NOTIFICATION

No. 174/2026 Dated : 03/10/2026

Subject : Implementation of syllabus of the subjects of Semester I to IV of the new Post-graduate Program Master of Technology (Artificial Intelligence & Data Science) [(M.T.ech. - A.I.D.S)] (Two Years Four Semesters Course) as per C.B.C.S. Pattern.

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new syllabus of the subjects of Semester I to IV of the new Post-graduate Program Master of Technology (Artificial Intelligence & Data Science([(M.T.ech. - A.I.& D.S)] (Two Years Four Semesters Course) as per C.B.C.S. Pattern to be implemented from the academic session 2026-2027 onwards as under:

Sd/-
(Dr.Avinash Asanare)
Registrar
Sant Gadge Baba Amravati University

Syllabus of Semester I to IV of **[(M.T.ech. - A.I. & D.S)] (C.B.C.S. Pattern)**

SEMESTER - I

1MTAIDS01 Program Core I- Machine Learning

Course Outcomes:

After completion of course, students would be able to:

1. Identify and Extract features that can be used for a particular machine learning approach in various IOT applications.
2. 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.
3. analyse mathematically various machine learning approaches and paradigms.

Unit I: Supervised Learning (Regression/Classification)

- Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Nave 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 10

Unit II: 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) 7

Unit III:

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests) 6

Unit IV:

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning 9

Unit V:

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. 9

Unit VI:

Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications. 5

Reference Books:

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.
4. Daniel Nedal, Python Machine Learning From Scratch, Step by Step Guide with Scikit-Learn and TensorFlow , AI Sciences Publisher
5. Alpaydin, E ,Introducation To Machine Learning, Prentice Hall,2015

6. Andriy Burkov The Hundred-Page Machine Learning Book, 2019
7. Python Machine Learning by Sebastian Raschka, Packt Publishing, 2015
8. Advanced Machine Learning with Python by John Hearty, Packt Publishing, 2016
9. Machine Learning - Algorithms, Models and Applications Edited by Jaydip Sen, IntechOpen, 2021
10. Mathematics for Machine Learning by M. P. Deisenroth, A. A. Faisal, C. S. Ong, Cambridge University Press, 2020.
11. Advanced Machine Intelligence and Signal Processing, Editors: Deepak Gupta, Koj Sambyo, Mukesh Prasad, Sonali Agarwal, Conference proceedings, Springer, 2022
12. Data Science and Machine Learning Mathematical and Statistical Methods by Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, Chapman Hall/CRC, 2019.

****

1 MTAIDS 2 PROGRAM CORE II- ADVANCED DATA STRUCTURES AND PRACTICES

Course Outcomes:

After completion of course, students would be able to:

1. Understand the implementation of symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
3. Develop algorithms for text processing applications.
4. Identify suitable data structures and develop algorithms for computational geometry problems.

Unit I:

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing**:** Review of Hashing, Hash Function, Collision Resolution Techniques in

Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing. 7

Unit II:

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists. 5

Unit III:

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees 9

Unit IV:

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem. 12

Unit V:

Computational Geometry**:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees. 10

Unit VI:

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem 5

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.
3. Peter Brass, Advanced Data Structures, Cambridge University Press, 2008
4. Mark Allen Weiss ,Data Structures and Algorithm Analysis in C++, , 4 th Edition, 2014, Pearson.
5. Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 3 rd Edition, 2009, The MIT Press.
6. Algorithms and Data Structures for Massive Datasets by Dzejla Medjedovic, Emin Tahirovic, and Ines Dedovic, ISBN 9781617298035, Manning, 2022 .

****

1 MTAIDS 3x Program Elective I-

1MTAIDS 31Pattern Recognition

Course Outcomes

After successful completion of course, the student would be able to-

1. Analyze the fundamental pattern recognition and machine learning theories
2. design and implement certain important pattern recognition techniques
3. apply the pattern recognition theories to applications of interest.

Unit I:

Introduction to Pattern Recognition, Classifier based on Bayes decision theory 7

Unit II:
Linear classifiers and nonlinear classifiers. 7

Unit III:
Feature selection, feature generation using data transformation and dimensionality reduction, regional features. 7

Unit IV:
Template matching, Context dependent classifiers. 7

Unit V:
Clustering algorithms: sequential algorithm and Hierarchical Algorithms, Clustering based on functional optimization and graph theory. 8

Unit VI:
Cluster algorithms based on graph theory, competitive learning algorithms, binary morphology cluster algorithm, boundary detection algorithm, kernel clustering methods, density based algorithm for large data sets, clustering algorithm on high dimensionality data sets, cluster validity. 12

Text Books :

1. Pattern Recognition by Sergios Theodoridis and Konstantinos Koutroumbas, Academic Press , 4e, Elsevier Publication 2009
2. Pattern Recognition and Machine Learning ,C.M. Bishop, Springer, 2006
3. Pattern Recognition an Introduction, V. Susheela Devi M. Narasimha Murthy, University Press, 2015
4. Pattern Recognition: an algorithmic approach by . M. Narasimha Murthy and V. Susheela Devi, Springer, University Press, 2011

Reference Books :

1. Pattern Recognition and Image Analysis, Earl Gose, Richard John Baugh, Steve Jost, PHI 2004.
2. C. M. Bishop, 'Neural Networks for Pattern Recognition', Oxford University Press, Indian Edition, 2003.
3. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2002.

****

1MTAIDS 32 DIGITAL IMAGE PROCESSING

Course Outcomes: After successful completion of course, the student would be able to

- Develop an overview of the field of image processing.
- Understand the Image segmentation, enhancement, compression etc., approaches and how to implement them.
- Gain experience in applying image processing algorithms to real problems
- Analyze general terminology of digital image processing.

