JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21DBS102	Mathematical and Statistical Foundations	PC	3	0	0	3
2.	21D97101	Artificial Intelligence	PC	3	0	0	3
3.	21D58103a 21D08102c 21D97102a	**Program Elective Course - I** Machine Learning Cloud Computing Neural Networks and Genetic Algorithms	PE	3	0	0	3
4.	21D97105 21D25102b 21D58101	**Program Elective Course – II** Principles of Data Science Information Retrieval Advanced Data Structures And Algorithms	PE	3	0	0	3
5.	21D97103	R Programming Lab	PC	0	0	4	2
6.	21D97104	Artificial Intelligence Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	21D97201	Advanced Data Mining	PC	3	0	0	3
2.	21D58203a	Deep Learning	PC	3	0	0	3
3.	21D58301c 21D97203a 21D97203b	**Program Elective Course – III** Data Analytics Pattern Recognition Intelligent Agent Systems	PE	3	0	0	3
4.	21D97204a 21D58203c 21D97204b	**Program Elective Course – IV** Intrusion Detection Systems Computer Vision Natural Language Processing	PE	3	0	0	3
5.	21D97205	Advanced Data Mining Lab	PC	0	0	4	2
6.	21D97206	Deep Learning Lab	PC	0	0	4	2
7.	21D97207	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
Total							**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D97301a 21D97301b 21D97301c	**Program Elective Course –V** Reinforcement Learning Game Theory Applied Artificial Intelligence	PE	3	0	0	3
2.	21DOE301b 21DOE301c 21DOE301f	**Open Elective** Industrial Safety Business Analytics Optimization Techniques	OE	3	0	0	3
3.	21D97302	Dissertation Phase – I	PR	0	0	20	10
4.	21D97303	Co-curricular Activities					2
Total							**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D97401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	MATHEMATICAL AND STATISTICAL FOUNDATIONS	L	T	P	C
21DBS102		3	0	0	3
	Semester	I			

Course Objectives:

- To identify the mathematical concepts in the field of data science
- To employ the techniques and methods related to the area of data science in variety of applications
- To apply logical thinking to understand and solve the problem in context.

Course Outcomes (CO):

- Ability to use the mathematical concepts in the field of data science
- Employ the techniques and methods related to the area of data science in variety of applications
- Apply logical thinking to understand and solve the problem in context.

UNIT - I	Lecture Hrs:8

Basics of Data Science: Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems

UNIT - II	Lecture Hrs:8

Linear Algebra: Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigenvalues and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyperplanes; half-planes.

UNIT - III	Lecture Hrs:9

Probability, Statistics and Random Processes: Probability theory and axioms; Random variables; Probability distributions and density functions (univariate and multivariate); Expectations and moments;

UNIT - IV	Lecture Hrs:9

Covariance and correlation; Statistics and sampling distributions; Hypothesis testing of means, proportions, variances and correlations; Confidence (statistical) intervals; Correlation functions; White-noise process.

UNIT - V	Lecture Hrs:9

Optimization: Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions; Introduction to nongradient techniques; Introduction to least squares optimization; Optimization view of machine learning. Introduction to Data Science Methods: Linear regression as an exemplar function approximation problem; Linear classification problems.

Textbooks:

1 G. Strang . Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA, 2016.
2. Bendat, J. S. and A. G. Piersol. Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA, 2010

Reference Books:

1. Montgomery, D. C. and G. C. Runger. Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA, 2011.
2. David G. Luenberger . Optimization by Vector Space Methods, John Wiley & Sons (NY), 1969.
3. Cathy O'Neil and Rachel Schutt . Doing Data Science, O'Reilly Media, 2013.

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Course Code	ARTIFICIAL INTELLIGENCE	L	T	P	C
21D97101		3	0	0	3
	Semester	I			

Course Objectives:

- The goal of Artificial Intelligence is to build software systems that behave "intelligently".
- The ability to create representations of the domain of interest and reason with these representations is a key to intelligence.

Course Outcomes (CO): Student will be able to

- Understand the major areas and challenges of AI
- Ability to apply basic AI algorithms to solve problems
- Able to describe search strategies and solve problems by applying a suitable search method.
- Able to describe and apply knowledge representation
- To learn different knowledge representation techniques
- Represent knowledge of a domain formally,
- 7. Design, implement and apply a knowledge-based system.

UNIT - I — Lecture Hrs:9

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT - II — Lecture Hrs:9

Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Greedy best first search, A* search Game Playing: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

UNIT - III — Lecture Hrs:9

Knowledge Representation**:** Using Predicate logic, representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification.
Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning.

UNIT - IV — Lecture Hrs:9

Learning: What is learning, Rote learning, Learning by Taking Advice, Learning in Problem-solving, Learning from example: induction, Explanation-based learning.
Connectionist Models: Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks. Connectionist AI and Symbolic AI

UNIT - V — Lecture Hrs:9

Expert System: Representing and using Domain Knowledge, Reasoning with knowledge, Expert System Shells, Support for explanation examples, Knowledge acquisition-examples.

Textbooks:

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.
2. Artificial Intelligence, Kevin Knight, Elaine Rich, B. Shivashankar Nair, 3rd Edition,2008
3. Artificial Neural Networks B. Yagna Narayana, PHI

Reference Books:

1. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).
2. Artificial Intelligence and Expert Systems – Patterson PHI.
3. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
4. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
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Education.
5. Neural Networks Simon Haykin PHI
6. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	MACHINE LEARNING (Common to M.Tech CSE, SE,AI & ML)	L	T	P	C
21D58103a		3	0	0	3
	Semester	I			

Course Objectives:

- To understand various key paradigms for machine learning approaches.
- To familiarize with the mathematical and statistical techniques used in machine learning.
- To understand and differentiate among various machine learning techniques.

Course Outcomes (CO): Student will be able to

- To formulate a machine learning problem
- Select an appropriate pattern analysis tool for analysing data in a given feature space.
- Apply pattern recognition and machine learning techniques such as classification and feature selection to practical applications and detect patterns in the data.

UNIT - I	Lecture Hrs:
Introduction: Definitions, Datasets for Machine Learning, Different Paradigms of Machine Learning, Data Normalization, Hypothesis Evaluation, VC-Dimensions and Distribution, Bias-Variance Tradeoff, Regression	
UNIT - II	Lecture Hrs:
Bayes Decision Theory: Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions. Parameter Estimation: Maximum Likelihood and Bayesian Parameter Estimation	
UNIT - III	Lecture Hrs:
Discriminative Methods: Distance-based methods, Linear Discriminant Functions, Decision Tree, Random Decision Forest and Boosting Feature Selection and Dimensionality Reduction: PCA, LDA, ICA, SFFS, SBFS	
UNIT - IV	Lecture Hrs:
Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labelled and unlabelled data.	
UNIT - V	Lecture Hrs:
Kernel Machines: Kernel Tricks, SVMs (primal and dual forms), K-SVR, K-PCA (6 Lectures) Artificial Neural Networks: MLP, Backprop, and RBF-Net	

Textbooks:

1. Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
2. R. O. Duda, P. E. Hart, D. G. Stork (2000), Pattern Classification, Wiley-Blackwell, 2nd Edition.

