Semester - 5th

Semester	Course Code	Nomenclature	Credit	Contact Hours Per Week				Internal Assessment		External Assessment		Total Marks		Min Pass Marks	
				L	T	P	CH	T	P	T	P	T	P	Int	Ext
5	24-BTPC-501	Analysis and Design of Algorithms	4	3	0	2	5	15	5	60	20	75	25	10	30
	24-BTPC-502	Theory of Computation	4	4	0	0	4	20	0	80	0	100	0	08	32
	24-BTPC-503	Optimization Techniques in Machine Learning	4	3	0	2	5	15	5	60	20	75	25	10	30
	Professional Elective - I		3	2	0	2	4	10	5	40	20	50	25	10	20
	Professional Elective - II		3	2	0	2	4	10	5	40	20	50	25	10	20
	24-BTEEC-501	Minor Project	3	0	0	6	6	0	15	0	60	0	75	06	24
	24-BTAU-501	Indian Constitution	0	3	0	0	3	0	0	0	0	0	0	0	0
	Semester Total		21	17	0	14	31								

Indian Constitution Paper is Zero Credit Paper but essential to pass to be eligible to get the degree.

Profession Elective –I

24-BTPE-501	Predictive Analytics
24-BTPE-502	Natural Language Processing
24-BTPE-503	Social Network Analysis

Profession Elective –II

24-BTPE-504	Bio Informatics
24-BTPE-505	Image and Video Processing
24-BTPE-506	Big Data Analytics

Semester - 6th

Semester	Course Code	Nomenclature	Credit	Contact Hours Per Week				Internal Assessment		External Assessment		Total Marks		Min Pass Marks	
				L	T	P	CH	T	P	T	P	T	P	Int	Ext
6	24-BTPC-601	Soft Computing	4	3	0	2	5	15	5	60	20	75	25	10	30
	24-BTPC-602	Deep Learning	4	3	0	2	5	15	5	60	20	75	25	10	30
	Professional Elective - III		3	2	0	2	4	10	5	40	20	50	25	10	20
	Professional Elective - IV		3	2	0	2	4	10	5	40	20	50	25	10	20
	24-BTEEC-501	Minor Project	3	0	0	6	6	0	15	0	60	0	75	06	24
	Open Elective		3	2	0	2	4	10	5	40	20	50	25	10	20
	Semester Total		21	12	0	16	28								

Professional Elective III

24-BTPE-601	AI in Healthcare
24-BTPE-602	AI in Gaming
24-BTPE-603	AI in Finance

Professional Elective IV

24-BTPE-604	Machine Learning for Data Science
24-BTPE-605	Genome Sequencing
24-BTPE-606	Algorithms for DNA Sequencing

Open Elective (Any One)

24-BTOE-601	Internet of Things
24-BTOE-602	Statistical Thinking for Data Science
24-BTOE-603	Robotics

W.e.f. B.Tech started in 2024-25	
Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Analysis and Design of Algorithms
Course Code	24-BTPC-501
Course Type	Programme Core
Course Objectives	The students should be able to analyse various algorithms, mainly for time and space complexity.They should be able to develop an algorithm for solving various computational problems by applying various algorithm design strategies. They should be able to understand the effect of the choice of data structures on the complexity of the algorithm.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Apply the best data structure for designing an algorithm to solve a given problem. 2. Evaluate different algorithms with respect to time and space complexity. 3. Create algorithms to solve various computational problems. 4. Understand different complexity classes.
Max. Marks	Th. 75 Pr. 25
Internal Assessment Max Marks	Th. 15 Pr. 5
End Term Exam Max Marks	Th. 60 Pr. 20
Internal Min Pass Marks	Th. 6 Pr. 2
External Min Pass Marks	Th. 24 Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics
Unit I:	Notion of Algorithm, Fundamentals of Algorithmic Solving, Important problem types, Fundamentals of the Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical analysis of non-recursive algorithms. Mathematical analysis of recursive algorithm: recurrence relations, solution of recurrence relations using the substitution method.
Unit II:	Selection sort, Bubble sort, Sequential searching (Linear Search), Brute force string matching, General method, Merge sort, Quick Sort, Binary Search, Strassen's matrix multiplication.
Unit III:	Fractional Knapsack problem, Minimum cost spanning tree: Prim's and Kruskal's algorithm, Single source shortest path problem, Principle of optimality, Multi-stage graph problem, all pair shortest path problem, 0/1 Knapsack problem, Traveling salesperson problem.
Unit IV:	General method backtracking, N-Queen problem, 0/1 Knapsack problem, General method of branch & bound, 0/1 Knapsack problem, Traveling sales person problem, Lower

bounds, Decision trees, P, NP and NP Complete problems.

Part C-Learning Resources

Reference Books:

