



HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

Under CBCS

(Applicable for Students admitted from Academic Year 2018-19)

B. Tech. Computer Science Engineering
With Specialization in Artificial Intelligence and Machine Learning
(In Collaboration with IBM)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTING SCIENCES

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

VISION AND MISSION

MOTTO

“To Make Every Man A Success And No Man A Failure”

VISION

To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.

MISSION

- To create an ecosystem for learning and world class research.
- To nurture a sense of creativity and innovation.
- To instill highest ethical standards and values with a sense of professionalism.
- To take up activities for the development of Society.
- To develop national and international collaboration and strategic partnership with industry and institutes of excellence.
- To enable graduates to become future leaders and innovators.

VALUE STATEMENT

- Integrity, Innovation, Internationalization

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

VISION AND MISSION

VISION

To excel in Computer Science and Engineering education, research and project management by empowering the students with strong conceptual knowledge.

MISSION

- M1:** To educate the students with basic foundation blocks of core and allied disciplines of Computer Science and Engineering.
- M2:** To provide practical skills in the advancements of the Computer Science and Engineering field required for the growing dynamic IT and ITES industries.
- M3:** To sculpt strong personal, technical, research, entrepreneurial, and leadership skills.
- M4:** To inculcate knowledge in lifelong learning, professional ethics and contribution to the society.

B. Tech. Computer Science and Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The Program Educational Objectives (PEOs) of the **Computer Science and Engineering** are listed below:

The graduate after 3-5 years of programme completion will

- PEO1:** Excel in his/her professional career and/or pursue higher education including research by applying the knowledge of Computer Science and Engineering.
- PEO2:** Demonstrate the technical skills to analyze and design appropriate solutions for problems with social consciousness and ethical values.
- PEO3:** Adapt themselves to organizational needs by understanding the dynamically changing technologies.

PROGRAM OUTCOMES (ALIGNED WITH GRADUATE ATTRIBUTES) (PO)

(To be achieved by the student after every semester/year/and at the time of graduation)

At the end of this program, graduates will be able to

- PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8: Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

On completion of the B.Tech. Computer Science & Engineering degree the graduates will be able to

- PSO1:** Apply mathematical, conceptual knowledge of computing and analytical skills to solve complex problems.
- PSO2:** Design and develop computer systems based on the domains of Cyber Physical Systems, Algorithm Design Techniques and Enterprise systems security.
- PSO3:** Do innovative system design with analytical knowledge by developing modern tools and techniques.



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SCHOOL OF COMPUTING SCIENCES

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (IN COLLABORATION WITH IBM)

(171CREDIT STRUCTURE)

SEMESTER – I

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	HS/ES	ELA4101/ MEA4101	Professional English and Soft Skills /Engineering Graphics and Computer Aided Design	1	1	2	3	1	4
2	BS	MAA4101	Matrices and Calculus	3	0	2	4	0	5
3	BS	PHA4102/C YA4101	Engineering Physics/Engineering Materials	3	0	0	3	1	3
4	PC	CSA4101	Problem Solving Using C	2	0	2	3	1	4
5	ES	EEB4101 /CSB4101	Introduction to Digital Systems / Engineering and Design	3	0	0	3	1	3
6	ES	GEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2
7	BS	PHA4131/C YA4131	Engineering Physics Lab/ Materials Chemistry Lab	0	0	2	1	0	2
Total				12	1	10	17.5	6	23

B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (IN COLLABORATION WITH IBM)

(171 CREDIT STRUCTURE)

SEMESTER – II

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	MAA4117	Analytical Mathematics	3	0	2	4	1	5
2	BS	PHA4102/C YA4101	Engineering Physics/ Engineering Materials	3	0	0	3	1	3

3	HS/ES	ELA4101/ MEA4101	Professional English and Soft Skills /Engineering Graphics and Computer Aided Design	1	1	2	3	1	4
4	ES	EEB4101 / CSB4101	Introduction to Digital Systems / Engineering and Design	2	0	2	3	1	4
5	ES	GEA4102	Sustainable Engineering Systems	2	0	0	2	1	3
6	PC	CSB4117	Data Structures using C	3	0	0	3	1	3
7	PC	CSB4118	Object Oriented Programming using C++	3	0	2	4	1	5
8	PC	CSB4146	Data Structures Lab	0	0	3	1	0	3
9	ES	GEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2
10	BS	PHA4131/C YA4131	Engineering Physics Lab/ Materials Chemistry Lab	0	0	2	1	0	2
11	PC	IBA4101	Introduction to Artificial Intelligence and Machine Learning	3	0	0	3	0	3
Total				20	1	15	27.5	9	37

**B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
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(171 CREDIT STRUCTURE)

SEMESTER – III

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	MAA4201	Partial Differential Equations and Transforms	3	0	2	4	0	5
2	PC	CSB4201	Design and Analysis of Algorithms	2	1	2	4	1	5
3	PC	CSB4202	Database Management Systems	3	0	0	3	1	3
4	PC	CSB4203	Java Programming	3	0	2	4	0	5
5	DE	IBA4201	Applied statistics (with Lab component in R – Self-study)	3	0	0	3	0	3
6	NE	CSD42**	Non-Department Elective- I	2	0	0	2	0	2
7	PC	IBA4202	Introduction to Python Programming	3	0	2	4	0	5
8	PC	CSB4232	Database Management Systems Lab	0	0	3	1	0	3

Total				19	1	11	25	2	31
B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (IN COLLABORATION WITH IBM)									
(171 CREDIT STRUCTURE)									
SEMESTER – IV									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	MAA4219	Discrete Mathematics	3	1	0	4	0	4
2	PC	CSB4216	Computer Organization and Architecture	3	0	0	3	1	3
3	PC	CSB4217	Computer Networks	3	0	0	3	1	3
4	PC	CSB4218	Operating Systems	3	0	0	3	1	3
5	DE	IBA4302	Data Mining and Predictive Modelling	3	0	2	4	0	5
6	NE	CSD42**	Non-Department Elective–II	2	0	0	2	0	2
7	PC	CSB4241	Networking Lab	0	0	3	1	0	3
8	PC	CSB4242	Operating Systems Lab	0	0	3	1	0	3
9	PC	CSB4243	Design Project-I	0	0	2	1	0	2
10	-	-	Internship	0	0	0	1	0	0
Total				17	1	10	23	3	28