Reference Books:

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc.,2001
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	CLOUD COMPUTING	L	T	P	C
21D08102c	(Common to M.Tech CN, SE, AI&ML)	3	0	0	3
	Semester	I			

Course Objectives:

- Understand the hardware, software concepts and architecture of cloud computing
- Realize the importance of Cloud Virtualization, Abstractions and Enabling Technologies.
- Explore the Programming for Applications on Cloud.
- Apply Map-Reduce concept to applications.

Course Outcomes (CO): Student will be able to

- Explain industry relevance of cloud computing and its intricacies, in terms of various challenges, vulnerabilities, SLAs, virtualization, resource management and scheduling, etc.
- Examine some of the application paradigms, and Illustrate security aspects for building cloud-based applications.
- Conduct a research study pertaining to various issues of cloud computing.
- Demonstrate the working of VM and VMM on any cloud platforms (public/private), and run a software service on that.

UNIT - I — Lecture Hrs:9

Introduction, Cloud Infrastructure

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Major challenges faced by cloud computing; Cloud Infrastructure: Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Service- and compliance-level agreements, User experience and software licensing. Exercises and problems

UNIT - II — Lecture Hrs:9

Cloud Computing: Application Paradigms

Challenges of cloud computing, Existing Cloud Applications and New Application Opportunities, Workflows: coordination of multiple activities, Coordination based on a state machine model: The ZooKeeper, The MapReduce Programming model, A case study: The Grep TheWeb application, HPC on cloud, Biology research

UNIT - III — Lecture Hrs:9

Cloud Resource Virtualization.

Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization, Case Study: Xen a VMM based para virtualization, Optimization of network virtualization, The darker side of virtualization, Exercises and problems.

UNIT - IV — Lecture Hrs:10

Cloud Resource Management and Scheduling

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers; Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Exercises and problems.

UNIT - V — Lecture Hrs:10

Cloud Security, Cloud Application Development

Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Exercises and problems.

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Amazon Simple Notification services.
Textbooks:
1.Cloud Computing Theory and Practice. Dan C Marinescu: Elsevier (MK), 1st Edition, 2013, ISBN: 9780124046276. 2.Distributed Computing and Cloud Computing, from parallel processing to internet of things. Kai Hwang, GeofferyC.Fox, Jack J Dongarra: Elsevier(MK), 1st Edition, 2012, ISBN: 978-0-12-385880-1
Reference Books:
1.Cloud Computing Principles and Paradigms, RajkumarBuyya, James Broberg, AndrzejGoscinski: Willey, 1st Edition, 2014, ISBN: 978-0-470-88799-8. 2.Cloud Computing Implementation, Management and Security, John W Rittinghouse, James F Ransome: CRC Press, 1st Edition, 2013, ISBN: 978-1-4398-0680-7
Online Learning Resources:
OLI Course: http://oli.cmu.edu (accessed through https://blackboard.andrew.cmu.edu) **The Project Zone:**https://TheProject.Zone **Piazza:** http://piazza.com/cmu/spring2016/1531915619/home

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	NEURAL NETWORKS AND GENETIC ALGORITHMS	L	T	P	C
21D97102a		3	0	0	3
	Semester	**I**			

https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html

Course Objectives:

- Neural networks provide a model of computation drastically different from traditional computers.
- Typically, neural networks are not explicitly programmed to perform a given task; rather, they learn to do the task from examples of desired input/output behavior.
- To understand the search methods in the genetic algorithms.
- To implement the reproduction concepts.
- To design the techniques of dominance in genetic algorithms

Course Outcomes (CO): Student will be able to

- An ability to understand and the fundamental concepts of Genetic algorithms.
- Understand the consequence of applying various genetic operators.
- Ability to analyze GA operators and implement them to solve different types of GA problems.
- Creating and understanding about the way the GA is used and the domain of application

UNIT – I	Lecture Hrs:9

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units. Feed forward Neural Networks: Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks, Analysis of pattern storage Networks; Analysis of Pattern Mapping Networks

UNIT – II	Lecture Hrs:9

Feedback Neural Networks: Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks. Competitive Learning Neural Networks & Complex pattern Recognition:
Introduction, Analysis of Pattern Clustering Networks, Analysis of Feature Mapping Networks, and Associative Memory

UNIT – III	Lecture Hrs:9

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

UNIT – IV	Lecture Hrs:9

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

UNIT - V	Lecture Hrs:9

APPLICATIONS OF GA The rise of GA – GA application of Historical Interaction. – Dejung& Function optimization – Current applications of GA -Advanced operators & techniques in genetic search :Dominance, Diploidy & abeyance – Inversion & other reordering operators. – other mine-operators – Niche & Speciation – Multi objective optimization – Knowledge-Based Techniques. –

GA & parallel processes – Real life problem
Textbooks:
1. Artificial Neural Networks B. Yagna Narayana, PHI 2. Neural Networks Simon Haykin PHI 3. David E. Gold Berg, "Genetic Algorithms in Search, Optimization & Machine Learning", Pearson Education, 2001 . 4. S.Rajasekaran, G.A.VijayalakshmiPai, " Neural Networks, Fuzzy Logic and Genetic Algorithms ", PHI , 2003 (Chapters 8 and 9)
Reference Books:
1. Kalyanmoy Deb, "Optimization for Engineering Design, algorithms and examples", PHI 1995. 2. An Introduction to Genetic Algorithm by Melanie Mitchell. 3. The Simple Genetic Algorithm Foundation &Theores by Michael P. Vosk

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COURSE STRUCTURE & SYLLABI

Course Code	PRINCIPLES OF DATA SCIENCE	L	T	P	C
21D97105		3	0	0	3
	Semester	I			

Course Objectives:

- Discussion and dissemination of best practice in use of data science
- 2 Aims to bring to together researchers interested in data science to focus on techniques and methods that cut across all disciplines.
- DSC will bring together researchers that develop methods and techniques and those that apply these methods to their research.
- Will be used to raise awareness of funding opportunities (nationally and internationally) and potential collaborations related to the use of data analytics/big data techniques.
- Will be led by a small academic steering group to ensure alignment with current academic topics.

Course Outcomes (CO): Student will be able to

- Use R to carry out basic statistical modeling and analysis.
- Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA.
- Describe the Data Science Process and how its components interact.
- Use APIs and other tools to scrap the Web and collect data.
- Apply EDA and the Data Science process in a case study.

UNIT - I	Lecture Hrs:8

Introduction: What is Data Science: Big Data and Data Science hype – and getting past the hype, Why now? – Deification, Current landscape of perspectives, Skill sets needed.

UNIT - II	Lecture Hrs:8

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm).
Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (kNN),k-means.

