I. K. Gujral Punjab Technical University, Jalandhar

Study Scheme and Syllabus - 2020

of

Master of Technology (Artificial Intelligence)

- **Eligibility: B.E. / B. Tech. (CSE/ IT/ Software Engg./ Computer Engg./ Software Systems/ Information Security/ Cyber Security/ Computational Engg./ Machine learning) with atleast 50% (45% in case of candidate belonging to reserved category).**

SEMESTER - 1

Sem	Course Code	Course Name	L	T	P	Hrs	Internal	External	Total	Credits
1	**MTAI-101-20**	Mathematical Foundations of Computer Science	3	0	0	3	40	60	100	3
1	**MTAI-102-20**	Advanced Data Structures	3	0	0	3	40	60	100	3
1	**MTAI-PE***	Program Elective – 1	3	0	0	3	40	60	100	3
1	**MTAI-PE****	Program Elective – 2	3	0	0	3	40	60	100	3
1	**MTAI-111-20**	Advanced Data Structures LAB	0	0	4	4	60	40	100	2
1	**MTAI-112-20**	Electives Based LAB	0	0	4	4	60	40	100	2
1	**MTEC-RM1-20**	Research Methodology and IPR	2	0	0	2	40	60	100	2
1	**MTEC-AU1-20**	Audit Course 1	0	0	0	0	40	60	100	s/us
		Total	**14**	**0**	**8**	**22**	**360**	**440**	**800**	**18**

SEMESTER - 2

Sem	Course Code	Course Name	L	T	P	Hrs	Internal	External	Total	Credits
2	**MTAI-103-20**	Soft Computing	3	0	0	3	40	60	100	3
2	**MTAI-104-20**	Advanced Robotics	3	0	0	3	40	60	100	3
2	**MTAI-PE $**	Program Elective – 3	3	0	0	3	40	60	100	3
2	**MTAI-PE $$**	Program Elective – 4	3	0	0	3	40	60	100	3
2	**MTAI-113-20**	Advanced Robotics LAB	0	0	4	4	60	40	100	2
2	**MTAI-114-20**	Electives Based LAB	0	0	4	4	60	40	100	2
2	**MTAI-MP1-20**	Mini Project	0	0	4	4	60	40	100	2
2	**MTAI-AU2-20**	Audit Course 2	0	0	0	0	40	60	100	s/us
		Total	**12**	**0**	**12**	**24**	**380**	**420**	**800**	**18**

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SEMESTER-3

Sem	Course Code	Course Name	L	T	P	Hrs	Internal	External	Total	Credits
3	**MTAI-PE#**	Program Elective-V	3	0	0	3	40	60	100	3
3	**MTAI-OE*-20**	Open Elective	3	0	0	3	40	60	100	3
3	**MTAI-DS1-20**	Dissertation Phase-I	0	0	20	20	60	40	100	10
		Total	**6**	**0**	**20**	**26**	**140**	**160**	**300**	**16**

SEMESTER-4

Sem	Course Code	Course Name	L	T	P	Hrs	Internal	External	Total	Credits
4	**MTAI-DS2-20**	Dissertation Phase-II	**6**	**0**	**20**	**20**	**60**	**40**	**100**	**16**
		Total				**68**	**960**	**1060**	**2000**	**68**

PROGRAMME ELECTIVE COURSES

Programme Elective-I	**MTAI-PE ***	**MTAI-PE1-20** Data Preparation and Analysis	**MTAI-PE2-20** Data Warehousing & Mining	**MTAI-PE3-20** Data Visualization
Programme Elective-II	**MTAI-PE****	**MTAI-PE4-20** Advanced Machine Learning	**MTAI-PE5-20** Data Science	**MTAI-PE6-20** Data Security and Access Control
Programme Elective-III	**MTAI-PE $**	**MTAI-PE7-20** Advanced Computer Vision	**MTAI-PE8-20** Pattern Recognition	**MTAI-PE9-20** Human Computer Interaction
Programme Elective-IV	**MTAI-PE $$**	**MTAI-PE10-20** Advanced Deep Learning	**MTAI-PE11-20** Natural Language Processing	**MTAI-PE12-20** GPU Computing
Programme Elective-V	**MTAI-PE#**	**MTAI-PE13-20** Big Data Analytics	**MTAI-PE14-20** Distributed Systems	**MTAI-PE15-20** Blockchain Technology

