Annexure-V

Curriculum and Rules and Regulations

for

B.Tech. Minor Degree

(in addition to existing Major Degree)

in

Computer Science and Engineering

Computer Science and Engineering Department

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

(An autonomous Institute under the aegis of Ministry of Education, Govt. of India.)

Department of Computer Science and Engineering
National Institute of Technology Delhi

About the Department

The Computer Science and Engineering Department was started in 2010 along with the foundation of NIT Delhi. Initially, only the Bachelor of Technology Programme was offered with the intake 30 which presently has been increased to 60. Now, apart from B. Tech., the department also offers Master of Technology (CSE & Analytics), and Ph.D. program which cover a number of important areas of Computer Science and Engineering. The department provides the students with a broad undergraduate and graduate curriculum, based on the application and theoretical foundations of computer science. The departmental faculties and students participate in interdisciplinary research. The department envisions producing quality graduates, capable of leading the world in the technical realm. The department is equipped with the latest configuration and high computing system with hi-speed Internet facilities. The Computer Science Program at this institute are dedicated to educate students and to advance research in computer and information technology. The department has all the facilities to carry out the related teaching and research work.

VISION

To communicate quality Computer Science Education for producing globally identifiable skilled technocrats and entrepreneurs upholding sound ethics, profound knowledge, and innovative ideas to meet industrial and societal expectations.

MISSION

- **M1** To impart value-based **technical knowledge** and skill relevant to Computer Science and Engineering through effective pedagogies and hands-on experience on the latest tools and technologies to **maximize employability**.
- **M2** To strengthen **multifaceted competence**, nurture **creativity, and innovation,** and create **entrepreneurial environment** for an ever-changing technological scenario requiring communally cognizant solutions.
- **M3** To create an appetite for **research, and higher education** in contemporary, and emerging areas of Computer Science.
- **M4** To inculcate the **moral, ethical, and social ideals** essential for prosperous nation-building.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- **PEO1** Graduates are prepared to be employed in IT industries and be engaged in continuous learning, understanding, and applying innovative ideas while maintaining strong ethical standards.
- **PEO2** Graduates are prepared to pursue higher studies and continue to develop their professional knowledge.
- **PEO3** Graduates are equipped to do research in areas of specialization and the allied fields.

PEO4 Graduates are prepared to meet the changing needs of society through knowledge-based service, exhibit leadership qualities with demonstrable attributes in lifelong learning and become successful entrepreneurs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 Ability to analyze, develop and design new tools and approaches to create cutting-edge solutions for Industry.

PSO2 Ability to carry out research and education in trans-disciplinary fields to solve the problems of national as well as international significance.

Rules and Regulations for the Proposed Minor Degree Programme

1. B. Tech students may opt for the minor degree in the CSE department as per their interest.
2. CSE department is providing minor degree through two different specializations.
    a. *Artificial Intelligence and Machine Learning*
    b. *Data Science*

    The detailed curriculum is attached herewith in the Annexures.
3. Students have to opt for a minimum of **4 courses (16 credits) and one project (2 credits)**, then only will be awarded the **minor degree in Computer Science and Engineering with the respective specialization.** The project should be approved by the department of CSE. Hence, in a minor degree a student should complete **18 credits other than the desired credits** of his/her major degree
4. The SGPA and CGPA calculation will also be completely different for a major and minor degree, with no mapping or no correlation.
5. Separate grade sheets for the minor degrees will be issued like the existing major degree.
6. To commence with the provision of Major and Minor Degrees will be applicable for the students studying in the 5th Semester only from the Academic Year 2022-23.
7. Upcoming 3dr year/ 5th semester Students, while registering for the 5th semester can choose this option.
8. Students studying in the 7th Semester in the Academic Year 2022-23 are not eligible for Minor Degrees.
9. Minor Degree is not mandatory for the students. It is optional for only those students who are willing to do it.
10. The students can opt for the courses for Minor Degree from the 5th semester to the 8th semester with not more than 2 courses in a semester.
11. For a Minor degree, the students can opt for a maximum of two courses through online modes such as MOOC/ NPTEL, etc.
12. In case, the student opts for online courses (as mentioned in the previous point), the Department as per the academic calendar and prevailing norms will do the evaluation.
13. Subjects listed in the 8th semester will be purely online modes such as MOOC/ NPTEL, etc. However, the Department as per the academic calendar and prevailing norms will do the evaluation.