1. Algorithm Design, Jon Kelinberg and Eva Tardos, 1st Edition, Pearson Education 2014.
2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Book Publishing 2018.
3. Fundamentals of algorithms, Horowitz E, Sahini S, Rajasekaran S., University Press2008.
4. Introduction to algorithms, Cormen, Leiserson, Rivest, Stein, 3rd Edition, PHI. 2012
5. An introduction to analysis of algorithms, R. Sedgewick, 1st edition, Pearson Education 1996.
6. Data Structures and Program Design in C By Robert L. Kruse, C.L. Tondo, Bruce Leung, Pearson Education. 2007.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Theory of Computation
Course Code	24-BTPC-502
Course Type	Programme Core
Course Objectives	Students should be able to understand fundamentalmathematical and computational principles that are the foundations of computer science. They should learn about abstract models of computation, finite representations for languages and gain a formal understanding of algorithms and procedures.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Evaluate computer science problems as mathematical statements and formulate proofs. 2. Understand properties of the corresponding language classes defined by various computation models and the relations between them. 3. Understand the general properties of computation and learn how to increase the efficiency with which computers solve problems. 4. Understand how to model different computational problems using state machines.
Max. Marks	**Th. 100**
Internal Assessment Max Marks	Th. 20
End Term Exam Max Marks	Th. 80
Internal Min Pass Marks	Th. 8
External Min Pass Marks	Th. 32
Examination Time	Th. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units	Topics
Unit I:	Introduction to formal proof, Additional forms of proof, Inductive proofs, Finite Automata (FA), Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA), Finite Automata with Epsilon transitions.
Unit II:	Regular Expression, FA and Regular Expressions, proving languages not to be regular, Closure properties of regular languages, Equivalence and minimization of Automata.
Unit III:	Context-Free Grammar (CFG), Parse Trees, Ambiguity in grammars and languages, Definition of the Pushdown automata, Languages of a Pushdown Automata, Equivalence of Pushdown automata and CFG, Deterministic Pushdown Automata, Normal forms for CFG, Pumping Lemma for CFL, Closure Properties of CFL.
Unit IV:	Turing Machines, Programming Techniques for TM, Variations of TM, Non-Universal TM, Universal TM. A language that is not Recursively Enumerable (RE), An

undecidable problem that is RE Undecidable problems about Turing Machine, Post's Correspondence Problem, The classes P and NP.

Part C-Learning Resources

Reference Books:

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computations", second Edition, Pearson Education, 2007.
2. H.R. Lewis and C.H. Papadimitriou, "Elements of the Theory of Computation", Second Edition, Pearson Education, 2003.
3. R.B. Patel, "Theory of Computation (with Formal Languages)/ 2nd Edition", Khanna Book Publishing, 2020.
4. Thomas A. Sudkamp," An Introduction to the Theory of Computer Science, Languages and Machines", Third Edition, Pearson Education. 2007
5. J. Martin, "Introduction to Languages and the Theory of computation" Third Edition, Tata McGraw-Hill, 2007.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Optimization Techniques in Machine Learning
Course Code	24-BTPC-503
Course Type	Programme Core
Course Objectives	The students will be able to understand and analyze how to deal with changing data. They will also be able to identify and interpret potential unintended effects in your project. They will understand and define procedures to operationalize and maintain your applied machine learning model.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand and analyze how to deal with changing data. 2. Understand and interpret potential unintended effects in their project. 3. Understand and define procedures to operationalize and maintain the applied machine learning model. 4. Understand how to optimize the use of Machine Learning in real-life problems.
Max. Marks	Th. 75 Pr. 25
Internal Assessment Max Marks	Th. 15 Pr. 5
End Term Exam Max Marks	Th. 60 Pr. 20
Internal Min Pass Marks	Th. 6 Pr. 2
External Min Pass Marks	Th. 24 Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: What is optimization, Formulation of LPP, Solution of LPP: Simplex method, Basic Calculus for optimization: Limits and multivariate functions, Derivatives and linear approximations: Single-variate functions and multivariate functions.

Unit II:Machine Learning Strategy: ML readiness, Risk mitigation, Experimental mindset, Build/buy/partner, setting up a team, Understanding and communicating change.

Unit III:Responsible Machine Learning: AI for good and all, Positive feedback loops and negative feedback loops, Metric design and observing behaviours, Secondary effects of optimization, Regulatory concerns.

Unit IV:Machine Learning in production and planning: Integrating info systems, users break things, time and space complexity in production, when to retain the model? Logging ML model versioning, Knowledge transfer, Reporting performance to stakeholders.

Care and feeding of your machine learning model: MLPL Recap, Post deployment challenges, QUAM monitoring and logging, QUAM Testing, QUAM maintenance, QUAM updating, Separating Datastack from Production, Dashboard Essentials and Metrics monitoring.

Part C-Learning Resources

Reference Books:

1. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.
2. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
3. Optimization for Machine Learning, Suvrit Sra, Sebastian Nowozin and Stephen J. Wright, MIT Press, 2011.
4. Optimization in Machine Learning and Applications, Suresh Chandra Satapathy, Anand J. Kulkarni, Springer, 2019.
5. Algorithms for Optimization by Mykel J. Kochenderfer and Tim A. Wheeler, MIT Press, 2019.
6. Accelerated Optimization for Machine Learning: First-Order Algorithms by Cong Fang, Huan Li, and Zhouchen Lin, Springer, 2020.
7. https://www.coursera.org/learn/optimize-machine-learning-model-performance

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Predictive Analytics
Course Code	24-BTPE-501
Course Type	Professional Elective
Course Objectives	The students should be able to understand how totransform data and make it suitable for datadriven predictive tasks. Understand how to compute basic statistics using real-world datasets of consumer activities, like product reviews.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Apply Python to create interactive data visualizations to make meaningful predictions and build simple demo systems. 2. Apply simple regressions and classifications ondatasets using machine learning libraries. 3. Understand the usage of different python libraries.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction: Data Product, Data Product Examples in Enterprise, Developing a Data Product Strategy.

Unit II:Reading Data in Python: Reading CSV & JSON Files, Processing Structured Data in Python, Live-Coding: JSON, Extracting Simple Statistics from Datasets.

Data Processing in Python: Data Filtering and Cleaning, Processing Text and Strings in Python, Processing Times and Dates in Python.

Unit III:Python Libraries and Toolkits: Matrix Processing and Numpy, Introduction to Data Visualization, Introduction to Matplotlib, urllib and BeautifulSoup

Gradient Descent: Classification in Python, Introduction to Training and Testing, Gradient Descent in Python, Gradient Descent in TensorFlow

Unit IV: Diagnostics for Data: Meaningful Predictive modelling, Regression Diagnostic, Over- and Under-Fitting, Classification Diagnostics: Accuracy and Error, Classification Diagnostics: Precision and Recall. Codebase for Evaluation and Validation, Model Complexity and Regularization, Evaluating Classifiers for Ranking.