OPEN ELECTIVES:

MTAI-OE1-18 Cost Management of Engineering Projects
MTAI-OE2-18 Business Analytics
MTAI-OE3-18 Industrial Safety
MTAI-OE4-18 Operations Research
MTAI-OE5-18 Composite Materials
MTAI-OE6-18 Waste to Energy

AUDIT COURSES I & II

MTA101-18 English for Research Paper Writing
MTA102-18 Disaster Management
MTA103-18 Sanskrit for Technical Knowledge
MTA104-18 Value Education
MTA105-18 Constitution of India
MTA106-18 Pedagogy Studies
MTA107-18 Stress Management by Yoga
MTA108-18 Personality Development through Life Enlightenment Skills
MTA108-18 Personality Development through Life Enlightenment Skills

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M. Tech (Artificial Intelligence)

FIRST SEMESTER

Course Code	**MTAI-101-20**
Course Name	**Mathematical Foundations of Computer Science**
Credits	**3**
Pre Requisites	**Discrete Mathematics**

COURSE OBJECTIVE

- To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis to many modern techniques in in for technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

COURSE OUTCOMES

- After completion of course, students would be able to:
- To understand the basic notions of discrete and continuous probability.
- To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
- To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

Syllabus Contents:

Unit 1:

Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Unit 2:

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Unit 3:

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

Unit 4:

Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

Unit 5:

Computer science and engineering applications Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

Unit 6:

Recent Trands in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision.

Text books:

1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman , Pearson Education Asia.
2. Discrete Mathematical structures with application to Computer Science – J.P. Tremblay and R. Manohar.
3. Cryptography and Network Security, William Stallings.(Second Edition)Pearson Education Asia.

Reference books:

1. Introduction to languages and theory of computation – John C. Martin (MGH)
2. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole)
3. Cryptanalysis of number theoretic Cyphers, Samuel S. WagstaffJr.Champan& Hall/CRC Press 2003
4. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes –Ousley, Keith Strassberg Tata McGraw-Hill.

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Course Code	**MTAI-102-20**
Course Name	**Advanced Data Structures**
Credits	**3**
Pre Requisites	**UG level course in Data Structures**

COURSE OBJECTIVE

- 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:

- Analyze the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- Categorize the different problems in various classes according to their complexity.
- Students should have an insight of recent activities in the field of the advanced data structure.

Syllabus Contents:

Unit 1:
Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit 2:
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3:
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit 4:

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

Unit 5:
Linear Programming: Geometry of the feasibility region and Simplex algorithm. NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.

Unit 6:
Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Textbooks

1. Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2. Introduction to Algorithms by Cormen, Leiserson, Rivest, Stein.
3. The Design and Analysis of Computer Algorithms by Aho, Hopcroft, Ullman.
4. Algorithm Desig by Kleinberg and Tardos.

References

1. Design methods and analysis of Algorithms, SK Basu, PHI.
2. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, Universities Press.

Course Code	**MTEC-RM1-20**
Course Name	**Research Methodology and IPR**
Credits	**3**

COURSE OBJECTIVE

To enable student to acquire knowledge of research process: gather data, implement the proposed work and collect the results and publish them.

COURSE OUTCOMES

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

- Understand research problem formulation.
- Analyze research related information 0 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.

Syllabus Contents:

Unit 1:
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 2:
Effective literature studies approaches, analysis Plagiarism, Research ethics

Unit 3:
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 4:
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 5:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6:
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.

References:

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. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners".
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.