B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (IN COLLABORATION WITH IBM)									
(171 CREDIT STRUCTURE)									
SEMESTER – V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	MAA4302	Probability and Statistics	3	0	2	4	0	5
2	PC	CSB4301	Web Technology	2	0	2	3	1	4
3	PC	CSB4302	Theory of Computation	3	1	0	4	1	4
4	PC	IBA4401	Application of Machine Learning in Industries	2	0	2	3	0	3
5	HS	GEA4216	Professional Ethics and Life Skills	2	0	0	2	1	2

6	DE	IBA4216	Machine Learning	3	0	2	4	0	5
7	NE	CSD43**	Non-Department Elective–III	2	0	0	2	0	2
8	PC	CSB4331	Skill Development in Programming	0	0	2	1	0	2
9	PC	CSB4332	Design Project with IoT	0	0	3	1	0	3
Total				17	1	13	24	3	30

**B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
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(171 CREDIT STRUCTURE)

SEMESTER – VI

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSB4316	Principles of Compiler Design	3	1	0	4	1	4
2	PC	IBA4316	Deep Learning	3	0	2	4	0	5
3	PC	CSB4318	Data Warehousing and Data Mining	3	0	0	3	1	3
4	PC	CSB4319	Modern Software Engineering	3	0	2	4	1	5
5	HS	GEA4304	Business Economics	2	0	0	2	1	2
6	NE	CSD43**	Non-Department Elective–IV	2	0	0	2	0	2
7	PC	CSB4341	Compiler Design lab	0	0	3	1	0	3
8	PC	CSB4342	Design Project-II	0	0	2	1	0	2
9	-	-	Internship	0	0	0	1	0	0
Total				16	1	9	22	4	26

**B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
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(171 CREDIT STRUCTURE)

SEMESTER – VII

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSB4401	Software Project Management	3	0	0	3	1	3
2	PC	CSB4402	Big Data and Analytics	3	0	2	4	1	5

3	PC	CSB4403	Applied Cryptography and Network Security	3	1	0	4	1	4
4	PC	CSB4404	Programming Paradigms	3	0	0	3	1	3
5	PC	IBA4301	Computational Linguistics and Natural Language Processing	3	0	2	4	0	5
6	DE	CSD44**	Non-Department Elective-V	2	0	0	2	0	2
7	PC	CSB4431	Cloud Deployment Lab	2	0	2	3	0	4
8	PC	IBA4431	Mini Project	0	0	2	1	0	2
Total				19	1	8	24	4	28
B.TECH.CSE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (IN COLLABORATION WITH IBM)									
(171 CREDIT STRUCTURE)									
SEMESTER – VIII									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSB4441	Project & Viva – voce	0	0	16	8	0	16
Total				0	0	16	8	0	16
Total							171		

SYLLABUS

SEMESTER – II

COURSE TITLE		INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING		CREDITS	3
COURSE CODE	IBA4101	COURSE CATEGORY	PC	L-T-P-C	3-0-0-3
CIA	50%			ESE	50%
LEARNING LEVEL	BTL-3				
CO	COURSE OUTCOMES				PO
Upon completion of this course, the students will be able to					
1	Understand the concept of Artificial Intelligence				1,2
2	Familiarize with Knowledge based AI systems and approaches				1,2,5,12
3	Apply the aspect of Probabilistic approach to AI				1,2,5,12
4	Identify the Neural Networks and NLP in designing AI models				1,2,3,5,12
5	Recognize the concepts of Machine Learning and its deterministic tools				1,2,5,12
MODULE 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE					(6)
History of artificial intelligence, The birth of artificial intelligence, AI Winters, Today's AI, Historical milestones in the development of AI, Great contributors, People who have influenced AI, Differences between strong AI and weak AI, Artificial Intelligence definitions, Emergence of AI – Technological advances, Machine Learning ---> Deep Learning --->AI, Functions of AI, Characteristics of artificial intelligence, Applications of AI, AI in health care, Industry 4.0, AI in manufacturing, AI in education sector, AI in business, AI in Finance Sector, AI in Law, AI in society, Cognitive science and AI, Cognition and process of Cognition, Disciplines in Cognitive science, Multidisciplinary subject, Linguistics, Artificial intelligence as Cognitive science, Methods in Cognitive science, Watson.					
MODULE 2: LOGICAL APPROACH TO AI AND KNOWLEDGE-BASED SYSTEM					(6)
Introduction to knowledge representation systems, Knowledge representation using logic, Propositional logic, Semantics of propositional logic, Properties of propositional logic statements, Tautologies and logical implication, Resolution, Conjunctive normal form, Resolution is valid, Resolution algorithm, Knowledgebase systems, Structure of a knowledge based system, Recap of artificial intelligence, Components of expert systems, Expert systems development, Wumpus world, Logic, A simple knowledge base, Exploring the Wumpus world, Semantic net, Inference in semantic networks, Semantic networks: Types and components, Types of relationships in semantic network, Frames, Frames: Some examples, Non-monotonic logic, Circumscription, Default logic.					
MODULE 3: PROBABILISTIC APPROACH TO AI					(9)
Probability, Basic concepts, Probability of an event, Example on Sample Space, counting rules, Event relations, Conditional Probabilities, Defining Independence, The Law of Total Probability, Bayes' Rule,					

Examples. Random Variables, Discrete Random Variable, Probability Distributions, Probability Mass Function, Probability Density Function, Expectations of Random Variables, Medians of Random Variables, The variance of a Random Variable, Chebyshev's Inequality, Quantiles of Random Variables, Jointly Distributed Random Variables, Marginal Probability Distributions, Independence and Covariance, Bayesian Networks, Merits of Bayesian Networks, Construction of a Bayesian Network, Representation in Bayesian Networks, Benefits of Bayesian Networks, Why learn Bayesian networks? Constructing Bayesian networks, Example from medical diagnostics, Software for Bayesian networks, Gaussian Bayesian Networks, Linear Gaussian BN to joint Gaussian, Theorem: From Gaussian to Bayesian networks, Noisy OR-Gate model, Promedas: A clinical diagnostic decision support system, Organization of PROMEDAS development.