Credit Requirement

Semester wise Credit Structure for Minor Degree

Sl. No.	Courses	Credits								Total
		1st Year		2nd Year		3rd Year		4th Year		
		1st Sem	2nd Sem	3rd Sem	4th Sem	5th Sem	6th Sem	7th Sem	8th Sem	
1	Programme Core	—	—	—	—	—	—	—	—	—
2	Programme Electives	—	—	—	—	08	04	04	—	16
3	Open Electives	—	—	—	—	—	—	—	—	—
4	Applied Sciences	—	—	—	—	—	—	—	—	—
5	Humanities	—	—	—	—	—	—	—	—	—
6	Summer Training, Independent Study & Project	—	—	—	—	—	—	—	02	02
7	Allied Engineering	—	—	—	—	—	—	—	—	—
Total		—	—	—	—	**08**	**04**	**04**	**02**	**18**

Course Scheme

Year	Fifth Semester						Sixth Semester					
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
Ist	CSBB XXX	Elective-I [Select from Specialization-I/ Specialization-II/ Specialization-III]	3	0	2	4	CSBB XXX	Elective-III [Select from Specialization-I/ Specialization-II/ Specialization-III]	3	0	2	4
	CSBB XXX	Elective-II [Select from Specialization-I/ Specialization-II/ Specialization-III]	3	0	2	4						
	Total					**08**	**Total**					**04**
IInd	**Seventh Semester**						**Eight Semester**					
	CSBB XXX	Specialization-I/ Specialization-II/ Specialization-III	3	0	2	4	CSPB XXX	Project II	0	0	4	2
	Total					**04**	**Total**					**02**

Specialization in Artificial Intelligence and Machine Learning												
Set-1												
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	CSBB 311	Machine Learning	3	0	2	4	CSBB 312	Pattern Recognition	3	0	2	4
	CSBB 313	Digital Image Processing	3	0	2	4	CSBB 314	Computer Vision	3	0	2	4
	CSLB 315	Optimization Techniques	3	1	0	4	CSBB 405	Fuzzy Logic and Applications	3	0	2	4
	CSBB 406	Cloud Computing	3	0	2	4						
Set-2												
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	CSBB 314	Computer Vision	3	0	2	4	CSLB 315	Optimization Techniques	3	1	0	4
	CSBB 316	Information Storage & Retrieval	3	0	2	4	CSBB 317	Soft Computing	3	0	2	4
	CSBB 405	Fuzzy Logic and Applications	3	0	2	4	CSBB 407	Natural Language Processing	3	0	2	4
	CSBB 408	Reinforcement Learning and Applications	3	0	2	4	CSBB 409	Social Network Analysis	3	0	2	4
	CSBB 412	Motion Analytics	3	0	2	4	CSBB 415	Motion Planning for Robotics	3	0	2	4
	CSBB 424	Deep Learning and Applications	3	0	2	4						
Set-3												
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	CSBB 405	Fuzzy Logic and Applications	3	0	2	4	CSBB 406	Cloud Computing	3	0	2	4
	CSBB 407	Natural Language Processing	3	0	2	4	CSBB 408	Reinforcement Learning and Applications	3	0	2	4
	CSBB 409	Social Network Analysis	3	0	2	4	CSBB 412	Motion Analytics	3	0	2	4
	CSBB 413	Introduction to Cognitive Computing	3	0	2	4	CSLB 414	Game Theory	3	1	0	4
	CSBB 415	Motion Planning for Robotics	3	0	2	4	CSBB 424	Deep Learning and Applications	3	0	2	4

