SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE

B. TECH.
ARTIFICIAL INTELLIGENCE & DATA SCIENCE

IV YEAR
(VII & VIII Semester)

Effective for the students admitted in the year 2020-21

Teaching & Examination Scheme
B.Tech.: Artificial Intelligence & Data Science
4th Year - VII Semester

THEORY												
SN	**Category**	**Course**		**Contact hrs/week**			**Marks**					**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exam Hrs**	**IA**	**ETE**	**Total**		
1	PCC	7AD4-01	Deep Learning, NLP and Generative AI	3	0	0	3	30	120	150		**3**
2	OE		Open Elective – I	3	0	0	3	30	120	150		**3**
		Sub Total		**6**	**0**	**0**	**6**	**60**	**240**	**300**		**6**
PRACTICAL & SESSIONAL												
3	PCC	7AD4-21	Deep Learning Lab	0	0	4	2	60	40	100		**2**
4		7AD4-22	Natural Language Processing Lab	0	0	4	2	60	40	100		**2**
5	PSIT	7AD7-30	Industrial Training	1	0	0	-	75	50	125		**2.5**
6		7AD7-40	Seminar	2	0	0	-	60	40	100		**2**
7	SODECA	7AD8-00	Social Outreach, Discipline & Extra-Curricular Activities	-	-	-	-	0	25	25		**0.5**
		Sub- Total		**3**	**0**	**8**	**-**	**255**	**195**	**450**		**9**
		TOTAL OF VII SEMESTER		**9**	**0**	**8**	**-**	**315**	**435**	**750**		**15**

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

Teaching & Examination Scheme
B.Tech.: Artificial Intelligence & Data Science
4th Year - VIII Semester

THEORY												
SN	**Category**	**Course**		**Contact hrs/week**			**Marks**				**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exam Hrs**	**IA**	**ETE**	**Total**	
1	PCC/PEC	8AD4-01	Statistical Modeling and Forecasting	3	0	0	3	30	120	150	**3**
2	OE		Open Elective – II	3	0	0	3	30	120	150	**3**
		Sub Total		**6**	**0**	**0**	**6**	**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
3	PCC	8AD4-21	Statistical Modeling and Forecasting Lab	0	0	2	2	30	20	50	**1**
4		8AD4-22	Big Data Analytics Lab	0	0	2	2	30	20	50	**1**
5	PSIT	8AD7-0	Project	3	0	0	-	210	140	350	**7**
7	SODECA	8AD8-00	Social Outreach, Discipline & Extra-Curricular Activities	-	-	-	-	-	25	25	**0.5**
		Sub- Total		**3**	**0**	**4**	**-**	**270**	**205**	**475**	**9.5**
		TOTAL OF VIII SEMESTER		**9**	**0**	**4**	**-**	**330**	**445**	**775**	**15.5**

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

List of Open Electives for Artificial Intelligence & Data Science				
Subject Code	**Title**		**Subject Code**	**Title**
Open Elective - I			**Open Elective - II**	
7AG6-60.1	Human Engineering and Safety		8AG6-60.1	Energy Management
7AG6-60.2	Environmental Engineering and Disaster Management		8AG6-60.2	Waste and By-product Utilization
7AN6-60.1	Aircraft Avionic System		8AN6-60.1	Finite Element Methods
7AN6-60.2	Non-Destructive Testing		8AN6-60.2	Factor of Human Interactions
7CH6-60.1	Optimization Techniques		8CH6-60.1	Refinery Engineering Design
7CH6-60.2	Sustainable Engineering		8CH6-60.2	Fertilizer Technology
7CR6-60.1	Introduction to Ceramic Science & Technology		8CR6-60.1	Electrical and Electronic Ceramics
7CR6-60.2	Plant, Equipment and Furnace Design		8CR6-60.2	Biomaterials
7CE6-60.1	Environmental Impact Analysis		8CE6-60.1	Composite Materials
7CE6-60.2	Disaster Management		8CE6-60.2	Fire and Safety Engineering
7EE6-60.1	Electrical Machines and Drives		8EE6-60.1	Energy Audit and Demand side Management
7EE6-60.2	Power Generation Sources.		8EE6-60.2	Soft Computing
7EC6-60.1	Principle of Electronic communication		8EC6-60.1	Industrial and Biomedical applications of RF Energy
7EC6-60.2	Micro and Smart System Technology		8EC6-60.2	Robotics and control
7ME6-60.1	Finite Element Analysis		8ME6-60.1	Operations Research
7ME6-60.2	Quality Management		8ME6-60.2	Simulation Modeling and Analysis
7MI6-60.1	Rock Engineering		8MI6-60.1	Experimental Stress Analysis
7MI6-60.2	Mineral Processing		8MI6-60.2	Maintenance Management
7PE6-60.1	Pipeline Engineering		8PE6-60.1	Unconventional Hydrocarbon Resources
7PE6-60.2	Water Pollution control Engineering		8PE6-60.2	Energy Management & Policy
7TT6-60.1	Technical Textiles		8TT6-60.1	Material and Human Resource Management
7TT6-60.2	Garment Manufacturing Technology		8TT6-60.2	Disaster Management

