MAHATMA GANDHI INSITITUTE OF TECHNOLOGY (Autonomous)
M.Tech. in Artificial Intelligence
Scheme of Instruction and Examination
(Choice Based Credit System)
For the batches to be admitted with effect from the academic year 2021-22

I Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	CS101PC	Advanced Data Structures	3	0	0	30	70	3	3
2	CS102PC	Machine Learning	3	0	0	30	70	3	3
3	CS11XPE	Professional Elective-I	3	0	0	30	70	3	3
4	CS11XPE	Professional Elective-II	3	0	0	30	70	3	3
5	CS101MC	Research Methodology & Intellectual Property Rights	2	0	0	30	70	3	2
6	AC10XHS	Audit Course – I	2	0	0	30	70	3	0
7	CS151PC	Advanced Data Structures Lab	0	0	2	30	70	3	1.5
8	CS152PC	Machine Learning Lab using Python	0	0	2	30	70	3	1.5
9	EN151HS	Finishing School-I	0	0	2	30	70	3	1
Total Hours/Marks/Credits			**16**	**0**	**8**	**270**	**630**		**18**

II Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	CS201PC	Deep Learning	3	0	0	30	70	3	3
2	CS202PC	Computational Tools for Artificial Intelligence	3	0	0	30	70	3	3
3	CS21XPE	Professional Elective-III	3	0	0	30	70	3	3
4	CS21XPE	Professional Elective-IV	3	0	0	30	70	3	3
5		Mini Project with Seminar	0	0	4	100	-	3	2
6	AC20XHS	Audit Course – II	2	0	0	30	70	3	0
7	CS251PC	Deep Learning Lab	0	0	3	30	70	3	1.5
8	CS252PE	Fundamentals of Data Science Lab using Python	0	0	3	30	70	3	1.5
9	MA252BS	Finishing School-II	0	0	2	30	70	3	1
Total Hours/Marks/Credits			**14**	**0**	**12**	**340**	**560**	**--**	**18**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** -Semester End Examination

List of Professional Electives offered by M.Tech. CSE (AI)

Professional Elective-I

CS111PE: Artificial Intelligence - A Modern Approach
CS112PE: Cryptography and Network Security
CS113PE: Big Data Engineering

Professional Elective-II

CS114PE: Cloud Computing
CS115PE: Internet of Things
CS116PE: Computer Vision & Image Processing

Professional Elective-III

CS211PE: Fundamentals of Data Science
CS212PE: Semantic Web
CS213PE: Robotics in Artificial Intelligence

Professional Elective-IV

CS214PE: Genetic Algorithms and Fuzzy Logic
CS215PE: Speech Information Processing
CS216PE: Cloud Security

Audit Courses

Audit Course-I

AC101HS: English for Research Paper Writing
AC102HS: Sanskrit for Technical Knowledge
AC103HS: Stress Management by Yoga

Audit Course-II

AC201HS: Disaster Management
AC202HS: Value Education
AC203HS: Pedagogy Studies
AC204HS: Personality Development through Life Enlightenment Skills

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3	0	0	3

M.Tech. in Artificial Intelligence
I Semester Syllabus
CS101PC: Advanced Data Structures

Pre-Requisites: UG level course in Data Structures

Course Objectives

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Student should be able to come up with analysis of efficiency and proofs of correctness.

Course Outcomes

After completion of course, students would be able to:

- Demonstrate Dictionaries and understand the implementation of symbol table using hashing techniques.
- Analyze and construct Skip Lists
- Develop and analyze algorithms for red-black trees, B-trees and Splay trees
- Develop algorithms for text processing/applications.
- Identify suitable data structures and develop algorithms for computational geometry problems.

Unit-I

Dictionaries: Dictionaries as Linear list, Skip List-Searching, insertion, deletion, deterministic skip List, Analysis.

Hashing: Hash tables, Hash Functions ,Collision Resolution Techniques ,Linear Probing, Quadratic Probing, Double Hashing, Separate chaining, Double Hashing, Rehashing, Extendible Hashing.

Unit-II

Search Trees: Binary Search Trees operations- Insertion, deletion, Searching, AVL Balanced Trees- Insertion, deletion, B-Trees- insertion, deletion, searching, Red-Black trees, Splay Trees.

Priority Queues:-Binary Heaps, Applications of binary heap.

Unit-III

Text Processing: Pattern Matching Algorithms, Brute-Force Algorithm, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Tries-Searching a Trie, Inserting into a Trie, Deleting an element, Compressed Tries, Suffix Tries.

Unit-IV

Fundamental Techniques: The Greedy Method-The Fractional Knapsack Problem, Task Scheduling, Divide-and-Conquer - Recurrence Equations, Integer Multiplication, Matrix Multiplication, Dynamic Programming-The 0/1 Knapsack Problem.

Unit-V

Computational Geometry: One Dimensional Range Searching, Two-Dimensional Range Searching, constructing a Priority Search Tree, Searching in a Priority Search Tree, Priority Range Trees, Quad-trees, kd-Trees.

NP-Completeness: P and NP, NP-Completeness, NP-Complete problems- CLIQUE and Set Cover, Hamiltonian cycle and TSP.

Suggested Readings:

1. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

Reference Books:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in JAVA", 3rd Edition, Pearson, 2004.
2. SartajSahni, "Data structures, Algorithms and Applications in Java", 2nd Edition, Universities Press, 2005.
3. V.V.Muniswamy, “Advanced Data Structure & Algorithms in C++”, JAICO Publishing House,2010.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
CS102PC: Machine Learning

Pre-Requisites: UG level course in Programming and problem solving

Course Objectives

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the regression and classification
- To understand building blocks artificial neural network and develop different algorithm for learning.
- To Understand various instance based methods and unsupervised learning techniques
- To study the various probability based learning techniques.

Course Outcomes

After completion of course, students would be able to

- Identify potential applications of machine learning in practice
- Describe the differences in approaches and applicability of regression, classification
- Understand the Neural Networks and its usage in machine learning applications
- Understand the basic principles behind unsupervised learning methods.
- Apply Evolutionary Computation Methods to find solutions to complex problems.

Unit - I

Introduction to Machine learning

Introduction - Learning- Well-posed learning problems, Types of Machine Learning-Supervised learning-Regression, classification-Unsupervised Learning-The machine learning process

Concept learning - introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias.

Model Evaluation: Overfitting - Training, Testing, Validation sets-Confusion matrix, Accuracy metrics-The Receiver Operating Characteristic (ROC) Curve

Unit - II

Linear models and Tree based learning

Linear Regression-Estimating the coefficients, Logistic Regression-The logistic model-estimating the regression coefficients, Dimensionality reduction-Linear Discriminant analysis (LDA), principal components analysis (PCA), independent components analysis (ICA)

Tree based Methods: Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, Bagging-Random Forests-Boosting

Unit - III

Neural Networks and Maximum Margin Classifiers

Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back propagation algorithm.

Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, Support vector machines (SVM)- optimal separation, kernels, the SVM algorithm, extensions to the SVM.

Unit - IV

Unsupervised learning

Instance-Based Learning-Introduction, k-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning Unsupervised learning- the k-means algorithm, Self Organizing Maps(SOM),

Unit - V

Bayesian learning and Evolutionary methods

Bayesian learning-Introduction, Bayes theorem, Bayes theorem and concept learning, minimum description length principle, Bayes optimal classifier, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, EM algorithm,

Evolutionary Learning-The Genetic Algorithm (GA), Generating offspring, Genetic operators, Genetic programming.

Suggested Readings:

1. Machine Learning – Tom M. Mitchell, -McGraw Hill Education; First edition (1 July 2017)
2. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis, 2014.

Reference Books:

1. Pattern Recognition: An Introduction, V. Susheela Devi, M. Narasimha Murthy, Universities Press, 2011.
2. Pattern recognition and Machine Learning, C. M. Bishop, Springer, 2007
3. Introduction to Machine Learning, E. Alpaydin, MIT Press, 3rd Edition, 2014.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Professional Elective-I
CS101PE: Artificial Intelligence - A Modern Approach

Pre-Requisites: UG level course in Mathematics, Data Structures.

Course Objectives

- To train the students to understand different types of AI agents, various AI search Algorithms.
- To give understanding of fundamentals of knowledge representation.
- To train the students to understand different Machine Learning Algorithms.

Course Outcomes

After completion of course, students would be able to

- Solve basic AI based problems
- Apply AI techniques to real-world problems to develop Knowledge representation models
- Apply AI Techniques to real world problems and develop models.