MODULE 4: EVOLUTIONARY INTELLIGENCE AND NEURAL NETWORKS, NATURAL LANGUAGE UNDERSTANDING (12)

Using LSTMs to synthesize text, Neural Style transfer and applications, Image synthesis with variational auto encoders, Generative Adversarial Networks: 1 What does a GAN look like? 2 Generator, 3 Discriminator, 4. Generator vs Discriminator, 5 Training GANs.

MIMO Deep Learning models, Layers graphs: acyclic and directional, can layers share weights? Hyper parameter tuning, Bag of tricks: ensemble of models.

Introduction, Artificial Neural Network, Appropriate problems for neural network learning, Characteristics of the problems, Basic understanding of neural networks, A single neuron, Activation Functions, Architectures of neural networks, Feedforward neural network, Single-Layer feedforward architecture, Multiple-Layer feedforward architecture, Types of feedforward networks, Multi-layer perceptron, Training MLP: The back-propagation algorithm, Step 1: Forward propagation, Step 2: Back propagation and weight updation, Process of learning in neural network, Recurrent or feedback architecture, Mesh Architectures, GRADIENT-DESCENT(training examples, η), Stochastic GRADIENTDESCENT(training examples, η), Multilayer networks and Backpropagation algorithm, The Backpropagation algorithm, Natural language processing, Classical NLP, Feed-forward networks, Recurrent neural networks and recursive networks, Features for NLP problems, Framenet Vs. Wordnet, Features for text, Features for word relations, NGRAM features, Some terminologies.

MODULE 5: INTRODUCTION TO MACHINE LEARNING AND LEARNING DETERMINISTIC MODELS (12)

Motivation for Machine Learning, Applications, Machine Learning, Learning associations, Classification, Regression, The Origin of machine learning, Uses and abuses of machine learning, Success cases, How do machines learn, Abstraction and knowledge representation, Generalization, Factors to be considered, Assessing the success of learning, Metrics for evaluation of classification method, Steps to apply machine learning to data, Machine learning process, Input data and ML algorithm, Classification of machine learning algorithms, General ML architecture, Group of algorithms, Reinforcement learning, Supervised learning, Unsupervised learning, Semi-Supervised learning, Algorithms, Ensemble learning, Matching data to an appropriate algorithm.

Supervised Learning, Regression, Linear regression, Multiple linear regression, A multiple regression analysis, The analysis of variance for multiple regression, Examples for multiple regression, Overfitting,

Detecting overfit models: Cross validation, Cross validation: The ideal procedure, Parameter estimation, Logistic regression, Decision trees: Background, Decision trees, Decision trees for credit card promotion, An algorithm for building decision trees, Attribute selection measure: Information gain, Entropy, Decision Tree: Weekend example, Occam's Razor, Converting a tree to rules, Unsupervised learning, Semi-Supervised learning, Clustering, K – means clustering, Automated discovery, Reinforcement learning, Multi-Armed Bandit algorithms, Influence diagrams, Risk modelling, Sensitivity analysis, Casual learning.

TEXT BOOK

1. Introduction to Artificial Intelligence and Machine Learning (IBM ICE Publications).

SEMESTER III

COURSE TITLE	INTRODUCTION TO PYTHON PROGRAMMING			CREDITS	4
COURSE CODE	IBA4202	COURSE CATEGORY	PC	L-T-P-C	3-0-2- 4
CIA	60%			ESE	40%
LEARNING LEVEL	BTL-4				
CO	COURSE OUTCOMES				PO
Upon completion of this course, the students will be able to					
1	Appreciate the Python programming concept with simple examples				1,2
2	Familiarize with Python data types and regular expressions aspects.				1,2,5,12
3	Design and develop python programs, with Python installation, with key focus on files and exception handling.				1,2,3,5,12
4	Appreciation of nuances such as standard libraries of Python				1,2,5,12
5	Perform testing with applications of Python in IoT				1,2,3,5,12

Prerequisites : NIL

MODULE 1: INTRODUCTION TO PYTHON

(12)

History of Python, What's Python buzz? Why to Learn Python? Features of Python, Python interpreter, Growth, Strength of Python, Python use cases, Flavors of Python, Python 2 vs Python 3, When would one choose 2.7? Introduction to Python Versions, Python Installation, Testing and Validating Installation, PIP3 LIST.

Practical Component:

Hardware requirement:

- i5 Processor, 8GB RAM, Internet Connection

Software Environment:

- IDE recommended PYCHARM (Recommended), JUPYTER, VISUAL STUDIO

- (i) Python Program to Reverse a Given Number and compare it to the original number

- (ii) Python Program to Read a Number n and Print the Natural Numbers
- (iii) Python Program to Determine all Pythagorean Triplets in the Range
- (iv) Python Program to Check if a Number is an Armstrong Number

MODULE 2: DATA TYPES & REGULAR EXPRESSION

(12)

Simple Python Program, Basic Data Types Statement, Basic Data types identifiers, Basic Data types, Integer Data Type, Float and Complex Data Type, Mathematical Function, String Data Types, String Manipulation Function, Sample String Python Code, Data types List, List Basic Operation, List Sorting, List – Count & Append, Dictionary, Python-Specialized data type, Basic Data types Collections, Files Directories & Flow control, Expression, Unicode, Example of RE, Control Statements, Range Function.