4th Year - VII Semester
B. Tech. (Artificial Intelligence & Data Science)

7AD4-01: Deep Learning, NLP and Generative AI

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	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	**Improving Deep Neural Networks** Training a deep neural network, hyper-parameter tuning, Hidden layers, Generalization Gap – Under-fitting Vs Over-fitting – Optimization, Normalization	7
3	**Introduction to Convolution Neural Networks** CNN Architecture and Operations, convolutional layer, Pooling layer, Variants of the Convolution Model **Introduction to Recurrent Networks** Recurrent Neural Networks - Bidirectional RNNs, Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders, LSTM , Gated RNNs.	10
4	**Basic Overview of Natural Language Processing:** Various stages of NLP, Text Preprocessing, Language Modelling and Large Language Models, Applications of NLP	8
5	**Basic Overview of Generative AI:** A basic introduction to Generative AI, Background on Generative AI, Generative Adversarial Networks, Transformers, diffusion models, Stable Diffusion **Basic overview of Generative AI models**: OpenAI models (ChatGPT, GPT 4.0, DALL-E 2), Google Bard, Microsoft models (CoDi, Kosmos-2)	8
		40

Suggested Books:

1. Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017(Url: https://www.deeplearningbook.org/)
2. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
3. Goodfellow, Ian, et al. "Generative Adversarial Networks." arXiv preprint arXiv:1406.2661 (2014).
4. François Chollet "Deep Learning with Python," First Edition, Manning Publication,2018
5. Neural Networks and Deep Learning, Michael Nielsen, Determination Press (2015) Url: http://neuralnetworksanddeeplearning.com/
6. Deep Learning Step by Step with Python, N D Lewis, 2016
7. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017
8. Nitin Indurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
9. Chris Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing",2nd edition, MITPress Cambridge, MA, 2003.
10. Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019.
11. Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012
12. Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.
13. GAN for Efficient & High Fidelity Speech Synthesis https://proceedings.neurips.cc/paper/2020/hash/c5d736809766d46260d816d8dbc9eb44-Abstract.html
14. Generative Models. OpenAI, https://openai.com/generative-models/
15. DALL·E 2, https://openai.com/dall-e-2
16. Kosmos-2: Grounding Multimodal Large Language Models to the World, https://arxiv.org/abs/2306.14824
17. CoDi: Any-to-Any Generation via Composable Diffusion, https://codi-gen.github.io/
18. An overview of Bard: an early experiment with generative AI, https://ai.google/static/documents/google-about-bard.pdf

4th Year - VII Semester
B. Tech. (Artificial Intelligence & Data Science)

7AD4-21: Deep Learning Lab

Credit: 2
0L+ 0T+ 4P

Max Marks: 100 (IA :60, ETE:40)
End Term Exams: 2 hr

Exp. 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

4th Year - VII Semester
B. Tech. (Artificial Intelligence & Data Science)

7AD4-22: Natural Language Processing Lab

Credit: 2
0L+ 0T+ 4P

Max Marks: 100 (IA :60, ETE:40)
End Term Exams: 2 hr

SN	List of Experiments
1	Word Analysis
2	Word Generation
3	Morphology
4	N-Grams
5	N-Grams Smoothing
6	POS Tagging: Hidden Markov Model
7	POS Tagging: Viterbi Decoding
8	Building POS Tagger
9	Chunking
10	Building Chunker

Resource :

1. Natural Language Processing virtual lab: https://nlp-iiith.vlabs.ac.in/Introduction.html

4th Year - VIII Semester
B. Tech. (Artificial Intelligence & Data Science)

