure (LTPC)	3	0	2	4
To be offered for	M.Tech and Dual Degree Students (CSE and Electronics), PG and PhD	Status	Core ☐		Elective ▬	
Faculty Proposing the course	Dr. Umarani J.	Type	New ▬		Modification ☐	
Recommendation from the DARC – attached.		Date of DARC	09-10-2024			
External Expert(s)	Prof. Pabitra Mitra , CSE Dept , IIT Kharagpur Prof. Surya Prakash, CSE, IIT Indore					
Pre-requisite	COT	Submitted for approval			08-10-2024	
Learning Objectives	To introduce students to the fundamental concepts of representation learning and explain its importance in extracting meaningful features from data for machine/deep learning tasks.					
Learning Outcomes	• Apply representation learning techniques to various data types. • Build and optimize neural networks for supervised tasks. • Implement unsupervised models like autoencoders and GANs. • Use transfer, self-supervised, and semi-supervised learning methods.					
Contents of the course (With approximate break-up of hours for L/T/P)	1. **Introduction to Representation Learning:** Overview of representation learning, its importance, and applications. Foundations of neural networks, activation functions, loss functions, and optimization (12) 2. **Supervised Representation Learning:** Deep neural networks (DNNs), Convolutional Neural Networks (CNNs), Transformer, Vision Transformers (ViT) (6) 3. **Unsupervised Representation Learning:** Autoencoders, Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), Score/Diffusion based models (4) 4. **Few-shot and Meta Learning:** Introduction to Multi-task and Transfer learning, Meta-learning framework for few-shot learning, Metric learning, comparators and relational networks, Optimization-based meta learning, Generative meta learning (6) 5. **Semi and Self-Supervised Learning:** Consistency Regularization, Proxy-label Methods, Active Learning, Weakly supervised learning methods, Self-supervised and Contrastive Representation Learning, Contrastive losses, Memory-bank techniques, BYOL, SWAV, SimCLR, MoCo, Hard negative mining (6) 6. **Graph Representation Learning:** Introduction to Graph Neural Networks (GNNs), node and edge embeddings. Semi-Supervised Classification with Graph Convolutional Networks (4). 7. **Representation Learning for Time Series:** Recurrent Neural Networks (RNNs), LSTMs, and Temporal Convolutional Networks (TCNs)(4) **Practice Sessions:** 1. Neural Networks and Basic Training , Implementing and Visualizing PCA for Feature Extraction (4) 2. Training a Convolutional Neural Network (CNN), Vision Transformers (ViT) for Image Classification (4) 3. Implementing Autoencoders for Feature Extraction ,Generative Adversarial Networks (GANs) for Image Generation,Contrastive Representation Learning with SimCLR (4) 4. Semi-Supervised Learning with Graph Convolutional Networks (GCNs),Time Series with LSTMs and TCNs,Multimodal Representation Learning with Cross-Modal Retrieval (2)					
Text Book	1. Deep Learning by Goodfellow, I., Bengio,Y., and Courville, A., MIT Press, 2016. ISBN: 9780262035613 2. Representation Learning for Natural Language Processing by Zhiyuan Liu, 2023,Springer, ISBN 9789819915996					
Reference Books	1. Unsupervised Learning: Foundations of Neural Computation by Geoffrey Hinton and Terrence J. Sejnowski, 1999, ISBN electronic: 9780262288033 2. Deep Learning with Python by François Chollet, ISBN-10. 2021, 9781617294433 3. Pattern Recognition and Machine Learning by Bishop, C. ,M., Springer, 2006. ISBN: 9780387310732					