UNIT - III	Lecture Hrs:9

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web
Feature Generation and Feature Selection (Extracting Meaning From Data) : Motivating application: user (customer) retention, Feature Generation (brainstorming, role of domain expertise, and place for imagination),Feature Selection algorithms, Filters; Wrappers; Decision Trees; Random Forests.

UNIT - IV	Lecture Hrs:9

Recommendation Systems: Building a User-Facing Data Product: Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis.
Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs.

UNIT - V	Lecture Hrs:9

Data Visualization: Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects.
Data Science and Ethical Issues: Discussions on privacy, security, ethics, a look back at Data Science, Next-generation data scientists.

Textbooks:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from the Frontline. O'Reilly. 2014.

Reference Books:

1. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1,Cambridge University Press. 2014. (free online)
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2011
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know aboutData Mining and Data-analytic Thinking. ISBN 1449361323. 2013

Online Learning Resources:

SOURCE LINK:
https://jntuacea.ac.in/pdfs/B%20Tech%20CSE%20R17%20Syllabus.pdf

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COURSE STRUCTURE & SYLLABI

Course Code	INFORMATION RETRIEVAL	L	T	P	C
21D25102b	(Common to M.Tech. SE,AI & ML)	3	0	0	3
	Semester	I			

Course Objectives:

- To provide an overview of Information Retrieval
- To introduce students about insights of the several topics of Information retrieval such as – Boolean retrieval model, Vector space model, Latent semantic indexing, XML and Image retrieval model
- To provide comprehensive details about various Evaluation methods
- To provide implementational insight about the topics covered in the course.

Course Outcomes (CO): Student will be able to

- Analyze and implement algorithms to extract relevant information from unstructured data using Information retrieval techniques.
- Evaluate information retrieval algorithms for document indexing, relevance ranking, web search, query processing, recommender systems, etc.
- Apply various information retrieval techniques to retrieve information.
- Create information retrieval applications based on various ranking principles and retrieval methods.

UNIT – I — Lecture Hrs:8

Boolean Retrieval
An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval.
The term Vocabulary and Postings Lists
Document delineation and character sequence decoding, Obtaining the character sequence in a document, Choosing a document unit, Determining the vocabulary of terms, Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization, Faster postings list intersection via skip pointers, Positional postings and phrase queries, Bi-word indexes, Positional indexes, Combination schemes.

UNIT - II — Lecture Hrs:8

Dictionaries and tolerant retrieval
Search structures for dictionaries, Wildcard queries, General wildcard queries, k-gram indexes for wildcard queries, Spelling correction, Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction
Index Construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing and Other types of indexes.

UNIT - III — Lecture Hrs:8

Index compression
Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage.
Scoring, term weighting and the vector space model
Parametric and zone indexes, Weighted zone scoring, Learning weights, The optimal weight *g*, Term frequency and weighting, Inverse document frequency, TF-IDF weighting, The vector space model for scoring, Dot products, Queries as vectors, Computing vector scores.

UNIT - IV — Lecture Hrs:8

Computing scores in a complete search system
Efficient scoring and ranking, Inexact top *K* document retrieval, Index elimination, Champion lists, Static quality scores and ordering, Impact ordering, Cluster pruning, Components of an information retrieval system, Tiered indexes, Query-term proximity, Designing parsing and scoring functions. Putting it all together**.**

Evaluation in information retrieval
Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results.

UNIT - V		Lecture Hrs:7

XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval
Review of basic probability theory, The Probability Ranking Principle, The Binary Independence Model.

Textbooks:

1. An Introduction to Information Retrieval, Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze:, Cambridge University Press, England, 2008, ISBN 13: 9780521865715.
2. Statistical Language Models for Information Retrieval, ChengXiangZhai, , Morgan & Claypool Publishers, 2009, ISBN: 9781598295900

Reference Books:

1. Modern Information Retrieval, Ricardo Baeza-Yates, BerthierRibeiro-Neto, Addison Wesley Longman Publishing Co. Inc, 2009, ISBN-10: 0321416910.
2. Information Retrieval Data Structures and Algorithms,William B. Frakes, Ricardo Baeza-Yates, First Edition, Pearson Education Limited,2012, ISBN-9788131716922.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS (Common to M.Tech CSE, CN, SE,AI & ML)	L	T	P	C
21D58101		3	0	0	3
	Semester	I			

Course Objectives:

- To understand concepts of dictionaries and hash tables.
- To implement lists and trees.
- To analyze usage of B trees, Splay trees and 2-3 trees.
- To understand the importance of text processing and computational Geometry.

Course Outcomes (CO): Student will be able to

- Understand the implementation of symbol table using hashing techniques
- Apply advanced abstract data type (ADT) and data structures in solving real world
- problem
- Effectively combine the fundamental data structures and algorithmic techniques in
- building a solution to a given problem
- Develop algorithms for text processing applications

UNIT - I		Lecture Hrs:

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.

UNIT - II		Lecture Hrs:

Skip Lists : Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists, Trees: Binary Search Trees (BST), AVL Trees, Red Black Trees: Height of a Red Black Tree, Red Black Trees Bottom-Up Insertion, Top-Down Red Black Trees, Top-Down Deletion in Red Black Trees, Analysis of Operations.

UNIT - III		Lecture Hrs:

2-3 Trees , Advantage of 2-3 trees over Binary Search Trees, Search and Update Operations on 2-3 Trees, Analysis of Operations, B-Trees: Advantage of B- trees over BSTs, Height of B-Tree, Search and Update Operations on 2-3 Trees, Analysis of Operations, Splay Trees: Splaying, Search and Update Operations on Splay Trees, Amortized Analysis of Splaying.

UNIT - IV		Lecture Hrs:

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

UNIT - V		Lecture Hrs:

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.

Textbooks:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, second Edition, Pearson, 2004.
2. T.H. Cormen, C.E. Leiserson, R.L.Rivest, Introduction to Algorithms, Third Edition Prentice Hall, 2009

Reference books:

1. Michael T. Goodrich, Roberto Tamassia, Algorithm Design, First Edition, Wiley, 2006.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	R PROGRAMMING LAB	L	T	P	C
21D97103		0	0	4	2
	Semester	I			

Course Objectives:

- To implement installation of R in windows.
- To implement data types.
- To implement descriptive statistics using R.
- To implement visualization techniques in R.

Course Outcomes (CO):

- Implement installation of R in windows.
- Implement data types.
- Implement descriptive statistics using R.
- Implement visualization techniques in R.