Unit I: Introduction, 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**. 9**

Unit II: 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**. 8**

Unit III: Thresholding, Edge Based Segmentation: Edge Image Thresholding, Region Based Segmentation, Matching, Representation and Description: Representation , Boundary Descriptors, Regional Descriptors**. 8**

Unit IV: Fundamentals of Image Compression, image compression models, elements of information theory, error-free compression, lossy compression, Image Compression Standards **8**

Unit V: Preliminaries, dilation, erosion, open and closing, hit transformation, basic morphologic algorithms**. 8**

Unit VI: Color fundamentals, Color Models and basics of full-color image processing. 7

Text Books :

1. "Digital Image Processing", Rafael C. Gonzalez and Richard E. Woods, Fourth Edition, Pearson Education, 2018
2. Digital Image Processing", S. Sridhar, Oxford University Press, Second Edition, 2016

Reference Books :

1. "Fundamentals of Digital Image Processing" , S. Annadurai, Pearson Edun, 2001.
2. "Digital Image Processing and Analysis", B. Chanda and D. Dutta Majumdar, PHI, 2003.
3. "Image Processing" , Analysis and Machine Vision , Milan Sonka, Vaclav Hlavac and Roger Boyle, 2nd Edition, Thomson Learning, 2001.
4. "Digital Image Processing with MATLAB and LabVIEW" by Vipula Singh, Cengage Learning India Pvt Ltd. , 2019

****

1MTAIDS 33 DATA SCIENCE

Course Outcomes:

Upon successfully completing the course, the student would be able to-

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

Unit I: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications. 6

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 **7**

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**. 10**

Unit IV : Data visualisation: Introduction, Types of data visualisation, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings**. 11**

Unit V: Applications of Data Science, Technologies for visualisation, Bokeh (Python)**7**

Unit VI: Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science**. 7**

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2013
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets, Cambridge University Press, 2014
3. Data Science: Theories, Models, Algorithms, Analytics by S. R. Das, 2016
4. Foundations of Data Science by Avrim Blum, John Hopcroft, and Ravindran Kannan, Cornell, 2018
5. Statistics for Data Science by James D. Miller, , ISBN: 9781788290678, Packt Publishing 2017
6. Data Science from Scratch by Joel Grus, ISBN: 9781491901427, O'Reilly Media, Inc., 2015
7. The Kaggle Book Data analysis and machine learning for competitive data science by Konrad Banachewicz, Luca Massaron, Packt Publishing, 2022
8. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, Copyright © 2015 by John Wiley & Sons, Inc., Indianapolis, Indiana

****

1MTAIDS 34 DATA PREPARATION AND ANALYSIS

Course Outcomes ; After completion of the course, the student would be able to-

1. extract the data for performing the Analysis.

Unit I:
Data formats, parsing and transformation 5

Unit II:
Scalability and real-time issues, Consistency checking 7

Unit III:
Heterogeneous and missing data, Data Transformation and segmentation 8

Unit IV:
Descriptive and comparative statistics, Clustering and association, Hypothesis generation 9

Unit V:
Designing visualizations, Time series, Geolocated data. 9

Unit VI:
Correlations and connections, Hierarchies and networks, interactivity 10

Text BookS

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt, Wiley-Blackwell, 2006
2. Data Preparation for Data Mining by Dorian Pyle, Morgan Kaufmann Publishers, Inc, 1999.

****

1MTAIDS 4X PROGRAM ELECTIVE - II

1MTAIDS 41 ADVANCES IN ARTIFICIAL INTELLIGENCE

Course Outcomes:

After completion of course, students would be able to

1. Compare between optimal reasoning and human like reasoning
2. Analyze the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
3. Use different knowledge representation techniques
4. Appreciate the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

UNIT I: Introduction: What is AI? Foundations of AI, History of AI, Agents and environments, The nature of the Environment, Problem solving Agents, Problem Formulation, Search Strategies. **8**

UNIT II: Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining **8**

UNIT III: Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, why learning works, Learning in Neural and Belief networks **8**

UNIT IV: Practical Natural Language Processing: Practical applications, Efficient parsing, Scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception 8

UNIT V: Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis 8

UNIT VI: Robotics: Introduction, Tasks, parts, effectors, Sensors, Architectures, Configuration spaces, Navigation and motion planning, Introduction to AI based programming Tools. **8**

Text Book:

1. Stuart Russell, Peter Norvig: “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2022

References:

1. The Cambridge Handbook of Artificial Intelligence Edited by Keith Frankish William M. Ramsey, Cambridge University Press, 2014
2. Artificial Neural Networks B. Yagna Narayana, PHI, 2004.
3. Neural Networks and Learning Machines by Simon Haykin, Third Edition, Pearson, 2009
4. Artificial Intelligence , 3rd Edition, E. Rich, K. Knight and S. B. Nair, Tata McGraw Hill, 2009
5. Artificial Intelligence and Expert Systems – Patterson, PHI, 1990
6. Expert Systems: Principles and Programming- Fourth Edn, Giarratano, Joceph C. and G. D. Riley, Course Technology, 2004
7. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education, 2002
8. Nils J. Nilsson, “ THE QUEST FOR ARTIFICIAL INTELLIGENCE A HISTORY OF IDEAS AND ACHIEVEMENTS”, Cambridge University Press, 2010
9. Huimin Lu and Xing Xu(Ed.), “Artificial Intelligence and Robotics”, Springer, 2018.

****

1MTAIDS 42 NATURAL LANGUAGE PROCEESSING

Course Outcomes:

After completion of course, students would be able to-

1. explain and apply fundamental algorithms and techniques in the area of naturallanguage processing (NLP)
2. Analyze approaches to syntax and semantics in NLP.
3. Use current methods for statistical approaches to machine translation.
4. Develop language modeling.
5. Understand machine learning techniques used in NLP.

UNIT I:

Introduction to Natural language, The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax. 8

Unit II:

Grammars and Parsing- Top- Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks. 7

UNIT III:

Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers. 7

UNIT IV:

Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts & embedded sentences, Defining semantics structure model theory.

Language Modeling:

Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross lingual Language Modeling. 9

UNIT V:

Introduction to Machine Translation, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status.

Anusaaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem Structure of Anusaaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusaaraka Output, Language Bridges. 9

UNIT VI :

Multilingual Information Retrieval Introduction, Document Preprocessing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software and Resources, Multilingual Automatic Summarization, Introduction, Approaches to Summarization, Evaluation, How to Build a Summarizer, Competitions and Datasets. 8

TEXT BOOKS:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2. Multilingual Natural Language Processing Applications : From Theory To Practice-Daniel M. Bikel and Imed Zitouni , Pearson Publications.
3. Natural Language Processing, A paninian perspective, Akshar Bharathi, Vineet Chaitanya, Prentice –Hall of India.

REFERENCE BOOKS:

1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008.
3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

****

1MTAIDS 43 SPEECH PROCESSING AND APPLICATIONS

Course Outcomes:

After completion of course, student would be able to-

1. Analyze the mechanism of human speech production and perception.
2. Learn Each component of speech recognition systems.
3. Analyze probabilistic modeling in speech recognition. 4.Build a speech recognition system.

UNIT I: Introduction to Speech processing, Basic audio processing 8

UNIT II ;Human Voice, Human auditory system 7

UNIT III: Psycho acoustics, speech communications 7

UNIT IV: Audio analysis 7

UNIT V: Speech recognition 7

UNIT VI:

Speech synthesis, stereo encoding, formant strengthening and steering, voice and pitch changer, statistical voice conversion, whisper to speech conversion, whisperisation ,super audible speech. 12

Reference Books:

1. Speech and audio processing-A Matlab based approach, Ian Vince Mcloughlin, Cambridge university press,2016
2. Digital Speech Processing: Synthesis, and Recognition by Sadaoki Furui, 2e, CRC Press, 2018
3. Speech Synthesis and Recognition by Wendy Holmes, CRC Press, 2001
4. Audio Signal Processing and Coding by Andreas Spanias, Ted Painter and Venkatraman Atti, Wiley InterScience, 2007
5. Introduction to Digital Speech Processing Lawrence R. Rabiner and Ronald W. Schafer, now Publishers Inc., 2007
6. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, by Daniel Jurafsky and James H. Martin, Third Edition, 2021.
7. Speech and Audio Processing for Coding, Enhancement and Recognition by Tokunbo Ogunfunmi • Roberto Togneri Madihally (Sim) Narasimha (Ed.), Springer, 2015.

****

1MTAIDS 44 BIG DATA ANALYSIS

Course Outcomes:
After completion of course, students would be able to

1. Implement basic concepts of big data and Hadoop.
2. Analyze HDFS and Map Reduce and their working principle.
3. Create the design of HDFS with different design issues.

UNIT I:
Introduction to Big Data, Analysis flow for big data, mapping analysis flow to big Data Stack, 8

UNIT II:
Setting of Big Data stack, Big Data patterns 8

UNIT III:
Data Acquisition, Big Data storage 8

.

UNIT IV:
Batch analysis with Hadoop 8

Unit V:
Real time analysis, surveying data bases and web frames 8

Unit VI:
Analytics algorithm , data visualization frameworks and libraries 8

Text Books:

1. Big Data Science and analytics-A hands on approach , A. Bahga, Vijay Madisetti, 2019
2. Raj Kamal, Preeti Saxena , Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, , McGraw Hill, 2018.
3. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business intelligence and Analytic trends for Today's Business, John Wiley & Sons, 2013,

References:

1. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
2. Hadoop: The Definitive Guide, Tom White ,Third Edition, O' Reilley, 2012.
3. Hadoop Operations, Eric Sammer, O'Reilley, 2012.
4. Programming Hive, E. Capriolo, D. Wampler, and J. Rutherglen, O' Reilley, 2012.
5. HBase: The Definitive Guide, Lars George, O' Reilley, 2011.
6. Cassandra: The Definitive Guide, Eben Hewitt, O' Reilley, 2010.
7. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data Published by John Wiley & Sons, Inc. 10475 Crosspoint Boulevard Indianapolis, Copyright © 2015 by John Wiley & Sons, Inc., Indianapolis, Indiana.

****

1MTAIDS 5 RESEARCH METHODOLOGY AND IPR

Course Outcomes:
After completion of the course, the student would be able to-

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics
4. Develop innovative ideas, concept, and creativity.
5. Understand that IPR protection provides an incentive to inventors for further research workand 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 9

Unit II:
Effective literature studies approaches, analysis Plagiarism, Research ethics 7

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 7

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. 9

Unit V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
8

Unit VI
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. 8

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. Ranjit Kumar, 2 nd 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.

****

1MTAIDS6x AUDIT COURSE

1MTAIDS61 ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Course outcomes:
After completion of the course, the student would be able to

1. improve writing skills and level of readability
2. write effectively in each section
3. Understand the skills needed when writing a Title
4. Compose a good quality of paper for submission

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 Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:
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-V:
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. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

REFERENCES:

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.

****

1MTAIDS 62 DISASTER MANAGEMENT (Audit Course - I & II)

Prerequisite: None
Course Outcomes:
After completion of the course, the student would be able to:

1. demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

4. critically understand the strengths and weaknesses of disaster management approaches,
5. plan and programme in different countries, particularly their home country or the countries they work in

UNIT-I: Introduction:
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

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-II: 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-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 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.

REFERENCES:

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.

****

1MTAIDS 63

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Course Outcomes:
After completion of this course, students will be able to

1. Read and Write basic Sanskrit language
2. Read and Understand Ancient Sanskrit literature about science & technology
3. Appreciate Sanskrit as a logical language which 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

REFERENCES:

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.