Unit-I

Introduction: Overview of AI problems: Definition, Foundations, And Applications.
Agents: What are agents, Agent Environments, Structure of Agents, Types of Agents. Problem Solving Agents: Problem spaces, states, goals and operators.
Problem spaces (states, goals and operators). problems. Strong and weak, neat and scruffy, symbolic and sub-symbolic, knowledge-based and data-driven AI.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-II

Uninformed Searches: Breadth-First, BFS Algorithm, Traversing, and Complexity Study Uniform cost Search: Algorithm, Traversing, and Complexity Study. Depth-First Search: Algorithm, Traversing, Complexity Study. Depth-first with Iterative Deepening: Algorithm, Traversing, Complexity Study.
Heuristic Search, Hill Climbing: Algorithm, Traversing, Complexity Study, Generic Best-First: Algorithm, Traversing, Complexity Study.**A***: Algorithm, Traversing, Complexity Study.
Constraint Satisfaction Problems: Definition, Crypt-Arithmetic Problems, Map Coloring, Backtracking.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-III

Game Playing: Adversarial Searches. Two player games. Min-max Search: Algorithm, Problems. Draw Back of Min-Max Algorithm. Alpha-beta pruning: Algorithm, Problems.

Knowledge representation and reasoning: Propositional Logic: Basics of logic, truth tables and sentence conversions. First order logic: Difference between Proposition & First order logic. Conjunctive Normal form.Disjunctive Normal Form. Conversion of English sentences into First order logic. Resolution and theorem proving Problems of Resolution.
Forward Chaining: Definition, Example problems. Backward Chaining: Definition, Example problems
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-IV

Probabilistic reasoning: Basics of probability: Probability, Joint & Conditional Probability. Bayes theorem.Representing Knowledge in an Uncertain Domain: Bayesian Networks.

Advanced Knowledge Representation: Semantic Nets: Definition, Examples. Extended Semantic Nets: Inference rules in ESNet. Semantic Frames: .Description, inheritance. Monotonic & Non- Monotonic reasoning.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-V

Introduction to Expert Systems: What are Expert Systems, Knowledge Engineering. Phases in Building Expert Systems, Expert System Architecture. , Knowledge Acquisition. Key Application Areas: Expert system, decision support systems, Speech and vision, Natural language processing, Information Retrieval, Semantic Web.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall. 2010, Third edition.
2. Artificial Intelligence by Elaine Rich, Kevin Knight and Shiva shankar B Nair, Tata McGraw Hill. Third edition 2017.

Reference Books:

1. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education. 1s Edition, 2015.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.
3. Artificial Intelligence – Patric Henry Winston – Third Edition, Pearson Education 2015.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Professional Elective-I
CS112PE: Cryptography and Network Security

Pre-Requisites: UG level course in Mathematics, Data Structures

Course Objectives

- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand various cryptographic algorithms.
- Understand the basic categories of threats to computers and networks
- Describe public-key cryptosystem.
- Describe the enhancements made to IPv4 by IPSec
- Understand Intrusions and intrusion detection
- Discuss the fundamental ideas of public-key cryptography.
- Generate and distribute a PGP key pair and use the PGP package to send an encrypted e-mail message.
- Discuss Web security and Firewalls.

Course Outcomes

After completion of course, students would be able to:

- Student will be able to understand basic cryptographic algorithms, message and web authentication and security issues.
- Ability to identify information system requirements for both of them such as client and server.
- Ability to understand the current legal issues towards information security.

Unit-I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric keycryptography, steganography, key range and key size, possible types of attacks.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipheroperation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, ElGamalCryptography, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512),

Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, ElGamal Digital Signature Scheme.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH)

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit -V

E-Mail Security: Pretty Good Privacy, S/MIME **IP Security:** IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations,Internet Key Exchange.

Firewalls: Firewall Design Principles, Types of Firewalls. Viruses and Intruders.

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Cryptography and Network Security - Principles and Practice: William Stallings, PearsonEducation, 6th Edition 2014.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition 2017.

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition 2011.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition 2010.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India 2011.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH 2016.
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning 2007.
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning 2010.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Professional Elective-I
CS113PE: Big Data Engineering

Pre-Requisites: UG level course in Mathematics, Data Structures

Course Objectives

- Introduces the basic concepts of Big Data.
- Reviews basic Big data models.
- Introduces a variety of Big data and applications.
- Introduces open source models such as Hadoop.

Course Outcomes

After completion of course, students would be able to

- Ability to select the Big data architecture that efficiently model the information in a problem.
- Ability to assess efficiency trade-offs among different big data platform implementations or combinations.
- Define & implement Hadoop architecture
- Examine the different frameworks in Big data
- Analyze and understand the functioning of different components involved Big data analytics.

Unit - I

Introduction to Big Data: Introduction to Big Data Platform – Challenges of Conventional System – Intelligent data analysis – Nature of Data – Analytic Processes and Tool – Analysis vs Reporting – Modern Data Analytic Tool – Statistical Concepts: SamplingDistributions–Re-Sampling–StatisticalInference–PredictionError.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Introduction To Stream Concepts – Stream Data Model and Architecture -Stream Computing – Sampling Data in a Stream – Filtering Stream –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.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

Hadoop: History of Hadoop-The Hadoop Distributed File System–Components of Hadoop–Analyzing the Data with Hadoop–Scaling Out–Hadoop Streaming – Design of HDFS- Java interfaces to HDFS Basics- Developing a Map Reduce Application – How Map Reduce Works – Anatomy of a Map Reduce Job run – Failures – Job Scheduling – Shuffle and Sort – Task Execution – Map Reduce Types and Formats – Map Reduce Features.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

Hadoop Environment: Setting up a Hadoop Cluster – Cluster specification –Cluster Setup and Installation – Hadoop Configuration – Security in Hadoop – Administering Hadoop–HDFS– Monitoring– Maintenance – Hadoop Benchmarks – Hadoop in the Cloud.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Frameworks: Applications on Big Data Using Pig and Hive – Data Processing operators in Pig – Hive Services – Hive QL –Querying Data in Hive –fundamentals of H Base and Zookeeper – IBM Info Sphere Big Insights and Streams. Visualization –Visual data analysis techniques, interaction techniques; Systems and applications.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Michael Berthold, David J.Hand, Intelligent Data Analysis, Spingers, 2007.
2. Tom White, Hadoop: The Definitive Guide Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, Uderstanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGrawHill Publishing, 2012.
4. AnandRajaraman and Jeffrey David UIIman, Mining of Massive Datasets Cambridge University Press, 2012.

Reference Books:

1. Bill Franks, Taming the big Data tidal Wave: Finding OpportUnit -ies in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data , John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber, Data Mining Concepts and Techniques, Second Edition 2012.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Professional Elective-II
CS114PE: Cloud Computing

Pre-Requisites: UG level course in Mathematics, Data Structures

Course Objectives

- To impart fundamental knowledge of various computing paradigms
- To understand the 5-4-3 principles of cloud computing, working of a cloud application, benefits and drawbacks in cloud computing.
- To understand the role of network connectivity in the cloud, managing the cloud and application migration to cloud.
- To analyze the characteristics, suitability, pros and cons of Cloud Deployment models and Cloud Service models.
- To understand the various cloud service providers and the applications.

Course Outcomes

After completion of course, students would be able to

- Understand the various Computing Paradigms.
- Understand the fundamental concepts of the cloud computing and virtualization concepts.
- Analyze Cloud Computing Architecture and Management
- Distinguish between various Cloud Deployment and Service models
- Use different tools of cloud service providers.

Unit - I

Basics of Operating Systems and Computer Networks: Basics of Operating Systems concepts - Process and CPU Scheduling –Deadlocks - Process Management and Synchronization - Memory Management and Virtual Memory - File System Interface and Operations - Basics of Computer Networking concepts – OSI Layers and network applications – Case studies in Operating Systems and Computer Networks.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit – II

Cloud Computing Fundamentals: Motivation for Cloud Computing, Basic Principles of Cloud computing. Five Essential Characteristics, Four Cloud Deployment Models, Three service Offering Models, Requirements for Cloud Services - Cloud Ecosystem, Cloud Application - Virtualization- approaches and types of virtualization.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

Cloud Computing Architecture and Management: Cloud architecture Layers, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Networking Technologies, Applications on the Cloud, Managing the Cloud application, Migrating Application to Cloud- Phases of Cloud Migration Approaches for Cloud Migration

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

Cloud Deployment Models: Private Cloud, Public cloud, CommUnit -y Cloud and Hybrid Cloud – Characteristics, Suitability, Issues, Advantages and Disadvantages.

Cloud Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service - Characteristics, Suitability, Pros and Cons and Summary.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Cloud Service Providers and Applications: Amazon Web Services, Amazon Elastic Compute Cloud, Google Cloud Platform, Google App Engine, Microsoft Azure, Windows Azure, IBM Cloud Models – Cloud Security issues – Case studies in Cloud Computing and its applications.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Essentials of Cloud Computing: K. Chandra Sekaran, CRC press, 2014 (Reprint 2020)
2. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley 2004.
3. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition TMH, 2006.

Reference Books:

1. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms by Wiley, 2011.
2. Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Distributed and Cloud Computing Elsevier, 2012.
3. Tim Mather, Subra Kumara Swamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly, SPD, rp2011.