Practical Component:

- (i) Python Program to Remove Vowels and Punctuation from String
- (ii) Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings
- (iii) Python program to read a list, sorted in increasing order by the last element in each tuple from a given list of non-empty tuples
- (iv) Python program to generate and print a list of first and last 5 elements where the values are square of numbers between a range
- (v) Python program to merge two dictionaries

MODULE 3: PYTHON VERSIONS OF PYTHON INSTALLATION (12)

File & Directory manipulation, File functions, File object attributes, close () method, Opening a binary file, File Attributes, read(read_fixed_size) readline()tell(), Two Input modes to read data from Keyboard, Parallel Processing os.fork() and os.exec (), Function arguments pass by value and reference, Default arguments, Try Except Code, Types of Exceptions, Sample class Example, Instantiating & Inheriting classes, Serializing Python Objects.

Practical Component:

- (i) Python program to find the second lowest grade of any student(s) from the given names and grades of each student using lists and lambda
- (ii) Python program to convert a roman numeral to an integer
- (iii) Python program to find validity of a string of parentheses, '(', ')', '{', '}', '[' and ']'
- (iv) Python program to calculate student Grades with Multiple Inheritance
- (v) Python program to create an Address Book with Multiple Inheritance

MODULE 4 : STANDARD LIBRARIES(12)

Python Standard libraries, Creating modules, Adding variables in the Module, Order of search for the modules in the code, Standard Libraries (SYS Module), Data Compression and Archiving, Creating zip files using the ZipFile Object, Tar file tools, Tar file Exceptions, Gzip, Bzip2, Python Web Development, Request module: Access web page, Example of a code that cannot connect to the remote, Request module: passing the payload, Request module: To view the status code, Response Module, http Module: Overview, http Module : http client, Django - Web Development framework, Django Interface, Django - Creating an app, Flask: Web Development Framework, Flask, Flask Code, Flask -Templates,

Flask - Template Engine : Jinga, Flask – Jinga Template creation, Flask – Jinga Template, Network programming, Extending and Embedding Python using C, Custom Function, Mapping Functions, Initialization Function, Building and Installing Extensions.

Practical Component:

- (i) Python program to create an application to implement a Calculator
- (ii) Python program to implement Euclidean Algorithm to compute the greatest common divisor (gcd)
- (iii) Python program that reads a given expression and evaluates it
- (iv) Python program to group a sequence of key-value pairs into a dictionary of lists
- (v) Python program to convert an array to an array of machine values and vice versa
- (vi) Python program to Create widget to draw a line, two buttons, insert a text and delete section of the text
- (vii) Python program to create a calculator using GUI – TK
 - (viii) Python program to display details about the operating system, working directory, files and directories in the current directory, lists the files and all directories, scan and classify them as directories and files
 - (ix) Python program to get information about the file pertaining to the file mode and to get time values with components using local time and gmtime

MODULE 5: PYTHON IN IoT

(12)

Python in IoT, Python on Rasbian image, RPIGPIO module, Paho -MQTT, Python code using MQTT libraries, Client Code: Publish and Subscribe, Some of the APIs explained in larger scope, Output, Numpy, Working with Numpy, Constructing Numpy arrays, Printing arrays, Arithmetic Operations on matrix's, numpyzeros(), Slicing the arrays, Random number generation, Load data from a text file, Mysqldb, Installation of Python Interface module, Creating a database, Tested Database, Python : PyMySQL module, Exception handling in pymysql, OpenCV, Open CV - Installation, Sample code – Open CV, Matplotlib, Matplotlib-Installation & Sample code, Sample code – Bar Chart, Pandas : Data Processing Module, Pandas-Installation, Pandas-Data structure, Pandas-Series data, Pandas – Series data Sample Code, Pandas-Data Frames, Pandas Basic functionality, Example code of a 1-dimensional list.

Practical Component:

- (i) Python program to connect to Google using socket programming
- (ii) Python program to perform Array operations using Numpy package
- (iii) Python program to display multiple types of charts using Matplotlib package
- (iv) Python program to perform File Operation on Excel DataSet

TEXT BOOK

- 1. Programming with Python (IBM ICE Publications 2018 Edition).

SEMESTER IV

COURSE TITLE		DATA MINING AND PREDICTIVE MODELING		CREDITS	4	
COURSE CODE		IBA4302	COURSE CATEGORY	DE	L-T-P-C	3-0-2- 4
CIA		60%		ESE	40%	
LEARNING LEVEL		BTL-3				
CO	COURSE OUTCOMES				PO	
Upon completion of this course, the students will be able to						
1	Recognize the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.				1,2	
2	Compare and contrast the underlying predictive modeling techniques.				1,2,5,12	
3	Select appropriate predictive modeling approaches to identify particular cases				1,2,3,5,12	
4	Appreciate the nuances of Support Vector Machines and clustering techniques.				1,2,5,12	
5	Apply predictive modeling approaches using a suitable package such as SPSS Modeler				1,2,3,5,12	
MODULE 1: DATA UNDERSTANDING & PREPARATION(9)						
Identifying business objectives, translating business objectives to data mining goals, reading data from various sources – Database/ Excel/ Text/others, data visualization – tabular & graphic, distributions and summary statistics, field reordering, Reclassify data.						
MODULE 2: DATA TRANSFORMATIONS (9)						
Data quality issues, Data Audit, anomalies, relationships among variables, Extent of Missing Data, Segmentation, Outlier detection, Variable transformations, Variable derivation, Variable selection, Automated Data Preparation, combining data files, data restructuring, Aggregation, Duplicates removal, Sampling cases, Data Caching, Partitioning data, Missing Value replacement.						
MODULE 3: MODELING TECHNIQUES – I(9)						
Partitioning The Data - Training, Validation & Testing, Model selection, Model development techniques - Linear regression, Logistic regression, Discriminant analysis, Bayesian networks, Neural networks, Rule Induction.						
MODULE 4: MODELING TECHNIQUES – II(9)						
Support vector machines, Cox regression, Time series analysis, Decision trees, Clustering, Association Rules, Sequence Detection, Which Technique to use when.						