Part C-Learning Resources

Reference Books:

1. https://www.coursera.org/learn/basic-data-processing-visualization-python
2. https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products

3. https://www.coursera.org/learn/meaningful-predictive-modeling
4. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst,
Dean Abbott, 2014, Wiley.
5. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic
Thinking, Tom Fawcett, O'Reilly, 1st edition, 2013.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Natural Language Processing
Course Code	24-BTPE-502
Course Type	Professional Elective
Course Objectives	The students should be able to study language and the tools that are available to efficiently study and analyze large collections of text. They should learn about and discuss the effects of electronic communication on our language.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand language and the tools that are available to efficiently study and analyse large collections of text. 2. Analyze and discuss the effects of electronic communication on our language 3. Learn natural language processing with manual and automated approaches. 4. Learn computational frameworks for natural language processing.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Introduction: A computational framework for natural language, description of English or an Indian language in the frame work, lexicon, algorithms and data structures for implementation of the framework, Finite state automata, the different analysis levels used for NLP (morphological, syntactic, semantic, pragmatic, Recursive and augmented transition networks. Applications like machine translations.

Unit II:Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and correction, Words and Word classes, Part-of Speech Tagging.

Syntactic Analysis: Context-free Grammar, Constituency, Parsing-Probabilistic Parsing. Machine readable dictionaries and lexical databases, RTN, ATN.

Unit III:Semantic Analysis: Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation. Discourse Processing: cohesion, Reference Resolution, Discourse Coherence and Structure. Knowledge Representation, reasoning.

Unit IV:Natural Language Generation (NLG): Architecture of NLG Systems, Generation Tasks and Representations, Application of NLG. Machine Translation:

Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation Approaches, Translation involving Indian Languages.

Information Retrieval: Design features of Information Retrieval Systems, Classical, Non-classical, Alternative Models of Information Retrieval, valuation Lexical Resources: World Net, Frame Net, Stemmers, POS Tagger.

Part C-Learning Resources

Reference Books:

1. Natural Language understanding by James Allen, Pearson Education, 2002.
2. NLP: A Paninian Perspective by Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, Prentice Hall, 2016.
3. Meaning and Grammar by G. Chirchia and S. McConnell Ginet, MIT Press, 1990.
4. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition by Daniel Jurafsky and James H. Martin, Pearson Education, 2006.
5. Natural language processing in Prolog by Gazdar, & Mellish, Addison-Wesley
6. https://www.coursera.org/specializations/natural-language-processing

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Social Network Analysis
Course Code	24-BTPE-503
Course Type	Professional Elective
Course Objectives	The students will be able tounderstand the fundamentals of Social Network Analysis and its significance in understanding societal connections and behaviors and alsoanalyze various models of network growth and understand the properties of real-world networks.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Illustrate the core concepts of Social Network Analysis and its levels of study. 2. Demonstrate the different network growth models for real-world networks 3. Apply algorithms of PageRank and SimRank to analyze and interpret link relationships. 4. Apply community detection methods and evaluating their effectiveness in real-world scenarios. 5. Analyze heuristic, probabilistic, and supervised models to predict network link formations and changes.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Networks and Society - What is Social Network Analysis, why do We Study Social Networks, Applications of Social Network Analysis, Preliminaries, Three Levels of Social Network Analysis.

Network Measures - Network Basics, Node Centrality, Assortativity, Transitivity and Reciprocity, Similarity, Degeneracy.

Unit II: Network Growth Models - Properties of Real-World Networks, Random Network Model, Ring Lattice Network Model, Watts–Strogatz Model, Preferential Attachment Model, Price's Model, Local-world Network Growth Model, Network Model with Accelerating Growth, Ageing in Preferential Attachment.

Unit III:Link Analysis - Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis Algorithms, PageRank, Personalised PageRank, DivRank, SimRank, PathSIM.

Community Structure in Networks - Applications of Community Detection, Types of Communities, Community Detection Methods, Disjoint Community Detection, Overlapping Community Detection, Local Community Detection, Community Detection vs Community Search, Evaluation of Community Detection Methods.

Unit IV:Link Prediction - Applications of Link Prediction, Temporal Changes in a Network, Problem Definition Evaluating Link Prediction Methods, Heuristic Models, Probabilistic Models, Supervised Random Walk, Information-theoretic Model, Latest Trends in Link Prediction.

Part C-Learning Resources

Reference Books:

1. Tanmoy Chakraborty, "Social Network Analysis", Wiley India Pvt. Ltd., 2021
2. Albert-Laszlo Barabasi, "Network Science", Cambridge University Press, 2016
3. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods andApplications", Cambridge University Press, 1994
4.https://onlinecourses.nptel.ac.in/noc22_cs117/preview
5. https://social-network-analysis.in/
6. https://www.coursera.org/learn/social-network-analysis

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Bioinformatics
Course Code	24-BTPE-504
Course Type	Professional Elective
Course Objectives	The students should be able to understand the scope of Bioinformatics. They should know about popular bioinformatics databases and sequence alignment algorithms.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the various challenges and applicationsof bioinformatics. 2. Analyze various biological sequence databases 3. Perform sequence comparison and sequencealignment 4. Apply predictive methods to DNA and proteinsequences.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction: History, scope and important contributions, aims and tasks of Bioinformatics, applications of Bioinformatics, challenges and opportunities, introduction to NCBI data model, various file formats for biological sequences.