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M. Tech. in Artificial Intelligence
I Semester Syllabus
Professional Elective-II
CS115PE: Internet of Things

Pre-requisites: Fundamentals of Microcontrollers.

Course Objectives

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To Introduce Programming Raspberry Pi with Python.
- To introduce the hardware and working principles of various sensors used for IoT

Course Outcomes

On successful completion of the course, the student will

- Understand the concepts of Internet of Things.
- Design IoT applications in different domain and be able to analyze their performance.
- Able to know the Language features of Python.
- Able to know about working of Raspberry Pi
- Able to know the working of various Sensors.

Unit - I

Introduction to Internet of Things —Introduction, Definition and Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT communication models, IoT Communication APIs

IoT Enabling Technologies — Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Deployment Templates- IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Domain Specific IoT—Introduction , Home Automation- Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Smart Cities- Smart Parking, Smart lighting, Smart roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment- Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy- Smart Grids, Renewable Energy Systems, Prognostics, **Retail-** Inventory Management, Smart Payments, Smart Vending Machines, **Logistics-** Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring, Remote Vehicle Diagnostics, **Agriculture-** Smart Irrigation, Green House Control, **Industry-** Machine Diagnosis & Prognosis, Indoor Air Quality Monitoring, **Health & Lifestyle-** Health & Fitness Monitoring, Wearable Electronics.

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT- Software Defined Networking, Network Function Virtualization

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

IoT Systems - Logical Design using Python- Introduction, Python Data Types & Data Structures-Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, **Control Flow-** if, for, while, range, break/continue, pass Functions,

Modules, Packages, File Handling, Date/Time Operations, Classes, Python Packages of Interest for IoT- JSON, XML, HTTPLib, URLLib, SMTPLib

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

IoT Physical Devices and Endpoints- What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces - serial,SPI,I2C,
Programming Raspberry Pi with Python- Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Buzzer- Function of a Buzzer, Two Kinds of Buzzer, Relays- What is a Relay, Its Working, Relay Uses,Why Relay is used in Motor Control, Relay Module.

Sensors: What is an IoT Sensor, IoT Sensors Types- Pressure Sensors, Light Sensors, Temperature & Humidity Sensors, Working with Camera Module.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Internet of Things -A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
2. A Hands-On Course in Sensors Using the Arduino and Raspberry Pi (Series in Sensors) 1st Edition, Kindle Edition by Volker Ziemann.

Reference Books:

1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.
2. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016.
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Professional Elective-II
CS116PE: Computer Vision & Image Processing

Pre-Requisites: UG level course in Mathematics, Data Structures

Course Objectives

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques.
- To study image segmentation and compression methods.
- To study the various image morphological operations.
- To study the fundamental concepts of computer vision.

Course Outcomes

After completion of course, students would be able to

- Review the fundamental concepts of a digital image processing system.
- Evaluate the techniques for image enhancement.
- Categorize various compression techniques and interpret image segmentation and representation techniques.
- Perform various transformation techniques.
- Evaluate the fundamentals of computer vision.

Unit - I

Image Fundamentals: What is Image Processing, examples of fields that use digital image processing, fundamental Steps in Digital Image Processing, Components of an Image processing system, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Image Enhancement: Image Enhancement in the spatial domain: some basic gray level transformations, histogram processing, enhancement using arithmetic and logic operations, basics of spatial filters, smoothening and sharpening spatial filters, combining spatial enhancement methods.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

Segmentation: Thresholding, Edge Based Segmentation: Edge Image Thresholding, Region Based Segmentation, Matching, Representation and Description: Representation, Boundary Descriptors, Regional Descriptors.

Image Compression: Fundamentals, image compression models, elements of information theory, error-free compression, lossy compression, Image Compression Standards.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit transformation, basic morphologic algorithms.

Color Image Processing: Color fundamentals, Color Models and basics of full-color image processing.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Computer Vision: Introduction, Visual Perception, Vision systems, sensing devices, Interpreting devices, Applications of Computer Vision, Pipeline, Classifier Learning algorithm.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. "Digital Image Processing", Rafael C. Gonzalez and Richard E. Woods, Third Edition, Pearson Education, 2007.
2. **"**Deep Learning for Vision Systems", Mohamed Elgendy, Manning, October 2020.

Reference Books:

1. Computer Vision: Algorithms and Applications by RichardSzeliski.
2. "Digital Image Processing", S. Sridhar, Oxford University Press.
3. "Fundamentals of Digital Image Processing", S. Annadurai, Pearson Edun, 2001.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
CS101MC: Research Methodology & Intellectual Property Rights

Course Objectives

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Unit-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit-III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit-IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications**.**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Suggested Readings:

1. C. R. Kothari and Gaurav Garg, "Research Methodology – Methods and Techniques", New Age International
2. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
4. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel, "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Audit Course- I
AC101HS: English for Research Paper Writing

Course Objectives

Students will be able to:
- Improve their writing skills and level of readability
- Learn about structure and organization of sections and sub sections
- Develop requisite skills to write the title
- Enhance effective writing skills to publish research papers

Unit-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit-II

Clarifying, Highlighting Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstract, Introduction

Unit-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check

Unit-IV

Key Skills for: Writing a title, Writing an abstract, Writing an Introduction, Writing a review of the literature

Unit-V

Key skills for: Writing methods, Writing the results, Writing the discussion, Writing the conclusions.
Useful phrases and mechanics of effective writing to publish research papers.

Suggested Readings:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press(available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Audit Course - I
AC102HS: Sanskrit for Technical Knowledge

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

Unit-I
Alphabets in Sanskrit

Unit-II
Past / Present / Future Tense, Simple Sentences

Unit-III
Order, Introduction of roots

Unit-IV
Technical information about Sanskrit Literature

Unit-V
Technical Concepts of Engineering - Electrical, Mechanical, Architecture, Mathematics

Suggested Readings:

1. Prathama Deeksha-Vempati Kutumbshastri “Teach Yourself Sanskrit”, Rashtriya Sanskrit Sansthanam, New Delhi Publication

Reference Books:

1. Dr. Vishwas, Samskrita “Abhyaspustakam” -Bharti Publication, New Delhi
2. Suresh Soni “India’s Glorious Scientific Tradition”, Ocean books (P) Ltd., New Delhi.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
Audit Course - I
AC103H: Stress Management by Yoga

Course Objectives

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

Unit-I
Definitions of Eight parts of yoga. (Ashtanga)

Unit-II
Yam and Niyam.

Unit-III
Do's and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit-IV
Asan and Pranayam

Unit-V
i) Various yoga poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

Suggested Readings:
1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur

Reference Books:
1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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M.Tech. in Artificial Intelligence
I Semester Syllabus
CS151PC: Advanced Data Structures Lab

Pre-Requisites: UG level course in Data Structures

Course Objectives

- Introduces the basic concepts of Abstract Data Types.
- Reviews basic data structures such as stacks and queues.
- Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs, and B-trees.
- Introduces sorting and pattern matching algorithms.

Course Outcomes

After completion of course, students would be able to:

- Ability to select the data structures that efficiently model the information in a problem.
- Ability to assess efficiency trade-offs among different data structure implementations or combinations.
- Implement and know the application of algorithms for sorting and pattern matching.
- Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and B-trees.

List of Experiments:

1. Implement Dictionary using suitable Data Structure.
2. Write a program to implement all the functions of a dictionary using hashing.
3. Write a program which creates Skip Lists. Implement Insert, Search and Update Operations in Skip-Lists.
4. Write a program to create a Binary Search Tree and implement Insert, Delete and Search Operations for a Binary Search Tree.
5. Write a program to create an AVL tree and implement Insert and Delete Operations in AVL Tree. Note that each time the tree must be balanced.
6. Write a program to create a B Tree and implement Insert, Delete and Search Operations for a B-tree.
7. Write a program to create a Red-Black Tree and implement Insert, Delete and Search Operations for a Red-Black Tree.
8. Write a program for implementing Knuth-Morris-Pratt pattern matching algorithm.
9. Write a program for implementing Brute Force pattern matching algorithm.
10. Write a program for implementing Boyer pattern matching algorithm

Suggested Readings:

1. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.

Reference Books:

1. The C Programming Language, B.W. Kernighan, Dennis M. Ritchie, PHI/Pearson Education 2015.
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press 2001.
3. Data structures: A Pseudocode Approach with C, R.F. Gilberg and B. A. Forouzan, 2nd Edition, Cengage Learning 2004.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
CS151PC: Machine Learning Lab using Python

Pre-Requisites: UG level course in Python programming

Course Objectives

- The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python

Course Outcomes

After completion of course, students would be able to

- understand complexity of Machine Learning algorithms and their limitations;
- understand modern notions in data analysis-oriented computing;
- be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;
- Be capable of performing experiments in Machine Learning using real-world data.

