Syllabus for 4 Year B. Tech Course in Computer Science and Engineering (Artificial Intelligence)

Eighth Semester

Career Advancement & Skill Development-VIII-Values and Ethics (TIU-UMG-S400)
Contact Hours/Week: 2–0–0 (L–T–P)
Credit: Sessional–2

Course Content:

Employment Mentorship & Grooming -2
Module-1:
i) Interview process from recruiter's perspective, ii). The approach the candidates should adopt during the interview
Module-2:
i). Discussion on job roles for ECE, ii). Discussion of interview/Written test questions for specific roles
Module-3:
i) Resume writing, ii) Cover Letter writing, iii) statement of purpose
Module-4:
i). expectation from a newly joined employee in a corporate organization, ii). How to succeed in corporate environment.

Bioinformatics (TIU-UCS-E420)
Contact Hours/Week: 3–0–0 (L–T–P)
Credit: Theory–3

Course Outcome

CO1	Understand the genesis of Bioinformatics, comparison with its allied disciplines, theoretical and computational models and its significance in biological data analysis.
CO2	Explain nucleic acid and protein sequence databases, structural databases, literature databases, genome and organism-specific databases.
CO3	Describe retrieval tools of biological data, database similarity searching, biological file formats.
CO4	Analysis and development of models for better interpretation of biological data to extract knowledge.
CO5	Understand the genesis of Bioinformatics, comparison with its allied disciplines, theoretical and computational models and its significance in biological data analysis.

Course Content:

Module-1: Introduction
Introduction to bioinformatics; Bioinformatics Applications; Central Dogma of Molecular Biology; Genome projects; Sequence analysis, Homology and Analogy;

Module-2: Biological Resources
Protein Information Resources: Biological databases; Primary Sequence Databases; Composite Protein Sequence Databases; Secondary Databases; Composite protein pattern databases; Structure classification databases; Genome Information Resources: Introduction; DNA sequence databases; Specialized Genomic Resources;

Module-3: DNA sequence analysis
Gene structure and DNA sequence; Features of DNA sequence analysis; Issues in interpretation of EST searches; Different approaches to EST analysis; Effects of EST data on DNA databases.

Module-4: Pairwise Sequence Alignment
Database searching; Alphabet and Complexity; Algorithms and Programs; Comparing two sequences; Identity and Similarity; Local and global similarity; Global alignment: the Needleman and Wunsch algorithm; Local alignment: the Smith-Waterman algorithm; Dynamic Programming; Pairwise database searching; Basic Local Alignment Search Tool (BLAST).

Module-5: Multiple Sequence alignment:
Goal of Multiple Sequence Alignment (MSA); Purpose of MSA; Dynamic programming solution for multiple alignment; Methods of alignment.

Module-6: Protein Secondary Structure Predictions
Structure of protein; Different level of protein structure; Basics of machine learning; Methods for predicting secondary structure: Chou-Fasman method, Garnier-Osguthorpe-Robson method, Neural Network based method.

Module-7: Biomedical Text Mining
Named entity recognition; Document classification and clustering; Relationship discovery; Information extraction; Information retrieval and question answering; Applications of biomedical text mining.

Recommended Books:

Main Reading

1. T K Attwood, D J Parry-Smith, Samiron Phukan; Introduction to bioinformatics, Pearson
2. S. C. Rastogi, P. Rastogi, N. Mendiratta; Bioinformatics Methods and Applications: GenomicsProteomics and Drug Discovery, PHI.

3. Bryan Bergeron, Bioinformatics Computing, Pearson

Supplementary Reading:

1. S. Harisha, Fundamentals of Bioinformatics, I.K International

Deep Learning (TIU-UCS-E460)

Contact Hours/Week: 3–0–0 (L–T–P)

Credit: Theory–3

Course Outcome

CO1	Understand the basic concepts of deep learning, including feature selection, feature extraction, artificial neural networks, and convolutional neural networks.
CO2	Apply deep learning techniques to solve real-world problems, such as image processing, natural language processing, and speech recognition.
CO3	Understand the different types of deep learning architectures, such as convolutional neural networks, recurrent neural networks, and autoencoders.
CO4	Implement deep learning models using TensorFlow and Keras.
CO5	Evaluate the performance of deep learning models and select the best model for a given problem.

Course Content:

Module-1:

Feature Selection vs Feature Extraction, Introduction to TensorFlow andKeras Framework: Computational Graph, creating a Graph, Regression example, Gradient Descent, Modularity, Sharing Variables.