Unit II:Biological Databases and Data Search Methods: Importance of databases, biological databases, primary sequence databases, composite sequence databases, secondary databases, nucleic and sequence databases, protein sequence databases, structure databases, bibliographic databases, specialized genomic resources, analysis packages
Methods for searching sequence databases like FASTA and BLAST algorithms, Statistical analysis and evaluation of BLAST results.

Unit III:Sequence Comparison Methods: Methods for comparison of two sequences, Needleman Wush and Smith Waterman algorithms. Analysis of computational complexities, merits and demerits of these algorithms, theory of scoring matrices and their use for sequence comparison.

Unit IV:Sequence Alignment Methods: Sequence analysis of biological data, significance of sequence alignment, pair wise sequence alignment methods, use of scoring matrices and gap penalties in sequence alignments, multiple sequence alignment methods, tools and applications of multiple sequence alignment.
Predictive Methods Using DNA and Protein Sequences: Gene prediction strategies,

protein prediction strategies, molecular visualization tools, phylogenetic analysis: concept of trees, phylogenetic trees and multiple alignments.

Part C-Learning Resources

Reference Books:

1. Andreas D Baxevanis & B F Francis, "Bioinformatics-A practical guide to analysis of Genes and Proteins", John Wiley, 2010
2. T K Attwood, D J Parry-Smith, "Introduction to Bioinformatics", Pearson Education, 2005
3. Neil C. Jones, Pavel A. Pevzner, "An introduction to Bioinformatics Algorithms", MIT Press, 2005
4. Gary Benson Roderic, "Algorithms in Bioinformatics", Springer, 2004
5. Foundations of Bioinformatics, Manoj Darbari, Khanna Book Publishing Co., 2013.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Image and Video processing
Course Code	24-BTPE-505
Course Type	Professional Elective
Course Objectives	The students will be able to work with images and videos in several ways. These methods can be used as pre-processing steps for complex models.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand images and videos representation in a detailed manner. 2. Apply ML techniques for image processing in different scenarios. 3. Apply various object detection and image segmentation algorithms 4. Apply various image restoration techniques and algorithms
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Image representation and analysis: Introduction to computer Vision, Numerical representation of images, Image augmentation, enhancement, processing, color transforms, geometric transforms, feature recognition and extraction.

Unit II: Image Segmentation: Object detection, breaking image into parts, finding contours and edges of various objects in image, Background subtraction for video.

Unit III: Object Motion and tracking: Tracking a single point over time, motion models to define object movement over time, analyze videos as sequences of individual image frames, methods to track a set of features over time, matching features from image frame to other, tracking a moving car using optical flow.

Unit IV: Robotic localization: Bayesian statistics to locate a robot in space, sensor measurements to safely navigate an environment, Gaussian uncertainty, histogram filter for robot localization in python.

Image Restoration: Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters.

Part C-Learning Resources

Reference Books:

1. Audio Video Systems, Bali & Bali, Khanna Book Publishing 2020.
2. Handbook of Image and Video Processing by Alan C. Bovik, Academic Press, 2000.

3. Python 3 Image Processing, Ashwin Pajankar, BPB Publication, 2019.
4. https://www.coursera.org/learn/image-processing

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Big Data Analytics
Course Code	24-BTPE-506
Course Type	Professional Elective
Course Objectives	The students should be able to understand and apply big data flow to actual projects as well as apply data analytics life cycle to big data projects. The student should identify and successfully apply appropriate techniques and tools to solve big data problems.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand and apply big data flow to actual projects as well as apply data analytics life cycle to big data projects. 2. Apply appropriate techniques and tools to solve big data problems 3. Describe big data and use cases from selected business domains 4. Explain NoSQL big data management 5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introductionto Big Data: Introduction to BigData Platform, Traits of Big Data, Challenges of Conventional Systems, Web Data, Evolution of Analytic Scalability, Analysis vs Reporting, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error.

Unit II:Basic data analysis and data analytic methods using R

Regression Modelling, Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Networks, Support Vector and Kernel Methods, Analysis of Time Series: Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks: Learning and Generalization, Competitive Learning, Principal Component Analysis and Neural Networks, Fuzzy Logic: Extracting Fuzzy Models from Data Fuzzy Decision Trees, Stochastic Search Methods. Introduction to R, Statistics for Model Building and Evaluation.

Unit III: Frequent item sets and clustering

Mining Frequent item sets: Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent item sets in a Stream, Clustering

Techniques: Hierarchical, K-Means, Frequent Pattern based Clustering Methods.

Unit IV:Mining data streams

Introduction to Streams Concepts: Stream Data Model and Architecture, Stream Computing,

Sampling Data in a Stream: Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis, Stock Market Predictions.

Framework, technologies, tools and visualization Map Reduce: Hadoop, Hive, MapR, Sharding, NoSQL Databases: S3, Hadoop Distributed File Systems, Visualizations: Visual Data Analysis Techniques, Interaction Techniques; Systems and Analytics Applications, Analytics using Statistical packages, Industry challenges and application of Analytics.