Specialization in Data Science												
Set-1												
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	CSBB 311	Machine Learning	3	0	2	4	CSLB 315	Optimization Techniques	3	1	0	4
	CSLB 321	Mathematical Foundation of Data Science	3	1	0	4						
Set-2												
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	CSBB 314	Computer Vision	3	0	2	4	CSLB 315	Optimization Techniques	3	1	0	4
	CSBB 323	Data Handling & Visualization	3	0	2	4	CSBB 325	Time Series Analysis	3	0	2	4
	CSBB 326	Distributed System	3	0	2	4	CSBB 406	Cloud Computing	3	0	2	4
	CSBB 409	Social Network Analysis	3	0	2	4	CSBB 421	Internet of Things	3	0	2	4
	CSBB 422	Big Data Analytics	3	0	2	4	CSBB 424	Deep Learning and Applications	3	0	2	4
Set-3												
	Sub Code	**Subject Name**	**L**	**T**	**P**	**C**	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**C**
	CSBB 314	Computer Vision	3	0	2	4	CSBB 406	Cloud Computing	3	0	2	4
	CSBB 409	Social Network Analysis	3	0	2	4	CSLB 414	Game Theory	3	1	0	4
	CSBB 421	Internet of Things	3	0	2	4	CSBB 422	Big Data Analytics	3	0	2	4
	CSBB 424	Deep Learning and Applications	3	0	2	4	CSBB 425	Information Security and Privacy	3	0	2	4
	CSBB 426	Business Intelligence and Analytics	3	0	2	4	CSBB 427	Advanced Databases	3	0	2	4

COURSE CONTENT

Department: Computer Science and Engineering

Course Code: CSBB 311	**Open course (YES/NO)**	**HM Course (YES/NO)**	**DC (YES/NO)**	**DE (YES/NO)**
	NO	NO	NO	YES
Type of course	Elective			
Course Title	**MACHINE LEARNING**			
Course Objectives:	This course aims to provide students with the knowledge of key concepts of machine learning from a mathematically well motivated perspective. The course aims to familiarize the students with the two broad categories of machine learning algorithms supervised and unsupervised.			
Course Outcomes	**CO1:** Learn the basics and mathematical background of Machine learning			**L1, L2**
	CO2: Data exploratory analysis before applying machine learning			**L2, L3**
	CO3: Compare machine learning techniques			**L2, L3, L4**
	CO4: Apply Machine learning in real life applications.			**L4, L5, L6**

Semester	**Autumn:**		**Spring: YES**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Introduction to Machine Learning
	Author	Ethem Alpaydin
	Publisher	MIT Press
	Edition	2004

2	Title	Pattern recognition and machine learning
	Author	C. M. Bishop
	Publisher	Springer
	Edition	2007
Reference Book:		
1	Title	Machine Learning
	Author	Tom Mitchel
	Publisher	McGraw Hill
	Edition	2017
2	Title	Machine Learning in Action
	Author	Peter Harrington
	Publisher	Manning Publications Co.
	Edition	2002