List of Experiments:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Extract the data from database using python
4. Implement linear regression using python.
5. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Implement Random forest classification in python
7. Implement the finite words classification system using Back-propagation algorithm
8. Implement k-nearest neighbour classification using python
9. Implement Naïve Bayes theorem to classify the English text
10. Implement an algorithm to demonstrate the significance of genetic algorithm

Suggested Readings:

1. Machine Learning – Tom M. Mitchell, - MGH, 1997
2. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis, 2014.

Reference Books:

1. Pattern Recognition: An Introduction, V.Susheela Devi, M.Narasimha Murthy, Universities Press, 2011
2. Pattern recognition and Machine Learning, C. M. Bishop, Springer,2007
3. Introduction to Machine Learning, E. Alpaydin, MIT Press, 3rd Edition, 2014.

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M.Tech. in Artificial Intelligence
I Semester Syllabus
EN151HS: Finishing School-I
(Common to all Branches)

Course Overview

- In view of the growing importance of English as a tool for global Communication and the consequent emphasis on training students to acquire language skills, this syllabus has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

Course Objectives

- The main objective of this finishing school curriculum is to provide content for developing the LSRW skills of language learning and to facilitate proficiency in both receptive and productive skills, among students.

Methodology:

- Every Session will have activities on all the four skills-Listening, Speaking, Reading and Writing.
- To personalize the learning a variety of case studies and structured problem solving activities will be given to small groups and the teachers will facilitate peer reviews.
- Continuous grading, peer review and positive reinforcement will be emphasized
- Vocabulary exercises will also be a part of every session
- All sessions are designed to be student-centric and interactive.

Unit-I: Fundamentals of Communication

Unit Overview:

This is an introductory module that covers the fundamentals of communication. This module is intended to enable the students to communicate using greetings and small sentences/queries.

Learning Outcomes:

The students should be able to:

- Respond to questions
- Engage in informal conversations.
- Speak appropriately in formal situations
- Write formal and informal emails/letters

Competencies:

- Greeting appropriately
- Introducing themselves, a friend
- Situational Dialogue writing
- Responding to simple statements and questions both verbally and in writing
- Writing an email with appropriate salutation, subject lines, introduction and purpose of mail.
- Using appropriate vocabulary for both formal and informal situations.
- JAM sessions.

Sessions:

1. Introduction to Formal and Informal Conversations (Listening Activity)
2. Informal Conversations
3. Informal Conversations - Writing
4. Formal Conversations
5. Formal Conversations – Writing
6. Grammar-Prepositions
7. Adjectives and Degrees of Comparison
8. Word formation: Prefixes and Suffixes

Unit–II: Rational Recap

Unit Overview:

The module enables the participants to organize their communication, structure their speaking and writing, explain their thoughts/ideas, and summarize the given information.

Learning Outcomes:

The students should be able to:

- Classify content and describe in a coherent form
- Recognize and list the key points in a topic/message/article.
- Compare and contrast using appropriate structure
- Explain cause and effect
- Use appropriate transitions in their presentations and written assignments

Competencies:

- Organizing the communication based on the context and audience
- Structuring the content based on the type of information.
- Explaining a technical/general topic in detail.
- Writing a detailed explanation/process
- Recapitulating

Sessions:

1. Introduction to Mind maps
2. Classification
3. Sequencing
4. Description and Enumeration

Unit-III: Narrations and Dialogues

Unit Overview:

The Module is intended to develop the desired level of language competence that enables them to narrate and participate in casual dialogues.

Learning Outcomes:

The students should be able to

- Narrate a message/story/incident, both verbally and in writing.
- Describe an event/a session/ a movie/ an object / image
- Understand Vocabulary in context

Competencies:

- Framing proper phrases and sentences to describe in context
- Reading Stories and articles and summarizing.
- Speaking fluently with clarity
- Listening for main ideas and reformulating information in his/her own words
- Drawing and write appropriate conclusions, post reading a passage.
- Speaking Reading and Writing descriptive sentences and paragraphs
- Using appropriate tenses, adjectives and adverbs in conversations and written tasks

Sessions:

Grammar: Verb, Tenses

1. Recalling and Paraphrasing
2. Describing Events
3. Describing Objects/ Places
4. Story Telling
5. Describing Hypothetical events

Unit-IV: Technical Expositions and Discussions

Unit Overview:

The module enables the students to build strategies for effective interaction and help them in developing decisive awareness and personality, maintaining emotional balance.

Learning Outcomes:

The students should be able to:

- Participate in Professional discussions by providing factual information, possible solutions, and examples.

Competencies:

- Comprehending key points of a topic and identifying main points including supporting details.
- Construct a logical chain of arguments and decisive points.
- Writing a review about a product by providing reasons, causes and effects

Sessions:

Based on Case Studies

1. Compare and Contrast
2. Cause and Effect
3. Problem and Solution

Unit-V: Drawing Conclusions

Unit Overview:

This module is intended to provide necessary inputs that enable the studentsto draw conclusions out of a discussion and provide reports.

Learning Outcomes:

Students should be able to:

- Provide logical conclusions to the topics under discussion.
- Prepare, present, and analyze reports.

Competencies:

- Reasoning skills - Coherent and logical thinking
- Reporting and Analyzing skills.
- Analyzing the points discussed.
- Connecting all points without gaps.
- Connectives
- Communicating the decisions

Sessions:

1. Report Writing
2. Reasoning
3. Analyzing
4. Generalization and Prediction
5. Précis writing

Reference Books:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. Mc Murrey & Joanne Buckley. 2012.Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw- Hill 2009.
10. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
CS201PC: Deep Learning

Pre-requisites: Fundamentals of Programming, Knowledge about Machine Learning Techniques.

Course Objectives

- To build the foundation of deep learning.
- To understand how to build the neural network.
- To enable the students develop successful machine learning concepts.

Course Outcomes

- Learn the fundamental principles of deep learning.
- Identify the deep learning algorithms for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.

Unit - I

Introduction, motivation and history: Biological neural networks, Components of artificial neural networks, Fundamentals on learning and training samples, The perceptron, backpropagation and its variants.

Unit - II

Deep Networks: Deep Feedforward Networks, Three classes of Deep Learning, Networks, Regularization and Dropout for Deep Learning, Convolutional Neural Networks- Architectures, convolution / pooling layers, Pretrained CNN Models.

Unit - III

Sequence Modeling: Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures. Deep Unsupervised Learning: Autoencoders, Adversarial Generative Networks.

Unit -IV

Deep Reinforcement Learning: Introduction, Stateless Algorithms, The basic framework of Reinforcement Learning, Bootstrapping for Value Function Learning, Policy Gradient Methods, Case Studies.

Unit -V

Advanced Topics in Deep Learning: Introduction, Attention Mechanisms, Neural Networks with External Memory, GANs, Competitive Learning.

Suggested Readings:

1. A Brief Introduction to Neural Networks, David Kriesel (Ch 1-5), 2015.
2. Neural Networks and Deep Learning, Charu C. Aggarwal, part of Springer Nature, 2018.
   ISBN 978-3-319-94462-3 ISBN 978-3-319-94463-0 (eBook) https://doi.org/10.1007/978-3-319-94463-0
3. Deep Learning, Ian Good fellow Yoshua Bengio Aaron Courville (Ch-6,7,9,10)

Reference Books:

1. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
2. Probabilistic Graphical Models by D. Koller, and N. Friedman, MIT Press.
3. Deep Learning Methods and Applications, Li Deng and Dong Yu.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
CS202PC: Computational Tools for Artificial Intelligence

Pre-Requisites: UG Level course in mathematics, statistics.

Course Objectives

- Concept of rank and applying the concept to know the eigen values and eigenvectors.
- The basic ideas of statistics including measures of central tendency, curve fitting, correlation and regression.
- Provides comprehensive introduction to probabilistic graphical methods.
- Various methods to find the roots o an equation and concept of finite differences and to estimate the value for the given data using interpolation.

Course Outcomes

- After learning the contents of this paper, the student must be able to
- Write the matrix representation and find the eigenvalues and eigenvectors.
- Apply statistical methods for analyzing experimental data.
- Learn the structure of the graphical model from data.
- Find the root of a given equation and estimate the value for the given data using interpolation.

Unit-I
Linear Algebra

Introduction to Matrices- Various kinds- Rank of matrix using elementary transforms-Matrix Decomposition, Vector Spaces, Rank and Nullity Theorem, Eigen Values and Eigen vectors sparse matrices.

Unit-II
Applied Statistics

Curve fitting by Least Squares- Fitting of Straight lines, Second degree parabolas and more general curves. Correlation and Regression –Rank correlation.

Unit-III
Methods for Convex Optimization

Unconstrained optimization, Linear Optimization Convex quadratic optimization, second order cone optimization, Semi-definite optimization, convex composite optimization.

Unit-IV
Gradient descent methods

Newton's method, interior point methods, active set, Proximity methods, accelerated gradient methods, coordinate descent, cutting planes, stochastic gradient descent. Dimensionality reduction: Discriminant analysis, Principal component analysis, Factor analysis, k means.