Part C-Learning Resources

Reference Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to data Science and its Applications", Wiley publications, 2014.
2. V.K. Jain, Big Data & Hadoop, Khanna Book Publishing Co., Delhi. (ISBN 978-93-82609-131)
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2003.
4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2020.
5. Jeeva Jose, Beginner's Guide for Data Analysis using R Programming, Khanna Book Publishing House, 2019.
6. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley, 2012.
7. Glenn J. Myatt, "Making Sense of Data", Wiley, 2006.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Indian Constitution
Course Code	24-BTAU-501
Course Type	Audit Course

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:The Constitution - Introduction

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

Unit II:Union Government

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

State Government

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

Unit IV:Local Administration

- District Administration
- Municipal Corporation
- Zila Panchayat

Election Commission

- Role and Functioning
- Chief Election Commissioner
- State Election Commission

Part C-Learning Resources

Reference Books:

1 Ethics and Politics of the Indian Constitution, Rajeev Bhargava, Oxford University Press, New Delhi, 2008

2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)

3 Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

W.e.f. B.Tech started in 2024-25	
Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Soft Computing
Course Code	24-BTPC-601
Course Type	Programme Core
Course Objectives	Students should be able to understand soft computing concepts and techniques and foster their abilities in designing and implementing soft computing-based solutions for real-world problems.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand, Identify and describe soft computing techniques and their roles in building intelligent machines. 2. Apply a soft computing methodology for a particular problem. 3. Analyze and compare solutions by various soft computing approaches for a given problem. 4. Apply genetic algorithms to combinatorial optimization problems. 5. Evaluate and compare solutions by various soft computing approaches for a given problem.
Max. Marks	Th. 75 Pr. 25
Internal Assessment Max Marks	Th. 15 Pr. 5
End Term Exam Max Marks	Th. 60 Pr. 20
Internal Min Pass Marks	Th. 6 Pr. 2
External Min Pass Marks	Th. 24 Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Introduction to neural networks: Structure and working of Biological Neural Network, Fundamentals of Artificial Neural Networks & Applications, Characteristics of Artificial Neural Networks, History of neural network research, characteristics of neural networks terminology.

Unit II: Neural networks models and Learning Methods: Models of neuron McCulloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, Multilayer Neural Networks, Learning Methods, Backpropagation, Counter propagation, ART, BAM, Associative memories.

Unit III:Introduction of Fuzzy logic and Neuro Fuzzy Systems: Introduction, Fuzzy sets, Fuzzy model, Fuzzy rule generation Fuzzy inference system, Defuzzification, Architecture of a Neuro-Fuzzy system and its applications.

Unit IV:Machine Learning: Supervised learning: Primitive algorithms, Generative

algorithms, Support Vector Machine, Ensemble methods. Unsupervised learning: K-means, Principal component analysis, Independent component analysis. Reinforcement learning and control.

Applications of GA & GP, Hybrid systems.

Part C-Learning Resources

Reference Books:

1. Neuro fuzzy and soft computing by Jang, Pearson Education, 1996
2. Learning and Soft Computing by Kecman, Pearson Education, 2001
3. Fuzzy Sets and Fuzzy Logic - Klir and Yuan, PHI, 1995
4. Neural Network in computer Intelligence by Fu, TMH, 2003
5. Bio-Inspired Artificial Intelligence – Dario Floreano, PHI, 2008
6. Soft Computing – Ikvinderpal Singh, Khanna Book Publishing 2015.

W.e.f. B.Tech started in 2024-25

Part A - Introduction

Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	5th
Name of the Course	Deep Learning
Course Code	24-BTPC-602
Course Type	Programme Core
Course Objectives	To introduce the fundamentals of deep learning and the main research activities in this field. To learn architectures and optimization methods for deep neural network training
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the fundamentals of deep learning and the main research activities in this field 2. Remember architectures and optimization methods for deep neural network training 3. Implement, apply and test relevant learning algorithms in TensorFlow 4. Critically evaluate the method's applicability in new contexts and construct new applications
Max. Marks	Th. 75 Pr. 25
Internal Assessment Max Marks	Th. 15 Pr. 5
End Term Exam Max Marks	Th. 60 Pr. 20
Internal Min Pass Marks	Th. 6 Pr. 2
External Min Pass Marks	Th. 24 Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction: History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation

Unit IIActivation functions and parameters: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Parameters v/s Hyper-parameters

Unit III: Auto-encoders & Regularization: Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images, Batch Normalization

Unit IV:Deep Learning Models: Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Introduction to RNNs, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Deep Learning Applications: Image Processing, Natural Language Processing, Speech

recognition, Video Analytics

Part C-Learning Resources

Reference Books:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in MachineLearning 2.1, Now Publishers, 2009
3. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.
4. https://nptel.ac.in/courses/106/106/106106184/
5. https://www.coursera.org/specializations/deep-learning

Part A - Introduction

Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	AI in Healthcare
Course Code	24-BTPE-601
Course Type	Professional Elective
Course Objectives	The students should be able to understand how AI is transforming the practice of medicine. The students should learn the practical experience in applying machine learning to concrete problems in medicine.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand and apply on tree-based machine learning to estimate patient survival rates 2. Analyze convolutional neural network image classification and segmentation models to make diagnoses of lung and brain disorders. 3. Apply natural language processing to extract information from unstructured medical data. 4. Understand different types of prognosis models related to different diseases.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Disease detection with computer vision

Medical Image Diagnosis, Eye Disease and Cancer Diagnosis, Building and Training a Model for Medical Diagnosis, Training, prediction, and loss, Image Classification and Class Imbalance, Generating More Samples, Model Testing

Unit II: Evaluating models

Sensitivity, Specificity, and Evaluation Metrics, Accuracy in terms of conditional probability, Confusion matrix, ROC curve and Threshold

Image segmentation on MRI images

Medical Image Segmentation, MRI Data and Image Registration, Segmentation, 2D U-Net and 3D U-Net Data augmentation and loss function for segmentation, Different Populations and Diagnostic Technology, External validation

Unit III: Linear prognostic models

Medical Prognosis, Atrial fibrillation, Liver Disease Mortality, Risk of heart disease, Evaluating Prognostic Models, Concordant Pairs, Risk Ties, Permissible Pairs.

Prognosis with Tree-based models

Decision trees for prognosis, fix overfitting, Different distributions, Missing Data example,

Imputation.