List of Experiments:

1. Installation of R Installing R in windows, R Console (R window to edit and execute R Commands), Commands and Syntax (R commands and R syntax), Packages and Libraries (Install and load a package in R), Help In R, Workspace in R.
2. Implement the data structures using R Programming Introduction to Data Types (Why Data Structures?, Types of Data Structures in R), Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data.
3. Implement the Graphical Analysis using R Creating a simple graph (Using plot() command), Modifying the points and lines of a graph (Using type, pch, font, cex, lty, lwd, col arguments in plot() command), Modifying Title and Subtitle of graph (Using main, sub, col.main, col.sub, cex.main, cex.sub, font.main, font.sub arguments in plot() command), Modifying Axes of a Graph (Using xlab, ylab, col.lab, cex.lab, font.lab, xlim, ylim, col.axis, cex.axis, font.axis arguments and axis() command), Adding Additional Elements to a Graph (Using points(), text(), abline(), curve() commands), Adding Legend on a Graph (Using legend() command), Special Graphs (Using pie(), barplot(), hist() commands), Multiple Plots (Using mfrow or mfcol arguments in par() command and layout command).
4. Implement the Descriptive Statistics using R. Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution).
5. Extract data from files and other sources and perform various data manipulation tasks on them.
6. Use R Graphics and Tables to visualize results of various statistical operations on data.
7. Apply the knowledge of R gained to aplly for data analytics in real life applications.
8. Extend the functionality of R using add on packages.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	ARTIFICAL INTELLEGENCE LAB	L	T	P	C
21D97104		0	0	4	2
	Semester	I			

Course Objectives:

- Students will have the successful careers in the field of computer science and allied sectors as an innovative engineer.
- Students will continue to learn and advance their careers through participation in professional activities, attainment of professional certification and seeking advance studies.
- Students will be able to demonstrate a commitment to life-long learning.
- Students will be ready to serve society in any manner and become a responsible and aware citizen.
- Establishing students in a leadership role in any field

Course Outcomes (CO):

- Write a python program to implement simple Chatbot
- To apply various search algorithms of artificial intelligence.
- To apply knowledge representation and reasoning techniques.
- To understand & apply different types of machine learning and models
- To understand the design principles of pattern recognition with estimation and apply classification technique.

List of Experiments:

1.Write a program in prolog to implement simple facts and Queries
2. Write a program in prolog to implement simple arithmetic
3. Write a program in prolog to solve Monkey banana problem
4. Write a program in prolog to solve Tower of Hanoi
5. Write a program in prolog to solve 8 Puzzle problems
6. Write a program in prolog to solve 4-Queens problem
7. Write a program in prolog to solve Traveling salesman problem
8. Write a program in prolog for Water jug problem
9. Write a program to implement a Tic-Tac-Toe game.
10. Write a python program to implement simple Chatbot?

References:

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101	(Common to M.Tech CSE, CN, SE,AI & ML)	2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

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

UNIT - I — Lecture Hrs:

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

UNIT - II — Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, 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 - III — Lecture Hrs:

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 - IV — Lecture Hrs:

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

UNIT - V

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.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DATA MINING	L	T	P	C
21D97201		3	0	0	3
	Semester	**II**			

Course Objectives:

- To analyze Algorithms for sequential patterns.
- To extract patterns from time series data.
- To develop algorithms for Temporal Patterns.
- To identify computing frameworks for Big Data analytics.
- To extend the Graph mining algorithms to Web Mining

Course Outcomes (CO): Student will be able to

- Analyze Algorithms for sequential patterns.
- Extract patterns from time series data.
- Develop algorithms for Temporal Patterns.
- Identify computing frameworks for Big Data analytics.
- Extend the Graph mining algorithms to Web Mining

UNIT - I	Lecture Hrs:8
Review of Frequent Item set Mining. Sequential Pattern Mining concepts, primitives, scalable methods; Closed Sequential Patterns.	
UNIT - II	Lecture Hrs:8
Transactional Patterns and other temporal based frequent patterns, Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis.	
UNIT - III	Lecture Hrs:9
Graph Mining, Mining frequent sub-graphs, finding clusters, hub and outliers in large graphs, Graph Partitioning; Web Mining.	
UNIT – IV	Lecture Hrs:9
Classification- Decision Tree learning, Bayesian Learning, Class Imbalance Problem. Review of Clustering methods.	
UNIT – V	Lecture Hrs:9
Trajectory Pattern Mining: Moving together patterns, Sequential Pattern mining from trajectories, Trajectory Clustering.	

Textbooks:

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication,2011.
2. Vipin Kumar, Pang-Ning Tan, Michael Steinbach, Introduction to Data Mining, Addison Wesley,2006.

Reference Books:

1. Introduction to Data Mining , Tan steinbach, Kumar.
2. Data Mining Techniques: Gordon S Linoff&Micael J Berry, Wiley Publications, Third Edition.

Online Learning Resources:

Coursera.org

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	DEEP LEARNING	L	T	P	C
21D58203a		3	0	0	3
	Semester	**II**			

Course Objectives:

- To identify Convolutional Neural Networks models to solve Supervised Learning Problems
- To design Autoencoders to solve Unsupervised Learning problems
- To apply Long Shot Term Memory (LSTM) Networks for time series analysis classification problems.
- To apply Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

Course Outcomes (CO): Student will be able to

- Identify Convolutional Neural Networks models to solve Supervised Learning Problems
- Design Autoencoders to solve Unsupervised Learning problems
- Apply Long Shot Term Memory (LSTM) Networks for time series analysis classification problems.
- Apply Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

UNIT - I	Lecture Hrs:9

Introduction to Biological Neurons, Artificial Neural Networks, McCulloch Pitts Neuron, Learning processes, Perceptron, Perceptron convergence theorem, XOR problem, Multilayer perceptron, Back Propagation (BP) Learning.

UNIT - II	Lecture Hrs:9

Activation functions: Sigmoid, Linear, Tanh, ReLU, Leaky ReLU, SoftMax, loss functions, First and Second order optimization methods, Optimizers: Gradient Descent (GD), Batch Optimization, Momentum Based GD, Stochastic GD, AdaGrad, RMSProp, Adam; Introduction to Self Organizing Maps; Sequence to sequence models, RNN, Vanishing and Exploding Gradients, GRU, LSTM for NLP Applications.

UNIT - III	Lecture Hrs:9

Convolutional Neural Network, Building blocks of CNN, Transfer Learning; Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Dropout.

UNIT - IV	Lecture Hrs:9

Autoencoders : Unsupervised Learning with Deep Network, Autoencoders, Stacked, Sparse, Denoising Autoencoders, Variational Autoencoders; Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, GoogleNet, DensenNet, SqueezNet, MobileNet, NasNet Models.

UNIT - V	Lecture Hrs:9

Classical Supervised Tasks with Deep Learning, Segmentation Unet, FCN models, Object Localization (RCNN), FRCNN with Applications; Transformer, Generative Adversarial Network, Design own neural network models on Image, vision and NLP Applications..

Textbooks:

1. Deep Learning- Ian Good felllow, YoshuaBenjio, Aaron Courville, The MIT Press.
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,2006.

Reference Books:

1. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001.

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2. Deep Learning From Scratch: Building with Python from First Principles by Seth Weidman published by O`Reilley
3. Grokking Deep Learning by Andrew W. Trask published by Manning Publications

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	DATA ANALYTICS	L	T	P	C
21D58301c	(Common to M.Tech CSE, SE,AI&ML)	3	0	0	3
	Semester	II			

Course Objectives:

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

Course Outcomes (CO): Student will be able to

- Understand the ideas of statistical approaches to learning
- Understand the significance of exploratory data analysis (EDA) in data science and apply basic tools (plots, graphs, summary statistics) to perform EDA
- Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for predictive modeling. Explore the merits of Naive Bayes technique
- Recognize the characteristics of machine learning techniques that are useful to solve real-world problems

UNIT - I	Lecture Hrs:

Introduction: What is Data Science? Big Data and Data Science hype and getting past the hype, Why now?, Datafication, Current landscape of perspectives, Skill sets, Life cycle of Data Science, Different phases.