6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Code	**MTAI-PE1-20**
Course Name	**Data Preparation and Analysis**
Credits	**3**

COURSE OBJECTIVE

To prepare the data for analysis and develop meaningful Data Visualizations

COURSE OUTCOMES

After completion of course, students would be: Able to extract the data for performing the Analysis

Syllabus Contents:

Unit 1:

Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues

Unit 2:

Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Unit 3:

Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation

Unit 4:

Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

References:

1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

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Course Code	**MTAI-PE2-20**
Course Name	**Data Warehousing & Mining**
Credits	**3**

COURSE OBJECTIVE

The objective of this course is to introduce data warehousing and mining techniques. Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

COURSE OUTCOMES

After completion of course, students would be:

- Study of different sequential pattern algorithms.
- Study the technique to extract patterns from time series data and it application in real world.
- Can extend the Graph mining algorithms to Web mining
- Help in identifying the computing framework for Big Data

Syllabus Contents:

Unit 1:

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods

Unit 2:

Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns.

Unit 3:

Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

Unit 4:

Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;

Unit 5:

Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Unit 6:

Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

References:

1. Jiawei Han and M Kamber , Data Mining Concepts and Techniques, , Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

Course Code	**MTAI-PE3-20**
Course Name	**Data Visualization**
Credits	**3**

COURSE OBJECTIVE:

- Familiarize students with the basic and advanced techniques of information visualization and scientific visualization
- To learn key techniques of the visualization process
- A detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques

COURSE OUTCOMES:

On completion of the course the student should be able to

- Familiar with the design process to develop visualization methods and visualization systems, and methods for their evaluation.
- Preparation and processing of data, visual mapping and the visualization
- Have an understanding of large-scale abstract data.

Syllabus Contents:

Unit 1:

Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

Unit 2:

Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Unit 3:

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

Unit 4:

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

Unit 5:

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations.

Unit 6:

Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.

References:

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.

Course Code	**MTAI-PE4-20**
Course Name	**Advanced Machine Learning**
Credits	**3**

COURSE OBJECTIVE

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

COURSE OUTCOMES

After completion of course, students would be able to:

- Extract features that can be used for a particular machine learning approach in various IOT applications.
- To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
- To mathematically analyse various machine learning approaches and paradigms.

Syllabus Contents:

Unit 1:

Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models. Support Vector Machines, Nonlinearity and Kernel Methods. Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Unit 2:

Unsupervised Learning: Clustering: K-means/Kernel K-means. Dimensionality Reduction: PCA and kernel PCA. Matrix Factorization and Matrix Completion. Generative Models (mixture models and latent factor models)

Unit 3:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Unit 4:

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Unit 5:

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Unit 6:

Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

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Course Code	**MTAI-PE5-20**
Course Name	**Data Science**
Credits	**3**

COURSE OBJECTIVE

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

COURSE OUTCOMES

On completion of the course the student should be able to

- Explain how data is collected, managed and stored for data science;
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
- Implement data collection and management scripts using MongoDB

Syllabus Contents:

Unit 1:

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

Unit 2:

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 3:

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 4:

Data visualisation:Introduction, Types of data visualisation,Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Unit 5:

Applications of Data Science,Technologies for visualisation, Bokeh (Python)

Unit 6:

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk fromthe Frontline. O'Reilly.
2. Jure Leskovek, Annand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press

Course Code	**MTAI-PE6-20**
Course Name	**Data Security and Access Control**
Credits	**3**

COURSE OBJECTIVE

The objective of the course is to provide fundamentals of database security. Various access control techniques mechanisms were introduced along with application areas of access control techniques.

COURSE OUTCOMES

After completion of course, students would be:

- In this course, the students will be enabled to understand and implement classical models and algorithms
- They will learn how to analyse the data, identify the problems, and choose the relevant models and algorithms to apply.
- They will further be able to assess the strengths and weaknesses of various access control models and to analyse their behaviour.