Unit -V
Approximation Methods

Solutions of Transcendental equation, Regula-Falsi Method, Newton-Raphson method, Secant method, Interpolation with symmetric and un symmetric differences, Gauss forward, Gauss Backward, Stirling's and Everett's, Newton's general interpolation and Lagrange's interpolation and inverse Lagrange's interpolation.

Suggested Readings:

1. Introduction to Applied Linear Algebra- Vector matrices and least squares, by Stephen Boyd and Lieven Vandenberg he, Cambridge U press (2018)
2. Engineering Mathematics by S. S. Sastry, Prentice-Hall of India Pvt. Ltd, Volume 2, Fourth Edition, 2008.

Reference Books:

1. Machine learning: the Art and Science of Algorithms that make sense of Data, Flach Cambridge University press (2015).
2. Introduction to Linear Algebra, Gilbert Strang, 5th ed., Cengage Learning, 2015.
3. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, (2010).

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Professional Elective-III
CS211PE: Fundamentals of Data Science

Pre-requisites: Fundamentals of Programming, Knowledge about Machine Learning Techniques.

Course Objectives

- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
- Provide you with the knowledge and expertise to become a proficient data scientist.
- Produce Python code to statistically analyze a dataset.
- Critically evaluate data visualizations based on their design and use for communicating stories from data.

Course Outcomes

- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists.
- To design and implement efficient data collection, storage, retrieval and management techniques.

Unit - I

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit - II

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit - III

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central Tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT,Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit - IV

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Unit - V

Applications of Data Science, recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Suggested Reading:

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013.

Reference Books:

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014.
2. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt, 2015.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Professional Elective-III
CS212PE: Semantic Web

Pre-requisites: Web technology, Data Mining.

Course Objectives

- To understand knowledge representation for the semantic web
- To gain knowledge on ontology engineering
- To learn semantic web applications, services and technology
- To learn efficient data storage, retrieval and querying mechanisms on ontology
- To understand characteristics of distributed ontology and modularity

Course Outcomes

- Ability to understand semantic standards and formats for ontology based information sharing
- Ability to build an ontology infrastructure for information sharing.
- Ability to utilize meta data for building efficient semantic architecture systems
- Ability to integrate ontology with other information systems.
- Differentiate stand-alone and distributed ontology architectures

Unit - I

Semantic Integration and Ontology: Semantic Standards, Roles of XML and RDF, problem of heterogeneity, structural conflicts, semantic conflicts, handling information semantics, representing and comparing semantics, Ontology based information sharing, ontologies in information integration.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Ontology Based Information Sharing: A framework for information sharing, Ontology languages for semantic web, RDF schema, OWL Lite, OWL DL, OWL Full, simple relations between ontologies, languages for expressing ontology mappings, ontological engineering, building an ontology infrastructure for information sharing.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required

Unit - III

Meta Data and Ontology Creation: Role of meta data, use of meta data, problems with meta data management, generating ontology based meta data, using ontology based metadata, BUISY web based environmental information system, web master workbench, applying web master to the BUISY system.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required

Unit - IV

Ontology integration, querying and retrieval: Semantic integration, concept based filtering, processing complex queries, statistical metadata, basic ontology of statistics, modeling statistics, translation to semantic web languages, spatial representation and reasoning, ontologies and spatial relevance.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required

Unit - V

Distributed Ontology, Evolution Management: Distributed Ontologies, Modular ontologies, reasoning in modular ontologies, change detection and classification, characterizing changes, update management

Case studies: Onto Broker, BUSTER system, Wonder Web.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J. Davies, R. Studer, P. Warren, John Wiley & Sons.
2. Programming the Semantic Web, T. Segaran, C. Evans, J. Taylor, O'Reilly, SPD.

Reference Books:

1. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group)
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2016.
3. Thinking on the Web – Berners Lee, Godel and Turing, Wiley inter science, 2014.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Professional Elective-III
CS213PE: Robotics in Artificial Intelligence

Pre-requisites: Engineering Mathematics, Basic Computer Programming.

Course Objectives

- To introduce selected topics in AI with a focus on Robotics.
- To allow the students apply these ai techniques to the problems relevant to robotics such as planning localization & mapping and motion planning.
- To serve as an introductory robotics course for the design of control of complex robotics systems.
- To design robotics system and for developments of robots by first providing the students with require fundamentals.
- To enable the student to understand and work with robot hardware and software.

Course Outcomes

- On successful completion of the course, the student will
- Describe human intelligence and robotics applications in AI
- Explain how robotic system works.
- Develop some familiarity with current research problems and research methods in robotics and AI.
- Demonstrate and Illustrate about functionalities of Robots and Robotics.

Unit - I

Introduction to robots – Types of robots – Technology and basic principles of robots – Sensors in robots: types & measurements – Mathematical representation of robots – Robot kinematics: forward and inverse.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Introduction to mobile robots: wheeled robots, legged robots and drones – Environment perception – Path planning – Probabilistic based localization and mapping.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

Introduction to robotic vision – Object detection – Pose estimation – Introduction to Robot Operating System.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Applications: Autonomous robots, Mobile Robot Simulation systems, Mechanisms for negotiating with staircases and unstructured environments, Applications of robotics in Healthcare, defense and manufacturing industries.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. P. Corke," Robotics, Vision & Control", 2nd edition, Springer, 2011.
2. M.W. Spong, S. Hutchinson and M. Vidyasagar, "Robot Modeling and Control", Wiley, 2006.

Reference Books:

1. Ghosal, "Robotics: Fundamental Concepts & Analysis", Oxford University Press, Ninth Edition, 2006.
2. T. Bajd, M. Mihelj and M. Munih," Introduction to Robotics", Springer Briefs in Applied Sciences and Technology, 2013.
3. Robin Murphy, "Introduction to AI Robotics", MIT Press, 2000.
4. Roland Siegwart and IllahNourbakhsh, "Introduction to Autonomous Mobile Robots" MIT Press, 2004.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Professional Elective-IV
CS214PE: Genetic Algorithms and Fuzzy Logic

Pre-requisites: Fundamentals of Programming, basics of Algorithms, Knowledge of set theory and Engineering Mathematics.

Course Objectives

- To understand the search methods in the genetic algorithms
- To implement the reproduction concepts.
- To understand applications of genetic algorithms.
- To gain knowledge on fuzzy logic concepts.
- To learn fuzzy systems and rule based fuzzy system.

Course Outcomes

- Ability to understand and apply the fundamental concepts of Genetic algorithms
- Ability to analyze GA operators and implement them to solve different types of GA problems
- Creating and understanding about the way the GA is used and the domain of application.
- Ability to distinguish between crisp set and fuzzy set.
- Differentiate fuzzy systems and understand fuzzy logic applications.

Unit - I

Introduction to Genetic Algorithm Robustness of Traditional Optimization and Search methods – Goals of optimization-GA versus Traditional methods – Simple GA – GA at work – Similarity templates (Schemata) – Learning the lingo - Mathematical foundations: The fundamental theorem - Schema processing at work. – The 2-armed & k-armed Bandit problem. – The building Block Hypothesis. – Minimal deceptive problem.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

GA Operators - Data structures – Reproduction- Roulette-wheel Selection – Boltzman Selection – Tournament Selection-Rank Selection – Steady –state selection –Crossover mutation – A time to reproduce, a time to cross. – Get with the Main program. – How well does it work. – Mapping objective functions to fitness forum. – Fitness scaling. Coding – A Multi parameter, Mapped, Fixed – point coding – Discretization – constraints.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

Applications of GA - The rise of GA – GA application of Historical Interaction. – Dejung& Function optimization – Current applications of GA -Advanced operators & techniques in genetic search: Dominance, Diploidy& abeyance – Inversion & other reordering operators. – Other micro-operators – Niche & Speciation – Multi objective optimization – Knowledge-Based Techniques. – GA & parallel processes – Real life problem.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

Fuzzy Logic – Fuzzy Set Theory: Fuzzy Vs Crisp set, Crisp set: Operations on Crisp Set, Properties of Crisp set, and Fuzzy Set: Membership Function, Basic fuzzy set operations, Properties of fuzzy set, Crisp Relations, Fuzzy Relations.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Fuzzy Systems: Crisp logic, Predicate logic, Fuzzy logic, Fuzzy rule based system.
Fuzzy Logic Applications: Greg Viot's Fuzzy Cruise Controller, Air Conditioner Controller, Fuzzy Logic applications in Neural Networks.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. David E. Gold Berg, "Genetic Algorithms in Search, Optimization & Machine Learning", Pearson Education, 2001.
2. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI , 2003.

Reference Books:

1. Kalyanmoy Deb, "Optimization for Engineering Design, algorithms and examples", PHI 1995
2. An Introduction to Genetic Algorithm by Melanie Mitchell.
3. The Simple Genetic Algorithm Foundation &Theores by Michael P. Vosk.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Professional Elective-IV
CS215PE: Speech Information Processing

Pre-requisites: Fundamentals of Mathematics, Basics in Artificial Intelligence.