Content	**UNIT 1: Supervised Learning** Machine learning basics, Artificial Neural Network, Classifying with k Nearest Neighbors, Splitting datasets one feature at a time: decision trees, Classifying with probability theory: naive Bayes, Support vector machines, Improving classification with the AdaBoost meta algorithm. **UNIT 2: Unsupervised Learning** Grouping unlabeled items using k means clustering, Association analysis with the Apriori algorithm, Efficiently finding frequent itemsets with FP growth. **UNIT 3: Reinforcement Learning** Markov decision process (MDP), Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), Linear Quadratic Gaussian (LQG), Q learning, Value function approximation, Policy search, POMDPs. **UNIT 4: Forecasting and Learning Theory** Predicting numeric values: regression, Logistic regression, Tree based regression. Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, Vapnik– Chervonenkis (VC) dimension, Worst case (online) learning, Practical advice on how to use learning algorithms. **UNIT 5: Additional Tools** Dimensionality reduction: Feature Extraction Principal component analysis to simplify data, Simplifying data with the singular value decomposition, Feature Selection – Ranking methods, subset selection – forward and backward. Big Data and MapReduce.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	List of Experiments
1	Python Frameworks Tutorial (with Jupyter and Colab) and it's Data Structures
2	Introduction to Python libraries for Data Analysis (Pandas, NumPy, Matplotlib)
3	Data Collection & Creation Using Web Scraping- Static and Dynamic Webpages
4	Exploratory Data Analytics and Feature Engineering
5	Regression Techniques: Linear and Logistic
6	Traditional Computational Techniques (Decision Tree, KNN)
7	Implementing Classifier with Probability Theory(naïve Bayes and Bayesian Networks)
8	Implementation of Perceptron for logic gates (AND, OR, NOT)
9	Implementing Support Vector Machine Classifier from scratch
10	Neural networks for Binary Classification
11	Introduction to Reinforcement Learning: Path finding bot problem

Course Code: CSBB 313	Open course (YES/NO)	HM Course (YES/NO)	DC (YES/NO)	DE (YES/NO)
	NO	NO	NO	YES
Type of course	Elective			
Course Title	**DIGITAL IMAGE PROCESSING**			
Course Objectives:	The course aims to cover techniques and tools for digital image processing, image transformation in spatial and frequency domains. It introduces image analysis techniques in the form of image segmentation. The course also aims to cover the processing of colored images. The course also aims to cover techniques and tools for digital image processing and to provide hands-on experience in applying these tools to process images. The students would be encouraged to develop the image processing tools from scratch, rather than using any image processing library functions. Students will also get an opportunity to familiarize with image processing platforms such as Open CV, MATLAB, etc.			

Course Outcomes		
	CO1: Learn the basics and mathematical background of Image Processing	**L1, L3**
	CO2: Analysis and study of methods used for image sampling and quantization, image transforms, image enhancement and restoration, image encoding, image analysis and pattern recognition	**L2, L4**
	CO3: Utility of image compression techniques for storage and transmission purpose.	**L3, L5**
	CO4: To learn about color imaging, color models, and color image processing.	**L4**

Semester	**Autumn:**		**Spring: YES**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				
Text Books:					

1	Title	Digital Image Processing
	Author	R.C. Gonzalez, R.E Woods
	Publisher	Pearson Education
	Edition	2008
Reference Book:		
1	Title	Digital Image Processing Using MATLAB
	Author	R.C. Gonzalez, R.E Woods, S. L. Eddins
	Publisher	PHI
	Edition	2003
2	Title	Image Processing, Analysis, and Machine Vision
	Author	M. Sonka, V. Hlavac, R. Boyle
	Publisher	Brooks/Cole
	Edition	2007
3	Title	Digital Image Processing
	Author	W.K. Pratt
	Publisher	Wiley-Interscience
	Edition	2007