Unit IV: Survival Models and Time

Survival Model, Survival function, collecting time data, Estimating the survival function.

Build a risk model using linear and tree-based models

Hazard Functions, Relative risk, Individual vs. baseline hazard, Survival Trees, Nelson Aalen estimator.

Medical Treatment Effect Estimation

Analyze data from a randomized control trial, Average treatment effect, Conditional average treatment effect, T-Learner, S-Learner, C-for-benefit.

Part C-Learning Resources

Reference Books:

1. https://www.coursera.org/learn/ai-for-medical-diagnosis
2. https://www.coursera.org/learn/ai-for-medical-prognosis#syllabus
3. https://www.coursera.org/learn/ai-for-medical-treatment#syllabus
4. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Eric Topol, Basic Books, 1st edition 2019.
5. Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Arjun Panesar, Apress, 1st ed. Edition, 2019.
6. Artificial Intelligence in Healthcare, 2020, ISBN 978-0-12-818438-7, Elsevier Inc.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	AI in Gaming
Course Code	24-BTPE-602
Course Type	Professional Elective
Course Objectives	The students should be able to understand and use AI techniques for generating efficient, intelligent behaviour in games. Additional attention is to be given to AI algorithms for improving game play experience.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand and identify tasks that can be tackled using AI techniques. 2. Apply an appropriate AI technique for the problem under investigation. 3. Create efficient and robust AI algorithms for game tasks. 4. Apply learning mechanisms to gaming problems.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction

Introduction to Game AI, a kind of AI used in game development, model of game AI, and AI engine structure.

Unit II: Movement Algorithms and Steering Behaviour

Kinematic movement algorithms, problems related to the steering behaviour of objects and Solutions, Coordinated Movement and Motor Control.

Unit III: Pathfinding

Basic Pathfinding Algorithms in game development, Pathfinding for complex solutions.

Decision-Making and Uncertainty

decision trees and state machines for game development, models for implementing knowledge uncertainty, such as fuzzy logic and Markov systems.

Unit IV:Introduction to Learning Mechanisms

Board game theory and discusses the implementation of some key algorithms, such as minimax and negamax, Random Number Generation and Minimaxing, algorithms for implementing action prediction, decision learning and reinforcement learning.

Part C-Learning Resources

Reference Books:

1. https://www.athabascau.ca/syllabi/comp/comp452.php
2. https://www.udemy.com/course/artificial-intelligence-for-simple-games/
3. Artificial Intelligence for Games, Ian Millington and John Funge, CRC Press; 2nd edition, 2009.
4. Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, Springer International Publishing, 2018.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	AI in Finance
Course Code	24-BTPE-603
Course Type	Professional Elective
Course Objectives	The students should be able to understand the evolution of AI-driven online wealth management platforms, robo-advisors, and learn how they work and why they're successful.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the strengths and weaknesses of human financial advisors and investors. 2. Understand the business model of robo/AI-advisors. 3. Understand how InsurTech is redefining the insurance industry using AI techniques. 4. Understand stock selection and asset management related to financial world.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction

Fintech Innovations: Series Map and Learning Goals, Introduction to InsurTech, Investment & Market Size of the InsurTech Industry, Real Estate Tech, Residential Real Estate Tech Startups, Commercial Real Estate Tech

Unit II:Robo Advising

Expected Returns, Standard Deviations, and Correlation, Building an Efficient Portfolio, Diversified Investments, Exchange Traded Funds, Robo-Advisors, Pure Advisors vs RoboAdvisors, Customer support using robo advisors.

Unit III:Stock Selection & Asset Management

Fundamental Analysis: The Passive Benchmark, Manager Performance, Stock Selection Screening: Discovering Signals and Data Issue, Neural Networks, Smart Beta, Wealth Management: Automated Portfolio Optimization, Portfolio Rebalancing Recommendations

Unit IV: Compliance and Fraud Detection

Behavioural Profiling Analytics in Fraud Detection, Distinguishing Specialized fromGeneric Behaviour Analytics,

Case Studies: Fetch.ai, platforms or apps that use AI for financial applications.

Part C-Learning Resources

Reference Books:

1. https://www.coursera.org/learn/invest-tech#syllabus
2. https://www.coursera.org/learn/wharton-ai-application-insurtech-real-estate technology#syllabus
3. https://www.coursera.org/learn/innovation-strategy-fintech
4. https://my.cfte.education/courses/AI-in-Finance-Specialisation
5. Artificial Intelligence in Finance, Yves Hilpisch, O'Reilly Media, Inc., 2020.
6. Machine Learning for Finance: Principles and Practice for Financial Insiders, Jannes Klaas, Packt Publishing Limited, 2019.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	Machine Learning for Data Science
Course Code	24-BTPE-604
Course Type	Professional Elective
Course Objectives	The students will be able to derive practical solutions using predictive analytics. They will also understand the importance of various algorithms in Data Science.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Apply practical solutions using predictive analytics. 2. Understand the importance of various algorithms in Data Science. 3. Create a competitive advantage from both structured and unstructured data. 4. Predict outcomes with supervised machine learning techniques. 5. Unearth patterns in customer behaviour with unsupervised techniques.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction

Algorithms and Machine Learning, Introduction to algorithms, Tools to analyze algorithms, Algorithmic techniques: Divide and Conquer, examples, Randomization, Applications

Unit II: Algorithms

Graphs, maps, Map searching, Application of algorithms: stable marriages example, Dictionaries and hashing, search trees, Dynamic programming

Unit III:Application to Personal Genomics

Linear Programming, NP completeness, Introduction to personal Genomics, Massive Raw data in Genomics, Data science on Personal Genomes, Interconnectedness on Personal Genomes, Case studies.