UNIT - II	Lecture Hrs:

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: RealDirect (online real estate firm), Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means.

UNIT - III	Lecture Hrs:

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web, Feature Generation and Feature Selection (Extracting Meaning From Data), Motivating application: user (customer) retention,

UNIT - IV	Lecture Hrs:

Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms: Filters; Wrappers; Decision Trees; Random Forests, Recommendation Systems: Building a User-Facing Data Product: Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.

UNIT - V	Lecture Hrs:

Data Visualization: Basic principles, ideas and tools for data visualization, Case study on industry projects, Exercise: create your own visualization of a complex dataset, Data Science and Ethical Issues: Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists.

Textbooks:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly, 2014.
2. Jure Leskovek, AnandRajaraman and Jerey Ullman. Mining of Massive Datasets, Cambridge University Press, 2014.

Reference Books:

1. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press, 2013.
2. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. O'Reilly, 2013.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. Springer, 2009.
4. Avrim Blum, John Hopcroft and RavindranKannan. Foundations of Data Science.2018.

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5. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press, 2014.
6. Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. Morgan Kaufmann, 2011.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	PATTERN RECOGNITION	L	T	P	C
21D97203a		3	0	0	3
	Semester	**II**			

Course Objectives:

- The objective of the course is to understand the algorithms for Pattern Recognition. The representation of patterns and classes and the similarity measures are an important aspect of pattern recognition. Pattern recognition involves classification and clustering of patterns. The two well-known paradigms of machine learning namely, learning from examples or supervised learning and learning from observations or clustering covered in this course.

Course Outcomes (CO): Student will be able to

- Differentiate between supervised and unsupervised classifiers
- Classify the data and identify the patterns.
- Extract feature set and select the features from given data set.
- Apply fuzzy logic and genetic algorithms for classification problems, design systems and algorithms for pattern recognition, with focus on sequences of patterns that are analyzed using, e.g., hidden Markov models (HMM).
- Analyze classification problems probabilistically and estimate classifier performance.
- Understand and analyze methods for automatic training of classification systems.
- Apply Maximum-likelihood parameter estimation in relatively complex probabilistic models, such as mixture density models and hidden Markov models.

UNIT - I	Lecture Hrs:9

Overview of Pattern recognition – Basics of Probability and Statistics, Linear Algebra, Linear Transformations, Components of Pattern Recognition System, Learning and adaptation Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT - II	Lecture Hrs:8

Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.

UNIT - III	Lecture Hrs:9

Feature Extraction and Feature Selection: Feature extraction – discrete cosine and sine transform, Discrete Fourier transform, Principal Component analysis, Kernel Principal Component Analysis. Feature selection – class separability measures, Feature Selection Algorithms - Branch and bound algorithm, sequential forward / backward selection algorithms. Principle component analysis, Independent component analysis, Linear discriminant analysis, Feature selection through functional approximation – Elements of formal grammars, Syntactic description – Stochastic grammars – Structural Representation.

UNIT - IV	Lecture Hrs:8

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT - V	Lecture Hrs:8

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception.

Textbooks:

1. Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London,1999

Reference Books:

1. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

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2. M. Narasimha Murthy and V. Susheela Devi, "Pattern Recognition", Springer 2011.
3. Menahem Friedman, Abraham Kandel, "Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches", World Scientific publishing Co. Ltd, 2000.
4. . Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, 1992.
5. . R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001
6. . S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press. 2009.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	INTELLIGENT AGENT SYSTEMS	L	T	P	C
21D97203b		3	0	0	3
	Semester	II			

Course Objectives:

- To understand the fundamentals of key intelligent systems technologies
- To understand hybrid intelligent systems
- To understand evolutionary computation
- To practice in an integration of intelligent systems technologies for engineering applications.

Course Outcomes (CO): Student will be able to

- Explain the fundamentals of key intelligent systems technologies
- Describe neural networks, fuzzy systems, and evolutionary computation.
- Explain the hybrid intelligent systems
- List the integration of intelligent systems technologies for engineering applications.

UNIT - I	Lecture Hrs:9

Introduction: Computational Intelligence: Intelligence machines -Computational intelligence paradigms –History- Expert Systems: Rule-based expert systems – Uncertainty management - Fuzzy expert systems: Fuzzy sets and operations of fuzzy sets - Fuzzy rules and fuzzy inference - Fuzzy expert systems

UNIT - II	Lecture Hrs:9

Artificial Neural Networks: Fundamental neurocomputing concepts: artificial neurons, activation functions, neural network architectures, learning rules - Supervised learning neural networks: multi-layer feed forward neural networks, simple recurrent neural networks, time-delay neural networks, supervised learning algorithms - Unsupervised learning neural networks: self-organizing feature maps - Radial basis function networks - Deep neural networks and learning algorithms

UNIT – III	Lecture Hrs:8

Evolutionary computation: Representation: Chromosomes-fitness functions- selection mechanisms -Genetic algorithms: crossover and mutation - Genetic programming

UNIT – IV	Lecture Hrs:8

Hybrid Intelligent Systems: Neural expert systems -Neuro-fuzzy systems -Evolutionary neural networks

UNIT – V	Lecture Hrs:9

Applications and case studies: Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction-Case studies.

Textbooks:

1. A.P. Engelbrecht, Computational Intelligence: An Introduction, 2012,2nd Edition, John Wiley & Sons.
2. S.Rajasekaran and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy logic and Genetic Algorithms-Synthesis and Applications, 2003, PHI Learning

Reference Books:

1. Marsland S, Machine Learning: An Algorithmic Perspective, 2009, CRC Press.
2. S. Russell and P. Norvig, Artificial Intelligence – A Modern Approach,2010, Prentice Hall.
3. J.S.R.Jang, C.T.Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, 2004, PHI, Pearson Education.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	INTRUSION DETECTION SYSTEMS	L	T	P	C
21D97204c		3	0	0	3
	Semester	II			

Course Objectives:

- To understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise.
- Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems.
- Analyze intrusion detection alerts and logs to distinguish attack types from false alarms.
- To be able to analyze the basic Firewall mechanism.

Course Outcomes (CO): Student will be able to

- Acquire knowledge of Intrusion Detection.
- Ability to improve the security posture of any enterprise by applying the intrusion mechanism.
- Ability to design new Intrusion Detection Systems in the lower level.
- Identify attack types from false alarms.