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Course Objectives

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M (machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To Introduce Programming Raspberry Pi with Python.
- To introduce the hardware and working principles of various sensors used for IoT

Course Outcomes

On successful completion of the course, the student will

- Understand the concepts of Internet of Things.
- Design IoT applications in different domain and be able to analyze their performance.
- Able to know the Language features of Python.
- Able to know about working of Raspberry Pi
- Able to know the working of various Sensors.

Unit - I

Introduction to Internet of Things —Introduction, Definition and Characteristics of IoT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT communication models, IoT Communication APIs

IoT Enabling Technologies — Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Deployment Templates- IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Domain Specific IoT – Introduction, **Home Automation-** Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, **Smart Cities**- Smart Parking, Smart lighting, Smart roads, Structural Health Monitoring, Surveillance, Emergency Response, **Environment** - Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, **Energy**- Smart Grids, Renewable Energy Systems, Prognostics, **Retail-** Inventory Management, Smart Payments, Smart Vending Machines, **Logistics-** Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring, Remote Vehicle Diagnostics, **Agriculture-** Smart Irrigation, Green House Control, **Industry-** Machine Diagnosis & Prognosis, Indoor Air Quality Monitoring, **Health & Lifestyle-** Health & Fitness Monitoring, Wearable Electronics.

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT- Software Defined Networking, Network Function Virtualization

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

IoT Systems - Logical Design using Python- Introduction, Python Data Types & Data Structures-

Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, **Control Flow-** if, for, while, range, break/continue, pass

Functions, Modules, Packages, File Handling, Date/Time Operations, Classes, Python Packages of Interest for IoT- JSON,XML,HTTPLib,URLLib,SMTPLib.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

IoT Physical Devices and Endpoints - **What is an IoT Device-** Basic building blocks of an IoT Device, **Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces** - serial,SPI,I2C,

Programming Raspberry Pi with Python- Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Buzzer- Function of a Buzzer, Two Kinds of Buzzer, Relays- What is a Relay, Its Working, Relay Uses, Why Relay is used in Motor Control, Relay Module.

Sensors: What is an IoT Sensor, IoT Sensors Types- Pressure Sensors, Light Sensors, Temperature & Humidity Sensors, Working with Camera Module.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Internet of Things -A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
2. A Hands-On Course in Sensors Using the Arduino and Raspberry Pi (Series in Sensors) 1st Edition, Kindle Edition by Volker Ziemann.

Reference Books:

1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.
2. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016.
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Professional Elective-IV
CS216PE: Cloud Security

Pre-requisites: Computer Networks, Cryptography and Network Security, Cloud Computing.

Course Objectives

- To understand the fundamentals concepts of cloud computing.
- To understand the cloud security and privacy issues.
- To understand the Threat Model and Cloud Attacks
- To understand the Data Security and Storage
- To analyze the Security Management in the Cloud.

Course Outcomes

- Ability to acquire the knowledge on fundamentals concepts of cloud computing.
- Able to distinguish the various cloud security and privacy issues.
- Able to analyze the various threats and Attack tools
- Able to understand the Data Security and Storage
- Able to analyze the Security Management in the Cloud.

Unit - I

Overview of Cloud Computing: Introduction, Definitions and Characteristics, Cloud Service Models, Cloud Deployment Models, Cloud Service Platforms, Challenges Ahead.

Introduction to Cloud Security: Introduction, Cloud Security Concepts, CSA Cloud Reference Model, NIST Cloud Reference Model, NIST Cloud Reference Model.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - II

Cloud Security and Privacy Issues: Introduction, Cloud Security Goals/Concepts, Cloud Security Issues, Security Requirements for Privacy, Privacy Issues in Cloud.

Infrastructure Security: The Network Level, the Host Level,the Application Level, SaaS Application Security, PaaS Application Security, IaaS Application Security.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - III

Threat Model and Cloud Attacks: Introduction, Threat Model- Type of attack entities, Attack surfaces with attack scenarios, A Taxonomy of Attacks, Attack Tools-Network-level attack tools, VM-level attack tools, VMM attack tools, Security Tools, VMM security tools.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - IV

Information Security Basic Concepts, an Example of a Security Attack, Cloud Software Security Requirements, Rising Security Threats. **Data Security and Storage:** Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit - V

Evolution of Security Considerations, Security Concerns of Cloud Operating Models, Identity Authentication, Secure Transmissions, Secure Storage and Computation, Security Using Encryption Keys, Challenges of Using Standard Security Algorithms, Variations and Special Cases for Security Issues with Cloud Computing, Side Channel Security Attacks in the Cloud

Security Management in the Cloud- Security Management Standards, Availability Management, Access Control, Security Vulnerability, Patch, and Configuration Management.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Cloud Security Attacks, Techniques, Tools, and Challenges by Preeti Mishra, Emmanuel S Pilli, Jaipur R C Joshi Graphic Era, 1st Edition published 2022 by CRC press.
2. Cloud Computing with Security Concepts and Practices Second Edition by Naresh Kumar Sehgal Pramod Chandra, P. Bhatt John M. Acken,2nd Edition Springer nature Switzerland AG 2020.
3. Cloud Security and Privacy by Tim Mather, Subra Kumaraswamy, and Shahed Lati First Edition, September 2019.

Reference Books:

1. Essentials of Cloud Computing by K.Chandrasekaran Special Indian Edition CRC press.
2. Cloud Computing Principles and Paradigms by Rajkumar Buyya, John Wiley.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Audit Course – II
AC201HS: Disaster Management

Course Objectives

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in
- Provide knowledge about different disasters tools to handle disasters, methods for disaster management.

Course Outcomes

- Understanding disasters, manmade hazards & vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building
- Understanding concepts
- Understanding planning of disaster management

Unit-I: Introduction & Disaster Prone Areas in India

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. Study of Seismic Zones; Areas prone to Floods and Droughts, Landslides and Avalanches; Areas prone to Cyclonic and Coastal Hazards with special reference to Tsunami; Post-Disaster Diseases and Epidemics

Unit-II: Repercussions of Disasters and Hazards

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Unit-III: Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community preparedness.

Unit-IV: Risk Assessment

Disaster Risk- Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment: Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Unit-V: Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Readings:

1. Nishith R., Singh A K, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep et. al.," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Manual on Disaster Management, National Disaster Management, Agency Govt of India.

Reference Books:

1. Goel S.L., Disaster Administration and Management Text and Case Studies", Deep Publication Pvt. Ltd., New Delhi.
2. Pandharinath N., Rajan CK, Earth and Atmospheric Disasters Management BS Publications 2009.
3. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf).

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Audit Course – II
AC202HS: Value Education

Course Objectives

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

Course Outcomes

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

Unit-I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

Unit-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Unit-III

Personality and Behavior Development -Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

Unit-IV

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Unit-V

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Suggested Readings:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Audit Course – II
AC203HS: Pedagogy Studies

Course Objectives

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Unit-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

Unit-II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Unit-III

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Unit-IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Unit-V

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Suggested Readings:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
4. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

Reference Books:

1. Akyeampong K (2003) Teacher training in Ghana -does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Akyeampong K, Lussier K, Pryor J, WestbrookJ (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
3. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
Audit Course-II
AC204HS: Personality Development through Life Enlightenment Skills

Course Objectives

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

Unit-I
Neetisatakam-Holistic development of personality
- Verses-19, 20, 21, 22 (wisdom)
- Verses-29, 31, 32 (pride & heroism)
- Verses-26, 28, 63, 65 (virtue)

Unit-II
Neetisatakam-Holistic development of personality
- Verses-52, 53, 59 (dont's)
- Verses-71, 73,75,78 (do's)

Unit-III
Approach to day to day work and duties.
- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit-IV
Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16, 17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

Unit-V
- Chapter2-Verses 17, Chapter 3-Verses 36, 37, 42,
- Chapter 4-Verses 18, 38, 39
- Chapter18 –Verses 37, 38, 63

Suggested Readings:
1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
CS251PC: Deep Learning Lab

Pre-requisites: Knowledge in Python Programming.

Course Objectives

- To provide exposure of working on Deep learning.
- To design and implement solutions for real life problems.

Course Outcomes

- Simulate/implement given problem scenario and analyze its performance.
- Design solutions for real life problems.

List of Programs

1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
2. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
3. Write a program to construct a skip gram model using NLP
4. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library classes/API.
5. Write a program to implement Continuous Bag of Words Model using KNN Algorithm (using Python).
6. Build a model that takes an image as input and determines whether the image contains a picture of a dog or a cat.
7. Use CIFAR-10 dataset and build an image classification model that will be able to identify what class the input image belongs to.
8. Implement a Human Face Recognition Model and determine the accuracy in detecting the bounding boxes of the human face.

Suggested Readings:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models by D. Koller, and N. Friedman, MIT Press.

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M.Tech. in Artificial Intelligence
II Semester Syllabus
CS252PE: Fundamentals of Data Science Lab using Python

Pre-requisites: Machine Learning.

Course Objectives

- To provide exposure of working on python math library functions tools
- To solve data science problems by applying machine learning and statistics concepts.