Syllabus Contents:

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Unit1:

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.

Unit 2:

Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy.

Unit 3:

Biba'sintrigity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi line Insurance Company

Unit 4:

Smart Card based Information Security, Smart card operating systemfundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

Unit 5:

Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.

Unit 6:

Recent Trends related to data security management, vulnerabilities in different DBMS.

References:

1. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, RamaswamyChandramouli.
2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial.

Audit Courses:

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Course Code	**MTEC-AU1-18**
Course Name	**English for research paper writing**
Credits	**0**

COURSE OBJECTIVE

This course is to develop skills in effective English writing to communicate the research work

COURSE OUTCOMES

At the end of this course Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title
- Ensure the good quality of paper at very first-time submission

Syllabus Contents:

Unit 1
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Unit 5
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit 6
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

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

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Course Code	**MTEC-AU1-18**
Course Name	**Disaster Management**
Credits	**0**

COURSE OBJECTIVE

This course is to develop skills in helping society during natural disasters and how to manage.

COURSE OUTCOMES

At the end of this course **s**tudents will be able to:

- 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

Syllabus Contents:

Unit 1
Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit 2

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. 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 3
Disaster Prone Areas In India 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 4
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 5
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

And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit 6
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.

Recommended Books :

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep & Deep Publication Pvt. Ltd., New Delhi.

Course Code	**MTEC-AU1-18**
Course Name	**Sanskrit For Technical Knowledge**
Credits	**0**

COURSE OBJECTIVE

This course is to develop

- 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

At the end of this course students will be able to

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

Syllabus Contents:

Unit 1
Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.
Unit 2
Order, Introduction of roots, Technical information about Sanskrit Literature.

Unit 3
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Recommended Books :

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Code	**MTEC-AU1-18**
Course Name	**Value Education**
Credits	**0**

COURSE OBJECTIVE

This course is to develop

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

COURSE OUTCOMES

At the end of this course students will be able to

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

Syllabus Contents:

Unit 1

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 2

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 3

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, 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 4

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.

Recommended Books:

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

Laboratories

Course Code **MTAI-111-20**
Course Name **Advanced Data structures LAB**
Credits: 02 **Hours: 04**

Syllabus Contents:

Programs may be implemented using JAVA

Expt. 1:

WAP to store k keys into an array of size n at the location computed using a hash function, loc = key % n, where k<=n and k takes values from [1 to m], m>n. To handle the collisions use the following collision resolution techniques:

a. Linear probing
b. Quadratic probing
c. Double hashing/rehashing
d. Chaining

Expt. 2:

WAP for Binary Search Tree to implement following operations:

a. Insertion
b. Deletion
    i. Delete node with only child
    ii. Delete node with both children
c. Finding an element
d. Finding Min element
e. Finding Max element
f. Left child of the given node
g. Right child of the given node
h. Finding the number of nodes, leaves nodes, full nodes, ancestors, descendants.

Expt. 3:

WAP for AVL Tree to implement following operations: (For nodes as integers)

a. Insertion: Test program for all cases (LL, RR, RL, LR rotation)

b. Deletion: Test Program for all cases (R0, R1, R-1, L0, L1, L-1)

c. Display: using set notation.

Expt. 4:

WAP to implement Red-Black trees with insertion and deletion operation for the given input data as Integers/Strings

Expt. 5:

WAP to implement insertion, deletion, display and search operation in m-way B tree (i.e. a non-leaf node can have at most m children) for the given data as integers.

Expt. 6:

WAP that implements Kruskal"s algorithm to generate minimum cost spanning tree

Expt. 7:

WAP to perform string matching using Knuth-Morris-Pratt algorithm for pattern matching.

Expt. 8:

WAP to perform string matching using Boyer-Moore algorithm.

Expt. 9:

WAP to implement 2-D range search over computational geometry problem

Expt. 10:

WAP on latest efficient algorithms on trees for solving contemporary problems.