MODULE 5: MODEL EVALUATION & DEPLOYMENT (9)	
<p>Model Validation, Determining Model Accuracy, Rule Induction Using CHAID, Automating Models for Categorical Targets, Automating Models for Continuous Targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, Using Propensity Scores, Meta-Level Modeling, Error Modeling, Deploying Model, Exporting Model Results, Assessing Model Performance, Updating A Model.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Introduction to the Case Study (ii) Data Understanding and Preparation (iii) Partitioning Data 	
TEXT BOOK	
1.	Data Mining & Predictive Modeling(IBM ICE Publications).

SEMESTER V

COURSE TITLE		APPLICATION OF MACHINE LEARNING IN INDUSTRIES		CREDITS	3
COURSE CODE		IBA4401	COURSE CATEGORY	DE	L-T-P-C
CIA		50%		ESE	50%
LEARNING LEVEL		BTL-3			
CO	COURSE OUTCOMES-				PO
Upon completion of this course, the students will be able to					
1	Understand the concept of Machine Learning.				1,2
2	Familiarize with applications of Machine Learning in Banking sectors.				1,2,5,12
3	Appreciate the various applications in Communication and Education sectors.				1,2,5,12
4	Identify the applications in Health care and Government sectors .				1,2,5,12
5	Recognize the applications in Manufacturing, Transportation and Logistics sectors.				1,2,5,12
Prerequisites : Machine Learning					
MODULE 1: A BRIEF INTRODUCTION TO MACHINE LEARNING					(6)
Paradigms - Knowledge Representation - Data Acquisition - Data Pre-Processing. Feature Extraction and Processing - Feature Ranking and Selection - Feature Reduction. Model Learning, Evaluation and Deployment.					
MODULE 2: MACHINE LEARNING IN BANKING AND SECURITIES AND INSURANCE					(9)

Introduction - Analytics and Machine Learning Applications in Banking and Securities. Fraud Detection - Effective Application Screening - More Customer Acquisition and Retention. Better Knowledge of Customer Buying Habits - Efficient Cross-Selling - Improved Collections. Marketing Optimization. Increased Customer Lifetime Value - Effective Feedback Management.

Introduction - Insurance Industry Overview - Emerging Trends - New Product Guidelines, Standard Proposal Forms and Need-Based Sales - Multi Tie-up for Banks. Role of Machine Learning in Insurance Sales and Channel Management - Channel Strategy Optimization, Sales Reporting, Channel Management, Channel Analysis, Channel Profitability - Operations Management - New Business Processing, New Business Leakages, Customer Retention/Persistency, Attrition Analysis. Predicting Customer Behavior - Social Media Analytics, Use of GPS-Enabled Devices and CCTV Footage - Claims Management - Claims Payment Management, Claims Analysis - Marketing Management in Insurance Industry - Customer Segmentation, Product Management, Campaign Analysis - Profitability Management in Insurance Industry - Premium Analysis, Financial Analysis, Product Profitability Analysis, Underwriting Loss Analysis - Risk Management in Insurance - Reinsurance, Underwriting.

MODULE 3: MACHINE LEARNING IN COMMUNICATION, MEDIA AND ENTERTAINMENT AND EDUCATION SECTOR (9)

Introduction - Change in Landscape with the Advent of Smartphone and Social Media. The Benefactors of Big Data in Media and Entertainment Industry - Video Publishers, Media Owners, Gaming Companies, Television Channels - Analytics and Machine Learning Applications in Communication, Media and Entertainment Industries. Prediction of Audience Interests. Deriving Insights into Customer Churn - Optimizing Media Program Schedules - Content Monetization - Effective Targeting of Advertisements.

Introduction - Current Challenges in the Education Sector - Multiple Modes of Education, Rapidly Changing Education Trends, Targeting the Right Population, Curbing the Dropout Rate, Planning and Budgeting for Sustainable Expansion, Effective Development of Instructor and Curriculum. The Consequences of these Challenges - High Dropout Rate, Higher Debt Pressure on Dropouts, Increasing Loan Defaults, Failure of the Education System, Universities Lose Revenues. How Analytics Can Help? - What-if Scenarios Creation for Planning, Budgeting and Forecasting - Analytics for Educators - Analytics for Pupils. Smart Governance and Management of Education Programs & Career Prediction and Assisting Students in Choosing their Career Paths.

MODULE 4 : MACHINE LEARNING IN HEALTHCARE AND LIFE SCIENCES AND IN GOVERNMENT SECTORS (9)

Introduction - An Overview of Provider, Payer and Life Sciences Analytics - Business Value of Health Analytics - Value Life Cycle, Healthcare Analytics Framework- Key Drivers - Security, Privacy, and Risk Analytics in Healthcare. Meaningful Use and Role of Analytics - Complying with Regulatory Imperatives Measuring the Impact of Social Media in Healthcare.

Introduction - Machine Learning and Analytics for Government - An Overview. Emerging Technologies

for the Public Sector - Preparing for Big Data, Innovative Use Cases - Government Applications of the Internet of Things - Smart Cities, Motivations and Challenges for Government Use of the Internet of Things. Government Sponsored Healthcare and Life Sciences Projects - Genomics, Neuroscience. Government Use of Big Data for Cybersecurity - Illustrative Cybersecurity Solutions - Illustrative Case Studies - Dubai's Smart City Initiative, San Diego Supercomputer Center, National Center for Supercomputing Applications, Translational Genomics Research Institute, The Food and Drug Administration (FDA)'s Initiative to Detect and Study Patterns of Food Related Illness and Diseases.

MODULE 5: MACHINE LEARNING IN MANUFACTURING AND PETROLEUM INDUSTRIES, RETAIL AND SUPPLY CHAIN, TRANSPORTATION AND LOGISTICS, ENERGY AND UTILITIES (12)

Introduction - Analytics and Machine Learning Approaches in Optimizing Production and Process Efficiency - Optimizing Product Quality - Robust Risk Management - Enhancing Warranty Planning. Improving Demand Planning and Inventory Management - Increasing Maintenance Efficiency. Analytics Applications in Petroleum Industry - Introduction - Upstream Analytics in Petroleum Industry - Exploration and Production Optimization, Oilfield Production Forecasting, Predicting Failure of Field Assets, Reservoir Characterization, Analytics for Unconventional Resource Recovery, Integrated Planning Capabilities - Downstream Analytics in Petroleum Industry - Demand Forecasting for Refining, Facility Integrity and Reliability, Commodity Trading Risk Management, Customer Intelligence.