******

1MTAIDS 64 VALUE EDUCATION (Audit Course - I & II)

Course outcomes:

After completion of the course, the student would be able to-

1. Inculcate Knowledge of self-development
2. Closely follow the Human values
3. Develop 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

Text Book/ Reference:

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

1MTAIDS 7 Laboratory 1 (Based on Machine Learning)

1MTAIDS 8 Laboratory 2 (Based on Program Elective I)

****

M.TECH. (AI AND DS) SEMESTER - II

2 MTAIDS 1 Programme Core III – Deep Learning

Course Outcomes:

After Completion of the Course, the Student would be able to:

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

UNIT - I:

Fundamentals of Deep learning 8

UNIT - II:

Mathematical building blocks of Neural network, Introduction to Keras, Tensor flow, setting of a deep learning workstation 8

UNIT - III:

Deep learning for computer vision 8

UNIT - IV:

Deep Learning for text and sequence 8

UNIT - V:

Generative deep learning 8

UNIT - VI:

Advanced deep learning based practices, limitations of deep learning, future of deep learning 8

Reference Books:

1. Deep learning with Python , Francois Chollet, Manning Publication Compony, 2018
2. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, The MIT Press, 2016
3. Dive into Deep Learning *Release 1.0.0-alpha0 by* Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, 2022

4. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, 2e, Springer, 2009
5. Probabilistic Graphical Models by D. Koller, and N. Friedman, MIT Press, 2016.

****

2 MTAIDS 2 PROGRAMME CORE IV – COMPUTER VISION

After completion of course, students would be able to:

1. Develop the practical skills necessary to build computer vision applications.
2. gain exposure to object and scene recognition and categorization from images.

Unit I: Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis. **8**

Unit II: Edge detection, Edge detection performance, Hough transform, corner detection **9**

Unit III: Segmentation, Morphological filtering, Fourier transform **9**

Unit IV: Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing. **9**

Unit V: Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi- supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA,ICA, and Non-parametric methods. 9

Unit VI: Recent trends in Activity Recognition, computational photography, Biometrics**.** **4**

Text Books:

1. Computer Vision: Algorithms and Applications 2nd Edition Richard Szeliski Final draft, September 30, 2021 © 2022 Springer
2. Dictionary of Computer Vision and Image Processing, by Fisher et al., Second Edition, Wiley, 2013.
3. COMPUTER VISION A MODERN APPROACH, Second edition, David A. Forsyth and Jean Ponce Ecole Normale Supérieure, Pearson, 2012
4. Computer Vision and Image Processing Fundamentals and Applications by Manas Kamal Bhuyan, CRC Press, Taylor & Francis, 2020

Reference Book:

1. Deep Learning, by Goodfellow, Bengio, and Courville, The MIT Press, 2016.

****

2 MTAIDS 3x Programme Elective III –

2MTAIDS 31 GENETIC ALGORITHMS AND APPLICATIONS

Course Outcomes:

After completion of the course, student will be able to-

1. understand and the fundamental concepts of Genetic algorithms
2. Analyze the consequences of applying various genetic operators
3. analyze GA operators and implement them to solve different types of GAproblems
4. Apply GA in different domains of applications

UNIT- I:

Introduction to Genetic Algorithm, Mathematical foundation 8

UNIT – II :

Implementation of Genetic Algorithms 8

UNIT – III:

Some applications of Genetic Algorithm s 8

UNIT – IV:

Advanced operators and techniques in Genetic search 8

UNIT –V:

Genetic based machine learning 8

UNIT VI:

Applications of Genetic based machine learning 8

.

TEXT BOOKS:

1. David E. Goldberg, "Genetic Algorithms in Search, Optimization & Machine Learning", Pearson Education, 2001
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, " Neural Networks, Fuzzy Logic and Genetic Algorithms ", PHI , 2003 (Chapters 8 and 9)
3. A.E. Eiben and J.E. Smith, " Introduction to Evolutionary Computing", Second Edition, Springer, 2015
4. S. N. Sivanandam and S. N. Deepa, "Introduction to Genetic Algorithms", Springer, 2007

REFERENCE BOOKS:

1. Kalyanmoy Deb, "Optimization for Engineering Design, algorithms and examples", PHI 1995
2. An Introduction to Genetic Algorithm by Melanie Mitchell, The MIT Press, 1998
3. The practical handbook of genetic algorithms, applications / edited by Lance D. Chambers.—2nd ed, Chapman and Hall/CRC, 2001.

****

2MTAIDS 32 TEXT PROCESSING

Course Outcomes:

After completion of course, student will be able to

1. Analyze various static methods of the Character wrapper class
2. Know the additional methods of the String class
3. differentiate between a String object and a String Buffer object
4. use a String Tokenizer object that extracts tokens from a string
5. perform the processing of delimited values read in from a text file

UNIT-I:

Introduction to text mining , core text mining operations. 7

UNIT-II:

Text mining preprocessing techniques, text categorization, 7

UNIT-III:

Text clustering: Clustering in text analysis, clustering algorithm, Information extraction, probabilistic models for information extraction. 8

UNIT-IV:

Preprocessing application using probabilistic and hybrid approach: Application of Hidden Markov Model (HMM) to text analysis, using MEMM for information extraction, application of conditional random fields(CRF) to text analysis, Implementation of trainable extraction grammar using SCFG rules for hybrid statistical knowledge based IE 10

UNIT-V:

Presentation layer considerations for browsing query refinement , visualization approach. 7

UNIT-VI:

Text mining application : General considerations, mining industry literature for business intelligence, A horizontal text mining application : patent analysis solution leveraging a commercial text analytics platform, mining biological pathway information with gene ways. 9

Text Books:

1. The text mining handbook – Advanced approaches in analysing unstructured data , R. Feldman, James Sanger, Cambridge University Press, 2007

References:

1. Bran Boguraev, Ted Briscoe (Eds), "Computational Lexicography for Natural Language Processing", Longman, 1989.
2. A V Aho, Ravi Sethi, J D Ullman, "Compilers: Principles, Techniques and Tools", Addison-Wesley.
3. Robert Sedgewick, "Algorithms in C", Addison Wesley, 1990.
4. Gerald Salton, "Automatic Text Processing", Addison-Wesley, 1989
5. Text Mining: Applications and Theory, Editor(s): Michael W. Berry, Jacob Kogan, John Wiley & Sons, Ltd, 2010
6. Text Mining From Ontology Learning to Automated Text Processing Applications, Editors: Chris Biemann, Alexander Mehler, Springer, 2014
7. Text Mining with R by Julia Silge, David Robinson, June 2017, Publisher(s): O'Reilly Media, Inc., ISBN: 9781491981658
8. Mining Text Data, Editors: Charu C. Aggarwal, Cheng Xiang Zhai, Springer, 2012