8AD4-01: Statistical Modeling and Forecasting

Credit: 3 **Max Marks: 150 (IA :30, ETE:120)**

3L+ 0T+ 0P **End Term Exams: 3 hr**

SN	Contents	Hours
1	**Basic Properties of time-series data**: Distribution and moments, Stationarity, Autocorrelation, Heteroscedasticity, Normality **Introduction of Time Series Analysis**: Introduction to Time Series and Forecasting, Different types of data, Internal structures of time series. Models for time series analysis, Examples of Time series Nature and uses of forecasting, Forecasting Process, Data for forecasting, Resources for forecasting.	7
2	**Statistics Background For Forecasting**: Graphical Displays, Time Series Plots, Plotting Smoothed Data, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments, General Approach to Time Series Modelling and Forecasting, Evaluating and Monitoring Forecasting Model Performance. **Random walk model**: Non-stationarity and unit-root process, Drift and Trend models	7
3	**Autoregressive models and forecasting:** Autocorrelation and Partial autocorrelation, Autoregressive Moving Average (ARMA) Models , Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA , Seasonal Data, Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models **Introduction to Vector Auto-regressive (VAR) models**: Impulse Response Function (IRF), Error Correction Models, Co-integration, Vector ARIMA Models, Vector AR (VAR) Model **Model Selection Criteria**: Finding the "BEST" Model , Impulse Response Function to Study the Differences in Models Comparing Impulse Response Functions for Competing Models .	10
4	**Time Series Regression Model**: Introduction Least Squares Estimation in Linear Regression Models, Statistical Inference in Linear Regression, Prediction of New Observations, Model Adequacy Checking, Variable Selection Methods in Regression, Generalized and Weighted Least Squares, Regression Models for General Time Series Data, Exponential Smoothing, First order and Second order.	8
5	**Multivariate Time Series Models and Forecasting**: Multivariate Time Series Models and Forecasting, Multivariate Stationary Process **Panel data models**: Fixed-Effect and Random-Effect models Introduction to Neural Networks and Forecasting Spectral Analysis, Bayesian Methods in Forecasting, Principal Component Analysis (PCA) and Factor Analysis	10
		42

Suggested Books:

1. Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015)
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017)
3. Chris Brooks "Introductory Econometrics for Finance," Fourth Edition, Cambridge University Press 2019
4. Ruey S. Tsay "Analysis of Time-series data," Third Edition, Wiley 2014
5. John Fox and Sanford Weisberg "An R Companion to Applied Regression," Third Edition, SAGE 2018
6. Yves Croissant and Giovanni Millo "Panel Data Econometrics with R," First Edition, Wiley 2018

4th Year - VIII Semester
B. Tech. (Artificial Intelligence & Data Science)

8AD4-21: Statistical Modeling and Forecasting Lab

Credit: 1 **Max Marks: 50 (IA :30, ETE:20)**

0L+ 0T+ 2P **End Term Exams: 2 hr**

For Following experimentation following time series data may be used:

1.Download Monthly, Seasonal and Annual Min, Max and avg Temp Series from 1901 to 2017 from https://data.gov.in/catalog/all-india-seasonal-and-annual-minmax-temperature-series.

2.Stock market dataset https://www.kaggle.com/datasets/borismarjanovic/price-volume-data-for-all-us-stocks-etfs

3. Any Kaggle time series dataset https://www.kaggle.com

Exp. No.	List of Experiments
1	Cleaning, Preprocessing and Handling Time Series Data • Time Series Data Cleaning • Loading and Handling Times series data • Preprocessing Techniques
2	How to Checking Stationarity of a Time Series and making Time Series data Stationary Estimating & Eliminating Trend. • Aggregation • Smoothing • Polynomial Fitting Eliminating Trend and Seasonality • Differencing • Decomposition
3	Time Series analysis a) Moving Average time analysis data. b) Smoothing the Time analysis Data. c) Check out the Time series Linear and non-linear trends.
4	Time Series Modelling and Forecasting • Moving average • Exponential smoothing • ARIMA • Seasonal autoregressive integrated moving average model (SARIMA)

5	Dependence Techniques • Multivariate Analysis of Variance and Covariance • Canonical Correlation Analysis • Structural Equation Modeling Inter-Dependence Techniques • Factor Analysis • Cluster Analysis

4th Year - VIII Semester
B. Tech. (Artificial Intelligence & Data Science)

8AD4-22: Big Data Analytics Lab

Credit: 1 **Max Marks: 50 (IA :30, ETE:20)**
0L+ 0T+ 2P **End Term Exams: 2 hr**

Exp. No.	List of Experiments
1	Implement the following Data structures in Java i) Linked Lists ii) Stacks iii) Queues iv) Set v) Map
2	Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, Fully distributed.
3	Implement the following file management tasks in Hadoop: Adding files and directories Retrieving files Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
4	Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5	Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.
6	Implement Matrix Multiplication with Hadoop Map Reduce
7	Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.
8	Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
9	Solve some real life big data problems.