Content	**UNIT 1** Introduction: Digital image representation, Fundamental steps in image processing, Components of Digital Image processing systems, Elements of visual perception, Image Formation model, Image Sampling and quantization, Relationship between pixels – neighborhood, adjacency connectivity, regions, boundaries and distance measures. **UNIT 2** Image Enhancement: Enhancement by point processing, Sample intensity transformation, Histogram processing, Image subtraction, Image averaging, Spatial filtering- Smoothing Spatial filters, Sharpening Spatial filters, Frequency domain- Fourier Transform, Low-Pass, High-Pass, Laplacian, Homomorphic filtering. **UNIT 3** Image Segmentation: Detection of discontinuities – point, line and edge detection, Edge linking and boundary detection, Thresholding, Region-based segmentation – region growing, region splitting and merging, Use of motion in segmentation- Spatial techniques and Frequency domain techniques **UNIT 4** Image Compression: Coding redundancy, Interpixel redundancy, fidelity criteria, Image compression models, Error-free compression, Variable length coding, Bit-plane coding, Lossless predictive coding, Lossy compression, Image compression standards, Real-Time image transmission, JPEG and MPEG. **UNIT 5: Additional Tools** Color Image Processing: Color Models, Pseudo color Image Processing, Color Transformations, Smoothing and sharpening, Image Segmentation based on color.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	**List of Experiments**
1	Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale).
2	Implementation of transformations namely, translation, rotation, scale and shear.
3	Implementation of Histogram, and Histogram Equalization.
4	Implementation of FFT(1-D & 2-D) of an image.
5	Implementation of Image Compression by DCT.
6	Implementation of Image Smoothening Filters(Mean and Median filtering of an Image).
7	Implementation of image sharpening filters and Edge Detection using Gradient Filters.
8	Implementation of image restoring techniques.
9	Implementation of image segmentation techniques.
10	Program for morphological operation: erosion and dilation

Course Code: CSLB 315	**Open course (YES/NO)**	**HM Course (YES/NO)**	**DC (YES/NO)**	**DE (YES/NO)**
	NO	NO	NO	YES
Type of course	Elective			
Course Title	**OPTIMIZING TECHNIQUES**			
Course Objectives:	● This course aims to cover the concepts of optimization methods and algorithms developed for solving various types of optimization Problems. ● To apply the mathematical results and numerical techniques of Optimization theory to various Engineering and Analytics problems. ● Explain the theoretical workings of the graphical, simplex, and analytical methods for making effective decision on variables so as to optimize the objective function.			
Course Outcomes	**CO1:** Understand the fundamentals of Linear Programming and Dynamic Programming			**L1, L3**
	CO2: Enumerate the fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.			**L1, L2**
	CO3: Identify appropriate optimization methods to solve complex problems involved in various industries.			**L1, L2, L4**
	CO4: To understand the graphical, simplex, and analytical methods for making effective decisions.			**L2, L5**

Semester	**Autumn:**		**Spring: YES**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	1	0	4	36
Prerequisite course code as per proposed course numbers	NIL				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	An Introduction to Optimization
	Author	Edwin K.P. Chong, Stanislaw H. Zak

	Publisher	Wiley
	Edition	2017
Reference Book:		
1	Title	Convex Optimization
	Author	Stephen Boyd
	Publisher	LievenVandenberghe
	Edition	2004
2	Title	Modern Optimization with R (Use R)
	Author	Paulo Cortez
	Publisher	Springer
	Edition	2014
Content	**UNIT 1** Preliminaries: Proofs, Vector Spaces and Matrices, Linear Transformations, Eigenvalues and Eigenvectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Concepts from Geometry, Elements of Calculus. **UNIT 2** Unconstrained Optimization: Basics of Set Constrained and Unconstrained Optimization, One Dimensional Search Methods, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Solving Ax = b. **UNIT 3** Linear Programming: Introduction to Linear Programming, Simplex Method, Duality. **UNIT 4** Nonlinear Constrained Optimization: Problems with Equality Constraints, Problems with Inequality Constraints, Karush Kuhn Tucker Condition, Convex Optimization Problems. **UNIT 5: Additional Tools** Algorithms for Constrained Optimization: Projections, Project gradient methods, Penalty methods.	
Course Assessment	Continuous Evaluation 25%	
	Mid Semester 25%	
	End Semester 50%	

Course Code: CSBB 424	**Open course (YES/NO)**	**HM Course (YES/NO)**	**DC (YES/NO)**	**DE (YES/NO)**
	NO	NO	NO	YES
Type of course	Elective			
Course Title	**DEEP LEARNING AND APPLICATIONS**			
Course Objectives:	The purpose of this course is to provide the students with the advance knowledge of Machine learning. It aims to enable the students to understand the design of various Deep Learning models and applications.			
Course Outcomes	**CO1:** Solve problems in linear algebra, probability, optimization, and machine learning.			**L1, L2, L3**
	CO2: Implement deep learning models in Python using the PyTorch library and train them with real-world datasets.			**L4, L5, L6**
	CO3: Design convolutional networks for handwriting and object classification from images or video.			**L4, L5, L6**
	CO4: Design recurrent neural networks with attention mechanisms for natural language classification, generation, and translation.			**L4, L5, L6**