****

2MTAIDS 33 DATA VISUALIZATION

After completion of the course, the student will be able to-

1. develop visualization methods and visualization systems, and methods for their evaluation.
2. Analyze preparation and processing of data, visual mapping and the visualization
3. understand large-scale abstract data,

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

Unit II: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications. 8

Unit III:
Classification of visualization systems, Interaction and visualization techniques
misleading, Visualization of one, two and multi-dimensional data, text and text documents. 10

Unit IV:
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization 11

Unit V:
Visualization of volumetric data, vector fields, processes and simulations,
Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations 7

Unit VI:
Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization. 4

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.
3. Chun-houh Chen Wolfgang Härdle Antony Unwin (Editors), "Handbook of Data Visualization", Springer, 2008
4. Visualizing Data by Ben Fry, O'Reilly, 2008
5. Data Visualization Made Simple Insights into Becoming Visual by Kristen Sosulski, Taylor and Francis, Routledge, 2019
6. Data Visualization Principles and Practice by Alexandru Telea, Second Edition, CRC Press, 2007.

****

2MTAIDS 34 ADVANCED DATA MINING

After completion of the course, student will be able to:

1. develop the abilities of critical analysis to data mining systems and applications.
2. implement practical and theoretical understanding of the technologies for data mining
3. analyze the strengths and limitations of various data mining models.

UNIT-I:
Introduction about data mining, Need of data mining, Business data mining, data mining tools, Data Mining Process: CRISP Data Mining, Business Understanding, data understanding and data preparation, modeling, evaluation and deployment, SEMMAS Process, Data mining applications, comparison of CRISP & SEMMA. 7

UNIT-II:
Memory-Based Reasoning Methods, Matching, Weighted Matching, Distance Minimization Data Mining Methods As Tools X Contents, Association Rules in Knowledge Discovery, Market-Basket Analysis, Market Basket Analysis Benefits Demonstration on Small Set of Data, Real Market Basket Data The Counting Method Without Software. 8

UNIT-III:
Fuzzy Sets in Data Mining, Fuzzy Sets and Decision Trees, Fuzzy Sets and Ordinal Classification, Fuzzy Association Rules, Demonstration Model, Computational Results, Testing Inferences. 6

UNIT-IV:
Rough Sets :Theory of Rough Sets , Information System, Decision Table, Applications of Rough Sets, Rough Sets Software Tools, The Process of Conducting Rough Sets Analysis, Data Pre- Processing, Data Partitioning, Discretization, Reduct Generation, Rule Generation and Rule Filtering, Apply the Discretization Cuts to Test Dataset, Score the Test Dataset on Generated Rule set , Deploying the Rules in a Production System. 9

UNIT-V:
Support Vector Machines, Formal Explanation of SVM, Primal Form, Dual Form, Soft Margin, Non-linear Classification, Regression, implementation, Kernel Trick. Use of SVM–A Process-Based Approach, Support Vector Machines versus Artificial Neural Networks, Disadvantages of Support Vector Machines, Genetic Algorithm Support to Data Mining, Demonstration of Genetic Algorithm, Application of Genetic Algorithms in Data Mining. 9

UNIT-VI:

Performance Evaluation for Predictive Modeling, Performance Metrics for Predictive Modeling , Estimation Methodology for Classification Models, Simple Split, The *k*-Fold Cross Validation Bootstrapping and Jackknifing, Area Under the ROC Curve. Applications: Applications of Methods Memory-Based Application, Association Rule Application Fuzzy Data Mining, Rough Set Models, Support Vector Machine Application, Genetic Algorithm Applications-Product Quality Testing Design, Customer Targeting . 9

Text Books:

1. Advanced Data Mining Techniques Authors: David L. Olson (Author), Dursun Delen, Springer, 2008
2. Data Mining The Textbook by Charu C. Aggarwal, Springer, 2015
3. Data Mining Practical Machine Learning Tools and Techniques by Ian H. Witten Eibe Frank Mark A. Hall, Third Edition, Elsevier, 2011

References :

1. Advances in data mining and modeling by Wai-Ki Ching Michael Kwok-Po Ng, World Scientific, 2003
2. Techniques in Knowledge Discovery and Data Mining edited by Nikhil R. Pal, Lakshmi C Jain, Springer, 2005
3. Dynamic and Advanced Data Mining for Progressing Technological Development: Innovations and Systemic Approaches A B M Shawkat Ali (Central Queensland University, Australia) and Yang Xiang (Central Queensland University, Australia), Information Science, 2009.
4. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", Elsevier, 2012, Third Edition.
5. Statistical and Machine-Learning Data Mining Techniques for Better Predictive Modeling and Analysis of Big Data by Bruce Ratner, Third Edition, CRC Press, 2017.
6. Data Mining and Analysis by M. Zaki and Wagner M., Cambridge University Press, 2014.