Introduction - Merchandising Analysis - Assortment Planning, Product Placement, Space Allocation, Product Adjacency, Market Basket Analysis - Marketing Analytics - Promotions, Pricing, Personalization, Campaigns - Store Operations Analytics - Workforce Effectiveness, Shrinkage, Inventory, Store Performance - Supply Chain Analytics - Logistics, Inventory, Supplier Performance, Demand Forecasting, Bull-Whip Effect.

Introduction - Applications for Government - Traffic Control, Route Planning, Intelligent Transport Systems, Congestion Management - Applications for Private Sector - Revenue Management, Technological Enhancements, Logistics and for Competitive Advantage by Consolidating Shipments and Optimizing Freight Movement. Applications for Individuals - Route Planning for Saving Fuel and Time, Travel Arrangements in Tourism.

Introduction - Smart Grids - Demand Response - Revenue Management - Fraud and Loss Prevention - Energy Efficiency - Compliance - Asset Maintenance and Management - Customer Care and Management - Forecasting and Load Management.

TEXT BOOK

1. Application of machine learning in industries (IBM ICE Publications).

COURSE TITLE	MACHINE LEARNING			CREDITS	4
COURSE CODE	IBA4216	COURSE CATEGORY	DE	L-T-P-S	3-0-2- 4
CIA	60%			ESE	40%

LEARNING LEVEL	BTL-4	
CO	COURSE OUTCOMES	PO
Upon completion of this course, the students will be able to		
1	Understand the concept of Machine Learning.	1,2
2	Familiarize with Simple Linear Regression and Logistic Regression.	1,2,5,12
3	Appreciate the various nuances of Multiple Regressions and Model Building.	1,2,5,12
4	Identify and apply the Classification algorithms.	1,2,5,12
5	Apply the Clustering algorithms for developing applications.	1,2,3,5,12
Prerequisites : Data Mining		
MODULE 1: INTRODUCTION TO MACHINE LEARNING		(12)
<p>The Origins of Machine Learning, Uses and Abuses of Machine Learning, How do Machines Learn? - Abstraction and Knowledge Representation, Generalization, Assessing the Success of Learning, Steps to Apply Machine Learning to Data, Choosing a Machine Learning Algorithm - Thinking about the Input Data, Thinking about Types of Machine Learning Algorithms, Matching Data to an Appropriate Algorithm.</p> <p>Practical Component:</p> <p>Hardware requirement:</p> <ul style="list-style-type: none"> i5 Processor, 8GB RAM, Internet Connection <p>Software Environment:</p> <ul style="list-style-type: none"> IDE recommended PYCHARM (Recommended), JUPYTER, VISUAL STUDIO <ol style="list-style-type: none"> Introduction to pandas Introduction to NumPy Wine Quality Prediction Housing Price Prediction Air Quality Prediction Bank Marketing Liver Disease Prediction Heart Disease Prediction Credit Default Prediction Car Price Prediction Media Content Problem Online Retail Case Study Airline Passengers Prediction Energy Efficiency Analysis Stock Price Prediction Car Evaluation Movie Sentiment Analysis 		
MODULE 2: SIMPLE LINEAR REGRESSION(12)		

Introduction to Simple Linear Regression, Simple Linear Regression Model Building, Estimation of Parameters Using Ordinary Least Squares, Interpretation of Simple Linear Regression Coefficients, Validation of Simple Linear Regression Model, Coefficient of Determination (R-squared) and Adjusted R-Squared, Spurious Regression, Hypothesis Test for Regression Coefficients (t-Test), Test for Overall Model: Analysis of Variance (F-Test), Residual Analysis.

Practical Component:

- (i) Program to demonstrate Simple Linear Regression
- (ii) Program to demonstrate Logistic Regression using SCIKIT learn
- (iii) Program to demonstrate Logistic Regression

MODULE 3: MULTIPLE REGRESSION AND MODEL BUILDING

(12)

Introduction, Ordinary Least Squares Estimation for Multiple Linear Regression, Multiple Linear Regression Model Building, Partial Correlation and Regression Model Building, Interpretation of Multiple Linear Regression Coefficients - Partial Regression Coefficients, Standardized Regression Coefficient, Regression Models with Categorical (i.e., Qualitative) Variables - Interpretation of Regression Coefficients of Categorical Variables, Interaction Variables in Regression Models, Validation of Multiple Regression Model, Coefficient of Multiple Determination (R-Squared), Adjusted R-Squared, Statistical Significance of Individual Variables in Multiple Linear Regression: t-Test, Validation of Overall Regression Model: F-Test, Validation of Portions of a Multiple Linear Regression Model - Partial F-Test, Residual Analysis in Multiple Linear Regression.

Practical Component:

- (i) Program to demonstrate Multiple Linear Regression

MODULE 4 : INTRODUCTION TO CLASSIFICATION & CLASSIFICATION ALGORITHMS

(12)

What is Classification? General Approach to Classification, k-Nearest Neighbor Algorithm, Logistic Regression, Decision Trees, Naive Bayesian Classifier, Ensemble Methods: Bagging, Boosting and AdaBoost and XBoost, Random Forests, Advanced Classification Methods: Backpropagation in Multilayer Feed-Forward Neural Networks, Support Vector Machines, Rough Set and Fuzzy Set Approaches, Classification Model Evaluation and Selection: Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value, Lift Curves and Gain Curves, ROC Curves, Misclassification Cost Adjustment to Reflect Real-World Concerns, Decision Cost/Benefit Analysis.