UNIT - I		Lecture Hrs:9

History of Intrusion Detection: Audit, Concept and definition, Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

UNIT - II		Lecture Hrs:10

Intrusion Prevention System and Snort: Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis- Incident Responses – Incident Response Process – IDS ad IPS response Phases Forensics –Corporate Issues - Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

UNIT - III		Lecture Hrs:10

Snort Rules and ACID: Rule Headers, Rule Options, the Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL - Using ACID and Snort Snarf with Snort -Agent development for intrusion detection - Architecture models of IDs and IPs.

UNIT - IV		Lecture Hrs:10

Firewall Introduction and Technologies: Why Internet Firewalls - Internet Services - Security Strategies - Building Firewalls - Packets and Protocols - What Does a Packet Look Like? - IP - Protocols Above IP - Protocols Below IP - Application Layer Protocols - IP Version - Non-IP Protocols - Attacks Based on Low-Level Protocol Details - Firewall Technologies - Some Firewall Definitions - Packet Filtering - Proxy Services - Network Address Translation - Virtual Private Networks

UNIT - V		Lecture Hrs:9

Building Firewalls: Firewall Architectures - Firewall Design - Packet Filtering - Proxy Systems - Bastion Hosts - UNIX and Linux Bastion Hosts 176 - Windows NT and Windows 2000 Bastion Hosts

Textbooks:

1. RafeeqRehman , " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003.
2. Carl Endorf, Eugene Schultz and Jim Mellander"Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
3. Elizabeth D. Zwicky, Simon Cooper & D. Brent Chapman , "Building Internet Firewalls" O'Reilly

Reference Books:
1. Christopher Kruegel,FredrikValeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005. 2. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002. 3. T. Fahringer, R. Prodan, "A Text book on Grid Application Development and Computing Environment". 6th Edition,KhannaPublihsers, 2012.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	**COMPUTER VISION**	**L**	**T**	**P**	**C**
21D58203c	**(Common to M.Tech CSE, AI & ML)**	**3**	**0**	**0**	**3**
	Semester	**II**			

Course Objectives:

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks

Course Outcomes (CO): Student will be able to

- Develop the practical skills necessary to build computer vision applications.
- To have gained exposure to object and scene recognition and categorization from images

UNIT - I	Lecture Hrs:
Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	
UNIT - II	Lecture Hrs:
Edge detection, Edge detection performance, Hough transform, corner detection	
UNIT - III	Lecture Hrs:
Segmentation, Morphological filtering, Fourier transform	
UNIT - IV	Lecture Hrs:
Feature extraction, shape, histogram, colour, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing	
UNIT - V	Lecture Hrs:
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	

Textbooks:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.

Reference Books:

1. Deep Learning, by Goodfellow, Bengio, and Courville.
2. Dictionary of Computer Vision and Image Processing, by Fisher et al.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	NATURAL LANGUAGE PROCESSING	L	T	P	C
21D97204b		3	0	0	3
	Semester	II			

Course Objectives:

- To be able to tag a given word with basic language processing features
- To be able to discuss the current and likely future performance of several NLP applications;
- To be able to describe briefly a fundamental technique for processing language for several subtasks, such as morphological processing, parsing, word sense disambiguation etc.
- To understand how these techniques draw on and relate to other areas of Computer Science.

Course Outcomes (CO): Student will be able to

- Describe the current and likely future performance of several NLP applications.
- Explain how these techniques draw on and relate to other areas of Computer Science.
- Describe the processing language for subtasks
- List the language processing features

UNIT - I	Lecture Hrs:9

Introduction to NLP : Knowledge in Speech and Language Processing -–Information Theory-Ambiguity Models and Algorithms, Language : N-gram Language Models - Evaluating Language Models, Thought and Understanding - The State of the Art and the Near term Future

UNIT - II	Lecture Hrs:9

Speech Tagging and Transducers: Part of Speech Tagging, Probability Basics: Hidden Markov - Maximum Entropy Models, Word Transducers: Finite State Transducers - Orthographic Rules - Finite-State Transducers Combining FST Lexicon Rules, Lexicon Free FSTs: The Porter Stemmer Human Morphological Processing.

UNIT - III	Lecture Hrs:9

Syntax Parsing: Syntax Parsing: Grammar Formalisms - Tree Banks - Parsing with Context Free Grammars - Features and Unification, Statistical parsing: probabilistic CFGs (PCFGs) - Lexicalized PCFG

UNIT - IV	Lecture Hrs:9

Semantic Analysis: Representing Meaning – Semantic Analysis - Lexical Semantics – Computational Lexical Semantics - Supervised – Dictionary based and Unsupervised Approaches - Compositional Semantics - Semantic Role Labelling - Semantic Parsing – Discourse Analysis.

UNIT - V	Lecture Hrs:9

Case Studies and Applications: Machine Translation Language Similarities and Differences - Named Entity Recognition and Relation Extraction- IE using sequence labelling-Machine Translation (MT) - Basic issues in MT-Statistical translation - Word Alignment - Phrase-based Translation – Question Answering

Textbooks:

1. Daniel Jurafsky and James H. Martin, Martin Speech and Language Processing, 2008, 2nd Edition, Prentice Hall.

2. Christopher D. Manning and HinrichSchuetze, Foundations of Statistical Natural Language Processing, 1999, MIT Press.

Reference Books:

1. James Allen, Natural Language Understanding, 1994, 2nd Edition, Addison Wesley.

2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2009, 1st Edition.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DATA MINING LAB	L	T	P	C
21D97205		0	0	4	2
	Semester	II			

Course Objectives:

- To implement knowledge discovery.
- To design several OLTP and OLAP processes for various real time applications.
- To evaluate various case study on risk assessment.

Course Outcomes (CO):

- Implement knowledge discovery.
- Design several OLTP and OLAP processes for various real time applications.
- Evaluate various case study on risk assessment.

List of Experiments:

Credit Risk Assessment:

The business of banks is making loans. Assessing the credit worthiness of an applicant is of crucial importance. You have to develop a system to help a loan officer decide whether the credit of a customer is good, or bad. A bank's business rules regarding loans must consider two opposing factors. On the one hand, a bank wants to make as many loans as possible. Interest on these loans is the banks profit source. On the other hand, a bank cannot afford to make too many bad loans. Too many bad loans could lead to the collapse of the bank. The bank's loan policy must involve a compromise: not too strict, and not too lenient. To do the assignment, you first and foremost need some knowledge about the world of credit.

You can acquire such knowledge in a number of ways.

1. Knowledge Engineering. Find a loan officer who is willing to talk. Interview her and try to represent her knowledge in the form of production rules.
2. Books. Find some training manuals for loan officers or perhaps a suitable textbook on finance. Translate this knowledge from text form to production rule form.
3. Common sense. Imagine yourself as a loan officer and make up reasonable rules which can be used to judge the credit worthiness of a loan applicant.
4. Case histories. Find records of actual cases where competent loan officers correctly judged when, and when not to, approve a loan application.

The German Credit Data:

Actual historical credit data is not always easy to come by because of confidentiality rules. Here is one such dataset, consisting of 1000 actual cases collected in Germany. Credit dataset (original) Excel spreadsheet version of the German credit data.

