SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE of B. Tech. (Computer Science & Engineering (Artificial Intelligence)) VII & VIII Semester

[Draft Syllabus Subjected to approval]

Effective for the students admitted in year 2021-22 and onwards
Approved by ……. academic council meeting held on …….

Teaching & Examination Scheme
B. Tech. (Computer Science & Engineering (Artificial Intelligence))
3rd Year – VII Semester
(Effective for the students admitted in year 2021-22 and onward)

S. No.	Category	Course Code	Course Title	Hours			Exam Hours	Marks			Credit
				L	T	P		IA	ETE	Total	
	THEORY										
1	DC	7CA4-01	Deep Learning	3	-	-	3	30	70	100	**3**
2	UE	**University Elective subject** *Course code and title to be selected from the university elective pool of subjects*		3	-	-	3	30	70	100	**3**
3	DE	7CA5-11	GPU Computing	2	-	-	3	30	70	100	**2**
		7CA5-12	Pattern Recognition								
		7CA5-13	Generative AI								
Sub Total				**8**	**00**	**00**	**-**	**90**	**210**	**300**	**8**
PRACTICAL & SESSIONAL											
4	DC	7CA4-21	Deep Learning Lab	-	-	2	-	60	40	100	**1**
5	UI	7CA7-30	Industrial Training	-	-	1	-	60	40	100	**3**
	UI	7CA7-50	B.Tech Project - I			3	-	60	40	100	**2**
6	CCA	7CA8-00	SODECA / Co-Curricular Activity	-	-	-	-	-	100	100	**1**
Sub Total				**00**	**00**	**06**	**-**	**180**	**220**	**400**	**7**
Total				**8**	**00**	**06**	**-**	**270**	**430**	**700**	**15**

L = Lecture, **T** = Tutorial, **P** = Practical, **IA** = Internal Assessment, **ETE** = End Term Exam, **Cr** = Credits

Teaching & Examination Scheme
B. Tech. (Computer Science & Engineering (Artificial Intelligence))
3rd Year – VI Semester
(Effective for the students admitted in year 2021-22 and onward)

S. No.	Category	Course Code	Course Title	Hours			Exam Hours	Marks			Credit
				L	T	P		IA	ETE	Total	
	THEORY										
1	UE		**University Elective subject** *Course code and title to be selected from the university elective pool of subjects*	3	-	-	3	30	70	100	**3**
Sub Total				**3**	**00**	**00**		**30**	**70**	**100**	**3**
	PRACTICAL & SESSIONAL										
2	DC	8CA4-40	Seminar	-	-	2	-	60	40	100	**2**
5	UI	8CA7-50	B.Tech Project - II	-	-	3	-	60	40	100	**4**
12	CCA	8CA8-00	SODECA / Co-Curricular Activity	-	-	-	-	-	100	100	**2**
Sub Total				**00**	**00**	**05**	**-**	**120**	**180**	**300**	**8**
Total				**03**	**00**	**05**	-	**150**	**250**	**400**	**11**

L = Lecture, **T** = Tutorial, = Practical, **IA**=Internal Assessment**, ETE**=End Term Exam, **Cr**=Credits

VII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
7CA4-01: Deep Learning	
Credit: 3	**Max. Marks: 100 (IA:30, ETE:70)**
3L+0T+ 0P	**End Term Exams: 3 Hours**

- **Course Objectives:**

As a result of successfully completing this course, students will:
• To describe the major differences between deep learning and other types of machine learning algorithms.
• To explain the fundamental methods involved in deep learning.
• To understand various aspects of Deep Earning and its building block.
• To understand and differentiate between the major types of neural network architectures.
• To Select or design neural network architectures for new data problems based on their requirements and problem characteristics and analyze their performance.
• To understand basic working principles and how Deep Learning is used to solve real-world problems

Course Outcomes:
Upon successful completion of the course the students will be able to
CO-1: Able to learn the fundamental concepts of neural networks and deep neural networks.
CO-2: Able to understand the working principle of convolution neural networks.
CO-3: Able to perform hyperparameter tuning. CO-4: Able to analyze and design neural network for real work problem.
CO-5: Able to understand working principle of various types of neural networks.