Mini Project:

Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Course Code	**MTAI-112-20**
Course Name	**Elective Based Lab**
Credits:02	**Hours: 04**

Elective - I

Data Preparation, Analysis and Data Visualization

Course Objectives:

- To introduce data structures in Python.
- To familiarize with different kinds of data and file formats.
- To gain knowledge on data preprocessing and data visualization.
- To acquaint with supervised and unsupervised learning algorithms.
- To explore various case studies.

Course Outcomes:

Upon completing this course, students will be able to:

- Identify appropriate data structures for storing and processing the data.
- Work with multiple kinds of data and various file formats.
- Preprocess raw data and visualize the data.

- Apply supervised and unsupervised algorithms.
- Provide solutions to real world problems using machine learning algorithmsDemonstrate the usage of Python data structures.

List of Experiments:

1. Demonstrate the usage of Python data structures
2. Explore various kinds of data like time series, text, etc.
3. Perform file handling operations in Python for various file formats.
4. Apply various preprocessing techniques on any two datasets.
5. Visualise data using packages matplotlib, seaborn, etc., and provide your inference.
6. Build Classifiers and perform prediction.
7. Demonstrate various Clustering Techniques.
8. Predict if a loan will get approved or not.
9. Predict the price of a house (Boston Housing Dataset).
10. Classify text documents according to their labels.

Datasets:
1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/ multilabel.html#siam-competition2007 3. https://archive.ics.uci.edu/ml/index.php

Data Warehousing & Mining

List of Experiments:

1. Build Data Warehouse and Explore WEKA
2. Data Mining Query Languages
3. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets and demonstrate performing classification on data set.
4. Classification by decision tree induction
    a. Bayesian Classification
    b. Classification by Back propagation
5. Demonstrate performing clustering on data sets
6. Demonstrate performing Regression on data sets
7. Demonstration of clustering rule process on dataset iris.arff using simple k-means
8. Partitioning Methods, Density-Based Method and Grid-Based Methods

The following operation has to be performed using any database tools:

- Granting Roles and Privileges.
- Implementation of various constraints.
- performance tuning
- Creation of Index.
- Storage Management
- Recovery

- Hands on Testing with Database Administration tools- DBA studio
- Locking techniques
- Database Replication Management
- Distributed catalog management, query processing and Updating distributed data
- Distributed transactions, concurrency control and recovery.

Elective - II

Advanced Machine learning

Programs may be implemented using PYTHON

Expt. 1:

Study of platform for Implementation of Assignments. Download the open source software of your interest. Document the distinct features and functionality of the software platform.

Expt. 2:

Supervised Learning – Regression Generate a proper 2-D data set of N points. Split the data set into Training Data set and Test Data set.

i) Perform linear regression analysis with Least Squares Method.
ii) Plot the graphs for Training MSE and Test MSE and comment on Curve Fitting and Generalization Error.
iii) Verify the Effect of Data Set Size and Bias-Variance Trade off.
iv) Apply Cross Validation and plot the graphs for errors.
v) Apply Subset Selection Method and plot the graphs for errors. Describe your findings in each case.

Expt. 3:

Supervised Learning – Classification Implement Naïve Bayes Classifier and K-Nearest Neighbour Classifier on Data set of your choice. Test and Compare for Accuracy and Precision.

Expt. 4:

Unsupervised Learning Implement K-Means Clustering and Hierarchical clustering on proper data set of your choice. Compare their Convergence.

Expt. 5:

Dimensionality Reduction Principal Component Analysis-Finding Principal Components, Variance and Standard Deviation calculations of principal components.

I. K. Gujral Punjab Technical University, Jalandhar

Expt. 6:

Supervised Learning and Kernel Methods Design, Implement SVM for classification with proper data set of your choice. Comment on Design and Implementation for Linearly non-separable Dataset.