In spite of the fact that the data is German, you should probably make use of it for this assignment. (Unless you really can consult a real loan officer!)

A few notes on the German dataset

1. DM stands for Deutsche Mark, the unit of currency, worth about 90 cents Canadian (but looks and acts like a quarter).
2. owns telephone. German phone rates are much higher than in Canada so fewer people own telephones.
3. foreign worker. There are millions of these in Germany (many from Turkey). It is very hard to get German citizenship if you were not born of German parents.
4. There are 20 attributes used in judging a loan applicant. The goal is to classify the applicant into one of two categories, good or bad.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	DEEP LEARNING LAB	L	T	P	C
21D97206		0	0	4	2
	Semester	II			

Course Objectives:

- To implement Multilayer Feed Backward Neural network on MNIT digits dataset
- To construct RNN, LSTM, BiLSTM Networks for time series analysis classification problems.
- To design Autoencoders to solve Unsupervised Learning problems
- To evaluate Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

Course Outcomes (CO):

- Implement Multilayer Feed Backward Neural network on MNIT digits dataset
- Build RNN, LSTM, BiLSTM Networks for time series analysis classification problems.
- Design Autoencoders to solve Unsupervised Learning problems
- Implement Classical Supervised Tasks for Image Denoising, Segmentation and Object detection problems.

List of Experiments:

Implement perceptron learning algorithm and attempt to solve two input i) AND gate ii) Or Gate iii) EXOR gate problems.
1. Design and implement a perceptron learning algorithm and attempt to solve XOR problem
2. Implement a Multilayer Feed Backward Neural network algorithm on MNIT digits dataset.
3. Build your own Recurrent networks and Long short-term memory networks on IMDB movie reviews classification data.
4. Design and implement a BiLSTM and BERT on given a product review dataset to classify the review rating from 1 to 5 classes
5. Design and implement Autoencoders for credit card fraud detection.
6. Design and implement a Convolutional Neural Network for image classification on the Fashion-MNIST dataset.
7. Implement a VGG19 model for image classification with and without Transfer Learning on Grocery dataset.
8. Implement a U-Net convolutional neural network model on segmentation of electron microscopic (EM) images of the brain dataset.
9. Implement a FRCNN algorithm for object detection on small object dataset.

References:

1. Deep Learning- Ian Goodfelllow, YoshuaBenjio, Aaron Courville, The MIT Press.
2. Christopher Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
3. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001 .

Online learning resources/Virtual labs:

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	REINFORCEMENT LEARNING	L	T	P	C
21D97301a	(Common for MTech CSE, AI & ML)	3	0	0	3
	Semester	III			

Course Objectives:

- Reinforcement Learning is a subfield of Machine Learning, but is also a general-purpose formalism for automated decision-making and AI. This course introduces you to statistical learning techniques where an agent explicitly takes actions and interacts with the world.

Course Outcomes (CO): Student will be able to

- Formulate Reinforcement Learning problems
- Apply various Tabular Solution Methods to Markov Reward Process Problems
- Apply various Iterative Solution methods to Markov Decision Process Problems
- Comprehend Function approximation methods

UNIT - I		Lecture Hrs:

Introduction: Introduction to Reinforcement Learning (RL) – Difference between RL and Supervised Learning, RL and Unsupervised Learning. Elements of RL, Markov property, Markov chains, Markov reward process (MRP).

UNIT - II		Lecture Hrs:

Evaluative Feedback - Multi-Arm Bandit Problem: An n-Armed Bandit Problem, Exploration vs Exploitation principles, Action value methods, Incremental Implementation, tracking a non-stationary problem, optimistic initial values, upper-confidence-bound action selection, Gradient Bandits. Introduction to and proof of Bellman equations for MRPs

UNIT - III		Lecture Hrs:

Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations. Dynamic Programming (DP): Overview of dynamic programming for MDP, principle of optimality, Policy Evaluation, Policy Improvement, policy iteration, value iteration, asynchronous DP , Generalized Policy Iteration.

UNIT - IV		Lecture Hrs:

Monte Carlo Methods for Prediction and Control: Overview of Monte Carlo methods for model free RL, Monte Carlo Prediction, Monte Carlo estimation of action values, Monto Carlo Control, On policy and off policy learning, Importance sampling. Temporal Difference Methods: TD Prediction, Optimality of TD(0), TD Control methods - SARSA, Q-Learning and their variants.

UNIT - V		Lecture Hrs:

Eligibility traces: n-Step TD Prediction, Forward and Backward view of TD(λ), Equivalence of forward and backward view, Sarsa(λ),, Watkins's Q(λ), Off policy eligibility traces using importance of sampling. Function Approximation Methods: Value prediction with function approximation, gradient descent methods, Linear methods, control with function approximation.

Textbooks:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction", 2nd Edition, The MIT Press.
2. CsabaSzepesvari – Algorithms for Reinforcement Learning – Morgan & Claypool, 2010.

Reference Books:

1. Reinforcement Learning By Richard S. (University Of Alberta) Sutton,Andrew G. (Co-Director Autonomous Learning Laboratory) Barto

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	GAME THEORY	L	T	P	C
21D97301b		3	0	0	3
	Semester	III			

Course Objectives:

- To design games based on complete and incomplete information about the players.
- To evaluate games where players cooperate.
- To compute Nash equilibrium.
- To apply game theory in modeling network traffic and analyze auction strategy.

Course Outcomes (CO): Student will be able to

- Analyze games based on complete and incomplete information about the players
- Analyze games where players cooperate
- Compute Nash equilibrium
- Apply game theory to model network traffic
- Analyze auctions using game theory

UNIT - I	Lecture Hrs:10

Games, Old and New; Games, Strategies, Costs, and Payoffs; Basic Solution Concepts Finding Equilibria and Learning in Games; Refinement of Nash: Games with turns and Subgame Perfect Equilibrium; Nash Equilibrium without Full Information: Bayesian Games; Cooperative Games, Markets and Their Algorithmic Issues;

UNIT - II	Lecture Hrs:10

Is the NASH-Equilibrium Problem NP-Complete?; The Lemke-Howson Algorithm; The Class PPAD. Succinct Representations of Games; The Reduction; Correlated Equilibria; Bitmatrix Games and Best Response Condition; Equilibria Via Labeled Polytopes; The Lemke-Howson Algorithm; Integer Pivoting and Degenerate Games; Extensive Games and Their Strategic Form; Sub game Perfect Equilibria; Computing Equilibria with SequenceForm.

UNIT - III	Lecture Hrs:10

Model and Preliminaries; External Regret Minimization; Regret minimization and Game Theory; Generic Reduction from External to Swap Regret; On the Convergence of Regret- Minimizing Strategies to Nash Equilibrium in Routing Games; Fisher's Linear Case and the Eisenberg –Gale Convex Program; Checking if Given Prices are Equilibrium Prices; Two Crucial Ingredients of the Algorithm; The Primal-Dual Schema in the Enhanced Setting;

UNIT - IV	Lecture Hrs:9

Tight Sets and the Invariants; Balanced Flows; The Main Algorithm and Running Time; The Linear-Case of Arrow-Debreu Model; Algorithm for Single-Source Multiple-Sink Markets; Fisher Model with Homogeneous Consumers

UNIT - V	Lecture Hrs:9

.Exchange Economics Satisfying WGS; Specific Utility Functions; Computing Nash Equilibria in Tree Graphical Games; Graphical Games and Correlated Equilibria; Graphical Exchange Economies.