S. No.	Contents	Hours
1	**Introduction to Neural Networks** Introduction of artificial neural network and deep learning, characteristics of neural networks terminology, neurons, perceptron, backpropagation, Basic learning laws, Activation and Loss function - Function approximation, applications	7
2	**Introduction to Convolution Neural Networks** CNN Architecture and Operations, convolutional layer, Pooling layer, Variants of the Convolution Model, Forward and Backward propagation, Building a Deep Neural Network Improving Deep Neural Networks Training a deep neural network, hyper-parameter tuning, Hidden layers, Generalization Gap – Under-fitting Vs Over-fitting – Optimization, Normalization.	9
3	**Practical aspects of Deep Learning:** Train/Dev / Test sets, Bias/variance, Overfitting and regularization, Linear models and optimization, Vanishing/exploding gradients, Gradient checking – Logistic Regression, Convolution Neural Networks, RNN and Backpropagation – Convolutions and Pooling..	9
4	Optimization algorithms: Mini-batch gradient descent, exponentially weighted averages, RMS prop, Learning rate decay, the problem of local optima, Batch norm – Parameter tuning process.	8
5	**Neural Network Architectures:** Recurrent Neural Networks, Adversarial NN, Spectral CNN, Self-Organizing Maps, Restricted Boltzmann Machines, Long Short-Term Memory Networks (LSTM) and Deep Reinforcement Learning – Tensor Flow, Keras or MatConvNet for implementation	9
	Total	**42**

Suggested Books:

1. 1. Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017 (link:https://www.deeplearningbook.org/)
2. 2. Deep Learning Step by Step with Python, N D Lewis, 2016
3. 3. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017
4. 4. Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017
5. 5. James Allen “Natural Language Understanding”, Pearson Publication 8th Edition. 2012.
6. 6. François Chollet “Deep Learning with Python,” First Edition, Manning Publication,2018
7. 7. Neural Networks and Deep Learning, Michael Nielsen, Determination Press (2015) (link: http://neuralnetworksanddeeplearning.com/)

VII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
7CA4-11: GPU Computing	
Credit: 2	**Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+ 0P	**End Term Exams: 3 Hours**

- **Course Objectives:**
  As a result of successfully completing this course, students will: • Understand parallel programming with graphics processing units (GPUs). • Understand Memory management and mechanism for parallel computing

Course Outcomes:

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

CO-1: Define and understand terminology commonly used in parallel computing.

CO-2: Describe common GPU architectures and programming models.

CO-3: Understand a Given problem and develop an efficient parallel algorithm to solve it.

CO-4: Understand CUDA memory access mechanism.

S. No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	**01**
2	**GPU Introduction:** To study architecture and capabilities of modern GPUs and learn programming techniques for the GPU such as CUDA programming model. Heterogeneous Parallel Computing, Architecture of a Modern GPU, Speeding Up Real Applications, Parallel Programming Languages and Models.	**06**
3	History of GPU Computing: Evolution of Graphics Pipelines, The Era of Fixed Function Graphics Pipelines, Evolution of Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU, Scalable GPUs, Recent Developments, Future Trends. 5	**05**
4	Introduction to Data Parallelism and CUDA C: Data Parallelism, CUDA Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading.	**5**
5	Data-Parallel Execution Model: CUDA Thread Organization, Mapping Threads to Multidimensional Data, Matrix-Matrix Multiplication—A More Complex Kernel, Synchronization and Transparent Scalability, Assigning Resources to Blocks, Thread Scheduling and Latency Tolerance..	**6**
6	CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Tiled Matrix – À Matrix Multiplication Kernel, Memory as a Limiting Factor to Parallelism.	**5**
	Total	**28**

Suggested Books:

1. Sanders, J. and Kandrot, E., CUDA by Example: An Introduction to General-Purpose GPU Programming, Addison-Wesley Professional (2012) 4th Edition.
2. 2. Kirk, D. and Hwu, M., W., Programming Massively Parallel Processors: A Hands-on Approach. Morgan Kaufmann (2016) 3rd Edition.
3. 3. Hwu, M., W., A GPU Computing Gems Emerald Edition (Applications of GPU Computing Series), Morgan Kaufmann (2011) 1st Edition.