****

2 MTAIDS 4X PROGRAMME ELECTIVE IV –
2MTAIDS 41 AUGMENTED REALITY AND VIRTUAL REALITY

Course Outcomes:

After Completion of the course, student will be able to:

1. Analyze the characteristics, fundamentals and architecture of AR /VR.
2. Understand the scope for AR/VR
3. Select Hardware for the AR / VR application development
4. Analyze the software development aspects for AR / VR
5. design and develop the interactive AR / VR applications
6. analyze and build AR/VR applications for chosen industry, healthcare, education case study

Prerequisites: Programming in Java Script, C Sharp

Unit I:
Introduction - VR and AR Fundamentals, Differences between AR/VR Selection of technology AR or VR AR/VR characteristics Hardware and Software for AR/VR introduction. Requirements for VR/AR. Benefits and Applications of AR/VR. AR and VR case study. 8

Unit II:
Hardware Technologies for AR / VR Visual Displays (VR cardboard, VR headsets, Mixed Real- ity headsets), Auditory Displays, Haptics and AR/VR, Choosing the Output devices for AR/VR applications, Hardware considerations and precautions with VR/AR headsets –
8

Unit III:

3D user interface input hardware - Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home-Brewed Input Devices, Choosing Input Devices for 3D Interfaces **8**

Unit IV:

Software technologies - Database - World Space, World Coordinate, World Environment, Objects -Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes 8

Unit V: VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cam- eras, Scripts, Interaction-Simple, Feedback, Graphical User Interface, 8

Unit VI:

Control Panel, 2DControls, Hardware Controls, Room/Stage/Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market (Unity and Vuforia based) - Case Studies in AR, VR – Industrial applications, medial AR/VR, education and AR/VR. 8

Text Books:

1. José María Ariso, "Augmented Reality Reflections on Its Contribution to Knowledge Formation", Walter de Gruyter GmbH, Berlin/Boston, 2017
2. Samuel Greengard, "Virtual Reality", The MIT Press, 2019
3. Steven M. LaValle, "VIRTUAL REALITY", Cambridge University Press, 2019.
4. Jason Jerald, "The VR Book Human-Centered Design for Virtual Reality", Association for Computing Machinery and Morgan & Claypool Publishers, 2016

Reference Books:

1. Alan B Craig, William R Sherman, Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann,2009
2. Gerard Jounghyun Kim, Designing Virtual Systems: The Structured Approach, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J La Viola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA,2005
4. OliverBimber,RameshRaskar,SpatialAugmentedReality:MegingRealandVirtualWorlds, 2005
5. Burdea, Grigore C, Philippe Coiffet, Virtual Reality Technology, Wiley InterScience, India,2003

6. John Vince, Virtual Reality Systems, Addison Wesley, 1995

7. Howard Rheingold, Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society, Simon and Schuster,1991

8. William R Sherman, Alan B Craig, Understanding Virtual Reality: Interface, Application and Design, Morgan Kaufmann Publishers, San Francisco, CA, 2002.

****

2MTAIDS 42 REAL TIME AUTONOMOUS SYSTEMS

Course Outcomes:

After completion of the course, student would be able to

1. Understand and use the methodologies to design, model and implementation of autonomous systems for real time applications.

Unit I:
Introduction to Agents, Agent Architectures: Subsumption Architecture, Situated Automata, Hybrid Architecture. 8

Unit II:
Real time System Implementation. 8

Unit III
Mobile agents – locomotion (wheeled, legged, aerial), sensors and mechanisms. 8

Unit IV:

Robot localization & SLAM 8

Unit V:
Planning and Navigation 8

Unit VI:
Case Study: Autonomous car – learning to drive; human centered autonomous vehicle. 8

Text Books:

1. Plamen Angelov, “Autonomous Learning Systems From Data Streams to Knowledge in Real-time”, John Wiley & Sons Ltd., 2013
2. Seigwart, R. and Nourbakhsh, I.R. *Introduction to Autonomous Mobile Robots*, 2nd edition, The MIT Press 2011
3. Stuart J. Russell and Peter Norwig, *Artificial Intelligence: A Modern Approach*, Fourth edition ,Pearson Press, 2021
4. Markus Maurer et al. eds. *Autonomous Driving*, Springer Link (open access), 2015
5. Gerhard Weiss ed., *Multiagent System*, Second Edition, MIT Press, 2013.

Reference Books:

1. Tzafestas, S. G. (Ed.). (2012). *Advances in intelligent autonomous systems* (Vol. 18).Springer Science & Business Media.
2. Ge, S. S. (2006). *Autonomous mobile robots: sensing, control, decision making and applications*. CRC press.
3. Mhamed Itmi, Alain Cardon(2016), New Autonomous Systems, Wiley-ISTE.
4. De Gyurky, S. M., & Tarbell, M. A. (2013). *The Autonomous System: A Foundational Synthesis of the Sciences of the Mind*. John Wiley & Sons.
5. John Holland, “Designing Autonomous Mobile Robots”, Elsevier, 2004
6. Giorgio C. Buttazzo, *Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications*,” Springer US, Year: 2011
7. Intelligent Autonomous Systems 15, Proceedings of the 15th International Conference IAS-15, Editors: Marcus Strand, Rüdiger Dillmann, Emanuele Menegatti, Stefano Ghidoni, Springer, 2019
8. Designing Autonomous AI by Kence Anderson, June 2022, O'Reilly Media, Inc., ISBN: 9781098110758.

****

2MTAIDS 43 INTERNET OF THINGS

Course Outcomes: After Completion of the Course, the Students would be able to:

1. Understand IoT value chain structure (device, data cloud), application areas and technologies involved.
2. Identify and use IoT sensors
3. Accept technological challenges faced by IoT devices, with a focus on wireless, energy, power, and sensing modules.
4. Implement IoT devices with a focus on sensors.
5. Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi.

UNIT - I:

Introduction to Internet of Things- Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry. 9

UNIT - II:

IoT and M2M- Software defined networks, network function virtualization, difference between SDNand NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER. 8

UNIT - III:

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python

program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. 8

UNIT - IV:

Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors 8

UNIT V:

Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor. 8

UNIT - VI:

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API. 7

Text Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895.

Reference Books:

1. Rethinking the Internet of Things by Francis DaCosta, APress Open,
2. Building Blocks for IoT Analytics Internet-of-Things Analytics, Editor John Soldatos, River Publishers, 2017
3. Internet of Things From Hype to Reality The Road to Digitization by Ammar Rayes and Samer Salam, Second Edition, Springer, 2019
4. Internet of Things Principles and Paradigms, Edited by Rajkumar Buyya Amir Vahid Dastjerdi, Elsevier, 2016
5. The Internet of Things By Samuel Greengard, The MIT Press, 2015
6. Demystifying Internet of Things Security Successful IoT Device/Edge and Platform Security Deployment by Sunil Cheruvu, Anil Kumar, Ned Smith, David M. Wheeler, Apress open, 2020.