Textbooks:

1. Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V. Vazirani, Algorithmic Game Theory, Cambridge University Press, 2007.
2. Ronald Cohn Jesse Russell, Algorithmic Game Theory, VSD Publishers, 2012.

Reference Books:

1. Theory of games and economic behavior by John Von Neumann ,OskerMorgensten.
2. Games and Decisions by R Duncann Lucie and Howard Riffa.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	APPLIED ARTIFICIAL INTELLIGENCE	L	T	P	C
21D97301c		3	0	0	3
	Semester	**III**			

Course Objectives:

- To understand several data science concepts using python..
- To understand Foundations of Natural Language Processing and Machine Learning.
- To design Supervised Learning Models.
- To Analyze the feature engineering concept.

Course Outcomes (CO): Student will be able to

- Understand several data science concepts using python..
- Understand Foundations of Natural Language Processing and Machine Learning.
- Design Supervised Learning Modles.
- Analyze the feature engineering concept.

UNIT - I	Lecture Hrs:9

Fundamentals of programming: Python for data science- Introduction, Data Structures, Functions, Numpy, Matplotlib.

UNIT - II	Lecture Hrs:9

Data Science: Exploratory Data Analysis and Data Visualization- Plotting of Exploratory Data Analysis(EDA), Linear Algebra, Probability and Statistics, Dimensionality Reduction and Visualization, Principle Component Analysis(PCA), t-SNA(T- distributed Stochastic Neighborhood Embedding .

UNIT - III	Lecture Hrs:9

Foundations of Natural Language Processing and Machine Learning: Real world Problem- Predict rating, given product reviews on Amazon, Classification and Regression Models- K nearest Neighbors, Performance measurement of Models, Linear Regression, Logistic Regression, Solving Optimization problems.

UNIT - IV	Lecture Hrs:9

Machine Learning-II(Supervised Learning Models):Support Vector Machines, Decision Trees, Ensemble Models.

UNIT - V	Lecture Hrs:9

Feature Engineering-Product ionization and deployment of ML Models: Featurization and Feature Engineering-Introduction, Moving window for time series data,Fourier Decomposition, Deep Learning features- LSTM, CNN.

Textbooks:

1. Applied Artificial Intelligence- A handbook for business leaders by mariya yao, marlene jia, Adelyn Zhou.

Reference Books:

1. Applied Artificial Intelligence by Professor Lewis Brown.
2. Applied Machine Learning by M.Gopal, A tata Mc Grawhill edition.

Online Learning Resources:

https://www.appliedaicourse.com/course/11/Applied-Machine-learning-course

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COURSE STRUCTURE & SYLLABI

AUDIT COURSE-I

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I		Lecture Hrs:10
1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity		
UNIT - II		Lecture Hrs:10
Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization		
UNIT - III		Lecture Hrs:10
Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.		
UNIT - IV		Lecture Hrs:9
Key skills needed for writing a Title, Abstract, and Introduction		
UNIT - V		Lecture Hrs:9
Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions		

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
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'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate 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.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland 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,DroughtsandFamines,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 ADisasteror 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. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHa

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COURSE STRUCTURE & SYLLABI

ll OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student 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

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

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

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

AUDIT COURSE-II

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,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 theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th 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 teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.

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6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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COURSE STRUCTURE & SYLLABI

Course Code	**STRESSMANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
21DAC201b		**2**	**0**	**0**	**0**
	Semester	**II**			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

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

UNIT - I
Definitions of Eight parts of yog.(Ashtanga)
UNIT - II
Yam and Niyam.
UNIT - III
Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan
UNIT - IV
Asan and Pranayam
UNIT - V
i)Variousyogposesand theirbenefitsformind &body ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

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

UNIT - II

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

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

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OPEN ELECTIVE

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL SAFETY	L	T	P	C
21DOE301b	(Common to M.Tech CSE, CN, SE,AI & ML)	3	0	0	3
	Semester	III			

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

Course Outcomes (CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT - I — Lecture Hrs:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II — Lecture Hrs:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III — Lecture Hrs:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV — Lecture Hrs:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V — Lecture Hrs:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1.Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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COURSE STRUCTURE & SYLLABI

Course Code	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
21DOE301c	**(Common to M.Tech CSE, CN, SE,AI & ML)**	**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I	Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II	Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III	Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV	Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V	Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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M.TECH. IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE STRUCTURE & SYLLABI

Course Code	OPTIMIZATION TECHNIQUES	L	T	P	C
21DOE301f	(Common to M.Tech CSE, CN, SE,AI & ML)	3	0	0	3
	Semester	III			

Course Objectives:

- Enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems.
- Learn classical optimization techniques and numerical methods of optimization.
- Know the basics of different evolutionary algorithms.
- Explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.

Course Outcomes (CO): Student will be able to

- Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems.
- Use classical optimization techniques and numerical methods of optimization.
- Describe the basics of different evolutionary algorithms.
- Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas

UNIT - I — Lecture Hrs:

LINER PROGRAMMING (L.P):
Revised Simplex Method, Duel simplex Method, Sensitivity Analysis
DYNAMIC PROGRAMMING (D.P):
Multistage decision processes. Concepts of sub optimization, Recursive Relation-calculus method, tabular method, LP as a case of D.P.

UNIT - II — Lecture Hrs:

CLASSICAL OPTIMIZATION TECHNIQUES:
Single variable optimization without constraints, Multi variable optimization without constraints, multivariable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.
NUMERICAL METHODS FOR OPTIMIZATION:
Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method

UNIT - III — Lecture Hrs:

MODERN METHODS OF OPTIMIZATION:
GENETIC ALGORITHM (GA):
Differences and similarities between conventional and evolutionary algorithms, working principle, Genetic Operators- reproduction, crossover, mutation
GENETIC PROGRAMMING (GP):
Principles of genetic programming, terminal sets, functional sets, differences between GA &GP, Random population generation. Fuzzy Systems: Fuzzy set Theory, Optimization of Fuzzy systems

UNIT - IV — Lecture Hrs:

INTEGER PROGRAMMING:
Graphical Representation, Gomory's Cutting Plane Method,Balas' Algorithm for Zero–One Programming, Branch-and-Bound Method

UNIT - V — Lecture Hrs:

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS:
Formulation of model- optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Textbooks:

1. Engineering Optimization (4th Edition) by S.S.Rao, New Age International,

Reference Books:

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1. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers
2. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
3. Operations Research by Hillar and Liberman, TMH Publishers
4. Optimal design – JasbirArora, McGraw Hill (International) Publisher