VII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
7CA4-12:Pattern Recognition	
Credit: 2	**Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+ 0P	**End Term Exams: 3 Hours**

Course Objectives:

As a result of successfully completing this course, students will: • Students should be able to understand soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems..

Course Outcomes:

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

CO-1: Describe and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques

CO-2: Apply pattern recognition techniques to real-world problems such as document analysis and recognition

CO-3: Summarize, analyze and relate research in the pattern recognition area

S. No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basics Of Probability,** Random Processes And Linear Algebra, Bayes Decision Theory : Bayes' theorem , Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete Features	7
3	**Parameter Estimation Methods** : Maximum-Likelihood estimation, Gaussian case, Maximum a Posteriori estimation, Bayesian estimation, Gaussian case	6
4	**Unsupervised Learning and Clustering:** Criterion functions for clustering, Algorithms for clustering, K-Means, Hierarchical and other methods, Cluster validation, Gaussian mixture models, Expectation-Maximization method for parameter estimation, Maximum entropy estimation	7
5	**Sequential Pattern Recognition:** Hidden Markov Models (HMMs), Discrete Hmms, Continuous HMMs Nonparametric Techniques For Density Estimation Parzen-Window Method, K-Nearest Neighbor Method 7 Tot	7
	Total	**28**

Suggested Books:

Suggested Books:

1. Pattern Classification, Richard O. Duda, Peter E. Hart, David G. Stork John Wiley 2001
2. Pattern Recognition, Konstantinos Koutroumbas and Sergios Theodoridis 4th Edition., Academic Press 2009
3. Pattern Recognition and Machine Learning, Bishop, Christopher,Springer 2006V Raghvan, " Principles of Compiler Design," McGraw-Hill, ISBN:9780070144712

VII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
7CA4-13:Generative AI	
Credit: 2	**Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+ 0P	**End Term Exams: 3 Hours**

Course Objectives:

As a result of successfully completing this course, students will: • Students should be able to understand soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems..

Course Outcomes:

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

CO-1: Describe and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques

CO-2: Apply pattern recognition techniques to real-world problems such as document analysis and recognition

CO-3: Summarize, analyze and relate research in the pattern recognition area

S. No.	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Overview of Generative AI**: Types of Generative Models (VAE, GAN, RNN, etc.), Applications of Generative AI (Image Generation, Text Generation, etc.	7
3	**Generative Models for Computer Vision** : Convolutional Neural Networks (CNNs) for image processing, Generative Adversarial Networks (GANs) for image generation, Variational Autoencoders (VAEs) for image compression and generation, Case studies: Image generation, Image-to-image translation, etc.	6
4	**Generative Models for Natural Language Processing:** Recurrent Neural Networks (RNNs) for text processing, Transformers for text generation and language modeling, Generative models for text summarization, chatbots, and language translation,	7
5	**Advanced Generative AI Topics:** Generative models for multimodal data (images, text, audio, etc.), Generative models for sequential data (time series, videos, etc.), Advanced techniques: Style transfer, CycleGAN, etc	7
	Total	**28**

Suggested Books:

1. Generative Deep Learning" by David Foster
2. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3. Generative Adversarial Networks" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
4. Natural Language Processing (almost) from Scratch" by Collobert et al.
5. Neural Network Methods for Natural Language Processing" by Yoav Goldberg
6. Deep Learning for Computer Vision with Python" by Adrian Rosebrock

VII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
7CA4-21: Deep Learning Lab	
Credit: 1	**Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+ 2P	**End Term Exams: 2 Hours**

Course Objectives: As a result of successfully completing this course, students will:
• To describe the major differences between deep learning and other types of machine learning algorithms.
• To explain the fundamental methods involved in deep learning.
• To understand various aspects of deep learning and its building block.
• To understand and differentiate between the major types of neural network architectures.
• To Select or design neural network architectures for new data problems based on their requirements and problem characteristics and analyze their performance.
• To understand basic working principles and how Deep Learning is used to solve real-world problems

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

CO-1: Able to learn the fundamental concepts of neural networks and deep neural networks.

CO-2: Able to understand the working principle of convolution neural networks.

CO-3: Able to perform hyperparameter tuning.