Practical Component:

- (i) Program to demonstrate k-Nearest Neighbor flowers classification
- (ii) Program to demonstrate Decision Tree – ID3 Algorithm
- (iii) Program to demonstrate Naïve- Bayes Classifier
- (iv) Program to demonstrate Back-Propagation Algorithm

MODULE 5: INTRODUCTION TO CLUSTER ANALYSIS & CLUSTERING METHODS

(12)

The Clustering Task and the Requirements for Cluster Analysis , Overview of Some Basic Clustering Methods, Hierarchical Methods: Agglomerate versus Divisive Hierarchical Clustering, Distance Measures, Probabilistic Hierarchical Clustering, Multiphase Hierarchical Clustering Using Clustering Feature Trees, Partitioning Methods: k-Means Clustering, k-Medoids Clustering, Density-Based

Clustering: DBSCAN - Density-Based Clustering Based on Connected Regions with High Density, Measuring Clustering Goodness.

Practical Component:

- (i) Program to demonstrate k-means clustering algorithm
- (ii) Program to demonstrate K-Means Clustering Algorithm on Handwritten Dataset
- (iii) Program to demonstrate K-Medoid clustering algorithm
- (iv) Program to demonstrate DBSCAN clustering algorithm
- (v) Program to demonstrate SVM based classification
- (vi) Program to demonstrate PCA on face recognition
- (vii) Program to demonstrate PCA and LDA on Iris dataset
- (viii) Mini Project works shall be given with a batch of four students considering different datasets such as digit dataset, face dataset, flower dataset and micro-array dataset.

TEXT BOOK

1. Machine Learning (IBM ICE Publications).

SEMESTER VI

COURSE TITLE		DEEP LEARNING			CREDITS	4
COURSE CODE		IBA4316	COURSE CATEGORY	PC	L-T-P-C	3-0-2- 4
CIA		60%			ESE	40%
LEARNING LEVEL		BTL-3				
CO	COURSE OUTCOMES					PO
Upon completion of this course, the students will be able to						
1	Understand the fundamentals of Deep Learning					1,2
2	Familiarize with Neural Networks aspects					1,2,5,12
3	Appreciate the concept behind Convolution Neural Networks					1,2,5,12
4	Identify the Generative Deep learning models					1,2,5,12
5	Recognize the tangible applications of ML and Neural Networks.					1,2,5,12
Prerequisites : Machine Learning						
MODULE 1: THE FUNDAMENTALS OF DEEP LEARNING						(12)
How is Deep Learning different from machine learning? Evolution of AI and ML: Historical Epochs, why is Deep Learning relevant now?						
Practical Component:						
Hardware requirement:						
<ul style="list-style-type: none"> • Nvidia GPU: 8 GB+ GPU RAM • CPU RAM: 32 GB RAM+ 						

Software Environment:

- **OS** - Ubuntu 16x
- **Nvidia CUDA Version** - 10.0
- **Python 2.7.15 and 3.4+**
- **nvidia-smi**(verifiable by typing *nvidia-smi* in terminal and checking for GPU memory and running process-information)
Following Python packages:
 - Numpy version 1.15.4
 - Tensorflow version 1.12.0
 - **Keras**version 2.2.4
 - **sklearn**0.19.2
 - **Opencv**(cv2 package) - version 3.4.5

Please note that the hardware requirement specified is the **minimum needed**, and software versions needed are **exact**; installing older and newer versions not recommended.

MODULE 2: THE MATH BEHIND NEURAL NETWORKS AND DEPTHS OF DEEP LEARNING(12)

How does a neural network look like? The matrix magic: Scalars->Vectors->Matrices->Tensors. How they represent real world data? Tensor operations and visualization, Visualizing Deep Learning, Elephant in the room: Gradient Descent: Derivatives and tensors, Stochastic gradient descents, Back propagation: our very own chain rule of differentiation!

Layers: the atoms of DL, Models: the molecules of DL, Loss functions, Optimizers, Activation Functions: Application and types, Deep Learning in Action: This or that: binary classification, Which one is it? Multi-class classification and Regression. Does your network memorize? Overfitting and Under fitting.

Practical Component:

- (i) Print Dimensions of dataset
- (ii) Calculation of Accuracy Values
- (iii) Compose Matrix Shape and Tensor Shape
- (iv) Accessing and Manipulation of tensors
- (v) Understand the mechanism of practically training a binary classifier

MODULE 3: CONVOLUTIONAL NEURAL NETWORKS AND RECURRENT NEURAL NETWORKS (RNN) (12)

Convolution operation, Max pooling, Power of CNNs: abstraction across layers, what each convolution layer sees? Reusing popular CNNs & fine-tuning.

Why Recurrent Networks, LSTMs & GRU, Examples of simple RNNs, Complex recurrent neural networks: Overfitting in RNNs, Multi-layer RNNs, Multi-directional RNNs. Real-life examples: One-dimensional sequence processing, CNN+RNN.

Practical Component:

- (i) Access and manipulation of tensors
- (ii) Regression Data Sampling

- (iii) Combat Overfitting
- (iv) CNN Training
- (v) Reuse a model
- (vi) Reusing a part of an existing model

MODULE 4: GENERATIVE DEEP LEARNING(12)

Using LSTMs to synthesize text, Neural Style transfer and applications, Image synthesis with variational auto encoders, Generative Adversarial Networks: What does a GAN look like? Generator, Discriminator, Generator vs Discriminator, Training GANs.

MIMO Deep Learning models, Layers graphs: acyclic and directional, can layers share weights? Hyper parameter tuning, Bag of tricks: ensemble of models.

Practical Component:

- (i) Stages of the convnet
- (ii) Sequence Classification Problem
- (iii) Text-to-Speech synthesis
- (iv) Text Generation
- (v) Automatic Image Captioning with Pytorch using a pre-trained model
- (vi) Automatic Image Captioning with Keras
- (vii) Facial Recognition

MODULE 5: TANGENTIAL TOPICS OF ML AND NEURAL NETWORKS (12)

Information-Theoretic Machine Learning, Hebbian Learning, Competitive Learning, Boltzmann Learning, RadialBasis Function Networks.