Semester	**Autumn:**		**Spring: YES**		
III	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	36
Prerequisite course code as per proposed course numbers	Machine Learning Course				
Prerequisite credits	NIL				
Equivalent course codes as per proposed course and old course	NIL				
Overlap course codes as per proposed course numbers	NIL				

Text Books:		
1	Title	Deep Learning
	Author	Ian Goodfellow and Yoshua Bengio and Aaron Courville
	Publisher	MIT Press
	Edition	2016
Reference Book:		
1	Title	Machine Learning: An Algorithmic Perspective

	Author	Stephen Marsland
	Publisher	Chapman and Hall/CRC
	Edition	2014
2	Title	Introduction to Probability for Data Science
	Author	Stanley H. Chan
	Publisher	Michigan Publishing
	Edition	2021

Content	**UNIT 1: Introduction** Well posed learning problem, Types of Machine Learning, Applications, Linear Algebra, Probability and Information Theory, Numerical Computation. **UNIT 2: Learning Models** Traditional Machine Learning Basics: Linear Regression, Logistic, Regression, kNearest Neighbors, Classifier with Probability Theory, Decision Trees, Random Forest, Support Vector Machine, Artificial Neural Network: Artificial Neuron, Perceptron, Stochastic Gradient Descent, and Back Propagation Neural Network, Neural Network Architecture, NN with One Hidden Layer, NN with One Hidden Layer and Multiple Outputs, Neural Network Hyper-parameters. **UNIT 3: Deep Learning** Deep Architure: Need, applications, Hyper-parameters in Deep Neural Networks (Encoding, Layers, Loss function, Learning Rate, Momentum and Optimization, Regularization and dropout, Batch Norms) , vanishing gradient problem, and ways to mitigate it. Convolution Neural Network: from Dense Layers to Convolutions, pooling layers, CNN Architectures (AlexNet, VGG, NiN, GoogLeNet, ResNet, DensNet), Application in Image segmentation, Automated Object Detection models. **UNIT 4: Deep Sequence Models** Sequence Modeling Problems, Motivation and Applications, Traditional Models: Recurrent Neural Networks, Back-propagation through time; Modern Recurrent Neural Networks: Gated Recurrent Units, Long Short Term Memory (LSTM), Deep Recurrent Neural Networks, automatic image captioning, video to text with LSTM models. **UNIT 5: Deep Learning** Latent variable models, Autoencoders, Deep Generative Modeling: Variational Autoencoders, Generative Adversarial Networks (GANs), Recent Advance, Image generation with Generative adversarial networks. Transfer Learning: Need and motivation, Transfer Learning Process, Data Augmentation, Applications. Deep Reinforcement Learning: Components of an RL - (Agent, Policy, Value function, Model), MDP, DP, TDL, Q-Learning. SARSA Learning, Deep-Reinforcement Learning Need and Applications, Types of Deep-RL : Deep Q-Network (DQN) , Policy Gradient [Advantage Actor-Critic (A2C/A3C), DDPG, PPO] , Alpha zero Future Trends in Deep Leaning, Attention models for computer vision tasks.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%

Lab Experiments:

Exp. No.	List of Experiments
1	Implement vector addition in TensorFlow.
2	Implement regression models.
3	Implement Feed Forward Networks.
4	Improve Deep Learning models by fine tuning hyper parameters.
5	Use a pre-trained model to implement transfer learning.
6	Performa sentiment analysis using deep learning models.
7	Implement sequence models for prediction.
8	Implement financial planning via Deep Reinforcement Learning.