CO-4: Able to analyze and design neural network for real work problem.

CO-5: Able to understand working principle of various types of neural networks

S. No.	List of Experiments
1	Demonstration and implementation of Shallow architecture using Python, TensorFlow and Keras i) Google Colaboratory - Cloning GitHub repository, Upload Data, Importing Kaggle's dataset, Basic File operations ii) Implementing Perceptron, iii) Digit Classification: Neural network to classify MNIST dataset
2	Basic implementation of a deep Learning models in PyTorch and Tensor Flow. Tune its performance by adding additional layers provided by the library.
3	Implement custom operations in PyTorch by using deep learning via gradient descent; recursive chain rule (backpropagation); bias-variance tradeoff, regularization; output units: linear, softmax; hidden units: tanh, RELU.
4	Implement a simple CNN starting from filtering, Convolution and pooling operations and arithmetic of these with Visualization in PyTorch and Tensorflow.
5	ConvNet Architectures: Implement a famous convNet architectures - AlexNet, ZFNet, VGG, C3D, GoogLeNet, ResNet, MobileNet-v1.
6	Convolution Neural Network application using TensorFlow and Keras, i) Classification of MNIST Dataset using CNN ii) Face recognition using CNN
7	Image denoising (Fashion dataset) using Auto Encoders Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising)
8	Text processing, Language Modeling using RNN
9	Time Series Prediction using RNN
10	Sentiment Analysis using LSTM
11	Image generation using GAN

Suggested Books:

1. . Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017 (link: https://www.deeplearningbook.org/)
2. Deep Learning Step by Step with Python, N D Lewis, 2016
3. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017
4. 4. Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017
5. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
6. François Chollet "Deep Learning with Python," First Edition, Manning Publication,2018 Neural Networks and Deep Learning, Michael Nielsen, Determination Press (2015) (link: http://neuralnetworksanddeeplearning.com/)

VII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
7CA7-50 : B.Tech. Project – I	
Credit: 2	**Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P	**Mode of evaluation: Report and presentation**

Assessment or Evaluation

The evaluation criteria for B. Tech. Project - I

S. No.	Category	Internal Assessment Max Marks in %	End Term Examinations Max Marks in %
1	Project Motivation, Conceptual Design, Innovativeness, and utility in actual life application	10%	10%
2	Project Ideation, Project Formulation, and Design	10%	10%
3	Project Prototyping & Finalization, Project Planning & Timeline (Project Viability for 2 semesters)	10%	10%
4	Technology Used and Method	10%	10%
5	Project Execution, Development, Deployment, Demonstration and Delivery (Working and completeness) required to justify current semester work and presentation	30%	30%
6	Report writing and project documentation (organization of the report, clarity, use of figure/diagram, writing skills, presentation of result, paper publication, patent application, etc.)	20%	20%
7	Professional ethics (teamwork, punctuality, novelty, etc.)	10%	10%
Total		**100%**	**100%**

VIII Semester B. Tech. (Computer Science & Engineering (Artificial Intelligence))	
8CA7-50 : B.Tech. Project -II	
Credit: 4	**Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P	**Mode of evaluation: Report and presentation**

Assessment or Evaluation

The evaluation criteria for B. Tech. Project - II

S. No.	Category	Internal Assessment Max Marks in %	End Term Examinations Max Marks in %
1	Project Motivation, Conceptual Design, Innovativeness, and utility in actual life application	10%	10%
2	Project Ideation, Project Formulation, and Design	10%	10%
3	Technology Used and Method	10%	10%
4	Project Execution, Development, Deployment, Demonstration and Delivery (Working and completeness) required to justify current semester work and presentation	30%	30%
5	Report writing and project documentation (organization of the report, clarity, use of figure/diagram, writing skills, presentation of result, paper publication, patent application, etc.)	20%	20%
6	Professional ethics (teamwork, punctuality, novelty, etc.)	10%	10%
7	Paper Published in reputed journals (SCE, SCIE, Scopus, UGC care or any peer-reviewed journal), Paper publications (International or National conferences [IEEE, ACM, Springer, etc]), and presentations at Hackathon (Institute level or SIH) or any institute, state or national level project presentation competitions.	10%	10%
Total		**100%**	**100%**