Course Outcomes

- Design solutions for real world data analysis tasks
- Develop python code for various data analysis and machine learning tasks

List of Programs:

1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib, Scikit
2. Perform Data exploration and preprocessing in Python
3. Implement regularized Linear regression
4. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data
5. Implement Naive Bayes classifier for dataset stored as CSV file
6. Implement regularized logistic regression
7. Build models using different Ensembling techniques
8. Build models using Decision trees
9. Implement K-NN algorithm to classify a dataset.
10. Build model to perform Clustering using K-means after applying PCA and determining the value of K using Elbow method.

Suggested Readings:

1. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

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M.Tech.in Artificial Intelligence
II Semester Syllabus
MA252BS: Finishing School-II
(Common to all Branches)

Course Objectives

This is a foundation course and aims to enhance employability skills in students.

- Students will be introduced to higher order thinking skills and problem-solving on the following areas - Arithmetic ability, Numerical ability and General reasoning.
- Students will be trained to work systematically with speed and accuracy while solving problems.

Course Outcomes

- At the end of the course students will be to:
- Solve questions on the above-mentioned areas using shortcut and smart methods
- Understand the fundamental concepts of Aptitude skills
- Perform calculations with speed and accuracy.

Unit-I: Quantitative Aptitude - Numerical Ability

- Number systems
- LCM & HCF
- Speed Math
- Divisibility Rules
- Square root
- Cube root
- Problems on numbers with shortcuts

Unit -II: Quantitative Aptitude- Arithmetic Ability-I

- Percentage
- Profit loss and discounts
- Simple and Compound interest
- Ratio proportions
- Averages

Unit-III: Quantitative Aptitude- Arithmetic Ability-II

- Pipes and Cisterns
- Ages
- Time-Speed-Distance
- Clocks & Calendars
- Venn diagrams
- Tables and graphs

Unit-IV: Reasoning Ability – General Reasoning-I

- Coding decoding
- Directions
- Series completions - Letter, Number & Element Series
- Seating arrangements
- Odd one out

- Spatial ability questions

Unit-V: Reasoning Ability- General Reasoning -II

- Analogies
- Alphabet Analogy
- Numerical Analogy
- Classification
- Alphabet Classification
- Word Classification
- Miscellaneous Classification
- Alphabet test
- Arranging words in Alphabetical Order
- Problems based on Letter-Word
- Problems based on Alphabetical Quibble
- Blood Relations
- Statements and conclusions
- Direction Sense test

Reference Books:

1. R.S. Aggarwal - Quantitative Aptitude for Competitive Examinations.
2. Arun Sharma - Quantitative Aptitude for CAT.
3. Arihant Publications - Fast Track Objective Arithmetic.
4. Sarvesh K.-Quantitative aptitude
5. A New Approach to Reasoning Verbal & Non-Verbal, Book by B.S. Sijwalii and Indu Sijwali
6. A Modern Approach to Logical Reasoning, Book by Agarwala Vikas and R.S. Aggarwal.

III Semester

S.No.	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P	CIE	SEE		
1	CE31XPE	Professional Elective-V	3	0	0	30	70	3	3
2		Open Elective	3	0	0	30	70	3	3
3	CE351PC	Dissertation –I / Industrial Project	0	0	20	50 + 50	--	-	10
Total Hours/Marks/Credits			**6**	**0**	**20**	**160**	**140**	**-**	**16**

IV Semester

S.No.	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P	CIE	SEE		
1	CE451PC	Dissertation -II	0	0	32	50+ 50	--	-	16
		VIVA VOCE				--	100	-	
Total Hours/Marks/Credits			**0**	**0**	**32**	**100**	**100**	**-**	**16**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

Professional Elective-V
CS311PE: Block chain and its Applications
CS312PE: Digital Forensics
CS313PE: Introduction to Industry 4.0 and Industrial Internet of Things
Note: Facility of taking up any of the above or its equivalent course offered through NPTEL Online Certification will be explored

Open Elective Courses offered by M.Tech. CSE (AI) to other Branches
CS321OE: Advanced Data Structures Using Python
CS322OE: Data Science Using R
CS323OE: Web Technologies

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M.Tech. in Artificial Intelligence
III Semester Syllabus
Professional Elective-V
CS311PE: Blockchain and its Applications

Pre-requisites: Cryptography and Security

Course Objectives

- To introduce block chain, fundamentals of cryptocurrency, and how cryptocurrency works.
- To understand block chain concepts, digital identity verification, and block chain environment.
- To understand different types of cryptocurrencies: Gridcoin, Folding coin, and Bitcoin
- To learn the concepts: currency, token, tokenizing, campuscoin, coindrop, and multiplicity.
- To understand technical and business challenges in block chain, scandals and Government regulations.

Course Outcomes

Upon the Successful Completion of the Course, the Students would be able to:

- Learn about research advances related to one of the most popular technological areas today.
- Understand block chain concepts and environment.
- Understand different kinds of cryptocurrencies.
- Learn the **conce**pts: token, tokenizing, campuscoin, coindrop and multiplicity.
- Understand challenges in block chain technologies

Unit-I
Introduction: Blockchain or distributed trust, Protocol, Currency, Cryptocurrency, How a Cryptocurrency works, Crowd funding.

Unit-II
Extensibility of Blockchain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Blockchain Environment.

Unit-III
Blockchain Science: Gridcoin, Folding coin, Blockchain Genomics, Bitcoin MOOCs.

Unit-IV
Currency, Token, Tokenizing, Campuscoin, Coindrop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency.

Unit-V
Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations.

Suggested Readings:
1. Melanie Swan, “Blockchain Blue print for Economy”, 2015.
2. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

Reference Books:
1. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.Alex Leverington, “Ethereum Programming” Packt Publishing, 2017.

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M.Tech. in Artificial Intelligence
III Semester Syllabus
Professional Elective-V
CS312PE: Digital Forensics

Pre-Requisites: UG level course in Computer Network Security

Course Objectives

- Understand benefits of Digital Forensics and the process of investigating computer crime.
- Know about the digital evidence and best evidence rule.
- Understand and appreciate the need for windows forensics
- Understand the OSI and TCP/IP Layers and basic protocols which are pertinent for forensics.
- Understand various attacks in wireless networks, web and email and correlate to the forensics.

Course Outcomes

After completion of course, students would be able to:

- Know about basics and evolution of digital forensics
- Identify various technical, administrative and legal issues of digital forensics.
- Understand basic technologies and tools used to carry out data capture from a
- Windows system during forensic investigation.
- Know and understand usage of various network tools used in forensics.
- Know and categorize email attacks and crimes

Unit-I

Introduction to Digital Forensic:
Definition of Computer Forensics, Cyber Crime, Evolution of Computer Forensics, Objectives of Computer Forensics, Roles of Forensics Investigator, Forensics Readiness, Steps for Forensics.
Computer Forensics Investigation Process: Digital Forensics Investigation Process, Digital Forensics Investigation Process-Assessment Phase, Acquire the Data, Analyze the Data, Report the Investigation.

Unit-II

Digital Evidence and First Responder Procedure: Digital Evidence, Digital Evidence Investigation Process, First Responders Toolkit, Issues Facing Computer Forensics, Types of Investigation, Techniques in digital Forensics.
Understanding Storage Media and File System: The Booting Process, LINUX Boot Process, Mac OS Boot Sequence, Windows 10 Booting Sequence, File System, Type of File Systems

Unit-III

Windows Forensics: Introduction to Windows Forensics, Windows Forensics Volatile Information,Windows Forensics Non- Volatile Information, Recovering deleted files and partitions, More about recovering lost files/Data, Windows Registry, Windows Event Log File, Windows password storage.
Application Password Cracking: Introduction to Password Cracking, Password cracking methods, Tools for passwords cracking

Unit-IV

Network Forensics: Introduction to Network Forensics, Network Components and their forensic importance, OSI internet Layers and their Forensic importance, Forensics information from networks , Log analysis ,
Forensic Tools Introduction: Wireshark and TCPDUMP, Packet Sniffing and Analysis using Wireshark.
Mobile Forensics: Introduction, Challenges, Evidences in Mobile device, Mobile forensic Process, Forensic Acquisition Tools.

Unit-V

Wireless Attacks: Introduction, Wireless Fidelty, Wireless security Attacks, Wireless Attacks Detection techniques, Wireless Intrusion Detection Systems,

Web Attacks: Introduction, Types of Web attacks, Web attack Forensics, Web attack Forensic Tools.

Email Attacks: Introduction, Types of email services, Email attack and crimes, Privacy in email, Email Forensics, Email Forensics Tools.

Suggested Readings:

1. Digital Forensics by Dr. Jeetendra Pande and Dr. Ajay Prasad Uttarakhand Open University, Haldwani ISBN: 978-93-84813-94-9

Reference Books:

1. Real Digital Forensics by Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Addison- Wesley Pearson Education
2. Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brian Jenkinson, Springer International edition.
3. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning

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M.Tech. in Artificial Intelligence
III Semester Syllabus
Professional Elective-V
CS313PE: Introduction to Industry 4.0 & Industrial Internet of Things

Pre-requisites: Basic knowledge of computer and internet

Course Objectives

- The objective of this subject is make students aware about this latest technology and its application.
- To identify future scope for better manufacturing system.