Practical Component:

- (i) Digit Recognition using Softmax Regression
- (ii) Hand Movement Using OpenCV
- (iii) Implementing a recurrent neural network (RNN) in TensorFlow
- (iv) RNN that will generate new "Flower" names

TEXT BOOK

1. Deep Learning (IBM ICE Publications).

SEMESTER VII

COURSE TITLE		COMPUTATIONAL LINGUISTIC AND NATURAL LANGUAGE PROCESSING		CREDITS	4	
COURSE CODE		IBA4301	COURSE CATEGORY	PC	L-T-P-C	4-0-2- 4
CIA		60%			ESE	40%
LEARNING LEVEL		BTL-3				
CO	COURSE OUTCOMES				PO	
Upon completion of this course, the students will be able to						
1	Recognize the concepts of Natural Language Processing.				1,2	
2	Familiarize with Text processing, Lexical Analysis, Syntactic and Semantic Analysis aspects.				1,2,5,12	
3	Design and develop NLP with Corpus creation with key focus on Tree Bank annotation.				1,2,3,5,12	
4	Appreciate the nuances of Statistical techniques with modern speech recognition.				1,2,5,12	
5	Recognize the applications of NLP in various sectors like healthcare and education.				1,2,5,6,12	
MODULE 1: CLASSICAL APPROACHES TO NATURAL LANGUAGE PROCESSING (9)						
Introduction – Context - Classical Toolkit - Text Preprocessing – Tokenization – Sentence Segmentation - Lexical Analysis – Finite State Morphology – Finite State Morphology – Paradigm based Lexical Analysis - Syntactic Parsing – Cocke-Kasami-Younger Algorithm – Deductive Parsing – LR Parsing – Constraint-based Grammars – Issues in Parsing - Semantic Analysis – Theories and approaches to Semantic Representation – Fine Grained Lexical Semantic Analysis: Case studies - Natural Language Generation – Components of a Generator – Approaches to Text Planning – Linguistic Component.						
Practical Component:						
Lab Specifications:						
Regarding the lab requirement for CL & NLP, as suggested IBM Watson can be implemented along with Python NLTK. Python is open source as required. Pycharm or Jupyter IDEs can be used for the same.						
(i) Print Dimensions of dataset						
(ii) Calculation of Accuracy Values						
(iii) Compose Matrix Shape and Tensor Shape						
(iv) Accessing and Manipulation of tensors						

MODULE (9)	2:	ANNOTATION, TAGGING AND PARSING
<p>Corpus Size, Representation, Sampling – Data Capture – Corpus Markup and Annotation – Multilingual Corpora – Multimodal Corpora -Corpus Annotation Types - Morphosyntactic Annotation – Treebanks: Syntactic, Semantic, and Discourse Annotation - Process of Building Treebanks - Applications of Treebanks - Searching Treebanks. Fundamental Statistical Techniques: Binary Linear Classification - One-versus-All Method for Multi-Category Classification - Maximum Likelihood Estimation - Generative and Discriminative Models - Mixture Model and EM - Sequence Prediction Models. Part-of-Speech Tagging: General Framework – POS Tagging Approaches – Other Statistical and Machine Learning Approaches. Statistical Parsing: Basics - Probabilistic Context-Free Grammars - Generative Models - Discriminative Models - Beyond Supervised Parsing.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Understand the mechanism of practically training a binary classifier (ii) Access and manipulation of tensors (iii) Regression Data Sampling (iv) Combat Overfitting (v) CNN Training 		
MODULE 3: MULTIWORD EXPRESSIONS, WEB DISTANCE AND WORD SIMILARITY, WORD SENSE DISAMBIGUATION (9)		
<p>Multiword Expressions: Linguistic Properties of MWEs – Types of MWEs – MWE Classification – Research Issues - Methods of Word Similarity – Normalized Web Distance Method – Kolmogorov Complexity – Information Distance – Normalized Web Distance – Applications – Word Sense Inventories and Problem Characteristics – Applications of Word Sense Disambiguation – Approaches to Sense Disambiguation: Supervised, Lightly Supervised and Unsupervised.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Reuse a model (ii) Reusing a part of an existing model (iii) Stages of the convnet (iv) Sequence Classification Problem (v) Text-to-Speech synthesis (vi) Text Generation 		
MODULE 4: SPEECH RECOGNITION, ALIGNMENT, STATISTICAL MACHINE TRANSLATION (9)		

Modern Speech Recognition: Architectural Components – Historical Developments – Speech Recognition Applications – Technical Challenges and Future Research Directions – Alignment: Basics – Sentence Alignment – Character, Word, Phrase Alignment – Structure and Tree Alignment – Biparsing and ITG Tree Alignment – Statistical Machine Translation: Approaches – Language Models – Parallel Corpora – Word Alignment – Phrase Library – Translation Models – Search Strategies – Research Areas.

Practical Component:

- (i) Automatic Image Captioning with Pytorch using a pre-trained model
- (ii) Automatic Image Captioning with Keras
- (iii) Facial Recognition
- (iv) Digit Recognition using Softmax Regression

MODULE 5: APPLICATIONS

(9)

Information Retrieval – Indexing – IR Models – Evaluation and Failure Analysis – Natural Language Processing and Information Retrieval – Question Answering – Generic Question Answering System – Evaluation of Question Answering system – Multilinguality in Question Answering System – Recent trends and Related Works – Information Extraction – IE with Cascaded Finite State Transducers – Learning based Approaches in IE – Report generation – Emerging Applications of Natural language Generation in Information – Biomedical Text Mining – Sentiment Analysis and Subjectivity.

Practical Component:

- (i) Hand Movement Using OpenCV
- (ii) Implementing a recurrent neural network (RNN) in TensorFlow
- (iii) RNN that will generate new “Flower” names

TEXT BOOK

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|----|---|
| 1. | Introduction to Linguistics and Natural Language Processing (IBM ICE Publications). |
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