Unit IV: Machine Learning

Introduction, Classification, Linear Classification, Ensemble Classifiers, Model Selection, Cross Validation, Holdout

Machine Learning Applications

Probabilistic modelling, Topic modelling, Probabilistic Inference, Application: prediction of

preterm birth, Data description and preparation, Relationship between machine learning and
statistics

Part C-Learning Resources

Reference Books:

1. Introduction to Machine Learning, Jeeva Jose, Khanna Book Publishing House.
2. Machine Learning, Rajiv Chopra, Khanna Book Publishing House.
3. Data Science and Machine Learning: Mathematical and Statistical Methods Machine Learning & Pattern Recognition, by Dirk P. Kroese, Zdravko Botev, Thomas Taimre, Radislav Vaisman, Chapman & Hall/Crc, 2019.
4. Hands-On Data Science and Python Machine Learning, Frank Kane, Packt Publishers, 2017.
5. https://www.edx.org/course/machine-learning-for-data-science-and-analytics

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	Genome sequencing
Course Code	24-BTPE-605
Course Type	Professional Elective
Course Objectives	The students should be able to understand the basic biology of modern genomics and the experimental tools those can be used to measure it.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand how data from next-generation sequencing experiments are generated and analyzed. 2. Understand Galaxy framework and apply fordifferent types of analysis. 3. Analyze RNA sequences using Galaxy framework. 4. Analyze antibiotic sequence using genomic assembly tools.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: Introduction

Genomics, Genomic Data Science, Molecular Biology Structures, From Genes to Phenotypes, Polymerase Chain Reaction, Next Generation Sequencing, Applications of Sequencing, The String Reconstruction Problem, String Reconstruction as a Hamiltonian Path Problem, String Reconstruction as a Eulerian Path Problem.

Unit II: Genomic data science with galaxy

Challenges of Reproducibility, Introduction to the Galaxy Platform, Genomic Intervals, Workflows, Sequence Data Quality Control, ChIP-Sequence Analysis with MACS, RNA-seq Analysis: Mapping, RNA Sequence Analysis: Assembly Quantitation, and Differential Expression.

Unit III: Sequencing Antibiotics

Discovery of Antibiotics, How Do Bacteria Make Antibiotics, Sequencing Antibiotics by Shattering them into Pieces, A Brute Force Algorithm for Cyclopeptide Sequencing, Cyclopeptide Sequencing with Branch and Bound.

Unit IV: Ideal to Real Spectra for Antibiotics Sequencing

Adapting Sequencing for Spectra with Errors, from 20 to More than 100 Amino Acids; The Spectral Convolution; applying genome assembly tools to sequencing data from a dangerous pathogenic bacterium.

Proteomics

Protein structure, proteomics, and protein-protein interaction networks.

Part C-Learning Resources

Reference Books:

1. https://www.coursera.org/learn/genome-sequencing#syllabus
2. https://www.coursera.org/learn/galaxy-project?specialization=genomic-data science#syllabus
3. Bioinformatics with Python Cookbook, Packt Publishing, 2015
4. Python for Bioinformatics, Sebastian Bassi, Chapman and Hall/CRC.

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	Algorithms for DNA Sequencing
Course Code	24-BTPE-606
Course Type	Professional Elective
Course Objectives	The students should be able to understand computational methods, algorithms and data structuresfor analyzing DNA sequencing data.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand DNA sequences, genomics, and howDNA sequencing is used. 2. Apply python to implement key algorithms and datastructures to analyze real genomes and DNA sequencing datasets. 3. Understand human population genomics. 4. Analyze genome sequence of different species.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I: DNA sequencing, strings and matching

DNA sequencing past and present, Genomes as strings, reads as substrings, String definitions and Python examples, How DNA gets copied, Sequencing reads in FASTQ format, Sequencers give pieces to genomic puzzles, Read alignment and why it's hard, Naive exact matching.

Unit II:Pre-processing, indexing and approximate matching

Boyer-Moore basics, Diversion: Repetitive elements, Pre-processing, Indexing and the k-mer index, ordered structures for indexing, hash tables for indexing, Variations on k-mer indexes, Genome indexes used in research, Approximate matching, Hamming and edit distance, Pigeonhole principle.

Unit III: Edit distance, assembly, overlaps

Solving the edit distance problem, using dynamic programming for edit distance, a new solution to approximate matching, Meet the family: global and local alignment, read alignment in the field, Assembly: working from scratch, First and second laws of assembly, Overlap graphs.

Unit IV:Algorithms for assembly

The shortest common superstring problem, Greedy shortest common superstring, Third law of assembly: repeats are bad, De Bruijn graphs and Eulerian walks, When Eulerian walks go wrong.

Assemblers in practice

Assemble a genome from small pieces of DNA, comparing genomes of different species, gene finding, gene regulation, Cancer Sequencing, Fragment Assembly, Human Population Genomics

Part C-Learning Resources

Reference Books:

1. https://www.coursera.org/specializations/genomic-data-science
2. Python for Bioinformatics, Sebastian Bassi, Chapman and Hall/CRC.
3. Bioinformatics with Python Cookbook, Packt Publishing, 2015

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	Internet of Things
Course Code	24-BTOE-601
Course Type	Open Elective
Course Objectives	Understanding core technology, applications, sensors used and IOT architecture along with the industry perspective. Principles and operations of different types of sensors commonly used on mobile platform will be taught in a manner that by the end of the course the students will be able to design and implement real time solutions using IOT.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand core technology, applications, sensors used and IOT architecture along with the industry perspective. 2. Understand Raspberry's working and implementation. 3. Understand various communication protocols used in IoT. 4. Apply various IOT technologies in real-life applications.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Introduction to IoT:
What is IoT, how does it work? Difference between Embedded device and IoT device, Properties of IoT device, IoT Ecosystem, IoT Decision Framework, IoT Solution Architecture Models, Major IoT Boards in Market