****

2MTAIDS44 NEUROMORPHIC COGNITIVE SYSTEMS

Course Outcomes:

After successful completion of the course, students would be able to-

1. Design a Spike-Timing Based Integrated Model for Pattern Recognition
2. Classify Spatiotemporal Patterns
3. Perform Temporal Compression and Information Binding
4. Design Spiking Neuron Based Cognitive Memory Model

UNIT I: Introduction, Background, Spiking Neurons, Biological Background, Generations of Neuron Models, Spiking Neuron Models, Neural Codes, Rate Code, Temporal Code, Temporal Code Versus Rate Code, Cognitive Learning and Memory in the Brain, Temporal Learning, Cognitive Memory in the Brain. 6

UNIT II: Rapid Feedforward Computation by Temporal Encoding and Learning with Spiking Neurons: The Spiking Neural Network, Single-Spike Temporal Coding, Temporal Learning Rule, The Tempotron Rule, The ReSuMe Rule, The Tempotron-Like ReSuMe Rule, Simulation Results, The Data Set and the Classification Problem, Encoding Images, Choosing Among Temporal Learning Rules, Recognition Performance, Encoding Benefits from Biology, Extension of the Network for Robust Sound Recognition. 8

UNIT III: A Spike-Timing Based Integrated Model for Pattern Recognition: The Integrated Model, Neuron Model and General Structure, Latency-Phase Encoding, Supervised Spike-Timing Based Learning, .Numerical Simulations, Network Architecture and Encoding of Grayscale Images, Learning Performance, Generalization Capability, Parameters Evaluation, Capacity of the Integrated System. 8

UNIT IV: Precise-Spike-Driven Synaptic Plasticity for Hetero Association of Spatiotemporal Spike Patterns: Methods, Spiking Neuron Model, PSD Learning Rule, Association of Single-Spike and Multi-spike Patterns, Generality to Different Neuron Models, Robustness to Noise, Learning Capacity, Effects of Learning Parameters, Classification of Spatiotemporal Patterns. 8

UNIT V: A Hierarchically Organized Memory Model with Temporal Population Coding: The Hierarchical Organized Memory Model, Neuron Models and Neural Oscillations, Temporal Population Coding, The Tempotron Learning and STDP, Simulation Results, Auto-Associative Memory, Episodic Memory, Information Flow and Emergence of Neural Cliques, Storage, Recall and Organization of Memory, Temporal Compression and Information Binding. 8

UNIT VI: Spiking Neuron Based Cognitive Memory Model, SRM-Based CA3 Model, Spike Response Model, SRM-Based Pyramidal Cell, SRM-Based Interneuron, Convergence of Synaptic Weight, Maximum Synaptic Weight to Prevent Early Activation, Pattern Completion of Auto-Associative Memory. 7

Text Book : Neuromorphic Cognitive Systems A Learning and Memory Centered Approach, Qiang Yu, Huajin Tang, Jun Hu, Kay Chen Tan, Springer, 2017.

2MTAIDS 5x Audit Course

2MTAIDS 51 CONSTITUTION OF INDIA (Audit Course - I & II)

Course Outcomes: After completion of this course, students will be able to-

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Explain the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Describe the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I: History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), Philosophy of the Indian Constitution**:**
Preamble**,** Salient Features.

UNIT-II: Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties**.**

UNIT-III: Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions**.**

UNIT-IV: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy**.**

UNIT-V: Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

****

2MTAIDS52 PEDAGOGY STUDIES (Audit Course - I & II)

Course Outcomes:

After completion of this course, students will be able to-

1. use pedagogical practices in formal and informal classrooms
2. Identify and align pedagogical practices for professional development

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 in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school 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.

TEXT BOOKS/ REFERENCES:

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. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

****

2MTAIDS 53 STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Course Outcomes:
After completion of this course, students will be able to-

1. Develop healthy mind in a healthy body thus improving social health
2. Improve efficiency

UNIT-I:
Definitions of Eight parts of yog. (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, Ishwar pranidhan

UNIT-IV:
Asan and Pranayam

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

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Training-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur.
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

****

2MTAIDS 54 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (Audit Course - I & II)

Course Outcomes:
After completion of this course, students will be able to

1. Follow Shrimad-Bhagwad-Geeta in developing his personality and achieve the highest goal in life
2. Achieve peace and prosperity for all
3. develop versatile personality by Study of Neetishatakam

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

TEXT BOOKS/ REFERENCES:

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.

****

2 MTAIDS 6 - Laboratory 3 (Deep Learning with TensorFlow) DEEP LEARNING LAB

2 MTAIDS 7x - Laboratory 4 (Based on Program Elective - III)

2 MTAIDS 8 - Mini Project with Seminar

****

M.TECH. (AI AND DS) SEMESTER - III*

3 MTAIDS 1x *Programme Elective V –

3 MTAIDS 11 Cognitive robotics

Course Outcomes:

After completing the course, student will be able to-

1. Analyse the methods and software/hardware technologies for robotics research and applications
2. Understand how our psychology and neuroscience understanding of behaviour and intelligence informs the design of robotics models and applications
3. Compare, select and apply different machine learning methods for intelligent behaviour in robots
4. Discuss the state of the art in cognitive and intelligent robotics models, and how this informs the design of future robot applications
5. Discuss the role of ethics and responsible research and innovation in robotics
6. Design intelligent behaviour and cognitive skills in interactive robots.