Mini Project:

Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Data Science

Programs may be implemented using Matlab/Python/R

Expt. 1: Introduction to R

This Cycle introduces you to the use of the R statistical package within the Data Science and Big Data Analytics environment. After completing the tasks in this cycle you should able to:

a. Read data sets into R, save them, and examine the contents.

Tasks you will complete in this Cycle include:

a. Invoke the R environment and examine the R workspace.
b. Created table and datasets in R.
c. Examine, manipulate and save datasets.
d. Exit the R environment.

Expt. 2: Basic Statistics and Visualization This Cycle introduces you to the analysis of data using the R statistical package within the Data Science and Big Data Analytics environment. After completing the tasks in Tins Cycle you should able to:

a. Perform summary (descriptive) statistics on the datasets.
b. Create basic visualizations using R both to support investigation of the data as well as exploration of the data.
c. Create plot visualizations of the data using a graphics package.

Tasks you will complete in this Cycle include:

a. Reload datasets into the R statistical package.
b. Perform summary statistics on the data.
c. Remove outliers from the data.
d. Plot the data using R.
e. Plot the data using lattice and ggplot.

Expt. 3: K-means Clustering This Cycle is designed to investigate and practice K-means Clustering. After completing the tasks in This Cycle you should able to:

a. Use R functions to create K-means Clustering models.
b. Use ODBC connection to the database and execute SQL statements and load datasets from the database in an R environment.
c. Visualize the effectiveness of the K-means Clustering algorithm using graphic capabilities in R.

d. Use the ODBC connection in the R environment to create the average household income from the census database as test data for K-means Clustering.
e. Use R graphics functions to visualize the effectiveness of the K-means Clustering algorithm.

Expt. 4: Association Rules This Cycle is designed to investigate and practice Association Rules. After completing the tasks in This Cycle you should able to:

a. Use R functions for Association Rule based models.

Tasks you will complete in this Cycle include:

a. Use the R-Studio environment to code Association Rule models.
b. Apply constraints in the Market Basket Analysis methods such as minimum thresholds on support and confidence measures that can be used to select interesting rules from the set of all possible rules.
c. Use R graphics "arules" to execute and inspect the models and the effect of the various thresholds.

Expt. 5: Linear Regression

This Cycle is designed to investigate and practice linear regression. After completing tha tasks in This Cycle you should able to:

a. Use R functions for Linear Regression (Ordinary Least Squares - OLS).
b. Predict the dependent variables based on the model.
c. Investigate different statistical parameter tests that measure the effectiveness of the model.

Tasks you will complete in This Cycle include:

a. Use the R-Studio environment to code OLS models
b. Review the methodology to validate the model and predict the dependent variable for a set of given independent variables
c. Use R graphics functions to visualize the results generated with the mode.

Expt. 6: Naïve Bayesian Classifier This Cycle is designed to investigate and practice Navive Bayesian classifier. After completing the tasks in This Cycle you should able to:

a. Use R functions for Naïve Bayesian Classification
b. Apply the requirements for generating appropriate training data
c. Validate the effectiveness of the Naïve Bayesian Classifier with the big data

Tasks you will complete in Tins Cycle include:

a. Use R-Studio environment to code the Naïve Bayesian Classifier
b. Use the ODBC connection to the "census" database to create a training data set for Naïve Bayesian Classifier from the big data.
c. Use the Naive Bayesian Classifier program and evaluate how well it predicts the results using the training data and then compare the results with original data.

Expt. 7: Decision Trees This Cycle is designed to investigate and practice Decision Tree (DT) models covered in the course work. After completing the tasks in This Cycle you should able to:

a. Use R functions for Decision Tree models.
b. Predict the outcome of an attribute based on the model.

Tasks you will complete in This Cycle include:

a. Use the R-Studio environment to code Decision Tree Models.
b. Build a Decision Tree Model based on data whose schema is composed of attributes.
c. Predict the outcome of one attribute based on the model.

Mini Project: Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Data Security and Access Control

List of experiments will be decided by the instructor based on current research trends / ongoing projects.