Module-2:

Activation Functions Sigmoid, ReLU, Hyperbolic Fns, SoftMax, Artificial Neural Networks: Introduction, Perceptrons, Gradient Descent Rule: Stochastic Gradient Descent, Backpropagation, ANN Optimization and Regularization:Overfitting and Capacity, Cross Validation,Bias Variance Tradeoff, Regularization, Hyperparameters.

Module-3:

Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, Introduction to Convolutional Neural Networks, Kernel, Multiple Filters, CNN applications, Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, vanishing vs Exploding Gradient Problem in RNN, LSTM, RNN applications.

Module-4:

Auto Encoder: Types of Auto Encoder(Stacked AE, Denoising AE, Convolutional AE, Deep

Autoencoders),

Module-5:
Concept of Transfer Learning in Text(BERT) and Image Processing(ALEXNET, VGG16,VGG19).

`Recommended Books:

Main Reading

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Supplementary Reading:

1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Information Retrieval (TIU-UCS-E462)
Contact Hours/Week: 3–0–0 (L–T–P)
Credit: Theory–3

Course Outcome:

CO1	Understand the basics of Information Retrieval (IR) systems. Knowledge about the Corpus and IR techniques
CO2	Study the IR Data-Structures like inverted indexing, dictionary posting lists etc.
CO3	Identify the scope of information retrieval techniques like Boolean Retrieval
CO4	Learn about the Web-Search paradigm including Page-rank Algorithm
CO5	Explore several application areas of Information Retrieval (IR) techniques

Course Content:

Module-1: Overview of text retrieval systems
Boolean retrieval, The term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction and compression.

Module-2: Retrieval models and implementation
Vector Space Models, Vector Space Model, TF-IDF Weight, Evaluation in information retrieval.

Module-3: Query expansion and feedback
Relevance feedback, Pseudo relevance feedback, Query Reformulation

Module-4: Probabilistic models and statistical language models
Okapi/BM25, Language models, KL-divergence, Smoothing

Module-5: Text classification & Text clustering
The text classification problem, Naive Bayes text classification, k- nearest neighbors, Support vector Machine, Feature Selection, Vector-space clustering, K-means algorithm, Hierarchical clustering, DBSCAN algorithm, PAM and PAMK, EM algorithm

Module-6: Web search basics
Crawling, Indexes, Link analysis, Web Characteristic, Crawling, Web As a graph, Page Rank, Hubs and Authorities

Module-7: IR applications
Information extraction, Question answering, Opinion summarization, Social Network

Recommended Books:
Main Reading

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Statistical Language Models for Information Retrieval (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008.

Game Theory for AI and Data Science (TIU-UCS-E464)

Contact Hours/Week: 3–0–0 (L–T–P)
Credit: Theory–3

Course Outcome:

CO1	Understand the basic concepts of machine learning and game theory, including linear programming, game theory, and reinforcement learning.
CO2	Apply machine learning and game theory techniques to solve real-world problems, such as optimization problems, decision-making problems, and multi-agent systems.
CO3	Understand the different types of games and their strategies, and how to solve games with mixed strategies.
CO4	Design and implement multi-agent AI systems.
CO5	Understand the fundamentals of reinforcement learning, and how to apply it to solve real-world problems.

Course Content:

Module-1: Basics of Machine Learning and Game Theory
Introduction to Linear Programming, Introduction to Game Theory, Introduction to Different types of Learning including Reinforcement Learning.

Module-2: Introduction to Linear Programming
Linear Programming Models, The Simplex Method, Concepts of Duality and Sensitivity, Relationship between Linear Programming and Game Theory.

Module-3: Deep Dive into Game Theory
Terminologies of Game Theory, Different types of games and their strategies, Methods of solving games with mixed strategies, Decision Making in Game Theory.

Module-4: Multi Agent AI Systems
Multiagent framework, Representation of Games, Computing strategies, Group decision making, Belief networks and other Knowledge-based systems.

Module-5: Reinforcement Learning
Fundamentals of Reinforcement Learning, Value Based and Policy Based, Multi-Agent Reinforcement Learning, Markov Decision Process & Dynamic Programming, Application of Game Theory in Deep Reinforcement Learning.

Module-6: GANs
Generative Models, Discriminative models, Different types of GANs, Application of Game Theory in GAN

Recommended Books:

Main Reading

1. An Introduction to Linear Programming and Game Theory - Paul R. Thie, G. E. Keough, A JOHN WILEY & SONS, INC., PUBLICATION
2. A Gentle Introduction to Game Theory – Saul Stahl, American Mathematical Society
3. Reinforcement Learning Algorithms with Python – Andrea Lonza, Packt Publishing
4. GANs in Action: Deep learning with Generative Adversarial Networks - Jakub Langr, Vladimir Bok, Manning Publications