Unit I:
Intro introduction to cognitive robotics, Neuro Robotics, developmental robotics. 8

Unit II:
Evolutionary robotics, Swarm robotics, soft robotics. 8

Unit III:
Robot platforms and simulators, biomimetic skin, machine learning for cognitive robotics. 8

Unit IV:
Cognitive architectures, embodiment in cognitive science and robotics, ethics of robotics. 8

Unit V:
Entrancing motivations for open ended learning, principles of cognitive vision, cognitive robot manipulation. 8

Unit VI:
Cognitive control for decision for decision and human robot collaboration, human robot interaction, language and communication, knowledge representation and reasoning, robots and machine consciousness. 8

Text Book:
1. Cognitive Robotics, Edited by Angelo Cangelosi and Minoru Asada, The MIT Press Cambridge, Massachusetts London, England, 2022

References:
1. Neuroscience, edited by Dale Purves, et al., published by Sinauer Associates.
2. How the body shapes the way we think-A New View of Intelligence, by Rolf Pfeifer and Josh Bongard, MIT Press.
3. Control Systems: Classical, Modern, and AI-Based Approaches, by Jitendra R. Raol, Ramakalyan Ayyagari, CRC Press.

****

3MTAIDS 12 SWARM INTELLIGENCE

Course Outcomes
After completing the course, student will be able to-

1. evaluate the power and limitation of Swarm Intelligence when it comes to solving problems.
2. advance the state of the art in Swarm Intelligence.
3. Gain knowledge of individual/intelligent agents for modeling of industrial, social and biological systems.

Unit I
Introductory Chapter: Swarm Intelligence - Recent Advances, New Perspectives, and Applications. 8

Unit II
Use of Particle Multi-Swarm Optimization for Handling Tracking Problems. 8

Unit III
Particle Swarm Optimization: A Powerful Technique for Solving Engineering Problems. 8

Unit IV
Feature Selection for Classification with Artificial Bee Colony Programming. 8

Unit V
Sensor-Driven, Spatially Explicit Agent-Based Models. 8

Unit VI
Design of the Second-Order Controller by Time-Domain Objective Functions Using Cuckoo Search. 8

Text Books:
1. Swarm Intelligence Recent Advances, New Perspectives and Applications, Edited by Javier Del Ser, Esther Villar and Eneko Osaba, IntechOpen Book Series Artificial Intelligence, Volume 2, 2019
2. Rafael Parpinelli and Heitor S. Lopes (Ed.), " Theory and New Applications of Swarm Intelligence+, InTech, 2012
3. Xin-She Yang, Zhihua Cui, Renbin Xiao, Amir Hossein Gandomi, Mehmet. Karamanoglu, "Swarm Intelligence and Bio-Inspired Computation, Theory and Applications", Elsevier 2013.
4. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", The MIT Press, Cambridge, England, 2004.

References:

1. Ben Coppin, "Artificial Intelligence Illuminated", Jones and Bartlett Publishers, 2004. Kennedy J and Russel C Eberhart, "Swarm Intelligence", Morgan Kaufmann Publishers, USA, 2001.
2. Dervis Karaboga, Bahriye Akay," A comparative study of Artificial Bee Colony Algorithm" Applied Mathematics and Computation 214, Elsevier Publications, 2009.
3. Felix T. S. Chan and Manoj Kumar Tiwari (ed.) , "Swarm Intelligence Focus on Ant and Particle Swarm Optimization", I-Tech Education and Publishing, 2007.

****

3MTAIDS 13 HUMAN MACHINE INTERFACES

Course Outcomes:

After completion of course, students would be able to:

1. Understand the structure of models and theories of human computer interaction and vision.
2. Design an interactive web interface on the basis of models studied.

Unit I:
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. 9

Unit II:

Unit III:

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW. 8

Unit IV:

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. 8

Unit V:

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies. 8

Unit VI: Recent Trends: Speech Recognition and Translation, Multimodal System **5**

Text Books :

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rdEdition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, "Mobile Design and Development", First Edition , O'Reilly Media Inc., 2009 (UNIT –IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009.(UNIT-V)

Reference:

1. H. Sharp and Y. Rogers, "Interaction Design: beyond human-computer interaction", Fifth Edition, John Wiley & Sons, Inc., 2019.

****

3MTAIDS 14 EDGE AND FOG COMPUTING

Course outcomes: After completing the course student will be able to-

1. Explain edge computing
2. Understand Fog Computing and its architecture, challenges and applications in different context.
3. Understand the architecture and its components and working of components and its performance
4. Explore Fog on security, multimedia and smart data
5. Design and Implement Internet of Everything (IoE) applications through fog computing architecture.

Unit I: Taxonomy of Edge Computing: Challenges, Opportunities, and Data Reduction Methods **8**

Unit II:

Applications of the Internet of Things with the Cloud Computing Technologies: A Review 8

Unit III:

A Conceptual Framework for Security and Privacy in Edge Computing 8

Unit IV:

Fog Computing Fundamentals in the Internet-of-Things 8

Unit V:

The Present and Future of Privacy-Preserving Computation in Fog Computing 8

Unit VI:

Control-as-a-Service in Cyber-Physical Energy Systems over Fog Computing, Leveraging Fog Computing for Healthcare IoT 8

Text Books:

1. Edge Computing Editor From Hype to Reality Fadi Al-Turjman, Springer, 2019
2. Fog Computing in the Internet of Things Intelligence at the Edge, Amir M. Rahmani, Pasi Liljeberg, Jürgo-Sören Preden, Axel Jantsch Editors, Springer, 2018
3. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806

References:

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
2. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE, First Edition, Apress, 2019.

****

3 MTAIDS 2X OPEN ELECTIVE (ANY ONE FROM MOOCS SWAYAM)

1. Expert Systems
2. Blockchain
3. Social Network Analysis
4. Business Analytics
5. Stream analytics
6. Industry 4.0
7. Operations Research
8. Cost Management of Engineering Projects
9. Composite Materials
10. Waste to Energy
11. Any other Course as approved by the Department/College

3 MTAIDS 3 DISSERTATION-I /INDUSTRIAL PROJECT [CREDITS - 10]

M.TECH. (AI AND DS) SEM-IV

4MTAIDS1 DISSERTATION II [CREDITS- 16]

****