Course Outcomes

After completion of course, students would be able to:

- Describe Industrial Internet of Things and Cyber Physical manufacturing.
- Demonstrate Cyber Physical and Cyber Manufacturing systems.
- Describe Architectural design patterns for industrial Internet of Things.
- Analyze AI and data Analytics for Industrial Internet of Things.
- Evaluation of Workforce and Human Machine Interaction and Application of Industrial Internet of Things.

Unit-I

Introduction: Sensing & actuation, Communication Networking Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories Cyber Physical Systems and Next Generation Sensors

Unit–II

Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Business Model and Referece Architerture: IIoT-Business Models IIoT Reference Architecture

Unit–III

Industrial IoT- Layers: IIoT Sensing. IIoT Processing. IIoT Communication-Part. Layers: IIoT Communication. IIoT Networking. Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science R and Julia Programming, Data Management with Hadoop. Big Data Analytics and Software Defined Networks SDN in IIoT. Data Center.

Unit-IV

Industrial IoT: Networks, security and Fog Computing: Cloud Computing in IIoT- Security and Fog Computing - Fog Computing in IIoT, Security in IIoT, Application Domains: Factories and Assembly Line, Food Industry. Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control.

Unit-V

Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

Case study: Milk Processing and Packaging Industries, Manufacturing Industries, Virtual Reality Lab.

Suggested Readings:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

Reference Books:

1. The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publication.
2. Inside the Internet of Things (IoT), Deloitte University Press.
3. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series
4. Sabina Jeschke, Christian Brecher Houbing Song , Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems
5. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821- 140-7, Willy Publications Olivier Hersent, David Boswarthick, Omar Elloumi.

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M.Tech. in Artificial Intelligence
III Semester Syllabus
Open Elective
CS321OE: Advanced Data structures

Pre-requisites: Programming for Problem Solving

Course Objectives

- To explore basic linear data structures
- To understand different tree based search implementations and graph structures
- To understand different sorting algorithms

Course Outcomes

- Ability to select the data structures that efficiently model the information in a problem.
- Design programs using a variety of data structures, including hash tables, binary and balanced search trees
- Implement and know the application of algorithms for sorting.

Unit-I
Abstract Data Type, Model for an Abstract Data Type, ADT Implementations- Array Implementations, Linked List Implementations, Linear Lists, Stack ADT, Basic Stack Operations, Stack Applications, Queues, Queue Operations, Application, Stack Linked List, Queue Linked List Design

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-II
General Linear Lists, Basic Operations, Implementation, List ADT, Application, Complex Implementations- Circularly Linked Lists, Doubly Linked Lists

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-III
Introduction to Trees, Basic Tree Concepts, Terminology, User Representation, Binary Trees, Binary Trees, Binary Tree Traversals, Expression Trees, General Trees, Binary Search Trees, Basic Concepts, BST Operations, Binary Search Tree ADT, BST Applications, BST Applications

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-IV
AVL Search Trees, AVL Tree Basic Concepts, AVL Tree Implementations, AVL Tree Abstract Data Type, Application—Count Words, Heaps, Basic Concepts, Heap Implementation, Heap ADT, Heap Applications, M-way Search Trees, B-trees, B-tree Implementation, B-tree ADT, Simplified B-trees, B-tree Variations

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-V
Graphs, Basic Concepts, Operations, Graph Storage Structures, Graph Algorithms, Graph ADT, Sorting and Searching, Sorting, Sort Concepts, Exchange Sorts, External Sorts, Quick Sort Efficiency, Searching, List Searches, Search Implementations, Hashed List Searches, Basic Concepts, Hashing Methods, Collision Resolution

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Data Structures: A Pseudocode Approach with C, 2nd Edition, R. F. Gilberg and B.A. Forouzan, Cengage Learning.
2. Fundamentals of Data Structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson Freed, Universities Press.

Reference Books:

1. Data Structures using C – A. S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson Education.

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M.Tech. in Artificial Intelligence
III Semester Syllabus
Open Elective
CS322OE: Data Science Using R

Pre-requisites:

1. Acourseon "Database Management Systems".
2. Knowledge of probability and statistics.

Course Objectives

- To explore the fundamental concepts of data science.
- To explore the fundamental concepts of data preprocessing.
- To learn the principles and methods of statistical analysis
- Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
- To understand the various search methods and visualization techniques.

Course Outcomes

- Understand the impact of data Science for business decisions and strategy
- Carry out data analysis/statistical analysis
- To carry out standard data visualization and formal inference procedures
- Design Data Architecture
- Understand various Data Sources

Unit-I

Introduction: What is Data Science? Big Data and Data Science – Datafication – Current landscape of perspectives – Skill sets needed; Matrices – Matrices to represent relations between data, and necessary linear algebraic operations on matrices -Approximately representing matrices by decompositions (SVD and PCA); Statistics: Descriptive Statistics: distributions and probability – Statistical Inference: Populations and samples – Statistical modeling – probability distributions – fitting a model – Hypothesis Testing – Intro to R/ Python.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-II

Data preprocessing: Data cleaning – data integration – Data Reduction Data Transformation and Data Discretization. Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves-Exploratory Data Analysis – Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA – The Data Science Process.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-III

Basic Machine Learning Algorithms: Association Rule mining – Linear Regression- Logistic Regression Classifiers – k-Nearest Neighbors (k-NN), k-means -Decision tree – Naive Bayes- Ensemble Methods – Random Forest. Feature Generation and Feature Selection – Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-IV

Clustering: Choosing distance metrics – Different clustering approaches – hierarchical agglomerative clustering, k-means (Lloyd's algorithm), – DBSCAN – Relative merits of each method – clustering tendency and quality.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-V

Data Visualization: Basic principles, ideas and tools for data visualization.

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Cathy O'Neil and Rachel Schutt, " Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.
2. Jiawei Han, MichelineKamber and Jian Pei, " Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2011.
3. Mohammed J. Zaki and Wagner MieraJr, "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2014.

Reference Books:

1. Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, O'Reilly, 2016.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015.
3. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.

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M.Tech. in Artificial Intelligence
III Semester Syllabus
Open Elective
CS323OE: Web Technologies

Pre-requisites:
- A Course on "Computer Programming and Data Structures".
- A Course on "Java Programming".

Course Objectives
- To introduce Client-side scripting with JavaScript and AJAX.
- To introduce PHP language for server-side scripting
- To introduce XML and processing of XML Data with Java
- To introduce Server-side programming with Java Servlets and JSP

Course Outcomes
- Gain knowledge of client-side scripting, validation of forms and AJAX programming.
- Understand what is XML and how to parse and use XML Data with Java
- Understand server-side scripting with PHP language
- Gain knowledge of Server-side programming with Java Servlets and JSP

Unit-I

HTML Common tags - List, Tables, images, forms, Frames, Cascading Style sheets.
Client-side Scripting: Introduction to Javascript, Javascript language – declaring variables, scope of variables, Objects, Functions, event handlers (onclick, onsubmit etc.), HTML Document Object Model, Form validation, Introduction to AJAX.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-II

Introduction to PHP: Declaring variables, data types, arrays, strings, operators, expressions, control structures, functions, Reading data from web form controls like text boxes, radio buttons, lists etc., Handling File Uploads. Connecting to database (MySQL as reference), executing simple queries, handling results, Handling sessions and cookies
File Handling in PHP: File operations like opening, closing, reading, writing, appending, deleting etc. on text and binary files, listing directories.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-III

XML: Introduction to XML, Defining XML tags, their attributes and values, Document Type Definition, XML Schemes, XML-Document Object Model, XHTML Parsing XML Data – DOM and SAX Parsers in java.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-IV

Introduction to Servlets: Common Gateway Interface (CGI), Life cycle of a Servlet, deploying a servlet, The Servlet API, Reading Servlet parameters, Reading Initialization parameters, Handling Http Request & Responses, Using Cookies and Sessions, connecting to a database using JDBC.
Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Unit-V

Introduction to JSP: The Anatomy of a JSP Page, JSP Processing, Scripting Elements, Directive Elements, Action Elements Implicit objects, Using Beans in JSP Pages, Using Cookies and session for session tracking, connecting to database in JSP, Introduction to Content management System (CMS).

Note: Laboratory practice will be imparted with the help of relevant case studies as and when required.

Suggested Readings:

1. Web Technologies, Uttam K Roy, Oxford University Press
2. The Complete Reference PHP — Steven Holzner, Tata McGraw-Hill

Reference Books:

1. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dreamtech
2. Java Server Pages —Hans Bergsten, SPD O'Reilly,
3. Java Script, D. Flanagan
4. Beginning Web Programming-Jon Duckett WROX.