Unit II:Setting Up Raspberry/Arduino to Create Solutions:
Explore Raspberry Pi, setting up Raspberry Pi, showing working of Raspberry Pi using SSH Client and Team Viewer, Understand Sensing actions, Understand Actuators and MEMS

Unit III:Communication Protocols used in IoT:
Types of wireless communication, Major wireless Short range communication devices, properties, comparison of these devices (Bluetooth, WIFI, ZigBee, 6LoWPAN), Major wireless Long-range communication devices, properties, comparison of these devices (Cellular IoT, LPWAN)

Unit IV:IoT Applications: Industrial Internet 4.0, Applications such as: Smart home, wearables, smart city, smart grid, connected car, connected health (digital health, telehealth, telemedicine), smart retail

Sensors: Applications of various sensors: Google Maps, Waze, WhatsApp, Ola Positioning sensors: encoders and accelerometers, Image sensors: cameras, Global positioning sensors: GPS, GLONASS, IRNSS, Galileo and indoor localization systems, Motion & Orientation Sensors: Accelerometer, Magnetometer, Proximity Sensor, Gyroscope Calibration, noise modeling and characterization and noise filtering and sensor data processing. Privacy &Security

Part C-Learning Resources

Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), 1st Edition, VPT, 2014
2. Francis da Costa, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1stEdition, Apress Publications, 2014
3. CunoPfister, Getting Started with the Internet of Things, O Reilly Media, 2011
4. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing, 2015

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	Statistical Thinking for Data Science
Course Code	24-BTOE-602
Course Type	Open Elective
Course Objectives	This course will provide the students a statistical foundation for data science. They will be able to exercise statistical thinking in collecting, modelling and analyzing data.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the statistical foundation for data science 2. Apply statistical thinking in collecting, modellingand analyzing data 3. Ability to visualize all types of data 4. Understand how to use R for different types of data
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Introduction to Data Science

Data acquisition, cleaning, and aggregation, Exploratory data analysis and visualization, Feature engineering, Model creation and validation

Unit II:Statistical Thinking

Examples of Statistical Thinking, Numerical Data, Summary Statistics, From Population to Sampled Data, Different Types of Biases, Introduction to Probability, Introduction to Statistical Inference.

Unit III: Statistical Thinking 2

Association and Dependence, Association and Causation, Conditional Probability and Bayes Rule, Simpsons Paradox, Confounding, Introduction to Linear Regression, Special Regression Models

Unit IV: Exploratory Data Analysis and Visualization

Goals of statistical graphics and data visualization, Graphs of Data, Graphs of Fitted Models, Graphs to Check Fitted Models, What makes a good graph?, Principles of graphics

Introduction to Bayesian Modeling

Bayesian inference: combining models and data in a forecasting problem, Bayesian hierarchical modeling for studying public opinion, Bayesian modeling for Big Data

Part C-Learning Resources

Reference Books:

1. Tamhane, Ajit C., and Dorothy D. Dunlop. Statistics and Data Analysis: From Elementary to Intermediate. Prentice Hall, 1999.
2. Jeeva Jose, Beginner's Guide for Data Analysis using R Programming, Khanna Book Publishing House 2019.
3. V.K. Jain, Data Sciences & Analytics, Khanna Book Publishing House 2021.
4. Practical Statistics for Data Scientists by Peter Bruce and Andrew Bruce, O'Reilly, 2017
5. Statistics in Plain English by Timothy C. Urdan, Routledge, 2010
6. https://www.mooc-list.com/course/statistical-thinking-data-science-and-analytics-edx

Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	6th
Name of the Course	Robotics
Course Code	24-BTOE-603
Course Type	Open Elective
Course Objectives	The students will be able to understand the basic concepts and fundamentals of robotics. They will also be able to use AI in the field of robotics.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the basics of robotics 2. Understand game playing concepts involvingrobotics and AI. 3. Apply robotics to create robot driven systems. 4. Analyze and co-relate robotics with AI and use in real-world applications.
Max. Marks	Th. 50Pr. 25
Internal Assessment Max Marks	Th. 10Pr. 5
End Term Exam Max Marks	Th. 40 Pr. 20
Internal Min Pass Marks	Th. 4Pr. 2
External Min Pass Marks	Th. 16Pr. 8
Examination Time	Th. 3 Hrs Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper-Setter: The examiner will set 9 questions, asking two questions from each unit and one compulsory question, by taking the course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Units Topics

Unit I:Introduction:

Introduction to Robotics Fundamentals of Robotics, Robot Kinematics: Position Analysis, Dynamic Analysis and Forces, Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

Unit II:Need of AI in Robotics:

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

Unit III:Game Playing:

AI and game playing, plausible move generator, static evaluation move generator, game playing strategies, problems in game playing.

Unit IV:Robotics fundamentals:

Robot Classification, Robot Specification, notation, kinematic representations and transformations, dynamics techniques; trajectory planning and control.

Robotics and Its applications:

DDD concept, Intelligent robots, Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot, Robot joints and links-Robot classifications, Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system

Part C-Learning Resources

Reference Books:

1. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Peter Corke, Springer, 2011.
2. Robotics: Everything You Need to Know About Robotics from Beginner to Expert, Peter McKinnon, Createspace Independent Publishing Platform, 2016.
3. Introduction to AI Robotics, Second Edition, By Robin R. Murphy, MIT press, 2001.
4. Artificial Intelligence for Robotics: Build intelligent robots that perform human tasksusing AI techniques, Francis X. Govers, Packt Publishers, 2018.